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The Benefits of Gardening and Food Growing for Health and Wellbeing

by

Garden Organic and Sustain

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1 Introduction and approach

It is increasingly recognised, by individuals and health professional alike, that gardening and growing food 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 this 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 focus of this review is on the health benefits provided by community gardens, and specifically the benefits associated with the activity of gardening and food growing. Clearly, these benefits form part of a wider context of the health benefits associated with green spaces, nature and ecosystems. The wider subject of health values of ecosystems were comprehensively reviewed and summarised by Pretty et al. (2011) as part of the UK National Ecosystem Assessment (UK National Ecosystem Assessment, 2011). This reports concludes that "*observing nature and participating in physical activity in green spaces play an important role in positively influencing human health and wellbeing*". Furthermore, Pretty et al. (2011) concluded that 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. The report y also use a broad definition of the term 'health' including physical health, mental and emotional health, social health, spiritual health, lifestyle and functionality (Pretty et al. 2011). For this review we adopt this term and the World Health Organisations (WTO, 1948) long standing definition:

> "health is a state of complete physical, mental and social (individual) wellbeing, and not merely the absence of disease or infirmity"

In this study the benefits of gardening and food growing have been reviewed under a list of health and wellbeing headings, concurring with some of the major physical and mental health issues that face our society at present. The focus was to search specifically for studies where the impact of gardening and growing had been evaluated in relation to specific health issues, as opposed to more generic health outcomes, though in many instances the focus of the studies are not that specific.

The available literature published in English language has been collated under the following headings:

- Allergies, asthma and intolerances
- Cancer
- Cardiovascular diseases, heart diseases, stroke
- Dementia, Alzheimer's
- Diabetes
- Mental health, stress and depression
- Obesity and Childhood obesity
- Sexual transmitted diseases
- Social health and wellbeing (social and therapeutic horticulture)
- General health benefits of community gardens and green spaces

The methods used for the review were mainly literature searches using online tools like Google Scholar (http://scholar.google.co.uk) and other publicly available search engines and content. Full-text scientific papers were accessed were appropriate. We searched for all health conditions outlined under the

heading above and 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. We also used included methodology to measure evidence like *'social return on investment'*. We then followed up key references in peer-reviewed papers with robust methods and searched for the latest published findings. We also included advice given to us from UK experts and our stakeholders in the research. We have not included non-English language publications in our search.

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 well-being benefits, however most are not specific for disease. In this chapter we have combined the literature in a table and discuss the effects described in 10 papers. Many of the English language scientific publications assess are reporting from the USA, Canada, Australia and New Zealand.

Community gardens and health

There have a number of studies on the benefits of community gardens regarding social benefits, as well as nutritional benefits, and physical activity (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.

> **Excurse on methods**: 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, were 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 community cohesion. The mental health benefits are described by the gardeners as more general, like 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 Allergies, asthma and intolerances

Avoiding triggers, such as allergens, can prevent symptoms of asthma, a chronic inflammatory disease of the airways. Horticultural therapy (HT) has been used in Japan (Sadako, 2002; Kamata, 2008) to treat for asthmatic children, aged 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 (see chapter stress) 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.

4 Cancer

The Department of Health in the UK concurs recommending that "for general health, a total of at least 30 minutes a day of at least moderate intensity physical activity on five or more days of the week reduces the risk of premature death from cardiovascular disease and some cancers (Bedfordshire NHS, 2004).

Unruh's study 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 well-being, and highlighted a key role of gardening as a coping strategy for living with stressful diseases and cancer (Unruh, 2004).

There is further evidence for breath 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. This is an indirect benefit and more research for patient subgroups like older people or those with advanced cancer are necessary to detail the effects on those. 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 well-being". Studying patient perspectives when travelling for radiation cancer treatment Fitch et al. (2003) found that waiting for treatment and putting domestic activities like gardening on hold added to the patient stress.

5 Cardiovascular diseases, heart diseases, stroke

Rehabilitation: 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.

