



The benefits of gardening and food growing for health and wellbeing

By Garden Organic and Sustain

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Cover image: Sydenham Gardens, South London



Foreword by Professor Tim Lang

We can all benefit from gardening and community food-growing projects. It is widely recognised that regular contact with plants, animals and the natural environment can improve our physical health and mental well-being. When we grow food and flowers, we are engaging with the natural world at a pace that provides a welcome antidote to the stresses of modern life.

For the large number of people in our society – children and adults – who live with challenging physical or mental health problems, gardening and community food growing can be especially beneficial. Such activities can relieve the symptoms of serious illnesses, prevent the development of some conditions, and introduce people to a way of life that can help them to improve their well-being in the longer term. And even if you are feeling fine, gardening is... well, just a very nice thing to do. It sets a different pace to what makes life: seasons, weather, soil.

Gardening and community food growing therefore deserve the attention of health professionals, spatial planners and other policy makers who are well placed to make it possible for people to participate in beneficial horticultural activities, wherever they live. People in a mass urbanised society like Britain don't have easy access to land.

Green space and food growing spaces need to be created and protected in the environments where we live, to make it easy for people to participate in gardening, allotments, community food growing and horticultural therapy. This is a job for local authorities and their planning departments, as well as for land owners such as housing developers. Meanwhile, action already piloted by local GPs and health authorities to 'prescribe' gardening and food growing to those with physical or mental health conditions should be recognised and replicated throughout the NHS.

All this might seem obvious. However, with tight budgets and many calls on their time and services, policy-makers often require scientific evidence to prove what we generally take to be common sense, and to make the case for such work to be prioritised and provided with appropriate facilities and funding. This helpful study therefore reviews the extensive scientific literature that exists, examining the benefits of gardening and community food growing for both physical and mental health.

As a result, this study presents a compelling case for action by health professionals and the NHS; local authority planners and Government planning policy specialists; and by communities themselves, to create the circumstances in which gardening and community food growing can thrive, for the benefit of everyone.

Professor Tim Lang, Centre for Food Policy at City University London; Fellow of the Faculty of Public Health; President of Garden Organic; and keen vegetable grower

Summary highlights of the literature review

This review of the scientific literature set out to demonstrate the strength of evidence for the benefits of gardening and food growing for physical and mental health and wellbeing. It shows that:

..to improve physical health, regular involvement in gardening or community food growing projects, or formal horticultural therapy, can:

- Increase overall levels of physical activity and fitness, burn more calories and hence contribute to healthy weight management and reducing the risk of obesity.
- Increase healthy fruit and vegetable consumption, for adults that grow food, and among schoolchildren participating in food-growing activities at school – as well as improving young people's attitudes to healthy eating.
- Reduce physical pain, and help with rehabilitation or recovery from surgery or other medical interventions.
- Help people cope with physically challenging circumstances, such as intensive cancer treatment or learning how to live with chronic conditions such as asthma or severe allergies.

..to improve mental health, for people with acute or persistent mental health problems, or especially difficult personal circumstances, regular involvement in gardening or community food-growing projects, or formal horticultural therapy, can:

- Contribute to improved social interactions and community cohesion.
- Reduce the occurrence of episodes of stress, and the severity of stress and associated depression.
- Reduce reliance on medication, self-harming behaviour, and visits to psychiatric services, whilst also improving alertness, cognitive abilities and social skills.
- Alleviate symptoms of dementia and Alzheimer's disease, such as agitation and aggressive behaviour, which can in turn improve circumstances for carers.
- Provide productive manual activity and beneficial social interaction for people tackling drug and alcohol dependency.
- Help people manage the distress associated with mentally challenging circumstances, such as making the end of life more peaceful, sociable and enjoyable for hospice patients.

1. Introduction and approach

It is increasingly recognised, by individuals and health professional alike, that gardening and food growing is good for our health and wellbeing. Whilst much of the evidence for these benefits is anecdotal, there is a large, and growing, body of evidence published in the scientific literature. The aim of this review was to draw together some of the published evidence so that it can be used to support decision making and to encourage health professionals to actively use gardening and food growing as part of the health care service provision.

The aim was to focus on the health benefits provided by **community gardens** and the **activities of gardening and food growing**. The literature relating to the health benefits associated with peoples' engagement with nature, green spaces and the outdoors more generally has already been summarised by Pretty et al. (2011) as part of the UK National Ecosystem Assessment (UK National Ecosystem Assessment, 2011). Therefore, the aim of this study was to focus more specifically on community gardens and food growing. Pretty et al. (2011) concluded in their review that the evidence was that "*observing nature and participating in physical activity in green spaces play an important role in positively influencing human health and wellbeing*". They also concluded that ecosystems provide direct positive effects on both mental and physical health and indirect effects by facilitating nature based activity and social engagement, which positively influence health and provide a catalyst for behavioural change in terms of encouraging the adoption of healthier lifestyles (Pretty et al., 2011). We note that these conclusions are also valid in relation to the health benefits of community food growing.

In our study we were particularly interested in gathering evidence of the benefits of gardening and food growing in relation to specific health and wellbeing issues, concurring with some of the major health issues that face our society at present, including obesity, diabetes, cardiovascular diseases, cancer, mental health and wellbeing, dementia, stress, depression, substance misuse, and harmful behaviours associated with some of these conditions. However, although we searched specifically for studies where the health impact had been evaluated in relation to these specific health issues we found that in most papers the focus of the study was not that specific.

The methods used for the review were mainly literature searches using online tools like Google Scholar, Coventry University's online library services and publicly available search engines. Full-text scientific papers were accessed where appropriate. Searches were made for health conditions listed above then followed up peer-reviewed and grey literature in the English language. For example, we used the term '*allergy treatment*' and '*gardening*' or '*horticulture*' or '*community gardening*' or '*community food growing*' or '*horticultural therapy*' with '*active involvement in gardening*' to find any documentation on allergy and gardening as treatment. Papers and reports were also found via suggestions made from academics and experts working in this area including member advisory groups for the project. The review did not include non-English language publications.

2. General benefits of community gardening

There is a growing body of literature on the general benefits of community gardening. Many of them mention health and wellbeing benefits, however most do not address the benefits for the treatment or prevention of specific diseases. Many of the English language scientific publications assessed are reporting from the USA, Canada, Australia and New Zealand (Kingsley et al., 2009, Draper and Freedman, 2010). Quayle (2007) summarised this qualitative research on the general benefits of community gardens and city farms for the UK. Most of such evidence is qualitative research and although benefits for community cohesion, the local economy, the environment are well documented, direct benefits regarding mental health are in the subject of only a few studies (Quayle, 2007).

One publication (Calleau, 2005) reported health benefits for volunteers with mental health issues at a garden nursery; after attending the nursery, volunteers' visits to psychiatric hospitals reduced. In addition, self-harming behaviour stopped or reduced and half of the volunteers had their medication reduced or removed (Calleau, 2005). The other study (Velde et al., 2005) describes how animals can be used by occupational therapists, resulting in improved alertness and cognitive ability in clients with chronic and persistent mental illness. This outcome allowed clients to focus and remain attentive for longer periods of time.

Recently there have been more studies on the benefits of community gardens regarding social benefits, as well as nutritional benefits, and physical activity (Barnidge et al., 2013, Zick et al., 2013). Studies on the impact of community gardening on direct health outcomes are, however, rare. One example is a Canadian study on the specific health impacts of community gardening, using Toronto, Ontario as a case study (Wakefield et al., 2007). The research project collected data on the perceived health impacts of community gardening through participant observation, focus groups and in-depth interviews. The research method used was referred to as community-based research (CBR) and can be defined as research with a substantial level of community participation for the purposes of community improvement and social change. The observations were carried out involving participants who helped out with the 2004 growing season and attending garden meetings. Ten focus groups were held and each was 1-2 hours long. Overall 55 people participated in the focus groups and 13 in-depth interviews were held. All focus groups and interviews, where possible, were tape-recorded and transcribed verbatim by professional transcribers.

Results from the study suggested that community gardens were perceived by gardeners to provide numerous health benefits, including improved access to food, improved nutrition, increased physical activity and improved mental health. Community gardens were also seen to promote social health benefits and social connections. The mental health benefits are described by gardeners as more general i.e. helping to be more mentally (and physically) active or to reduce stress e.g. *"sometimes when you are stressed out...when you go to the garden, you feel different"*.

3. Social and therapeutic horticulture

Therapeutic horticulture and/or formal horticultural therapy, have been widely promoted over the past few decades, although they certainly have a longer history than this. Whilst the terms are often used interchangeably horticultural therapy is the use of plants by a trained professional as a medium through which certain clinically defined goals may be met. Therapeutic horticulture is a perhaps less formal process by which individuals may develop wellbeing using plants and horticulture either by active or passive involvement. Although many publications have been produced, many have not provided measured evidence of its effectiveness (Sempik et al., 2003), perhaps because of the subjective or qualitative nature of many of the outcomes.

3.1 Horticultural therapy

Engaging people in horticulture as a formal clinical therapy is well documented in the scientific literature. By this definition persons suffering or recovering from illness (mental or physical) are engaged in horticultural tasks as a means to ease their clinical suffering or as an aid to promote longer-term recovery or cure. To that end, and strictly speaking, a horticultural therapy ought to offer a defined treatment procedure focusing on horticultural or gardening activities that is aimed at treating a diagnosed problem in a patient. This in turn implies that the treatment has a goal that can be measured and evaluated and that the treatment is overseen and delivered by a suitably qualified professional.

