



**Green Exercise:
Complementary Roles of Nature,
Exercise and Diet in Physical and
Emotional Well-Being
and
Implications for Public Health Policy**

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CES Occasional Paper 2003-1, University of Essex

March 2003

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Executive Summary

Two of the primary determinants of physical and mental health, leading to increases in life expectancy, are now acknowledged to be diet and physical activity. Ironically, just as food shortages have been largely conquered in industrialised countries, so diets have become a major public health cost. On average, people now consume more food calories than they burn, and consume types of food constituents that are making them ill. The costs of diet-related illness (coronary heart disease, strokes, obesity, maturity onset diabetes mellitus, gall-stones, osteoporosis and several cancers) now exceed those of tobacco use.

Physical activity is now known to be a cofactorial determinant of health. In Europe, there has been a dramatic fall in physical activity over the past 50 years with on average 2 MJ (500 kcal) less energy output per day in adults aged 20-60 years. This is equivalent to the running of a marathon each week. Although similar trends have occurred across Europe and North America, the UK compares badly with many countries. Jobs have become less physical, people are more likely to take the lift than walk the stairs, and adults and children are more likely to travel to work or school by car than to walk or bicycle. Only 32% of adults take 30 minutes of moderate exercise five times a week, and only 47% participate in sport more than 12 times a year.

Physical activity greatly reduces the risk of dying from coronary heart disease, and also reduces the risk of developing diabetes, hypertension and colon cancer. It enhances mental health, fosters healthy muscles and bones, and helps maintain health and independence in older adults. We use the term 'activity transition' to describe the changes in modern societies in the past 2-3 generations, with people no longer active in the workplace nor in travelling to and from work, nor during leisure time.

The primary role played by diet and physical activity in emotional and physical well-being is complemented by secondary roles played by connections to nature and social communities. An innate connectedness to nature is the core principle in the 'biophilia hypothesis', which suggests that closeness to nature increases well-being as well as the likelihood of understanding of and care for nature, and its rediscovery can lead to transformations in people and nature. It also suggests that disconnections are harmful – both to individuals and to societies and cultures at large.

There is a well-established literature that shows that the physical and social features of the environment affect behaviour, interpersonal relationships and actual mental states, as well as shape relations with nature. People seem to prefer natural environments to other settings, and the benefits go beyond just enjoyment. A growing number of researchers from many disciplines are now showing that contacts with the natural world can benefit mental and physical health. The contexts include the effectiveness of wildernesses in contributing to spiritually beneficial recreation and leisure experiences; the healing value of hospital gardens or of nature views from hospital or gaol windows; the benefits of community gardens and nature areas in urban settlements; and the psychological benefits of companion animals and pets; and the benefits of consuming distinctive local foods coming from systems with known positive effects on nature and rural communities.

Yet an important challenge remains. Intuition, experience and some evidence support that notion that nature contact should be seen as a positive health intervention, yet health professionals have not widely adopted horticulture, wilderness, nature or animal therapy.

Regular physical activity positively affects mental well-being and self-esteem. High self-esteem is important as it is seen as a key indicator of emotional stability, and adjustment to life demands is one of the strongest predictors of subjective well-being. The symptoms of low self-esteem include depression, anxiety, neuroses, suicidal ideation, sense of hopelessness, lack of assertiveness, and low perceived personal control. Evidence suggests that aerobic exercise can improve self-esteem as well as have an antidepressant effect, though like the research on the benefits of nature, much of the evidence is correlational rather than causal.

There is good evidence to support the idea that physical activity has a positive effect on self-esteem and depression. We conclude that exercise programmes can reduce clinically-defined depression, and that this can happen as quickly as 4-6 weeks. Most studies had good internal and external validity, though larger sample sizes, controlling for the effects of positive characteristics of an exercise leader, conducting long-term follow-ups, and managing the non-treatment group were all required in future analyses.

We believe, therefore, there is a synergistic benefit in adopting physical activities whilst at the same time being directly exposed to nature. We call this 'green exercise'.

Many people already appreciate the benefits of protecting the environment, undertaking physical activity, and combining the two. Despite the daily disconnections between a predominantly urban population and nature, and the increase in sedentary lifestyles imposed or adopted by the majority of the population, people still express their values in a variety of direct and indirect ways, through i) membership of environmental and wildlife organisations; ii) visits to the countryside and the growth in national and international ecotourism; and iii) membership of gymnasiums and of sports and outdoor organisations.

Green exercise is likely to have important public and environmental health consequences. A fitter and emotionally more content population costs the economy less. Increasing the support for and access to a wide range of green exercise activities for all sectors of society will produce substantial public health benefits. There are many policy options, including gyms at GP surgeries, healthy walks projects, exercise on prescription, healthy school environments and travel to school projects, green views in hospitals, protection and support for city farms and community gardens, less anonymous food (with substantial health benefits if there are increases in fruit and vegetable consumption), and more support for ecotourism, outdoor leisure activities, and visits to the countryside. These, though, still remain on the margins of public health, environmental and agricultural policy.

If everyone ate five pieces of fruit and vegetable per day, and engaged in 30 minutes of moderate physical activity five times per week, and ensured that calorie burning matched consumption in food and drink, then a significant proportion of the annual £10 billion costs of obesity, coronary heart disease and physical inactivity could be avoided. The emotional benefits and mental well-being would be additional, and could indeed outweigh them.

If these benefits are also achieved through activities that provoke long-term changes in attitudes to nature and the environment across society, then the possibilities for transformations and actions to support sustainability outcomes will be all the more likely to occur.