6 Dementia, Alzheimer's

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. As well as having profound impact on the individual, dementia can also have high impact on family members and friends. Dementia results in a progressive decline in multiple areas of 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. In 2009 the UK Department of Health has published a National Dementia Strategy (Department of Health, 2009). The aim of the Strategy is 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 are currently 750,000 people living with dementia in the UK, and it is predicted that the number of people living with dementia will rise to 1.7 million by 2050. The Alzheimer's Society estimate that in 2007 the total cost of dementia in the UK was £17 billion per annum or on average £25,472 per person per year with late onset dementia (Alzheimer's Society, 2012). In it's 2013 report (Alzheimer's Society, 2013) points out that the Welsh Assembly in its framework action recognises that low-level support services such as gardening clubs are vital, and reduce the need for more intrusive and costly (Welsh Assembly Government, 2011).

The UK National Institute for Health and Care Excellence (NICE) recommends that care plans should address activities of daily living that maximise independent activity, enhance function, adapt and enhance function and minimize need for support (Reference). A garden provides a non-pharmacological approach (Brawley, 2001, Detweiler et al. 2012, Gitlin, 2012 why) to address these goals, improve quality of life and promote patient/carer satisfaction.

Numerous studies have shown the benefits of therapeutic gardens and horticultural activities for patients with dementia:

- regular horticultural activities over 6-12 week periods resulted in a decrease in aggressive behaviour (Luk, 2011)
- higher levels of adaptive behaviour and engagements in other activities (Jarrot and Gigliotti, 2010)
- improvements in communication, engagement, behaviour and cognitive abilities (Yasukawa, 2009)
- less agitated behaviour, improved mood and used less PRN (pro re nata) medications (Detweiler et al., 2012)
- maintenance of memory and sense of well-being (D'Andrea 2008). The study researched if HT can delay cognitive deterioration in urban nursing home with Alzheimer's patients. A group of 20 were randomly selected to attend HT twice weekly for 12 weeks . Results showed the HT group had an overall higher functional level than the control group.
- improved sleep and reduced verbal agitation (Connell et al. 2007)

Jarrot and Gigliotti (2010) study demonstrated that horticultural therapy (HT) based activities are a viable and desirable choice for dementia-care programs. They reach groups of participants who are often difficult to engage in activities. In the study HT was compared to traditional activities and was implemented twice weekly at 4 treatment sites for 6 weeks. There was no difference on affective domains, however HT resulted in higher levels of active and passive engagement.

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).

Alzheimer's patients seem to respond better to green spaces like gardens (Mooney and Nicell, 1992) and this has been developed elsewhere with respect to recommendations for gardens (Centre for Child and Family Research, 2010).

7 Diabetes

The Department of Health in the UK concurs recommending that "for general health, a total of at least 30 minutes a day of at least moderate intensity physical activity on five or more days of the week reduces the risk of premature death from cardiovascular disease and some cancers, significantly reduces the risk of type 2 diabetes, and it can also improve psychological well-being" (Bedfordshire NHS, 2004).

8 Mental health, stress and depression

As discussed earlier there is a great deal of qualitative research on the general benefit of community gardens and city farms (Quayle, 2007). Quayle summarised those for the UK in 2007 however, most of the evidence is qualitative research and although benefits for community cohesion, the local economy, the environment are well documented regarding mental health only two studies are quoted. One documents volunteers at a gardening nursery. 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. (Calleau, 2005). The other study (Velde et al., 2005) includes livestock and describes how animals can be used by occupational therapists. Results showed improve 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.

Gardens, as well as the activity of gardening, have been shown to have a positive impact on peoples' health and well-being; the result of both the physical activity and the use of the garden as a space for mental relaxation and stimulation.

Gardeners seem to know this: gardeners involved with the Philadelphia Gardening Programme, one of the larger gardening projects in the USA at the time, were asked why they gardened. Of the 144 gardeners interviewed, after recreation (21% of those questioned giving this as a reason they gardened), it was the health benefits associated with gardening that were most important. This included mental health (19% of those questioned), physical health and exercise (17%) and produce quality and nutrition (14%) (Blair *et al*, 1991).