KSU (2010) provides a good overview of horticulture therapy research and the areas in which it can provide benefits. These include:

- *Reducing physical pain:* gardening can be part of a programme that aims to reduce chronic pain or discomfort in patients (e.g. Park et al., 2008). Unruh (2004) reports on a study that showed that gardening helped people with serious health problems cope with their situation when comparing groups of people with and without cancer.
- *Rehabilitation and recovery:* gardening can be part of a rehabilitation programme aimed at improving motor skills, speech skills, and/or cognitive skills after debilitating illness or traumas such as strokes. Söderback et al. (2004) review horticultural therapy in the rehabilitation hospital setting in Sweden but the general principles will apply more widely. Horticultural therapy as a holistic therapy is also used for patients to recover from life-challenging illnesses like cancer survivors (Eunhee, 2003).
- *Dementia:* is a growing problem in more developed economies and horticultural therapy is seen as a way of alleviating the symptoms, providing a higher quality of life and improved cognitive functioning (e.g. Yasukawa, 2009).
- *Hospice care:* may provide gardens and gardening activities, which aim to provide some combination of the above therapies. Sadler (2007) provides some background information to the use of gardens in hospice settings including a history and principles.

Rice and Lremy (1998) studied the impact of horticultural therapy on psychosocial functioning among urban jail inmates and found that horticultural therapy treatment effects retained at follow-up studies. They included lower depression in subjects who had emotionally detached mothers, reduced number of substance usage and a sustained desire for help.

3.2 Therapeutic horticulture

Therapeutic horticulture is widely promoted in the UK as a means of engaging people in practical activities with positive outcomes. Client groups in this case include special needs groups who have mental or physical disabilities that might lead to them being excluded in many social situations or from work. In some cases it might be more aptly described as social horticulture in that the outcome is to involve 'client groups' in practical activity, which is socially inclusive and meaningful. Such groups include offenders, drug or alcohol dependent persons and other socially excluded groups like recent immigrants or refugees. Such projects are also increasingly seen as a way of including older people in meaningful activity.

Although it is generally seen as a good way to promote social inclusion among vulnerable people (e.g. those with mental ill health, learning difficulties, older people etc.), as well as a therapy, Aldridge and Sempik et al. (2003) suggest that the evidence for this is scanty and of variable quality, perhaps because most studies focus on therapy.

Areas where therapeutic horticulture have been practiced with some effect include:

- *Mental health:* gardening and related activities have long been advocated in mental health programmes (Spurgeon and Underhill, 1979).
- *Physical health:* health problems centred around sedentary lifestyles, obesity and even old age have been alleviated or tackled with gardening programmes.
- *Substance misusers:* therapeutic and manual work is increasingly being used to include drug and alcohol dependent people and aside from horticulture projects Care Farms are also being increasingly used to meaningfully occupy this client group in the UK.
- *Excluded groups (refugees etc.):* once again horticulture projects are increasingly seen as a way of generating meaningful activity for excluded groups like refugees.



4. Mental health and wellbeing

4.1 Background

The Department of Health (2010) has stated that, “Mental health and wellbeing can positively affect almost every area of a person’s life: education, employment, family and relationships. It can help people achieve their potential, realise their ambitions, cope with adversity, work productively and contribute to their community and society. Promoting mental health and wellbeing has multiple benefits. It improves health outcomes, life expectancy, productivity and educational and economic outcomes and reduces violence and crime.” Estimates from 2006 put the wider economic costs of mental health problems at over £110bn/year. The UK Department of Health guidance and the Cross-government framework for wellbeing (Department of Health, 2010) defined wellbeing as “a positive state of mind and body, feeling safe and able to cope, with a sense of connection with people, communities and the wider environment”. The guidance document recommends promoting mental health and wellbeing across the whole population because: “Mental health and wellbeing can positively affect almost every area of a person’s life: education, employment, family and relationships. It can help people achieve their potential, realise their ambitions, cope with adversity, work productively and contribute to their community and society.” This UK public mental health framework identifies five key areas for action to promote wellbeing; ‘a life course approach’, ‘a positive start in life’, ‘healthy later years’, ‘build strength safety’ and ‘resilience and develop sustainable, connected communities’ (Department of Health, 2010).

4.2 Benefits of gardening and food growing for mental health and wellbeing

Gardens, as well as the activity of gardening, have been shown to have a positive impact on peoples’ health and wellbeing, the result of both the physical activity and the use of the garden as a space for mental relaxation and stimulation. In 2013 the UK charity Mind published a report on the outcomes of their 130 ecotherapy projects across England (Mind, 2013). They described “ecotherapy as an intervention that improves mental and physical health and wellbeing by supporting people to be active outdoors; doing gardening, food growing or environmental work”. Based on a number of external evaluations (Bragg et al. 2013, New Economics Foundation, 2013) of their projects they concluded ecotherapy services can help people to look after their mental wellbeing, support people who may be at risk support people who may be at risk of developing a mental health problem and help the recovery of people with existing mental health problems (Mind, 2013).

Gardeners appear to be aware that gardening is good for their mental health; in a USA study gardeners involved with the Philadelphia Gardening Programme were asked why they gardened (Blair et al., 1991). Interviewing a total of 144 gardeners Blair et al. found that recreation (21%) was the most important reason followed by health benefits including ‘mental health’ (19%), ‘physical health and exercise’ (17%) and ‘produce quality and nutrition’ (14%).

Besides the activity of gardening, viewing green space and being in green space has also been shown to have positive effects on mental health and stress. For example Lohr et al. (1996) report that views over ‘green space’ in the form of plants at work can already improve performance. According to Pretty et al. (2007) “less green nature means reduced mental wellbeing, or at least less opportunity to recover from mental stress”. Sugiyama et al. (2008)

reported in a review that perceived neighbourhood greenness was positively correlated with mental health (together with walking and social cohesiveness), and in this case more so than physical health.

More widely the theory that access to restorative spaces (e.g. gardens) helps to restore people's directive attention on tasks and thereby improve mental acuity (Berto, 2005) has been developed. This has also been expressed as attention restoration theory (ART), which has been studied and reviewed in the cognitive benefits of interacting with nature (Berman et al., 2008).

Children are purported to perform better mentally when they have access to green space (Wells, 2000) and students when their view is dominated by plants rather than buildings and pavement (Tennesson and Cimprich, 1995). Symptoms of attention deficit hyperactivity disorder (ADHD) are also relieved by green space (Kuo and Taylor, 2004).

'Life satisfaction' is harder to define objectively than physical or mental health. Life satisfaction loosely describes a person's ongoing state of mind and contentment with their unfolding life but has no strict clinical definition. For example 'happiness' is a state of mind that most people strive to attain without perhaps needing to strictly define exactly what it is. There is good evidence that physical activity positively influences moods and state of mind and that gardening (as described above) is beneficial in this respect.

Gardening when carried out in an uncompetitive manner can engage people in many different ways and when carried through lead to feeling of achievement or having succeeded. Simply completing a physical task can also lead to feelings of contentment and relaxation. Certainly the rhythm of the gardening year and recycling of resources can help to ground people in natural cycles and this seems to promote a more general feeling of wellbeing. Blair et al. (1991) found that 'those who are involved in gardening find life more satisfying and feel they have more positive things happening in their lives than those who are not'.

The theory of 'biophilia' was first put forward by Wilson (1984), which contends that humans have a 'tendency to focus on life and lifelike processes' and that knowledge about the natural world (especially plants and animals) contributed to the survival of the human race and is thus innate. In practical terms this implies that people feel most comfortable in settings where they can identify with life processes (Gullone, 2000).

The evidence that suggests that optimal physical health and psychological wellbeing are linked to positive emotional environments and the natural environment are by Haviland-Jones et al., 2005, Pretty et al., 2007, a review by Maller et al., 2008, and by Schultz, 2010). It has been suggested that these feelings are grounded in our evolutionary psychology as a species. For example, it has been suggested that the reason we find certain landscape features aesthetically pleasing is that we are attracted to those that have enabled the survival of our species (Gullone, 2000). This includes features such as bodies of water, plants, animals and trees, all elements that are found in pleasing gardens. Even elements of gardening have the ability to trigger emotions in people. For example, 'flowers are a powerful positive emotion inducer' and have immediate and long-term effects on emotional reactions, mood, social behaviour and even memory in both males and females (Haviland-Jones et al., 2005).

4.3 Benefits of gardens and gardening for stress and depression

Stress and stress-related illnesses have increased dramatically in Western societies and indeed are increasing worldwide. Stress is expressed physically through increased muscle tension, increased blood pressure, increased pulse, increased sweat gland production, increased production of adrenalin and hydrocortisone, and reduced digestive system activity. Long-term stress causes and aggravates many illnesses. These include cardiovascular diseases, high blood pressure, depression, anxiety, thrombosis, digestive problems, chronic fatigue, aches and pains, allergies and increased risk of infection. Prolonged stress can be a symptom of, or result in, underlying mental illness.

Gardens seem to be able to reduce stress in several ways:

1. **By simply allowing views of a green space or a (semi-) natural scene.** Numerous studies have shown that simply viewing a green space through a window can relax people and reduce stress levels and this is expressed by, for instance, decreased recovery times from illness and fewer stress related incidents. Good studies of this effect are provided by Ulrich (1984) and Kaplan (2001) and are reviewed by Maller et al. (2005), while Day (2007) provides a more critical view on the evidence and the limits of empirical evidence.
2. **By allowing immersion in a natural scene.** A range of studies has shown that by simply allowing people to immerse themselves in a natural setting can reduce stress and increase relaxation and improve recuperation (Cooper Marcus and Barnes, 1999, Ulrich, 1999). This is certainly true of gardens as witnessed by the number of people who simply like to sit in their gardens at the weekend, because it allows them to feel connected to nature; the role of connectedness to nature as Mayer et al. (2008) put it.
3. **By actively engaging people in a natural setting.** Perhaps the most effective way to reduce stress is to combine the effects of work (or exercise) in a natural or green setting and exercise in such a setting certainly seems to have greater effects than exercise alone or exercise in 'unnatural' or even unpleasant settings (Pretty et al., 2007)

Van den Berg and Clusters (2011) tested stress-relieving effects of gardening in a field experiment with 30 allotment gardeners in Amsterdam either gardening or reading on their allotment for 0.5 hour. Both, gardening and reading had cortisol decreases during the recovery period, however decreases were significantly stronger following gardening. Positive mood was fully restored after gardening, but further deteriorated during reading. The authors highlight that these findings provide the experimental evidence that gardening can promote relief from acute stress (van den Berg and Clusters, 2011) and building on the author's earlier work on 12 different allotment sites across the Netherlands (van den Berg et al., 2010).