1. Primary Determinants of Well-Being and Health

1.1 Framework of Interactions

Diet and physical activity are widely acknowledged to be two of the primary determinants of physical and mental health. A balanced diet and appropriate levels of physical activity are associated with substantial increases in life expectancy (CDC, 1996; Ferro-Luzzi and James, 2000; DCMS, 2002). Ironically, just as food shortages have been largely conquered in industrialised countries, so has come a recognition that ill-health arising from over-consumption of certain constituents of diets is now a major public health cost.

At the same time, the nature of 'work' has changed and people have adopted increasingly sedentary lifestyles, which have further contributed to ill-health. Both these trends are extremely costly, both to individuals and to the public health budget.

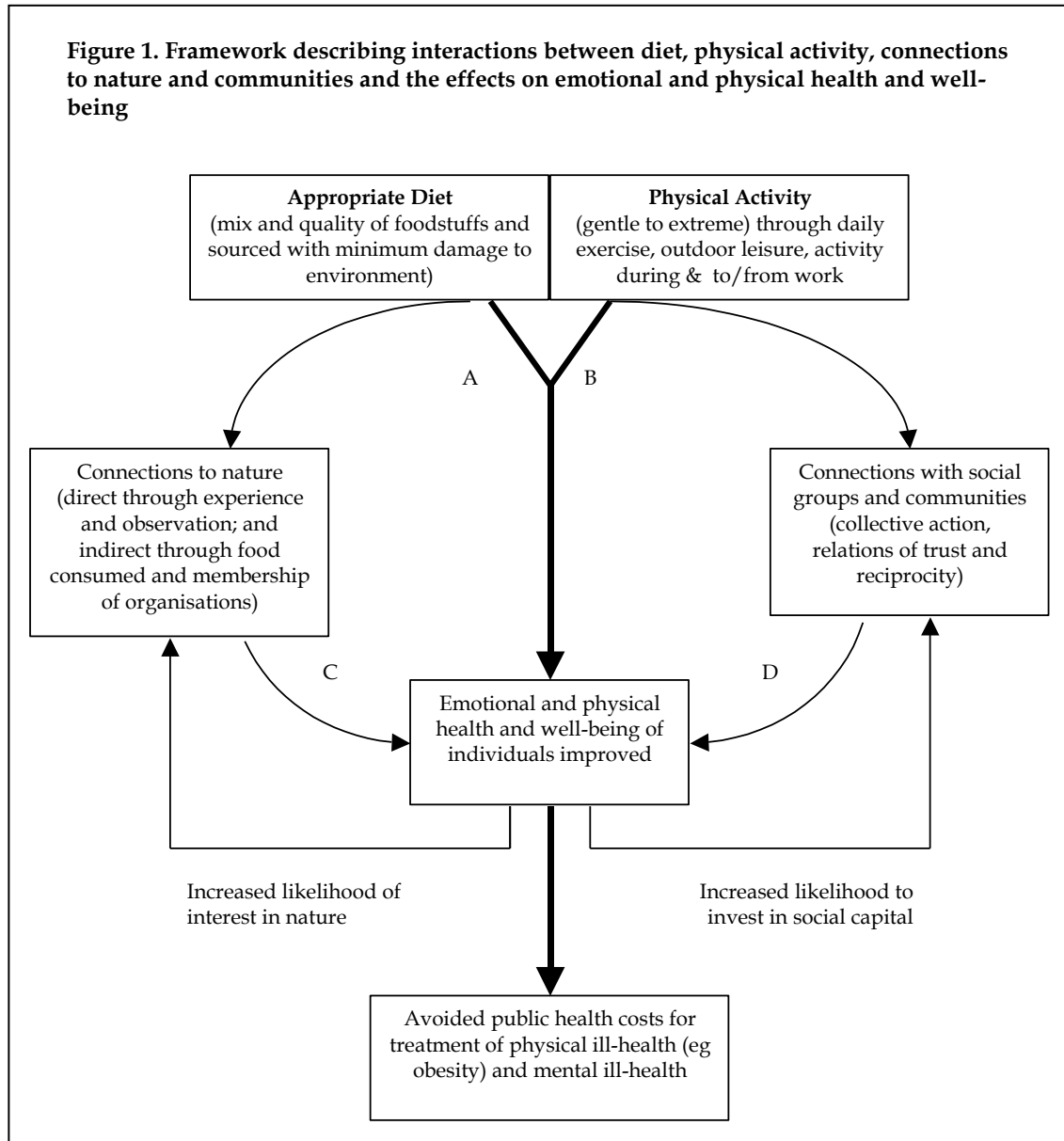
The framework in Figure 1 shows the primary role played by diet and physical activity in emotional and physical well-being, and illustrates the secondary roles played by connections to nature and social communities. An appropriate balanced diet containing sufficient, but not excessive, calories, together with physical activity associated with work, commuting and leisure activities, contribute to the physical and emotional health of individuals.

Well-being is further enhanced through close connections to both nature and communities. These connections can involve direct interaction but are also made indirectly through consumption of food and membership of environmental organisations, and by contact with others through social institutions and cultural mechanisms (Jacobs, 1961; Freeman, 1984; Coleman, 1988; Kellert and Wilson, 1993; Pretty, 2002). Furthermore, connectedness with the environment and with environmental organisations might have direct and indirect effects on the level and quality of physical activity. An emotionally and physically healthy population imposes few public health costs, and is also likely to improve the stocks of natural and social capital through investments of time, effort and resources. Emotional and physical health and well-being is therefore an asset in itself – a capital that can be built up over time or expended as income.