According to Pretty *et al.* (2005a) 'less green nature means reduced mental well-being, 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.

Views over 'green space' in the form of plants at work is said to improve performance (Lohr *et al*, 1996).

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 elsewhere (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).

8.1 Stress

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 (NHS, 2010c). 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 would seem to be able to reduce stress in three 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. The better-known studies of this effect are provided by Ulrich (1984) and Kaplan (2001) and reviewed by Maller *et al.* (2005). Day (2007) provides a more critical view on the 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 (e.g. 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, perhaps because it allows them to feel connected to nature (Stephan Mayer *et al*, 2008).
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*, 2005b)

Van den Berg and Clusters (2011) tested stress-relieving effects of gardening in a field experiment with 30 allotment gardeners 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 first experimental evidence that gardening can promote relief from acute stress (van den Berg and Clusters, 2011).

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 verdant 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.

8.2 Depression

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.

9 Adult and Childhood obesity

9.1 Adult obesity

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). A total 61.3% of adults are either overweight or obese and for children 23.1% of 4-5 year olds are overweight or obese and 33.3% 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 peoples 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 it is clear that changes in diet to reduce energy intake along with increasing physical activity are key to achieving weight loss and sustaining a healthy body weight. The very high levels of obesity are, at least in part, attributed to poor diet and lack of exercise (Taskforce report, The NHS Information Centre, Lifestyle Statistics (2011). Statistics on obesity, physical activity and diet, (England, 2011).

In April 2013 results were published which showed a significant reduction of BMI (body mass index) and obesity of people engaged in community gardening (Zick et al., 2013). There has been always anecdotal evidence or from small qualitative studies (Kingsley et al., 2009, Draper and Freedman 2010) that gardening may reduce obesity, but data showing a significant effect in a large and comparable study are rare. The researchers from University of Utah, USA, examined the BMI data from 198 community gardening participants in Salt Lake City in relationship to BMI data for 3 comparison groups: **neighbours**, **siblings**, and **spouses**. In the comparisons data were adjusted for gender, age, and the year of the BMI measurement.

For this study it is worth looking into the methods used in more detail, as this is necessary to arrive from anecdotal evidence to scientifically robust evidence.

> **Excurse on methods**: The study used unique administrative data to examine, for the first time, the relationship between community gardening and a health outcome. One group (neighbours) included unrelated people from the same geographic neighbourhood. This group would share similar physical environments, like walking options and proximity to food shops and stores, as well as economic status. The second group same sex siblings, who would be expected to share genetic predispositions for weight and family influences on diet and exercise. The third group married spouses of the gardeners, because they would likely share lifestyle and food choices, including food grown in the community garden.
>
> Gardeners were drawn from a pool of individuals active with Wasatch Community Gardens, a 20-year old non-profit organisation in Salt Lake City. Wasatch provides a network of urban gardens located throughout the local area, as well as classes, programs and events focused on gardening and eating locally. Wasatch provided names and addresses of 423 adults who had gardened on one of the community plots for at least one year between 1995 and 2010. Data for neighbours, siblings and spouses were drawn from administrative records, using the Utah Population Database, a multi-faceted data resource used by health researchers. It includes a large

set of Utah family histories, and links to publicly available historical birth, marriage, and driver's license records. 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.

Results showed that both women and men community gardeners had significantly lower BMIs than their **neighbours**. The multivariate analysis used showed estimated BMI reductions of -1.84 (female) and -2.36 (male). Similarly significantly lower BMIs were found in the **siblings comparison**: -1.88 below sisters and -1.33 below brothers. 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, however, its important to note that the this specific comparison is drawn from a substantially smaller sample and a larger sample might reveal different results or confirm the finding. Future research into this "spill-over" effect would be very important as community gardening might affect also all family members including friends and neighbours.