Research carried out in Sweden found that people with access to a garden had significantly fewer stress occasions per year (Stigsdotter and Grahn, 2004, Stigsdotter, 2005). They reported that people living in apartment blocks with no balcony or outdoor area had an average of 193 stress occasions per year. This was reduced to 126 stress occasions if respondents had a balcony. Those with a small garden had 86 stress occasions, while the least stress was reported by those with a large leafy garden, who only reported an average of 65 stress occasions per year. They also found that the more often people used their gardens, the fewer stress occasions they suffered per year. In comparing gardens with other urban green spaces they found that while both were important for health, but having a private garden was more important (Stigsdotter, 2005).

Hawkins et al. (2011 and 2013) have recently added to this by studying allotment gardening in Cardiff, Wales, UK. Their results found a similar significant difference in perceived stress levels between the activity groups of 'indoor exercise', 'walkers', 'allotment gardeners', and 'home gardeners'. Allotment gardeners reported significantly less perceived stress than participants of indoor exercise. Their second study Hawkins et al. (2013) had an older adult sample of community allotment gardening with a particular emphasis on stress recovery and again results indicate that allotment gardeners appreciate both 'doing' the gardening as well as 'being' in the garden/allotment landscape with a wide range of benefits to their health and wellbeing.

Therapeutic horticulture in clinical depression was studied by Gonzalez et al. (2010) in Norway. The data for the study was collected before, during and immediately after a 12-week therapeutic horticulture programme on 4 farms near Oslo to assess if a change in depression severity, perceived attentional capacity and rumination (brooding) in individuals occurred. Results showed a clinically relevant decline of depression ('Beck Depression Inventory') in 50% of the participants and the participants maintained their improvements in 'Beck Depression Inventory' scores at 3-month follow-up.

4.4 Benefits for sufferers of dementia and Alzheimer's disease

Dementia is a long-term condition with a high impact on a person's health, personal circumstances and family life. Alzheimer's disease is the most common form of dementia and is generally diagnosed in people of 70 years of age. Early-onset dementia refers to the onset of symptoms before the age of 65. As well as having profound impact on the individual, dementia can also have a high impact on family members and friends. Dementia results in a progressive decline in multiple areas of brain function including memory, reasoning, communication skills and those skills needed to carry out daily activities. Alongside this decline, individuals may develop behavioural and psychological symptoms such as depression, psychosis, aggression and wandering, which complicate care.

The UK's National Dementia Strategy, published in 2009, aims to ensure that improvements are made to dementia services across three areas: improved awareness, earlier diagnosis and intervention, and a higher quality of care (Department of Health, 2009). The Alzheimer's Society statistics show that there are currently 800,000 people living with dementia in the UK, and it is predicted that this number will rise to over one million people by 2021. It is estimated that dementia currently costs the NHS, local authorities and families £23 billion per year and this may grow to £27 billion by 2018 (Kane and Cook 2013). The Alzheimer's Society notes that the Welsh Assembly in its framework action recognises that low-level support services such as gardening clubs are vital within the dementia strategy. They reduce the need for more intrusive and costly care solutions (Kane and Cook, 2013).

The UK National Institute for Health and Care Excellence (NICE) recommends that care plans should address activities of daily living that maximise independent activity, adapt and enhance function, and minimise need for support (NICE, 2011). The garden and the activity of gardening provides a non-pharmacological approach to address these goals and horticultural therapy can be utilised to improve the quality of life for the aging population and yielded high level patient/carer satisfaction, possibly reducing costs of long-term, assisted living and dementia unit residents (Detweiler et al., 2012, Gitlin et al., 2012).

A number of studies have shown the benefits of therapeutic gardens and horticultural activities for patients with dementia. In a review of the literature of the evidence to support the use of therapeutic gardens for the elderly, Detweiler et al. (2012) concluded that many preliminary studies have reported benefits of horticultural therapy and garden settings in reduction of pain,

improvement in attention, lessening of stress, modulation of agitation, lowering of as need medications, and antipsychotics and reduction in falls.

Jarrot and Gigliotti (2004) studied whether planting, cooking, or craft activities engender differential responses from adult day service participants with dementia, and in a later study the same author team (Jarrot and Gigliotti, 2010) evaluated responses to horticultural based activities for randomly assigned groups in eight care homes and compared with responses to traditional activities. They showed that horticultural activities reached groups of participants who would often be difficult to engage in activities and resulted in higher levels of adaptive behaviour and in active and passive engagement. Similarly, Yasukawa (2009) showed improvements in communication, engagement, behaviour and cognitive abilities in a group of patients with Alzheimer's who participated in horticultural activity over a period of three months.

In a study investigating the use of horticultural therapy to prevent the decline of mental abilities in patients with Alzheimer's type dementia, D'Andrea et al. (2007) reported participation in horticultural activities resulted in maintenance of memory and sense of wellbeing and an overall higher functional level than the control group. Connell et al., (2007) compared outdoor and indoor activity programmes on sleep and behaviour in nursing home residents with dementia and showed that the outdoor activity group experienced significant improvements in sleep patterns and also a decline in verbal agitation. Luk (2011) studying horticultural activities in a nursing home in Hong Kong found no significant effect on the reduction of agitation among the home residents with dementia, however a significant decrease in aggressive behaviour.

Hewitt et al. (2013) evaluated the impact of therapeutic gardening for people with young-onset dementia, measuring outcomes for both participants with dementia and their carers. The conclusion from their preliminary study suggested that structured gardening over a 12 months period had a positive impact on the wellbeing, cognition and mood of people with young-onset dementia. Specific attention was drawn to the relationship between the wellbeing of participants and their cognition as the results of the study suggested that wellbeing can be maintained despite the presence of a cognitive deterioration. Self-identity and purposeful activity were reported as common themes as benefits of the gardening group, participants felt useful and valued and had a sense of achievement.



5. Obesity, healthy weight management and healthy eating

5.1 Background

The Government's obesity strategy 'Healthy Lives, Healthy People; a call to action on obesity in England' has identified that "overweight and obesity represent probably the most widespread threat to health and wellbeing" (Department of Health, 2011). 61% of adults are overweight or obese, and 23% of 4-5 year olds and 33% of 10-11 year old. The level of obesity in England, along with the rest of the UK, ranks as one of the most obese nations in Europe. It is the consequence of overweight and obesity that makes these statistics so serious, as excess weight is a major risk factor for diseases such as type 2 diabetes, cancer and heart disease. Alongside the serious ill-health it provokes, overweight can reduce peoples' prospects in life affecting self-esteem and mental health (Department of Health, 2011).

Excess weight gain is the result of eating more calories than needed and/or undertaking insufficient levels of physical activity to match the calorie intake. Although this energy imbalance is driven by complex environmental, physiological and behavioural factors, changes in diet to reduce energy intake along with increasing physical activity are key to achieving and maintaining a healthy body weight. The National Institute for Health and Clinical Excellence (NICE) clinical guideline on obesity includes advice for people to eat at least five portions of fruit and vegetables each day in place of foods higher in fat and calories, and lower in beneficial nutrients, and to make enjoyable physical activities part of everyday life. Engagement in gardening and food growing can address both of these recommendations and gardening is indeed recognised as moderate-intensity physical activity that adults are advised to undertake 30 minutes or more of on five or more days of the week (NICE, 2006).

5.2 Benefits for fruit and vegetable consumption

Reviews of academic studies from the UK and abroad, concluded that food growing programmes in schools can have positive impacts on pupil nutrition and attitudes towards healthy eating, specifically related to the willingness to try new foods and taste preferences (Draper and Freedman, 2010, Nelson et al., 2011). For example, a study carried out in the USA, with 8-11 year old students involved in hands-on school gardening programmes found a more positive attitude towards vegetables and increased snack preference for fruit and vegetables amongst the children Lineberger and Zajicek (2000). Ratcliffe et al. (2011), also in the USA, studied 11-12 year old students involved in food growing over a four month period and found that students were more willing to taste, and ate, a greater variety of vegetables than those in the control group.

The evaluation of the Food for Life Partnership (FFLP) programme in the UK (Orme et al., 2011) showed significant associations between healthy eating and FFLP related behaviours including participation in cooking and growing at school or at home. Orme et al. (2011) showed that following their participation in FFLP programme the proportion of primary school-age children eating five or more portions of fruit and vegetables increased by 28%. An evaluation of the school fruit and vegetable scheme in the UK found that, in schools running food-growing clubs, children ate more vegetables and intake was higher if parents were involved in the initiative (Ransley et al., 2010). In schools that achieved a high total score (derived from five key types of

initiatives to promote fruit and vegetables in school) children ate more vegetables, 123 g/day, compared with those that did not 98-g/day. They concluded that gardening, parental involvement and other activities promoting fruit and vegetables to children in schools may be associated with increased intake of vegetables but not fruit. Nelson et al. (2011) reported details of a number of studies in the UK and internationally demonstrating that pupils engagement in food growing activities resulted in increased consumption of vegetables. They also noted that most of the studies only considered whether pupils consumption habits had changed as an immediate effect of their involvement in growing, and highlighted the lack of longitudinal evidence research confirming whether such programmes can change eating habits longer term (Nelson et al. 2011).