Recent years have seen sharp declines in some of these important connections (A, B, C, D), with resulting falls in emotional and physical well-being and increases in public health costs. At the same time, as environmental resources (natural capital) and social and cultural aspects of communities (social capital) are degraded and diminished, so there is a further negative effect on well-being (human capital) (Pretty, 2002; Lang and Heasman, 2003).

In this paper, we set out the contributions made by diet and physical activity to physical and mental health, and explore in particular the role one secondary determinant of well-being – people's direct and indirect connections to nature – has in shaping well-being. We suggest that increased connections to nature, directly through experience and observation, and indirectly through consumption of food and membership of wildlife, sports and leisure organisations, increases well-being, and will thus have an impact upon the growing public health costs associated with obesity and mental health. We further explore the possible synergy that may come from 'green exercise' – physical activity in green places that may bring both physical and mental health benefits.

Figure 1. Framework describing interactions between diet, physical activity, connections to nature and communities and the effects on emotional and physical health and well-being



1.2 The Role of Diet

Since hominids diverged from the apes, we have passed some 350,000 generations as hunter-gatherers, the last 600 of which have seen us come to rely mainly on agricultural systems for our food (Pretty, 2002). In the last two generations (a mere 3.4 seconds if all human history were squeezed into a single week), the diets of most people in industrialised countries, and of an increasing number of those in developing countries, have undergone enormous changes (Popkin, 1998, 1999). On average, people now consume more food calories than they burn, and increasingly they consume types of food, such as those containing simple sugars and an excess of salt, that are making them ill.

The average UK diet has changed greatly in the past fifty years (Table 1). According to the National Food Survey (DEFRA, 2002), which has been collecting data on weekly

consumption of foods since 1942, the average Briton now consumes less milk/cream, eggs, vegetables, bread, direct sugar, fish and fats, and more cheese, fresh fruit, cereals and meat than in the 1940s. Consumption of sugar, meat, eggs, milk/cream and fats rose until the 1970s, and has since fallen. Of particular concern for public health is the 34% fall in vegetable consumption over 50 years, and the 59% decline in fish consumption. On the other hand, the consumption of fresh fruit has increased by 129% since the 1940s – though this still leaves UK consumption the third lowest in the EU (fruit consumption ranges from 400 g·day⁻¹ in Greece to 100 g·day⁻¹ in Ireland). Vegetable consumption in Europe ranges from 440 g·day⁻¹ in Greece, to 60 g·day⁻¹ in Iceland, with a value of 280 g·day⁻¹ in the UK.

Table 1. Changes in per capita weekly diet for UK, 1942-2000

Foods	1942-1949 average (g per person per week)	1974-1976 average g per person per week)	1998-2000 average (g per person per week)	Change from 1940s to 1998- 2000 (%)
Milk/cream products	2455	2899	2038	-17%
Cheese	73	106	106	+45%
Eggs (number)	2.42	4.1	1.72	-41%
Fresh fruit	316	504	724	+129%
Vegetables	3026	2324	1986	-34%
Bread	1741	948	726	-58%
Cereals (not bread)	645	680	757	+17%
Sugar (direct)	269	345	110	-59%
Fish	242	126	144	-59%
All fats and oils	251	314	189	-25%
All meats	727	1042	940	+29%

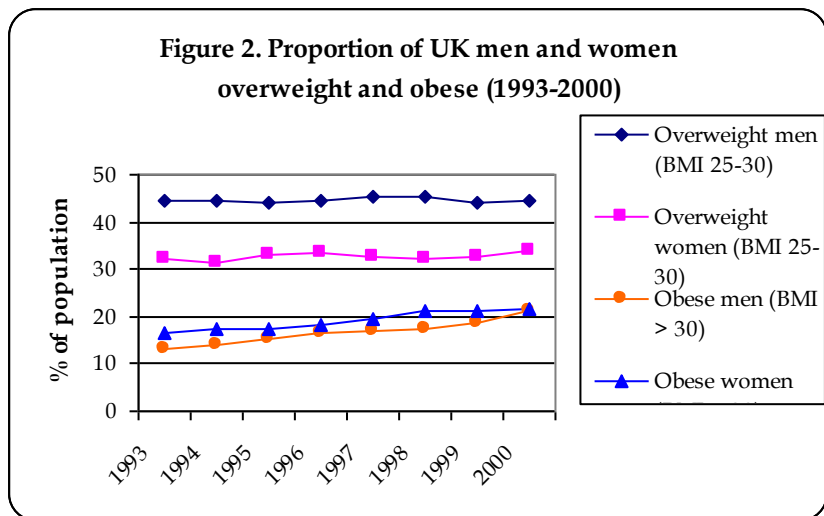
Source: National Food Survey (DEFRA, 2002)

These changes in diet have occurred far too quickly for human physiology to adapt through the process of evolution, and diet-related illness now has severe and costly public health consequences (Ferro-Luzzi and James, 2000; Eurodiet, 2001). According to the comprehensive Eurodiet study, in the second half of the 20th century *“most of Europe has seen a very substantial increase in a number of chronic diseases in adult life. These become worse with age and are multifactorial. The principal factors, however, are diet and inactivity in coronary heart disease, strokes, obesity, maturity onset diabetes mellitus, gall-stones, osteoporosis and several cancers”*.