In summary the author team (Zick et al. 2013) conclude that *"health benefits of community gardening may go beyond enhancing the gardeners' intake of fruit and veg. 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"*.

Obviously, these data are only from one sample, in one capital city of an US state, 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 then just for one US 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 Zick et al. (2013) this is the first study ever published worldwide comparing health benefits of community gardeners with non-gardeners in a robust sample. Only two other studies with a comparison community gardeners and non-gardeners were published and both focus on fruit and vegetable intake (Blair et al., 1991, Alaimo et al., 2008).

A further research need is to explore the costs associated with initiating and maintaining community gardens and to investigate the relative cost-effectiveness of various options designed to enhance urban access to fresh produce (e.g., community gardens, farmers markets, city farms, CSAs (community supported agriculture), urban gardening including private gardens, allotments, vertical, roof-top and guerilla gardening).

9.2 Childhood obesity

A recent review 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 willingness to try new foods and taste preferences (Nelson et al., 2011). For example, a study of 320 sixth grade students (11-12 years old) in the USA, involved in food growing over a four month period found that students were more willing to taste, and ate a greater variety of, vegetables than those in the control group (Ratcliffe et al., 2011). Lineberger and Zajicek (2000), also in the USA, reported more positive attitudes towards vegetables and increased snack preference for fruit and vegetables amongst third and fifth grade students (8-11 years old) involved in hands-on school gardening programmes.

The Nelson et al. (2011) review also report the details of a number of studies demonstrating that pupils engagement in food growing activities can result in increased consumption of vegetables, but also noted

that all of the studies examined only considered whether pupils consumption habits had changed as an immediate effect of their involvement in growing. The review highlights the lack of longitudinal evidence research confirming whether such programmes can change eating habits longer term.

In addition, Nelson et al. (2011) reviewed studies evaluating pupils physical activity levels in relation to growing. Numerous school food growing studies mention physiological outcomes, much of this evidence is anecdotal and has not been robustly tested. However, a few studies have attempted to measure physiological outcomes, such as changes in the amount of physical exercise undertaken by children involved in growing activities, including

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. It is probable 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).

Physical health: health problems centred around sedentary lifestyles, obesity and old age have been alleviated or tackled with gardening programmes.

10 Sexual transmitted diseases

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).

11 Social and Therapeutic Horticulture

Therapeutic horticulture and/or 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 the process by which individuals may develop well-being using plants and horticulture either by active or passive involvement. Although many publications have been produced many have not actually provided measured evidence of its effectiveness (Sempik *et al.*, 2003), perhaps because of the subjective nature of many of the outcomes.

11.1 Horticultural Therapy (HT)

Actually engaging persons in horticulture as a clinical therapy is 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 promoting some longer-term 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 qualified professional.

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

1. *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*, 2004). 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.
2. *Rehabilitation:* 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.
3. *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).
4. *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 HT 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. Horticultural therapy as a holistic therapy is also used for patients to recover from life-challenging illnesses like cancer survivors (Eunhee, 2003).

11.2 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, old 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.
- *Drug and alcohol addicts:* 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.

11.3 Life Satisfaction

'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 certainly engage people in many different ways (see section on education) 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 well-being. 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). In this respect gardens can be seen as a part of the household where emersion in life processes is most easily achieved. Some authors, including Wilson the original proposer, have postulated that the theory offers some hope for conservation of biodiversity on a global level (e.g. Simaika and Samways, 2010).

11.4 Psychological well-being

The evidence that suggests that optimal physical health and psychological well-being are linked to positive emotional environments and the natural environment are by Haviland-Jones *et al*, 2005; Pretty et al, 2005a; 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).

12 Social return on investment

Social Return on Investment (SROI) has been developed as a way to put monetary value to "invaluable" assets (SROI Network, 2012). This is only an academic method to capture and value information and assets which are normally not measured in monetary terms or have a tradable monetary value. The main advantage of the method is that it arrives at "hard figures" of Pounds, Euros or Dollars which most of us, and especially funders, are most familiar with. If this can truly capture all invaluable assets or even if it is wise to but monetary values to each and everything is another more philosophical question, which should not deter from using the methods as long as results are not over-interpreted.