For adults, Alaimo et al. (2008), reported that household members who participated in community gardening consumed 40% more fruits and vegetables per day than those that did not; they were 3.5 times more likely to consume the recommended 5 portions a day of fruits and vegetables. In the UK, the low-income diet and nutrition survey (Nelson et al., 2007) showed that men and women living in households that grew food consumed more fruit and vegetables than other men and women.

The evaluation of the Garden Organic 'Master Gardener Programme' in the UK showed that new food growers ate an average of 4.5 portions of fruit and vegetables per day after being part of the programme for 12 months, and 4.9 portions per day after being part of the programme for 36 months. This is above the national average for adults aged 19-64 (Kneafsey *et al.*, in preparation).

5.3 Benefits for physical activity

Gardening is a physical activity and there is a range of garden tasks that uses the upper and lower body such as digging, turning compost or raking (Park et al., 2008). They offer moderate intensity physical activity, whilst other tasks that use primarily the upper body in standing or squatting postures offer low intensity physical activity. Such garden tasks are for example hand weeding, mixing soil, filling containers with soil and transplanting seedlings (Park et al., 2008).

Calorie calculators provide estimates of calorie expenditure for different gardening activities, indicating that garden work burns around 250 - 500 calories per hour, depending on the level intensity of the activity (e.g. Boots Diet online calorie burn calculator, 2014).

The 'Growing a Healthier Older Population' project in Wales, UK measured the impact of being a gardener on aspects of physical and psychological health and wellbeing, comparing gardeners on an allotment plot or at a community garden with people same age group who were on an allotment waiting list (Hawkins et al., 2013). In this study, 68% of gardener participants reported exercise frequencies that met physical activity recommendations, compared to only 25 % of adults in the same age group in the Welsh population in general. Similarly, Park et al. (2008) concluded that healthy older gardeners in their study met their physical activity recommendation through gardening and that this may be a factor leading to better physical and mental health.

The evaluation of the Garden Organic 'Master Gardener Programme' showed that a common theme from interviews with new food growers participating in the programme was "*growing more vegetables means more exercise and time being active and the opportunity to get fresh air*" and results showed that 48% of the new growers spend 1-2 hour/week growing food and 50% spend more than 2 hours/week, including 7% that spend 8 or more hours/week (Kneafsey *et al.*, in preparation).

In their review of studies relating to the impact of food growing programmes in schools, Nelson et al. (2011) noted that a common perception of those involved in the studies was that food growing contributed to making young people more physically active. However, only a few studies reported actual results of physical activity levels. For example, Herman et al. (2006) and Phelps et al. (2010) showed that children involved in after-school gardening programmes self-reported a significant increase in physical activity levels, while Harris et al. (2009) report on a meta-analysis showing that encouraging physical activity in schools was only partially successful in improving children's health and unlikely to reduce obesity in itself and concluded that gardening needs to be part of a more concerted programme of physical activity to encourage children to be more active. As such incorporating gardening into the larger school playground or green space is likely to enhance the benefits of this space which already encourages open ended children's activities (Dyment and Bell, 2008). The physical tasks of food growing, such as digging and weeding, can contribute to a broader understanding of the various ways of staying active and teachers report that children and young people take greater responsibility for their own health (RHS, 2010).

5.4 Benefits for Body mass index (BMI)

Recently, Zick et al. (2013) published results including 3 different comparison groups from their study evaluating the potential weight control benefits of community gardening. Using unique administrative data from Salt Lake City Utah, they examined body mass index (BMI) data from community gardening participants in relationship to BMI data for 3 comparison groups (neighbours, siblings, and spouses). In the comparisons, the data was adjusted for gender, age, and the year of the BMI measurement. Results showed that both women and men community gardeners had significantly lower BMIs than their neighbours who were not in the community gardening programme. Similarly significantly lower BMIs were observed for women and men community gardeners compared with their sisters or brothers. The third comparison with their spouses showed no statistically significant differences and the authors hypothesise that spouses would likely enjoy the dietary advantages of the community garden and might also help with the physical demands of gardening.

In summary, Zick et al. (2013) concluded that "health benefits of community gardening may go beyond enhancing the gardeners' intake of fruit and vegetable" and "community gardens may be a valuable element of land use diversity that merits consideration by public health officials who want to identify neighbourhood features that promote health". These data are only from one city, but because of the robustness of the sampling and comparison there is little doubt that the evidence of community gardening activities towards adult obesity is more universal than just for one USA city. Future research with controlled, randomised field studies across a range of communities is needed to advance the understanding of gardening and healthy lives. According to the authors this is the first study published worldwide comparing health benefits of community gardeners with non-gardeners in a robust sample Zick et al. (2013).

6. Helping people cope with other serious health problems

Our literature review suggested that gardening and food growing can help people to cope with the symptoms or treatment of other serious health problems. This included studies of people with specific diseases or conditions; those at the end of their life in hospices or other care situations; and also people learning to deal with drug and alcohol dependency (the latter covered in our chapter on 'general benefits'). To provide useful insights on this theme, we looked specifically at the literature associated with horticultural activities for people with cancer; allergies, asthma and intolerances; and the sexually transmitted disease HIV/AIDS.

6.1 Cancer

Unruh's study "The meaning of gardens and gardening in daily life: a comparison between gardeners with serious health problems and healthy participants" in Canada showed that gardening helped people with serious health problems cope with their situation when comparing groups of people with and without cancer. The study revealed important benefits of gardening on physical, emotional, social, and spiritual wellbeing, and highlighted a key role of gardening as a coping strategy for living with stressful diseases such as cancer (Unruh, 2004). The study revealed the personal and subjective ways in which interest in gardening might change in response to the person's own situation and needs. The study used a phenomenological method where 27 women and 15 men were interviewed about the meaning of gardens and gardening in their daily life. The gardens were located in small towns or rural areas of Nova Scotia, Canada and 18 participants were diagnosed with cancer. The majority of the participants were aged 45 - 65 years. Semi-structured interviews were done 4 times per year during the growing season.

There is further evidence for breast cancer based on a literature review of 29 articles by Kirshbaum, 2007) that whole body exercise (including active gardening) has benefits during and after treatments for breast cancer. Kirshbaum (2007) found that many early studies had limited validity while recent studies were more robust. Consistent support for all types of aerobic exercise was most evident in studies of patients during chemotherapy and radiotherapy treatments against cancer, compared with post-treatment studies. The evidence, which suggested that aerobic exercise limits, cancer-related fatigue was particularly strong.

One Canadian study specifically included gardening exercise as a type of physical activity (Blanchard et al., 2003), conducting a comparison of physical activity of post treatment breast cancer survivors and non-cancer controls. This study investigated whether after breast cancer treatment, the survivors were meeting the Centre for Disease Control and Prevention/American College of Sports Medicine recommendations for physical activity. Results showed that breast cancer survivors engaged in as much moderate, vigorous, and combined physical activity as the controls. However, further analyses showed that survivors engaged in more garden and yard work than the controls. The frequency and the total time of stretching were significantly higher in breast cancer survivors, suggesting that breast cancer survivors engage in as much physical activity as controls do, but that the groups differ in specific activities (e.g. more active gardening work in the breast cancer survivor group).

Another link between gardening work and cancer and stress was found by Fitch et al. (2003). They were studying the patient perspectives while waiting and travelling for radiation cancer

treatment in the USA and found that waiting for treatment and putting domestic activities like gardening on hold added to the patient stress.

Our general knowledge and understanding regarding the benefits of gardening towards cancer treatment is however still weak and the Kirshbaum (2007) review therefore suggests additional studies with high methodological quality for specific patient subgroups like older people, those with advanced cancer and the disadvantaged. The author concludes that it is important for all healthcare professionals to be “aware of the evidence surrounding the benefits of exercise (including gardening) and to encourage patients to increase physical activity and improve their overall health and wellbeing”.

In the UK the charity Macmillan Cancer Support has offered gardening packs to encourage people to ease into physical activity after cancer treatment. The initiative was part of the charity’s Move More campaign (Macmillan, 2012). Macmillan Cancer Support and the National Gardens Scheme (NGS) have conducted a survey among 148 NGS gardeners showing that 75% of gardeners living with cancer said that gardening during and after treatment helped them manage feelings of depression and sadness. In another online survey of 41 gardeners living with cancer found that 80% say that gardening helps reduce stress and anxiety, and helps take their mind off treatment. Gardening also had a positive impact on the cancer patients’ physical wellbeing. Over 50% say that it helps to give them more energy while one in three say that it helps manage fluctuations in their weight as a result of treatment. The sample size of these two studies is small and they are not peer reviewed, nevertheless they give a good indication of the relationship of gardening and physical activity regarding to cancers.

6.2 Allergies, asthma and intolerances

Avoiding triggers, such as allergens, can prevent symptoms of asthma, a chronic inflammatory disease of the airways. Horticultural therapy has been used in Japan (Sadako, 2002, Kamata, 2008) to treat for asthmatic children. Sadako (2002) carried out horticultural therapy three times a week for children with intractable bronchial asthma who were hospitalised, and they were asked questions. The therapy seems to be useful for them to recover their confidence through experience in growing plants from the beginning while feeling a sense of the seasons, a feeling of freedom from an ordered life in a ward and communicating among each other. Kamata (2008) provided horticultural therapy was for long-stay asthmatic children as a supplemental holistic treatment to complement other treatments at the Osaka Prefecture Medical Centre for Respiratory and Allergic Disease. Children aged from four to fourteen. The horticultural therapy had the following three aims: interacting with nature, involvement with others, and learning to grow plants. Results showed that asthmatic children, who have not previously experienced nature, relaxed and harmonised with others. They learned teamwork skills and expressed their own feelings towards nature and towards other people.