Worse still, the Eurodiet (2001) study concludes that *“disabilities associated with high intakes of saturated fat and inadequate intakes of vegetable and fruit, together with a sedentary lifestyle, exceed the cost of tobacco use”*. Some problems arise from nutritional deficiencies of iron, iodide, folic acid, vitamin D and omega-3 polyunsaturated fatty acids, but most are due to excess consumption of energy and fat (causing obesity), sodium as salt (high blood pressure), saturated and trans fats (heart disease) and refined sugars (diabetes and dental caries). Highly energy-dense diets rich in sugars are nearly as conducive to over-consumption of energy as are diets containing excessive amounts of fatty foods. Consequently, many low fat alternatives provide an illusion of ‘healthfulness’ as they are in sugar. Diet is thought to be a factor in 30% of cases of cancer in developed countries (Key *et al.*, 2002). The strongest association between diet and cancer is provided by the positive relationship between the consumption of vegetables and fruit and a reduction in the risk of cancers of the digestive

and respiratory tracts, with some epidemiological evidence of an association between intake of salt and gastric cancer (Riboli and Norat, 2001). Low fibre content, vitamin and mineral insufficiency, high meat consumption and excessive alcohol intake have also been implicated as risk factors for cancer (Key *et al.*, 2002).

The most serious consequence of poor diet is the emerging obesity epidemic. Obesity (BMI¹ > 30 kg·m⁻²) now affects 10-20% of the adult population of Europe, and excess weight (> 25 kg·m⁻² BMI) affects a majority of middle-aged adults. In the UK, the proportion of the population that is overweight has remained stable since the early



1990s, but the numbers progressing into the obese class are rapidly increasing (Figure 2). In the USA, the situation is much worse, with nearly 97 million adults overweight (51% of women, 50% of men) and 40 million obese (25% of women, 20% of men)² (Table 2). In some developing countries, including Brazil, Colombia, Costa Rica, Cuba, Chile, Ghana, Mexico, Peru and Tunisia, overweight people now outnumber the hungry (WHO, 1998).

Table 2. Incidence of overweight and obese adults in the USA

	1960	2000
Overweight		
Men	38.3%	59.4% (50.2 million)
Women	25.3%	50.7% (46.9 million)
Obese		
Men	10.5%	19.5% (16.8 million)
Women	16.2%	25.0% (23 million)

Source: NIH (2002)

Obesity is a risk factor for type II diabetes, cardiovascular disease, certain cancers and reduced life expectancy. The risk of diabetes, for example, is increased by 100 fold if a child enters adulthood obese and continues to gain weight (Ferro-Luzzi and James, 2000). The rapid growth in obesity is making type II diabetes (non-insulin-dependent diabetes) so common that is becoming one of the major non-communicable diseases in the EU (Astrup, 2001). In 2001, there were 12.24 million people in the EU with type II diabetes, and this is predicted to increase to 15.4 million by 2020. The worst affected countries by proportion of population are Spain (7.3%), Italy (7.8%), Denmark (8.4%), Norway (8.6%) and Sweden (9.4%), with the incidence in the UK currently 2.1%.

¹ Body Mass Index is weight in kg divided by height in metres squared (kg m⁻²). A value of >25 indicates an adult is overweight, and one of >30 indicates obesity.

² The average American diet provides 3800 kcal day⁻¹, up by 500 kcal since 1970. This is approximately double the energy requirement for inactive women and 130% of the energy requirement for inactive men (Nestle, 1999).

According to the UK National Food Survey (DEFRA, 2002), energy intake in the home increased to a peak in the 1970s. Paradoxically, since then it has fallen during a period in which obesity has substantially increased – from 7% in 1980 to 19% in 1998. It appears that increases in energy intake outside the home have played a critical role, particularly the consumption of fast food, soft drinks and alcohol. At the same time as diets and eating habits have shifted, physical activity has declined and this also has an impact on energy balance. Furthermore, Astrup *et al.* (2002) have shown that a dose-response relationship exists between the proportion of energy consumed as fat and weight gain or loss. Thus, although diets have shown some improvements over the past 25 years, people are still consuming too many fats and sugars, and too many calories from all sources, for physical well-being.

1.3 The Role of Physical Activity

Along with diet, physical activity is now known to be an important determinant of health and well-being. Again, human metabolism and genetic make-up have been unable to adapt to the rate of change and magnitude of changes in lifestyle that have taken place over recent decades. People in both industrialised countries and urban settlements in developing countries have become increasingly sedentary in all aspects of daily life, including during leisure time, in travelling to and from work, and during work itself.

In Europe, there is evidence for a dramatic fall in physical activity over the past 50 years with on average 2 MJ (500 kcal) less energy output per day in adults aged 20-60 years (Eurodiet, 2001). According to the NAO (2001), changes in life style over this period have led to reduced physical activity equivalent to the running of a marathon each week. Yet the public health consequences of these changes have not been widely discussed or accepted, until very recently (DCMS, 2002). The recent Eurodiet (2001) study states *“the importance of physical activity has been underestimated for many years by both doctors and policy-makers”*.