SROI puts a financial value on the impact of an activity that otherwise may not be given value and therefore may not feature in decision making. As an example (Gorgie City Farm, 2011) a SROI analysis for a community garden project at Gorgie City, Edinburgh, Scotland, UK has shown that the farm benefits a wide range of "stakeholders" including volunteers, visitors, the NHS, the local council and the environment. It is calculated that for £1 invested by funders the equivalent of £3.56 of social value is generated. The authors estimate this as an understatement, as several outcomes and stakeholders were excluded from the analysis, and financial proxies may have underestimated the value of some outcomes (Gorgie City Farm, 2011). Besides the monetary calculation the SROI is still a useful exercise for the community garden project as it generates much additional information like e.g. in this case, volunteers stop taking anti-depressant medication as a result of farm involvement or encouraging quotations from visitors, volunteers and other service users.

To explain the concept in more detail we have extracted a short example calculation for a £10,000 investment and a SROI analysis focused on health benefits for volunteers and NHS funder from the study (Gorgie City Farm, 2011). The following outcomes for of the community gardening projects were recorded using a self-assessment questionnaire:

Volunteers

- Improvements in confidence and self-esteem
- Better mental health
- Eating more healthily
- More active

NHS

- Reduced demand for mental health services
- Reduced cost of prescribing
- Increased cost of prescribing

The SROI finds a financial proxy for the value and assumes the duration of the effect. In order the measure outcome more objectively assumptions on what would happen without the intervention and other effects are estimated as percentages. They are:

- "Deadweight" (What would have happened anyway?)
- "Displacement" (Outcome been created at expense of others?)
- "Attribution" (How much of the outcome is due to external factor?)
- "Drop off" (percentage decrease of outcome with time)

Another assumption is the discount rate for multi-year effects. All assumptions can be tested in a sensitivity analysis showing "what-if" SROI's results for other percentages is assumed. As example spreadsheet in Table 1 shows, financial figures for social return of community gardening are readily produced.

Table 1: Exemplified social return on investment (SROI) calculation (Source: Gorgie City Farm, 2011, calculation input changed to demonstrate method)

Stakeholders (who experiences change?)	**Outcomes** (how will the stakeholder benefit) - description	**Indicator** (how will you measure the Outcome?)	**Quantity**	**Duration** (years Outcome lasts)	**Financial proxy** for Outcome	**Value** of the financial proxy	**Source**	**Deadweight** (What would have happened anyway?)	**Displacement** (Outcome been created at expense of others?)	**Attribution** (How much of the outcome is due to external factor?)	**Drop off** (percentage decrease of outcome with time)	Year 1	Year 2	Year 3	Year 4	Year 5
Volunteers	Improvements in confidence and self esteem	No. of volunteers reporting increase in self confidence	10	1	Cost of training course 'How to be more self-confident'	1195	nef's SROI for Coventry's Local Enterprise and Growth Initiative (unpublished)	40%	0%	40%	0%	£4,302	£0	£0	£0	£0
	Better mental health	No. of volunteers reporting fewer visits to doctor/counsellor	5	1	Cost of local counselling for people on low incomes (1hr/week for a	1144	http://www.wellspring-scotland.co.uk/	40%	0%	40%	0%	£2,059	£0	£0	£0	£0
	Eating more healthily	No. of volunteers who reported eating more healthily	15	5	Money not spent on takeaways and snacks (av. household	354	Family Spending Survey 2009	15%	0%	40%	50%	£2,708	£1,354	£1,354	£1,354	£1,354
	More active	No. of additional hours spent walking	900	3	Cost per hour of joining a guided walk	2	http://www.transpentland.co.uk/transpentland_walks.html	30%	0%	40%	50%	£756	£378	£378	£0	£0
NHS	Reduced demand for mental health services	Reduction, in hours, of visits by volunteers to doctors	300	1	Cost of GP consultation	31	www.sroiproject.org.uk & www.pssru.ac.uk 'Unit Costs of Health and Social Care')	50%	0%	40%	0%	£2,790	£0	£0	£0	£0
		Reduction, in hours, of visits by volunteers to support workers	500	1	Cost of a consultation with a community nurse	35	www.sroiproject.org.uk (originally from Scottish NHS Cost Book 2008)	50%	0%	40%	0%	£5,250	£0	£0	£0	£0
	Reduced cost of prescribing	No. of volunteers who have reduced their medication levels	10	5	Cost saved per person	23	Cost of low level dose (20mg) of Fluoxetine (anti-depressant) for one year from British National Formulary	50%	0%	40%	90%	£69	£7	£7	£7	£7
	Increased cost of prescribing	No. of volunteers who have increased their medication levels	2	1	Increased cost per person	-630	Cost of increase from 20mg to 60mg of Fluoxetine (anti-depressant) for one year from British	50%	0%	40%	0%	-£378	£0	£0	£0	£0
												Total Impact	£17,556	£1,739	£1,739	£1,361	£1,361
												Present value per year	£17,556	£1,678	£1,678	£1,313	£1,313
												Dicount rate	3.50%				
																Total present value	**£23,539**
																Investment	**£10,000**
																Social return on investment	**2.35**