The effects of gardening and food growing on allergies and food intolerances (non-allergic food hypersensitivity) can be indirect through a reduction of general stress levels, as allergies and food intolerances are linked to stress through the general adaptation response (Gaby, 1998). Patients often experience short-term relief after ingesting foods, which are later, demonstrated to be the cause of their chronic symptoms.

6.3 HIV/AIDS

HIV/AIDS and malnutrition are prevalent in many parts of the world, especially in sub-Saharan Africa. There are well-established links between HIV/AIDS and poor nutrition and food insecurity. HIV, which causes weight loss and wasting, specifically affects nutritional status by increasing energy requirements, reducing food intake, and adversely affecting nutrient absorption and metabolism. It is generally recognised that nutrition is important for people living with HIV/AIDS (including pregnant women) and HIV-exposed children.

There are multiple studies for these effects including gardening and food growing for the prevention of HIV/AIDS. They are almost exclusively in Sub-Saharan Africa like Uganda (Weiser et al., 2010), South Africa (O'Hara Murdock et al., 2003) or Zimbabwe (Mubvami and Manyati, 2007).

Mubvami and Manyati (2007) highlight the benefits of food growing at family or community level for HIV/AIDS. The benefits are indirect, but substantial, and include improved nutrition of HIV/AIDS affected families, savings on food expenditures, added income from the sale of surpluses, and community mobilisation to respond to HIV and AIDS. This can also include the integration of former commercial sex workers from HIV/AIDS affected families (Mubvami and Manyati, 2007).

The link between HIV/AIDS and gardening and food growing is therefore indirect, via the provision of healthy, fresh and vitamin rich nutrition. Gardening has a mitigating and a prevention effect on these two sexual transmitted diseases, and this is even more important as a specific cure for the diseases is not widely available.

Currently the academic literature on sexual transmitted diseases and gardening is mainly concerned with sub-Saharan Africa and HIV/AIDS. We did not find gardening discussed as a prevention or mitigation strategy for any other sexual transmitted diseases like Herpes or Syphilis. Gardening without washing hands or wearing gloves can, however, be an infection risk for sexual transmitted diseases under certain conditions (Kaplan et al., 2010).

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In urban areas those benefits may even outweigh any risks like those from contaminated land in an overall risk assessment (Leake et al., 2009).

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Appendix: Benefit matrix of gardening and food growing for health and wellbeing

The aim of the Benefit Matrix table in this appendix is to summarise published evidence on the benefits of gardening and food growing in relation to specific health and wellbeing issues. We use a simple structure to make the evidence available to a wide audience beyond academia. The published evidence considered consists of documents in the English language across the world, which are either peer-reviewed (but often not-open access), or other published evidence which is open access (project reports, government documents).

To structure the benefit matrix table we use the following five headings:

Short scientific reference	Full title of the paper or report	Location (country, region)	Type of documented benefits of gardening and food growing (key results of the publication)	Main research and evaluation methods used
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Allergies, asthma and intolerances

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Sadako, 2002	The effects of gardening therapy for asthmatic children	Japan	Horticultural therapy was carried 3 times a week for children with intractable bronchial asthma who were hospitalised, and they were asked questions. The therapy seems to be useful for them to recover their confidence through experience in growing plants from the beginning while feeling a sense of the seasons, a feeling of freedom from an ordered life in a ward and communicating among each other	Horticultural therapy and questioning
Kamata, 2008	The practicability of horticultural therapy for asthmatic children	Japan	Horticultural therapy was provided for long-stay asthmatic children as a supplemental holistic treatment to complement other treatments at the Osaka Prefecture Medical Centre for Respiratory and Allergic Disease. Children ages 4-14, from April 2003 to May 2004 Results showed that asthmatic children, who have not previously experienced nature, relaxed and harmonised with others. They learned teamwork skills and expressed their own feelings towards nature and towards other people.	Horticultural therapy

Cancers				
Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Blanchard et al., 2003	A comparison of physical activity of post treatment breast cancer survivors and non-cancer controls	Canada	The paper determines whether, after treatment, the survivors were meeting the Centre for Disease Control and Prevention/American College of Sports Medicine recommendations for physical activity and were similar to the controls in physical activity. Secondly it compares the modes of activity of the 2 groups in frequency, min/session, and sessions/wk. Result showed that breast cancer survivors engaged in as much moderate, vigorous, and combined physical activity as the controls, however, chi-square analyses showed that survivors engaged in more garden/yard work than the controls did. Independent-sample t tests showed that the frequency and the total min/wk of stretching were significantly higher in breast cancer survivors, suggesting that breast cancer survivors engage in as much physical activity as controls do, but that the groups differ in specific activities (e.g. more gardening).	Comparison of breast cancer survivors obtained data from 335 breast cancer survivors and 6,880 non-cancer controls. Adjusted logistic regression analyses
Unruh, 2004	The meaning of gardens and gardening in daily life: a comparison between gardeners with serious health problems and healthy participants	Canada, Nova Scotia	The study revealed important benefits of gardening on physical, emotional, social, and spiritual wellbeing, and highlighted a key role of gardening as a coping strategy for living with stressful life experiences. The prospective nature of the study revealed the personal and subjective ways in which interest in gardening might change in response to the person's own situation and needs.	Phenomenological method. 27 women and 15 men were interviewed about the meaning of gardens and gardening in their daily life. Gardens are located in small towns or rural areas of Nova Scotia. 18 participants were diagnosed with cancer. The majority of the participants were aged 45 - 65 years. Semi-structured interviews (2 hours average) were done 4 times per year in each season. The data analysis used a constant comparative approach based on a construction of an emergent set of themes and sub-themes from the interview transcripts
Kirshbaum, 2007	A review of the benefits of whole body exercise during and after treatment for breast cancer	UK and global	Many early studies had limited internal and external validity. Recent studies were considerably more rigorous and robust. Consistent support for all types of aerobic exercise was most evident in studies of patients during adjuvant cancer treatments (chemotherapy and radiotherapy), compared with post-treatment studies. The evidence, which suggested that aerobic exercise limits, cancer-related fatigue was particularly strong. Only one study (Blanchard et al., 2003), as documented earlier, specifically included gardening exercise. Additional studies with higher methodological quality are particularly for patient subgroups (e.g. older people, those with advanced cancer and the disadvantaged) are recommended.	Literature review with systematic search strategy. 29 articles were retained for critical review, appraised for quality and synthesised

Dementia				
Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Jarrot and Gigliotti, 2004	From the garden to the table: Evaluation of a dementia-specific horticultural therapy program	USA	<p>The study considers whether planting, cooking, craft or horticultural therapy activities engender differential responses from adult day service participants with dementia. Two trained HT students led alternating planting, cooking, and craft activities three times each week over a nine-week period with 5-10 adult day service participants. Each participant was assessed for ability to complete the activities and benefits experienced. Most participants required some physical and/or verbal help with each activity, regardless of the category, although variability existed within each category.</p> <p>The most common benefits were: interaction, initiation, concentration, and activity completion. Special accommodations were rarely used, but activities were composed of steps requiring different abilities. Thus, individuals experienced success by performing at least one step in the activity. Preliminary analysis indicates that the categories of horticultural therapy activities promote cognitive, psychosocial, and physical benefits equally.</p>	Horticultural therapy and patient assessment
Connell et al., 2007	Therapeutic effects of an outdoor activity program on nursing home residents with dementia	USA	<p>1-year pilot study to compare outdoor and indoor activity program on sleep and behaviour in nursing home residents with dementia. Design: A two-group (outdoor program, indoor program) two phase (baseline, intervention), randomised subjects. Sleep and behaviour disturbance were assessed over a 10-day period. Because this was a pilot study, the significance level was set at $p < 0.10$.</p> <p>Results showed that the outdoor activity group experienced significant improvements in maximum sleep duration. Both groups showed significant improvements in total sleep minutes. There also was a significant improvement in verbal agitation in the outdoor activity group.</p>	Sleep was assessed with wrist actigraphs with photocells, which also allowed for monitoring of light exposure. Behaviour disturbance was assessed with the Cohen-Mansfield Agitation Inventory.
D'Andrea et al., 2007	Effect of horticultural therapy on preventing the decline of mental abilities of patients with Alzheimer's type dementia	USA	Horticultural activities (twice weekly for 12 weeks) resulted in maintenance of memory and sense of wellbeing . The horticultural therapy group had an overall higher functional level than the control group ($t(36) = 5.7, p < .0005$). It is concluded that horticultural therapy may be a useful alternative therapy for individuals with Alzheimer's disease.	HT Group of randomly selected individuals, 20 and 20 control, urban nursing home with Alzheimer's patients Mini mental state examination
Yasukawa, 2009	Horticultural therapy for the cognitive functioning of elderly people with dementia	Japan	Horticultural activities over 3 months resulted in improvements in communication, engagement, behaviour and cognitive abilities	Interview and Mini mental state examination (MMSE)

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Jarrot and Gigliotti, 2010	Comparing responses to horticultural-based and traditional activities in dementia care programmes	USA	Compared a randomly assigned horticultural therapy treatment group with traditional activities (TA). Horticultural therapy twice weekly at 4 treatment sites for 6 weeks. Results demonstrated horticultural therapy based activities are a viable and desirable choice for dementia-care programs. They reached groups of participants who are often difficult to engage in activities. There was no difference on affective domains, however horticultural therapy resulted in higher levels of active and passive engagement.	Mini mental state examination (MMSE)
Luk, 2011	The effect of horticultural activities on agitation in nursing home residents with dementia	Hong Kong	Horticultural activities for nursing home residents (30 min, twice weekly, for 6 weeks) resulted in no significant reduction of agitation but a decrease in aggressive behaviour	Chinese equivalent of Cohen Mansfield Agitation Inventory School of Nursing, The Hong Kong Polytechnic University
Detweiler et al., 2012	What Is the evidence to support the use of therapeutic gardens for the elderly	USA, Korea	Despite the history of horticultural therapy in various clinical settings, to the best of our knowledge there are no controlled clinical trials demonstrating the positive or negative effects of the passive or active rehabilitation of the elderly in garden settings. Experience is suggesting that regular time spent in a garden, results in less agitated behaviour, improved mood and less pro re nata (PRN) medications. The quantitative analysis of the benefits of garden settings for older individuals is overdue and there is need for scholarly innovative studies investigating this treatment modality.	Literature review