Although similar trends have occurred across Europe and North America, the UK compares badly with many countries. Jobs themselves have become less physical, people are more likely to take the lift than walk the stairs, and adults and children are more likely to travel to work or school by car than to walk or bicycle. In the 1970s, 90% of primary school children in the UK walked to school; today 10% walk and 90% travel by car (DEFRA, 2001). In the UK, the distance walked per year by each individual has fallen from 410 km·yr⁻¹ in 1975-76 to 298 km⁻¹ in 1998-2000 (DLTR, 2002). Though walking has declined across the whole of the EU since 1970, only people in Greece walk less than Britons. Cycling varies from a low of 70 km·yr⁻¹ in Greece to a high of 850-900 km·yr⁻¹ in Denmark and the Netherlands, with Britons well below the average for all 15 EU countries (Table 3).

Our dependence on the car is further illustrated by the fact that the UK is one of only four EU countries in which bus and coach travel per person has declined since 1980 (the others are Germany, Finland and the Netherlands). The 20% fall in the UK compares badly with a 40-80% increases in bus travel in Denmark, Italy, Spain and Portugal. Over the same period, car travel per person in the UK increased by 51%, and the road system has grown by 34,000 km since the early 1960s (DLTR, 2002).

Table 3. Distances cycled and walked by people in Europe (for 1995)

	Cycling	Walking
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	Km per person	Km per person
EU average	200	430
UK	77	415
Denmark	900	500
Netherlands	850	445
Germany	295	430
France	80	440
Greece	70	380

Source: Commission on Integrated Transport (2002)

Home life has also become more sedentary, and though gym and fitness club membership has risen in the past 20 years there are some indications that people are becoming less likely to engage in organised sports. There have been falls in the provision of opportunities for physical exercise in schools, linked not least to sales of playing fields in the 1980s and 1990s. The proportion of young people spending two hours or more per week on physical exercise fell from 46% in 1994 to 37% in 1999 (Sport England, 2000). The average young person also spent 26 hours per week watching television in the 1990s compared with 13 hours in the 1960s (NAO, 2001).

Physically inactive children become physically inactive adults, and in the UK only 32% of adults take 30 minutes of moderate exercise five times a week, the minimum recommended to maintain optimal health. This figure compares unfavourably with the 57% of Australians and 70% of Finns who achieve these recommendations. Furthermore, only 47% of adults in the UK participate in sport more than 12 times a year, compared with the highs of 70% in Sweden and 80% in Finland, and lows of 18% in Italy and 25% in Spain (DCMS, 2002). Consequently, some 63% of men and 75% of women in the UK do not take enough physical activity to benefit their health (DoH, 1998; Sport England, 2002; DCMS, 2002). In almost all activities (except swimming and yoga), female participation is lower than male. In the group aged 16-24 years, 42% of men and 68% of women are inactive, and these proportions rise steadily as people age. Again, this trend is not the same everywhere – in Sweden and Finland, in particular, participation in organised sport increases amongst older people. One of the major problems is that although 80% of people in the UK correctly believe that regular exercise is good for their health, a majority wrongly believe that they take enough exercise to stay fit (Allied Dunbar, 1992).

Sport England (2002) indicates that physical activity should now be considered “one of the best buys in public health, providing physical, social and mental health benefits.” Moderate regular exercise reduces morbidity rates by 30-50%, having a particularly protective effect against maturity onset diabetes, coronary artery diseases, strokes and colon cancer, as well as reducing blood pressure and improving blood lipid and glucose profiles. Appropriate volumes of moderate exercise also induce physical fitness which has a substantial influence on people’s sense of well-being. The Physical Activity Level (PAL) is the ratio of total daily energy expenditure to estimated metabolic rate. The PAL target for health is 1.75, which can be achieved by 60-80 minutes of walking per day. This volume of exercise is sufficient to avoid weight gain on high fat diets, and comfortably exceeds the 30 min per day that is necessary to reduce significantly the risk of CVD and diabetes (Schoeller *et al.*, 1997; NIH, 1996; Astrup, 2001). The UK Health Education Authority (1995) thus recommends that “individuals accumulate 30 minutes of moderate intensity physical activity at least 5 days of the

week”, and suggests that appropriate activities include brisk walking, cycling, and certain garden activities, as well as more formal structured sports and leisure activities.

In the USA, the comprehensive and ground-breaking report of the Surgeon General (CDC, 1996) documented similar alarming declines in physical activity and consequent increases in ill-health³. It found that 60% of Americans are not regularly active, and 25% are not active at all. Just 15% of adults exercise vigorously at least three times per week for 20 minutes, and 22% engage five times per week for 30 minutes or more in sustained physical activity of any type (Table 4). In young people, physical activity declines dramatically during adolescence. Of those reporting regular physical activity, 44% engaged in walking for exercise, 25-30% engaged in gardening, yard work or stretching exercises, 10-15% stair climbing, riding a bicycle or exercise bike, and weight lifting, 5-10% ran, swum or engaged in aerobic dance or played basketball, and less than 5% played tennis, bowling, golf, baseball, squash, football or skied or water-skied.

Table 4. Levels of physical inactivity by adults in the USA (average of 3 different surveys by Centers for Disease Control and Prevention)

	Proportion of adults (>18 years) reporting no participation in physical activity	Proportion of adults (>18 years) reporting regular sustained physical activity (5 or more occasions per week for 30 minutes)
All	24.9%	21.8%
Men	21.2%	24.1%
Women	28.2%	19.8%
By education		
< 12 years at school	39.4%	16.9%
>16 years (college)	14.4%	26.0%
By income group		
<\$10,000 per year	35.4%	20.6%
>\$50,000 per year	14.3%	25.8%

Source: CDC, 1996

Although there is no systematic data to establish long-term trends, it is clear that lifestyles have changed: *“most Americans today are spared the burden of excessive physical labour. Indeed few occupations today require significant physical activity, and most people use motorised transportation to get to work and to perform routine errands and tasks. Even leisure time is increasingly filled with sedentary behaviour”* (CDC, 1996). Barry Popkin (1998, 1999) coined the phrase the nutrition transition to describe how modern and urbanising societies adopt different types and amounts of foods, with severe health consequences. Echoing Popkin’s phrase, we believe that modern societies have also gone through an ‘activity transition’ in the past 2-3 generations, with people no longer active in the workplace nor in travelling to and from work, nor during leisure time. This too has very significant health consequences for whole populations.