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14 Appendix Benefit Matrix: Community growing (general)

Community gardening benefits – results general benefits (Specific health and well-being benefits are marked in red)
Source: York and Wiseman (2012) and Wisman (2013)

Reference	Population	Setting	Type and method	Results	Thematic analysis
Batten and Holdaway, 2011 The contradictory effects of timelines on community participation in a health promotion programme	21 adults interviewed volunteers and health professionals, but roles blurred. 40 meetings observed A small, regional, 3-year programme aiming to improve the fruit and veg intake of targeted groups, specifically Maori and low income	New Zealand Maori, Pacific peoples	A longitudinal, qualitative, instrumental case study of one health promotion programme 40 meetings observed photographic record of events and significant places; collation of programme documents and media	Many timelines. Funding is a problem. Seasonality is a problem – added together they mean that the project runs counter to its aims in order to meet funding and seasonal timelines. Evaluation process was useful in providing a structure.	Funding Evaluation process/structure Different perspectives of participants led to frustration
Beilin and Hunter, 2011 Co-constructing the sustainable city: how indicators help us "grow" more than just food in community gardens	Local government employees, community garden members, industry experts connected to four community gardens	Australia Sydney and Melbourne	Participatory research; clear description of collaborative process to develop value indicators useful to community gardening groups and local government planners. Two pilot studies, followed by two case study sites. Locally developed definitions of concepts. Very clear approach, well explained.	Indicators were derived for: • Local food production • Biodiversity • Wider community engagement and social well-being. • Urban sustainability Community gardens contribute to urban nature, and combine socially and ecologically positive outcomes	Shared values can be negotiated by diverse parties with expert facilitation.
Corrigan, 2011 Growing what you eat: Developing community gardens in Baltimore, Maryland	low-income and predominately African American community gardeners n=11	USA Baltimore, Maryland	Exemplar case study Qualitative data from in-depth interviews with gardeners and a non-profit organization and field observations from food stores and community gardens asking about food security	Community garden in this study contributes to individual, household, and community food security, additional help is needed in the form of education, policy, and funding to increase food security and promote healthy lifestyles.	Food security improved Education, policy, and funding Community leadership Prior gardening experience City and community organizations bottom up approach