Mental health and wellbeing				
Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Catanzaro and Ekanem, 2004	Home gardeners value stress reduction and interaction with nature	USA, Tennessee	Respondents rated the statements “Home gardens provide a reduction in feelings of stress” and “Home gardens provide interaction with nature” as very important. Results suggest that although gardeners select from a wide range of plant materials and activities in an individualistic manner, the interaction with nature in a nurturing environment provides a number of benefits important to them, including mental wellbeing.	A written survey instrument was developed in 2001 and conducted at two events: the Tennessee Green Industries Field Day (McMinnville), and the Tennessee State Fair (Nashville)
Stigsdotter and Grahn, 2004	A garden at your workplace may reduce stress	Sweden	Results show that having access to a garden has a significant positive impact on stress. There is also a significant positive relationship between frequency of garden visits and stress prevention. The study also showed that the amount of verdure in the garden is crucial to its restorative quality.	953 randomly selected persons in 9 Swedish cities answered a mail questionnaire concerning their experiences of their own health status and access to and use of gardens at home. Statistical analysis with SAS software the distribution of socio-demographic data is representative for Sweden, meaning no statistically significant deviation regarding socio-economic grouping, sex or age
Stigsdotter, 2005	Urban green spaces: Promoting health through city planning	Sweden and global	On the basis of the research results, urban green spaces are viewed as a health-promoting element of city planning. The purpose of health-promoting environments is to offer visitors rest or activities that help to promote their health over time.	Review of literature and design theories based on the research results
Calleau, 2005	The benefits of volunteers attending Cherry Tree Nursery	UK	After attending the nursery, volunteers' visits to psychiatric hospitals reduced dramatically with some were not returning. In addition, self-harming behaviour stopped or reduced and half of the volunteers had their medication reduced or removed completely.	
Gonzalez et al., 2010	Therapeutic horticulture in clinical depression: a prospective study of active components	Norway	Mean Beck Depression Inventory scores declined by 4.5 points during the intervention ($F = 5.5$, $p = 0.002$, F-test Fisher-Snedecor distribution, $p =$ probability value.). The decline was clinically relevant for 50% of participants. Attentional Function Index scores increased ($F = 4.1$, $p = 0.009$), while Brooding scores decreased. The changes in Beck Depression Inventory and Attentional Function Index scores were mediated by increases in Being Away and Fascination, and decline in Beck Depression Inventory scores was also mediated by decline in Brooding. Participants maintained their improvements in Beck Depression Inventory scores at 3-month follow-up.	A single-group study with a convenience sample of 28 people with clinical depression in 2009. Data were collected before, twice during, and immediately after a 12-week therapeutic horticulture programme on 4 farms near Oslo, Norway and at 3-month follow-up. Assessment instruments were the Beck Depression Inventory, Attentional Function Index, Brooding Scale, and Being Away and Fascination subscales from the Perceived Restorativeness Scale

Reference	Paper name	Country	Documented benefits of gardening and food growing	Research methods
van den Berg et al., 2010	Allotment gardening and health: a comparative survey among allotment gardeners and their neighbors without an allotment	Netherlands	After adjusting for income, education level, gender, stressful life events, physical activity in winter, and access to a garden at home as covariates, both younger and older allotment gardeners reported higher levels of physical activity during the summer than neighbours in corresponding age categories. Allotment gardeners of >62 years scored significantly or marginally better on all measures of health and wellbeing than neighbours. Health and wellbeing of younger allotment gardeners did not differ from younger neighbours. The greater health and wellbeing benefits of allotment gardening for older gardeners may be related to the finding that older allotment gardeners were more oriented towards gardening and being active, and less towards passive relaxation	Survey among 121 members of 12 allotment sites in the Netherlands and a control group of 63 respondents without an allotment garden living next to the home addresses of allotment gardeners. 5 self-reported health measures (perceived general health, acute health complaints, physical constraints, chronic illnesses, and consultations with GP), 4 self-reported wellbeing measures (stress, life satisfaction, loneliness, and social contacts with friends) and one measure assessing self-reported levels of physical activity in summer.
Hine et al., 2011	The mental health and wellbeing effects of a walking and outdoor activity based therapy project	UK	In this study, mental wellbeing was assessed using 3 outcome measures chosen for the measurement of wellbeing, self esteem and mood (Warwick Edinburgh Mental Well Being Scale (WEMWBS), Rosenberg Self Esteem scale (RSE) and the Profile of Mood States (POMS) to act as a proxy for mental wellbeing parameters. Positive changes in all 3 wellbeing measures were observed, with a statistically significant improvement in participant wellbeing, self esteem and total mood disturbance for the majority of participant.	Monitoring and evaluation programme to assess key outcomes of the Discovery Quest project. 2 phases: first a 6-month longitudinal study during the programme; secondly a series of before and after activity evaluations at regular intervals with quantitative and qualitative analysis using, questionnaires, on-site observation and informal interviews, and participatory appraisal techniques
van den Berg and Clusters, 2011	Gardening promotes neuroendocrine and affective restoration from stress	Netherlands	Results showed that both, gardening and reading had cortisol decreases during the recovery period, however decreases were significantly stronger following gardening. Positive mood was fully restored after gardening, but further deteriorated during reading. The authors highlight that these findings provide the first experimental evidence that gardening can promote relief from acute stress	Stress-relieving effects of gardening in a field experiment with 30 allotment gardeners (allotment complex 'Amstelglorie' in Amsterdam, the Netherlands) either gardening or reading on their allotment for 0.5 hour
Hawkins et al., 2011	Allotment gardening and other leisure activities for stress reduction and healthy aging	Wales, UK, indoor exercise, walkers, allotment gardeners, home gardeners	Results show a significant difference in perceived stress levels between the activity groups: indoor exercise, walkers, allotment gardeners, home gardeners. Allotment gardeners reported significantly less perceived stress than participants of indoor exercise classes. As there were no significant differences in reported levels of social support and physical activity. The explanation for the allotment gardeners' lower stress levels could be the potential contribution of engagement with nature and psychological restoration. The results contribute to the understanding of the benefits of allotment gardening a health-promoting behaviour in later life.	94 individuals aged 50 - 88 who were members of indoor and outdoor activity groups. Participants completed five physiological measures (height and weight to calculate BMI, systolic and diastolic blood pressure, lung function) and a questionnaire containing psychometric scales of self-rated health, perceived stress, physical activity level, and perceived social support.

Reference	Paper name	Country	Documented benefits of gardening and food growing	Research methods
Hawkins et al., 2013	“Doing” gardening and “being” at the allotment site: exploring the benefits of allotment gardening for stress reduction and healthy aging	Wales, UK	The study investigates the benefits to health and wellbeing of allotment gardening in community-dwelling older adult sample with a particular emphasis on stress recovery. Results indicate that allotment gardeners appreciate both “doing” gardening activity as well as “being” at the allotment landscape for affording a wide range of benefits to their health and wellbeing .	Semi-structured interviews were used to explore allotment gardener participants’ personal beliefs and ideas of the benefits of their allotment gardening activity. The sample consisted of 14 older adults with an age range from 53-82. The transcribed interviews were examined using thematic analysis.

Obesity – Adult and Childhood

Adult Obesity

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Nelson et al., 2007	Low-income diet and nutrition survey	UK	Men and women living in households that grew food consumed more fruit and vegetables than other men and women (fruit: men 95g vs.56g, women 86g vs.67g, vegetables: men124g vs.100g, women123g vs.99g).	3,728 people from 2,477 households were included in the survey (15% of the population in terms of most material deprivation). Used a doorstep survey and four 24-hour recalls of diet on random days
Alaimo et al., 2008	Fruit and vegetable intake among urban community gardeners	USA, Michigan	Adults with a household member who participated in a community garden consumed fruits and vegetables 1.4 more times per day than those who did not participate, and they were 3.5 times more likely to consume fruits and vegetables at least 5 times daily. Household participation in a community garden may improve fruit and vegetable intake among urban adults	766 adults in a cross-sectional random phone survey conducted in 2003. A quota sampling strategy was used to ensure that all census tracts within the city were represented. Behavioural Risk Factor Surveillance System. Generalised linear models and logistic regression models assessed the association between household participation in a community garden and fruit and vegetable intake, controlling for demographic, neighbourhood participation, and health variables
Park et al. 2008	Can older gardeners meet the physical activity recommendation through gardening?	USA, Kansas	The objective was to investigate if older gardeners meet the Centers for Disease Control and Prevention and American College of Sports Medicine physical activity (PA) recommendation of at least 30 minutes of moderate intensity PA on most days of the week through gardening. Results showed that gardening was a moderate intensity PA (3.8 ± 1.4 metabolic equivalents). The average gardening time during the observational study was 53 minutes. The subjects reported gardening an average of 33 hours in May and 15 hours in a typical week in June and July. Results from the SF-36 indicated that the subjects were physically and mentally healthy and it is concluded that healthy older gardeners can meet the PA recommendation from their daily gardening and it may be a factor leading to good physical and mental health.	The heart rate of 14 gardeners (5 women, 9 men) serving the Kansas State University, and aged 63 to 86 years, was continuously measured through radiotelemetry, during gardening. Oxygen uptake and energy expenditure were measured through indirect calorimetry using a sub maximal graded exercise test in a laboratory. To determine how long the subjects gardened and the kinds of gardening tasks performed, an observational study was conducted by two trained observers, and weekly logs were completed by the subjects. To investigate the subjects physical and mental health conditions, the Short-Form 36 Health Survey (SF-36) was used.
Kingsley et al., 2009	Cultivating health and wellbeing: members' perceptions of the health benefits of a Port Melbourne community garden	Australia	Results showed that the garden was felt by members to be a sanctuary where people could come together and escape daily pressures, a source of advice and social support, and a place, which gave them a sense of worth and involvement. Members also identified spiritual, fitness and nutritional benefits arising from participation in the community garden.	Small qualitative study. Semi-structured questions with 10 members from an urban community garden in Port Melbourne