Physical activity greatly reduces the risk of dying from coronary heart disease, the leading cause of death in the USA, and also reduces the risk of developing diabetes, hypertension

³ In the USA, 13.5 million people have CHD, and 1.5 million suffer the effects in any year; 8 million people have adult onset diabetes; 95,000 people are newly diagnosed with colon cancer each year; 250,000 people suffer hip fractures each year; 50 million people have high blood pressure; 59 million adults are obese with a BMI > 30 kg m⁻²; 9 million young people (15% of all those aged 6-19 years) are overweight; and 77% of adults do not eat the recommended 5 or more servings of fruit and vegetable per day.

and colon cancer. It enhances mental health, fosters healthy muscles and bones, and helps maintain health and independence in older adults (CDC, 1996).

Compared with active people, those who are sedentary have a 1.2-2 fold increased risk of dying (Slattery and Jacobs, 1988; Paffenbarger *et al.*, 1993), with levels of cardiovascular fitness strongly associated with overall mortality (Berlin and Colditz, 1990; Blair *et al.*, 1993). Paffenbarger *et al.* (1994) found that men reduced their risk of death by 33% if they walked 15 or more km per week, by 25% if they climbed 55 or more flights of stairs a week, and by 53% with 3 or more hours per week of moderate sports activity. There also appears to be a protective effect in later life, with Linstead *et al.* (1991) finding that the effects of activity early in life persists into the 70s and 80s. Nonetheless, taking up activity later in life can also be protective, with men aged 45-84, who take up moderately intense sports, adding on average 0.72 years to lifespan (Paffenbarger *et al.*, 1993).

Audrey Manning, the Surgeon General (in CDC, 1996), stated that *“because physical activity is so directly related to preventing disease and premature death and to maintaining a high quality of life, we must accord it the same level of attention as we give other important public health practices that affect the entire nation. Physical activity thus joins the front rank of essential health objectives, such as sound nutrition, the use of seat belts, and the prevention of adverse health effects of tobacco.”* The Surgeon General’s report also concluded that *“regular physical activity and higher cardiovascular fitness decrease overall mortality rates in a dose-response fashion”* – thus, the more exercise, the better for personal and public health (Box 1).

Box 1. Conclusions from US Surgeon General’s report on physical activity

1. People of all ages, both men and women, benefit from regular physical activity.
2. Significant health benefits can be obtained by including inactivity on most, if not all, days of the week.
3. Additional health benefits can be gained from greater amounts of activity.
4. Physical activity reduces the risk of premature mortality in general, and of coronary heart disease, hypertension, colon cancer and diabetes mellitus in particular.
5. More than 60% of American studies are not regularly active.
6. Nearly half of young people aged 12-21 are not vigorously active on a daily basis (daily enrolment in PE classes in schools fell from 42% in 1991 to 25% in 1995).

Source: CDC (1996)

1.4 The Public Health Costs

Changing diets and lifestyles have led to an epidemic of obesity in industrialised countries. More people are overweight, more are clinically obese, and the public health costs are large and growing. The direct costs of obesity in the UK have been estimated by the National Audit Office (2001) to be £480 million per year, with indirect costs an additional £2 billion, of which £1.3 billion is due to sickness and £0.8 billion due to premature mortality, equivalent to £44 per person per year. The annual personal costs include 18 million sick days, 30,000 deaths, resulting in 40,000 lost years of working life. Deaths linked to obesity shorten life by 9 years on average. The British Heart Foundation estimates the indirect costs to be a further £8 billion per year (Rayner, 2001).

The UK government has recently estimated the costs of physical inactivity in England, and these are of the same order as the costs of obesity (DCMS, 2002). Assuming a full range of effects of physical inactivity, including depression, the total cost is £8.2 billion per year (comprising £1.7 bn direct health care costs for the NHS, £5.4 bn of earnings lost due to sickness absence, and £1 bn in earnings lost to premature mortality). This comprises some 5% of the NHS budget, 72,000 days lost and 86,000 lives lost prematurely. Each day, 235 people die prematurely due to the effects of physical inactivity. Clearly, any increase in physical activity coupled with better diets could bring substantial public benefits through avoided costs, plus personal benefits for the people involved.

For the USA, Kenkel and Manning (1999) estimate direct medical expenditure and indirect costs through losses of productivity, and differentiate between internal costs (for individual patients) and external costs (those imposed by an individual's illness on others). They indicate that the economic cost of diet and exercise related illness in the USA amount to \$137 billion per year (which already includes \$107 billion costs of obesity), and compares with costs of alcohol abuse at \$118 billion and of smoking at \$90 billion (Table 5). Diet and inactivity account for 300,000 deaths per year, second only to tobacco (Kenkel and Manning, 1999; NIH, 2002)⁴.