Eizenberg, 2012 The Changing Meaning of Community Space: Two Models of NGO Management of Community Gardens in New York City	2 organizations: Trust for public land New York restoration Community gardens Community gardeners African American and Hispanic residents with low-income. No details given on numbers	USA New York	Large-scale grounded theory research Examines community gardens in New York City ethnographic methodologies of in-depth interviews with gardeners, representatives of supporting organisations and the municipality, observations in community gardens and at gardeners' events and meetings, and a quantitative analysis of data files provided by the municipality and other organisations.	Models of space management undermine opportunities for gardens to develop into autonomous community space Ownership and control by management is problematic 'build ourselves for ourselves by ourselves'.	Power struggle that transcends and interferes with the community garden, landowners vs. low-income residents.
Evers and Hodgson 2011 Food choices and local food access among Perth's community gardeners	Members of community gardens 28 gardeners and 7 coordinators Generally affluent	Australia Perth, Western	Part of a larger study about community gardening. Focuses on the food security and alternative food networks aspect. Standardized interviews completed face to face or independently by gardeners and returned by post.	Constraints in making choices. Would prefer own grown, but mostly bought produce. Barriers: time, space, productivity availability. Although numbers are small. More experienced as result of attendance. Majority also garden at home. Increased knowledge of seasonality of food	Education of people to grow their own at home, and social space. Social justice, and space for people with none is not happening.
Firth, Maye, and Pearson 2011 Developing "community" in community gardens	Survey of 25 community garden managers to identify, interviews with 4 key stakeholders, 2 sites for detailed case studies.	UK England Nottingham	Case studies purposive sampling to find representative sites for two models: interest or place-based initiative, and the nature of the management structure, more top-down (Health service generated) or bottom-up (grass roots)	Two categories identified, place based and interest based gardens. Analytical framework of types of capital applied. The core purpose needs to be consistent with the management processes – social capital comes from grass roots, and cannot be imposed.	Incentive (I) building social capital, cohesion, vitality Conflict with neighbours Conflict of values and ownership Strong links with community Paid community worker Good funding
Hale et al., 2011 Connecting food environments and health	67 community gardeners	USA Denver Colorado	Participatory research, gatekeeper selection bias – 44 gardens put forward. Interviews and focus groups clear methodological detail, sampling, participants and analysis of data.	Found the usual food/environment – went further to understand the Aesthetic experiences Engagement: Emotional Tactile, Cognitive: Spiritual/world view values	Good feeling bring connectedness Meaning enhances Engagement and participation

Litt et al., 2011 The influence of social involvement, neighbourhood aesthetics, and community garden participation on fruit and vegetable consumption.	1115 area sample 300 community gardeners list based sample, inaccessible or dangerous addresses excluded on visit (n=648). Remainder had response rate 59% 436 Urban adult residents across 58 block groups Gardeners self identified as non, home or community gardeners	USA Denver, Colorado	Population-based survey from 2006 to 2007. Multilevel statistical models to evaluate the survey data. Exploring food relationship between fruit and vegetable consumption and selected social and psychological processes, beneficial aesthetic experiences, and garden participation. Good methodological detail on sampling and statistical evaluation.	Neighbourhood aesthetics, social involvement, and community garden participation were significantly associated with fruit and vegetable intake	Fruit and veg intake associated with Aesthetics Social involvement Participation in community garden First convincing study that people eat what they grow.
Okvat and Zautra, 2011 Community gardening: a parsimonious path to individual, community, and environmental resilience.	Review of research that: (1) focused on contact with plants (2) used qualitative or quantitative research methods, (3) measured individual-level, community-level, or environmental dependent variables.	All literature, well evaluated	Literature review, Good overview, but process poorly explained.	Supports view of earth community	Looking after the earth
Richardson, 2011 At the Garden Gate: Community Building Through Food	Popular newspaper articles describing school food events relating to gardens, and multicultural education texts.	USA	Discourse analysis	School-community partnerships centred on food are developing in multi-ethnic contexts to promote progressive ideals such as volunteerism, civic engagement, and environmental awareness.	Food education Cultural education Community participation Environmental awareness.
Turner, 2011 Embodied connections: sustainability, food systems and community gardens	Community gardeners 20 participants from seven community gardens	Australia Capital Territory	An ethnographic study participant observation, informal conversations, and in-depth individual interview data gathered from	Embodied form of sustainability Ecological citizenship Best argument for embodiment and engagement with sustainability	Embodied engagement Natural world citizenship
York and Wiseman, 2012 Gardening as an occupation: a critical review	Research articles 2003-2010 4 of 214 chosen.	International, English language	A meta-ethnography gathering high quality qualitative studies, synthesising through a process of translations in order to preserve meanings from within a range of culturally specific contexts.	Gardening in the natural environment offers meaningful, satisfying opportunities to increase well-being and recovery. Social agent of change occurs through successful gardening projects, leading to wider community integration.	Links between gardening and well-being for individuals and communities