Reference	Paper name	Country	Documented benefits of gardening and food growing	Research methods
McCormack et al., 2010	Review of the nutritional implications of farmers' markets and community gardens: a call for evaluation and research efforts	USA	In total, 16 studies were identified, 4 focused on community gardens. It is concluded that only a few well-designed research studies (e.g., those incorporating control groups) utilizing valid and reliable dietary assessment methods on nutrition-related outcomes have been completed.	Review paper of studies published between January 1980 and January 2009 were identified via PubMed and Agricola database searches and by examining reference lists from relevant studies. Studies included took place in the USA and were qualitatively or quantitatively examined for nutrition-related outcomes, including dietary intake
Draper and Freedman, 2010	Review and analysis of the benefits, purposes, and motivations associated with community gardening in the United States	Global	Results showed sparse literature however, a large body of qualitative data. Eleven themes related to the purposes, benefits of, and motivations for participating in community gardens are identified.	Review paper of the scholarly literature from 1999 to 2010
Zick et al., 2013	Harvesting more than vegetables: the potential weight control benefits of community gardening	USA, Utah	Results showed that both women and men community gardeners had significantly lower BMIs (Body mass index) than their neighbours. Similarly significantly lower BMIs were found in the siblings comparison. The third comparison spouses showed no statistically significant differences and the authors hypothesise that spouses would likely enjoy the dietary advantages of the community garden and might also help with the physical demands of gardening.	The study used unique administrative data to examine, for the first time, the relationship between community gardening and a health outcome. Gardeners (423 in total) were drawn from a pool of individuals active with a 20-year old community garden. Data for neighbours, siblings and spouses were drawn from administrative records, using the Utah Population Database. A total of 375 gardeners were linked to BMI information in the database and once linked, driver's license records were used to build a sample of neighbours: individuals matched for age, gender and residential location, and Utah marriage, divorce and birth records to identify siblings and spouses. In the final sample data on 198 gardeners and 67 spouses were included in the analyses, and height and weight information came from driver's license records after they began community gardening.

Childhood obesity				
Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Lineberger and Zajicek, 2000	School gardens: can a hands-on teaching tool affect students' attitudes and behaviors regarding fruit and vegetables	USA	Third and fifth grade students involved in hands-on school gardening programmes were reported to have more positive attitudes towards vegetables and increased snack preference for fruit and vegetables	Pupils (8-11 years old)
Hermann et al., 2006	After-school gardening improves children's reported vegetable intake and physical activity	USA	Children involved in an after-school gardening programme self-reported a significant increase in physical activity levels. 43 completed the pre and post evaluation questions (47% were male 53% female) There was a significant increase in the proportion of children reporting "I eat vegetables every day" and "I am physically active every day" after the education and gardening program	Responses were scored as "yes" 2, "sometimes" 1, and "no" 0. Data were analyzed with SAS and non-parametric test. In order to conduct the data analysis the responses "sometimes" and "no" were collapsed into one group and labelled "no." Significance was set at $p = 0.05$
Phelps et al., 2010	Advantages of gardening as a form of physical activity in an after-school program	USA	Children participating in an after-school gardening programme resulted in a positive impact on childrens' activity levels The study evaluated the effect of an Oklahoma Cooperative Extension Service after-school gardening program. The ACTIVITY instrument described 3 physical activity levels: non-moving, moving, and fast-moving. A significant difference between pre- and post-test scores of children's self-reported physical activity level was observed. The results show that gardening is an effective non-competitive way to increase children's self-reported physical activity level in an after-school setting.	Self-reported physical activity level of children in 3rd through 5th grade using the ACTIVITY self-report questionnaire. The nonparametric Wilcoxon signed rank test for a matched sample was used to analyze the difference between pre- and post-test scores of children's self-reported physical activity level. Statistical significance at $p = 0.05$

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Ransley et al., 2010	Does nutrition education in primary schools make a difference to children's fruit and vegetable consumption?	UK	An evaluation of the School Fruit and Vegetable scheme found that, in schools running food-growing clubs, children ate more vegetables and intake was higher if parents were involved in the initiative. In schools that achieved a high total score (derived from five key types of initiatives to promote fruit and vegetables in school) children ate more vegetables, 123 g/day, compared with those that did not 98.g/day. It is concluded that gardening, parental involvement and other activities promoting fruit and vegetables to children in school may be associated with increased intake of vegetables but not fruit. Effects were independent of deprivation status and ethnicity.	129 English primary schools Year 2 children (aged 6-7 years, n 2530). Cross-sectional dietary survey. Main outcome measures were intakes of fruit, vegetables and key nutrients; and a score for initiatives promoting fruit and vegetables in school.
Nelson et al., 2011	Food growing activities in schools. Report submitted to Defra	UK	Review of academic studies (UK and international) concluded that food growing programmes in schools can have positive impacts on pupil nutrition and attitudes towards healthy eating, specifically related to willingness to try new food and taste preferences.	Review of the literature and paper-based survey questionnaire for senior leaders or other individuals with responsibility for food growing activities in schools, sent to a total of 4479 institutions with 29% response rate
Ratcliffe et al., 2011	The effects of school garden experiences on middle school-aged students' knowledge, attitudes, and behaviors associated with vegetable consumption	USA	A study of 320 sixth grade students in the USA, involved in food growing over a 4 month period found that students were more willing to taste, and ate a greater variety of, vegetables than those in the control group Future research should explore whether effects persist over time and if and how changes in children's behaviour affect the their parents/guardians.	320 pupils (11-12 years old), 236 students completed the Garden Vegetable Frequency Questionnaire and 161 complete a taste test

Sexually transmitted diseases

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
O'Hara Murdock et al., 2003	Peer-led HIV/AIDS prevention for women in South African informal settlements	South Africa	Results from this social influences peer led approach demonstrated that women residents are a valuable resource in providing effective HIV/AIDS prevention programs to South Africa's most vulnerable residents.	24 women trained from informal settlements to lead HIV/AIDS education workshops for 480 residents. reaching 1,440 residents. Focus groups
Mubvami, T. and M. Manyati, 2007	HIV/AIDS, urban agriculture and community mobilisation: cases from Zimbabwe	Zimbabwe	The authors highlight the benefits of food growing at family or community level for HIV/AIDS. The benefits are indirect, but substantial, and include improved nutrition of HIV/AIDS affected families, savings on food expenditures, added income from the sale of surpluses, and community mobilisation to respond to HIV and AIDS. This can also include the integration of former commercial sex workers from HIV/AIDS affected families.	Case studies descriptive: New Dawn of Hope Community Gardens, Harare; Allotment Gardens, Bulawayo; School gardens, Harare and Bulawayo; Household gardens, Harare; Integration of former Commercial Sex Workers, Gweru
Weiser et al., 2010	Food insecurity as a barrier to sustained antiretroviral therapy adherence in Uganda	Uganda	Food insecurity was common and an important barrier to accessing medical care and antiretroviral adherence. Among other mechanisms research showed that while working for food for long days in the fields, participants sometimes forgot medication doses. Despite these obstacles, many participants still reported high antiretroviral adherence and exceptional motivation to continue therapy.	Open-ended interviews with 47 individuals (30 women, 17 men) living with HIV/ AIDS recruited from AIDS treatment programs in Mbarara and Kampala, Uganda. Interviews were transcribed, coded for key themes, and analyzed using grounded theory (grounded theory is not a descriptive method, it has the goal of generating concepts that explain the way that people resolve their concerns)

Social health and wellbeing (social and therapeutic horticulture)