Individuals suffer from sedentary lifestyles, but also impose costs on others, as public money spent must be spent to care for them when ill. For policy makers, the ironic contradiction is that if public money were to be spent to reduce ill-health and thus people live longer, then this may well increase direct health care costs. However, only a perverse accounting approach would suggest that this was a cost rather than a benefit arising from longer and better quality lives.

Table 5. The annual costs of diet and exercise-related ill health in the USA

Condition or disease	Direct costs (\$ billion yr ⁻¹)	Indirect costs (\$ billion yr ⁻¹)	Total costs (\$ billion yr ⁻¹)	Proportion of disease caused by dietary factors and physical inactivity
Heart disease	97.9	77.4	175.3	20%
Stroke	28.3	15.0	43.3	20%
Arthritis	20.9	62.9	83.8	25%
Osteoporosis	na	14.9	14.9	na
Breast cancer	8.3	7.8	16.1	35%
Colon cancer	8.1	na	8.1	35%
Prostrate cancer	5.9	na	5.9	35%
Gall bladder disease	6.7	0.6	7.3	30%
Diabetes	45.0	55.0	100	60%
Obesity	55.7	51.4	107.1	-

Note: obesity cannot be summed from all the other values as some of the problems are interrelated factors
Sources: Kenkel and Manning (1999); Wolf and Colditz (1998)

⁴ Each year, Americans spend \$110 billion on fast food (up from \$6 billion in 1970) – almost the same amount as they also have to pay as public health costs associated with obesity, and more than that spent on higher education, computers or cars (Schlosser, 2001).

2. Connections to Nature as a Secondary Determinant of Emotional Well-Being

In Figure 1, we suggest a secondary role for connections to nature and communities in influencing well-being. It is interesting to note that the now convincing case for the primary role of both diet and physical activity is primarily made with respect to physical well-being – expressed through measures such as body mass index, disability life adjusted years, or lifespan. But a longer life does not necessarily mean a better quality of life. Indeed, the Eurodiet (2001) study states that the expanding elderly population sadly “*seems to be adding years of ill-health rather than well-being to their extended lives*”. Mental health or emotional well-being is rarely included in the list of benefits of activity and diet, or of the costs if these lifestyle factors are missing. We now explore the evidence for a role that connections to nature play in affecting well-being and mental health.

2.1 Shaping and Self-Shaping

For most of human history, humans have been intimately connected to nature on a daily basis. We have shaped nature, and it has shaped us, and we are an emergent property of this relationship (Pretty, 2002). Today, though, some may argue that there is little value in connections to land and nature. Is it not just something for indigenous people or remote tribes? Yet if we look carefully, even in predominantly urban-based societies, people never seem to get enough of nature. People in cities and towns are wistful about lost rural idylls. They visit for afternoons or occasional weekends, but on returning home, often feel that they should have stayed. Membership of environmental organisations in industrialised countries has never been higher, and is growing. We should ask: what makes people care about nature, and why are so many distressed about its loss? Why too does nature seem to have a positive effect on people (Milton, 2002)?

An innate connectedness to nature is the core principle in the ‘biophilia hypothesis’, originally developed by biologist E.O. Wilson (Wilson, 1984; Kellert and Wilson, 1993). This suggests that closeness to nature increases well-being as well as increases likelihood of understanding of and care for nature, and its rediscovery can lead to transformations in people and nature. According to Wilson (1993), “*humans have an innate sensitivity to and need for other living things – as we have co-existed for thousands of generations.*” Thus biophilia represents “*the connections that human beings subconsciously seek with the rest of life*”. Kellert (1993) further suggests that “*the human need for nature is linked not just to the material exploitation of the environment but also to the influence of the natural world on our emotional, cognitive, aesthetic and even spiritual development*”.

The biophilia hypothesis holds that multiple strands of emotional responses are woven into symbols comprising a large part of human culture. Despite removing ourselves from nature in recent generations, many (or even most) people still have these responses. Humans evolved in a biocentric world, not a machine world, and so there are links between emotional feelings and dreams, stories and myths about the natural world. These stories bind together culture, and are passed on from generation to generation through language. The fundamental connection to nature has also been emphasised by what Wilson calls ‘biophobia’ – why humans still seem to have innate negative emotional responses to spiders and snakes, whilst few modern artefacts (such as cars and guns) evoke similar emotional responses, even though they are potentially more dangerous. Some may say tsuch phobia

are irrational, but Wilson (1993) asserts this is because of the *“constant exposure through evolutionary time to the malign influence of snakes, the experience encoded by natural selection as a hereditary aversion and fascination, which in turn is manifested in the dreams and stories of evolving cultures”*.

We may thus ask, is nature part of us, or are we, as humans, somehow separate? These are questions that have exercised philosophers, scientists and theologians through the ages, and particularly since the enlightenment period, when Newton’s mechanics and Descartes’ ‘nature as machine’ helped to set out a new way of thinking for Europeans. The result has been the gradual erosion of connections to nature, and the emergence in many people’s minds of two separate entities – people and nature (Naess, 1989; Benton, 1994).

The greater vision, and the more difficult to define, involves looking at the whole, and seeking ways to redesign it. The Cartesian either/or between humans and nature remains a strange concept to many human cultures. It is only modernist thinking that has separated humans from nature in the first place, putting people up as distant controllers. Most people and cultures do not externalise nature in this way. From the Ashéninha of Peru to the forest dwellers of former Zaire, people commonly see themselves as just one part of a larger whole. Their relationships with nature are dialectical and holistic, based on ‘both/with’ rather than ‘either/or’ (Benton, 1994; Posey, 1999). For the Arakmbut of the Peruvian rainforest, Gray (1999) says: *“no species is isolated, each is part of a living collectivity binding human, animal and spirit”*. Mythologies and rituals express and embed these inter-relationships, both at the practical level, such as through the number of animals a hunter may kill, and how the meat should be shared, and at the spiritual, in which *“the distinction between animal, human and spirit becomes blurred”*.