15 Appendix Benefit Matrix of Food growing for health and wellbeing

The benefit matrix is ordered by heath issue as discussed in the chapters of the main text and year of publication (older papers are discussed first)

Benefit matrix of food growing for health and wellbeing

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 hospitalized in facilities, and questioning was executed on them. 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 (HT) and questioning
Kamata, 2008	The practicability of horticultural therapy for asthmatic children	Japan	Horticultural therapy (HT) 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 (HT)

Cancer				
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 Center 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 well-being, 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

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
Kirshbaum, 2006	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. 2004 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 synthesized
Cardiovascular diseases, heart diseases, stroke				
Diabetes				

Dementia, Alzheimer's				
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 HT program	USA	The study considers whether planting, cooking, or craft HT activities engender differential responses from adult day service (ADS) 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 ADS 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. 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 HT activities promote cognitive, psychosocial, and physical benefits equally.	HT and patient assessment
Connell et al., 2007	Therapeutic Effects of an Outdoor Activity Program on Nursing Home Residents with Dementia	USA	1-year pilot study to compare outdoor and indoor activity program on sleep and behavior 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 $p< 0.10$. 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.	Sleep was assessed with wrist actigraphs with photocells, which also allowed for monitoring of light exposure. Behavior disturbance was assessed with the Cohen-Mansfield Agitation Inventory.

Reference	Title of paper	Location	Documented benefits of gardening and food growing	Research and evaluation methods
D'Andrea et al., 2008	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 HT group had an overall higher functional level than the control group ($t(36)= 5.7$, $p < .0005$). It is concluded that HT 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)
Jarrot and Gigliotti, 2010	Comparing responses to horticultural-based and traditional activities in dementia care programmes	USA	Compared a randomly assigned HT treatment group with traditional activities (TA). HT twice weekly at 4 treatment sites for 6 weeks. Results demonstrated HT 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 HT 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 long history of HT 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 used 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

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. Behavioral Risk Factor Surveillance System. Generalized linear models and logistic regression models assessed the association between household participation in a community garden and fruit and vegetable intake, controlling for demographic, neighborhood participation, and health variables
Kingsley et al., 2009	Cultivating health and well-being: 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 (eg, 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 US 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

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 sand 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 behavior 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

Mental health, stress and depression				
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 well-being.	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.	

Reference	Paper name	Country	Documented benefits of gardening and food growing	Research methods
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
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 neighbors in corresponding age categories. Allotment gardeners of >62 years scored significantly or marginally better on all measures of health and well-being than neighbors. Health and well-being of younger allotment gardeners did not differ from younger neighbors. The greater health and well-being 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 well-being 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

Sexual 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	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. 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 well-being and the opportunity for social interaction and the development of independence.	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	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	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?

Sommerfeld et al., 2010	Growing Minds: Evaluating the Effect of Gardening on Quality of Life and Physical Activity Level of Older Adults	USA	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.	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.
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 well-being. 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: A Conceptual 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 well-being. 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 and green spaces				
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 neighborhoods (46%) were four times as likely as non low-income gardens to lead to other issues in the neighborhood 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 well-being 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 conceptualize 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 behaviors 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 behaviors.	Key-informant interviews to explores 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 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 on individuals' momentary experiences of their environment. Respondents are 'beeped' with questions at random moments via their smartphones, 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 well-being 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 well-being.	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 well-being (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