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Sempik et al., 2003	Social and therapeutic horticulture: evidence and messages from research	UK and global	<p>Hard evidence as to effectiveness of social and therapeutic horticulture is scant and of variable quality. Client groups include those recovering from major illness or injury, those with physical disabilities, learning disabilities and mental health problems, older people, offenders and those who misuse drugs or alcohol.</p> <p>The reported benefits of social and therapeutic horticulture include increased self-esteem and self-confidence, the development of horticultural, social and work skills, literacy and numeracy skills, an increased sense of general wellbeing and the opportunity for social interaction and the development of independence.</p>	Literature review: >300 articles examined from ~1000 available titles. Identified by searching library databases, references from known published work and by consulting with researchers in the field
Waliczek et al., 2005	The influence of gardening activities on consumer perceptions of life satisfaction	USA Texas	<p>Results indicated statistically significant differences in comparisons of the overall life satisfaction scores with gardeners receiving higher mean scores indicating more positive results on the LSIA. When responses to individual statements were analyzed, results indicated statistically significant differences on statements relating to energy levels, optimism, zest for life, and physical self-concept with gardeners answering more positively on all statements when compared to non-gardeners' responses. Additionally, gardeners rated their overall health and their physical activity levels higher than did non-gardeners</p>	<p>A survey based on the Life Satisfaction Inventory A (LSIA) was used to investigate gardeners' and non-gardeners' perceptions of life satisfaction. The LSIA was developed in 1961 by Neugarten and measures five components of quality of life including zest for life, resolution and fortitude, congruence between desired and achieved goals, high physical, psychological and social self-concept, and a happy optimistic mood tone. The survey was on one of the largest online resources for Texas Master Gardeners. During the 4 months, 402 responses were gathered. Additionally, identical 'paper/pencil' format surveys were distributed to garden, church, social and community groups with about 400 responses received. In each group of participants, respondents differentiated themselves as gardeners or non-gardeners by responding positively or negatively to the survey question, Do you garden?</p>
Sommerfeld et al., 2010	Growing Minds: evaluating the effect of gardening on quality of life and physical activity level of older adults	USA	<p>Results indicated statistically significant differences in comparisons of overall life satisfaction scores with gardeners receiving higher mean scores indicating more positive results on the LSIA. Four individual quality-of-life statements included in the LSIA yielded statistically significantly more positive answers by gardeners when compared with non-gardeners. Other questions regarding healthful practices revealed that personal reports of physical activity and perceptions of personal health were statistically significantly more positive among gardeners when compared with non-gardeners.</p>	<p>A questionnaire based on the Life Satisfaction Inventory A (LSIA) was used to investigate older adult (age 50+ years) gardeners' and non-gardeners' perceptions of personal life satisfaction and levels of physical activity. The LSIA measures five components of quality of life: "zest for life," "resolution and fortitude," "congruence between desired and achieved goals," "physical, psychological, and social self-concept," and "optimism." The survey was posted on a university homepage for ≈1 month. Responses were gathered from 298 participants.</p>

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Sempik, 2010	Green care and mental health: gardening and farming as health and social care: mental health and social inclusion	UK	Social and therapeutic horticulture (STH) is described as a community of vulnerable people working together on horticultural activities in a garden or allotment, with the aim of providing mutual support and benefit to their health and wellbeing . It argues that STH is an inexpensive way to treat and care for people with mental health problems, and that there is room for expansion of service provision.	Discussion article and literature review: history of STH and horticultural therapy; evidence of its effectiveness and current services and their funding
Sempik et al., 2010	Green Care: aconceptual framework. A report of the working group on the health benefits of green care	EU countries	It is concluded that research into green care spans a variety of different subject areas and issues. One area of specific interest is regarding the effectiveness of green care interventions. There is now an overwhelming body of evidence that shows that the natural environment is beneficial to health and wellbeing . There are opportunities where nature can be placed within existing therapies, which will help to spread the greening of medical, social and psychiatric services.	Literature review and conceptual framework. Report on European COST action

General health benefits of community gardens

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Armstrong, 2000	A survey of community gardens in upstate New York: implications for health promotion and community development	USA, New York State	The most commonly expressed reasons for participating in gardens were access to fresh foods, to enjoy nature, and health benefits. Gardens in low-income neighbourhoods (46%) were four times as likely as non low-income gardens to lead to other issues in the neighbourhood being addressed reportedly due to organizing facilitated through the community gardens.	Survey of 20 community garden programs in upstate New York (representing 63 gardens)
Twiss et al., 2003	Community Gardens: lessons learned from California Healthy Cities and Communities	USA California	Community gardens enhance nutrition and physical activity and promote the role of public health in improving quality of life. California Healthy Cities and Communities (CHCC) promotes an inclusionary and systems approach to improving community health. CHCC has funded community-based nutrition and physical activity programs in several cities. Results show that successful community gardens were developed by many cities incorporating local leadership and resources, volunteers and community partners, and skills-building opportunities for participants. Through community garden initiatives, cities have e.g. improved access to produce and elevated public consciousness about public health	'Field action report' Description of California's community gardens and public health funding regime

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Quayle H., 2007	The true value of community farms and gardens: social, environmental, health and economic	UK	Results demonstrate the contribution to wellbeing of individuals and communities: reconnect people, promote local action on global environmental issues, (recycling, composting, use of organic methods, creation of wildlife areas), uptake of healthier diets.	22 projects (farms, gardens, allotments and stables) across England using informal interview sessions, participatory appraisal (PA), rapid appraisal (RA) and postal questionnaires.
Wakefield et al., 2007	Growing urban health: community gardening in South-East Toronto	Canada	Results suggested that community gardens were perceived by gardeners to provide numerous health benefits, including improved access to food, improved nutrition, increased physical activity and improved mental health. Community gardens were also seen to promote social health benefits and community cohesion. Mental health benefits are described by the gardeners as more general, like helping to be more mentally (and physically) active or to reduce stress	Community-based research (CBR = research with a substantial level of community participation). Involving participants helping in 2004 growing season and attending garden meetings. 10 focus groups, 1-2 hours long with overall 55 people and 13 in-depth interviews. All focus groups and interviews recorded and professionally transcribed verbatim
Teig et al., 2009	Collective efficacy in Denver, Colorado: strengthening neighborhoods and health through community gardens	USA, Colorado	Descriptive results of social processes (like social connections, reciprocity, mutual trust, collective decision-making, civic engagement and community building) and the activities supporting them. No specific findings on health issues despite title.	Semi-structured interviews with community gardeners in Denver. 90 minutes 15 interviews were conducted with individuals and 14 were conducted in groups with at least 2 and up to 8 participants. Data from individual and group interviews were pooled to generate the final dataset (67 respondents, 29 garden sites). All coding, sorting, and comparing of the data during the analysis process took place using NVivo 7 (QSR International Pty. Ltd.)
Chen et al., 2010	Exploring dimensions of attitudes toward horticultural activities	Taiwan	Five dimensions of attitudes toward horticultural activities were extracted: increasing positive mood, improving the environment, leisure belief, improving social relationships, and escaping. These dimensions of attitudes toward horticultural activities had activity-based attributes that differed to some extent from those of general leisure.	Two steps: First open-ended interviews were used to conceptualise attitudes toward horticultural activities, and 7 themes and several sub themes of attitudes were induced. Based on the results, a quantitative survey was conducted to identify the dimensions of attitudes towards horticultural activities and their interrelationships

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Hale et al., 2011	Connecting food environments and health through the relational nature of aesthetics: gaining insight through the community gardening experience	USA, Colorado	Gardeners' aesthetic experiences generate meaning that encourages further engagement with activities that may lead to positive health outcomes. The physical and social qualities of garden participation awaken the senses and stimulate a range of responses that influence interpersonal processes and social relationships that are supportive of positive health-related behaviours and overall health. The research suggests that the relational nature of aesthetics, can help guide community designers and health planners when designing environment and policy approaches to improve health behaviours.	Key-informant interviews to explore gardeners' tactile, emotional, and value-driven responses to the gardening experience and how these responses influence health at various ecological levels ($n = 67$ participants, 28 urban gardens).
Anderson, 2011	An exploration of the potential benefits of healing gardens on veterans with post traumatic stress disorder (PTSD)	USA	This study looks at the potential benefits of using healing gardens in addition to traditional methods of treatment for veterans suffering from posttraumatic stress disorder (PTSD). Results are descriptive and design based but state that many PTSD practitioners at VA facilities across the country show interest in the use of healing gardens. However, there is also hesitation of professionals expressing concerns regarding a number of perceived obstacles for healing garden implementation.	Master study for landscape architecture. The study examines the history of healing gardens, problems facing veteran populations today, current treatment methods for PTSD, and how healing gardens could be beneficial to veterans with PTSD A Veterans Affairs (VA) healthcare facility that is in the process of implementing a healing garden was used to determine how their PTSD patients will potentially use a healing garden space during treatment.
MacKerron and Mourato 2011	Mappiness: quantifying wellbeing in relation to environment across space and time. (www.mappiness.org.uk)	UK	Wellbeing is a topic of increasing interest to economists, including environmental economists, however, available quantitative evidence remains limited. The paper describes a new primary research focused on individuals' momentary experiences of their environment. Results show that even after controlling for other factors (weather, daylight, activity, companionship, location type, time, day) participants are substantially happier outdoors in any natural or green habitat type than in the urban environment.	Environmental economics primary research using individuals' momentary experiences of their environment. Respondents are 'beeped' with questions at random moments via smart phones, creating a GPS geo-located panel data set comprising of 1,5m responses from 30k individuals. Using GIS to associate response locations with environmental data, we estimate a model relating habitat type to self-rated happiness.

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Pretty et al., 2011	The UK National Ecosystem Assessment technical report chapter 23: health values from ecosystems	UK	The report concludes that observing nature and participating in physical activity in green spaces play an important role in human health and wellbeing. Ecosystems provide direct positive effects on both mental and physical health. In addition, there are indirect positive effects by facilitating nature based activity and social engagement, which positively influence health and provide a catalyst for behavioural change in terms of encouraging the adoption of healthier lifestyles.	Literature review and ecosystem assessment
White et al., 2013	Would you be happier living in a greener urban area? A fixed-effects analysis of panel data	UK	Results showed that on average, individuals have both lower mental distress and higher wellbeing when living in urban areas with more green space. Although effects at the individual level were small, the potential cumulative benefit at the community level highlights the importance of policies to protect and promote urban green spaces for wellbeing .	Earlier research was unable to control for time-invariant heterogeneity (e.g., personality) and focused on indicators of poor psychological health. The current research advances the field by using panel data from over 10,000 individuals to explore the relation between urban green space and wellbeing (indexed by ratings of life satisfaction) and between urban green space and mental distress (indexed by General Health Questionnaire scores) for the same people over time

The benefits of gardening and food growing for health and wellbeing

A Sustain publication

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Growing Health is a national project run by Garden Organic and Sustain, which is funded by the Tudor Trust, to see how community food growing can be routinely used by the health and social care services as a way of promoting health and wellbeing for a range of individuals and population groups.



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