One of the best known of these visible and invisible connections is the Australian Aboriginal peoples’ Dreamtimes. Aboriginal people have inhabited Australia for 30,000 years or more, during which time some 250 different language groups developed intimate relations with their own landscapes. Bennett (1999) says *“Aboriginal peoples hold that there is a direct connection between themselves and their ancestral beings, and because they hold that their country and their ancestral beings are inseparable, they hold that there is a direct connection between themselves and their country”*. Each Aboriginal group has its own stories, or Dreamtimes, about the creation of their land by their ancestors, and these stories connect people with today’s land. Such land is non-transferable, and so is not a commodity. Events took place there, and people invested their lives and built enduring connections - so no one owns it, or rather, everyone does. As Bennett (1999) also says, *“those who use the land have a collective responsibility to protect, sustainably manage and maintain their ‘country’”*.

If these connections do have fundamental importance, then this suggests that disconnections could be harmful or costly – both to individuals and to societies and cultures at large. René Dubos (1969) says *“we are shaped by the Earth. The characteristics of the environment in which we develop condition our biological and mental being and the quality of our life. Were it only for selfish reasons, therefore, we must maintain variety and harmony in nature”*.

2.2 Nature and Community Deprivation and Self-Identity

If nature is important to humans, then deprivation is likely to create problems. Kellert (1993) suggests that *“a degraded relationship to nature increases the likelihood of diminished material, social and psychological existence”*. Thus increasing disconnections between people and nature

will have an impact on individuals, on their communities and cultures, and ultimately on how they treat and care for nature. These disconnections are now a common part of many lifestyles in modern industrialised societies – with increasing numbers of people living in urban areas, and fewer people having daily or routine contact with nature. Wilson (1993) asks: *“what will happen to the human psyche when such a defining part of the human evolutionary experience is diminished or erased?”*

There is a well-established literature that shows that the physical and social features of the environment affect behaviour, interpersonal relationships and actual mental states (Newman, 1980; Freeman, 1984, 1998), as well as shape relations with nature (Pretty and Ward, 2001). The design of the built and natural environment thus matters for mental health (Kaplan *et al.*, 1998; Freeman, 1984; Halpern, 1995). People seem to prefer natural environments to other settings, and the benefits go beyond just enjoyment. Kaplan *et al.* (1998) indicate that such natural settings need not be remote wildlands, and emphasise the value of *“the everyday, often unspectacular natural environment that is, or ideally would be, nearby”* – parks and open spaces, street trees, vacant lots and backyard gardens, as well as fields and forests. Equally, a dysfunctional built environment can often be a source of stress, and a malign influence over social networks and support mechanisms. Despite this, we seem not to care. Halpern asserts *“almost no reference is made by planners to psychological literatures”*.

Physical features of the built environment leading to problems include sick building syndrome arising from materials used in some buildings and air conditioning systems, long distance commutes to work, and suburban communities with self-contained homes encouraging little contact with neighbours (Garreau, 1992). Social features might include access to an immediate family environment or extended networks of friends and neighbours, as well as access to green spaces, meeting places, and opportunities for reciprocity, all of which lead to improvements in mental and spiritual health (Newman, 1980; Pretty and Ward, 2001).

Some of the most obvious effects occur when environments are transformed. After slum clearances, for example, people gain from improvements in physical assets and services, but lose in social networks. Like nature deprivation, this is a process of culture deprivation. As Freeman (1998) puts it, such clearances often involved *“the demolition of a neighbourhood and not just the destruction of buildings, but also that of a functioning social system, with a characteristic culture of its own and important social networks that could never be reproduced artificially”*. Willmott’s (1963) study of social change in Dagenham found that people in small streets and cul-de-sacs had more social connections and reciprocal arrangements than those in large, busy streets. When these were replaced by large modern estates, these social support networks based on geographic proximity can entirely break down, leading to an atomised community.

One study of a housing project in St Louis, Minnesota, with 43 eleven storey blocks housing 12,000 people, found that although people had a similar number of friends as non-project dwellers, these *“bore little or no relation to the physical proximity of families to each other”* (Yancey, 1971, in Halpern, 1995). Neighbours were generally now hostile, and the quality of life much lower, even though individuals were generally satisfied with their own apartments. The problem was that the project offered no natural or defensible space (Newman, 1972) and common facilities around which neighbouring relationships could develop. The space between the blocks was called ‘wasted space’ by residents. In 1972, only 18 years after the project had been opened, all the blocks were demolished after years of

vacancy rates exceeding 70% (Halpern, 1995). Ironically, the design won architectural praise – before the people lived in it.

Another important determinant of mental well-being is people's perceived ability to control their own environment. Halpern (1995) says *"the negative impact of environmental stresses is greatly reduced when people feel they have control over them. Similarly, the impact and quality of people's relationships with their neighbours is critically mediated by the extent to which they are able to regulate their interactions with them"*. Acute forms of deprivation related to lack of control have been noted after environmental disasters. Lee (1999) uses the term Chronic Environmental Stress Disorder (CESD) to describe the effect of stress arising from environmental harm – either directly experienced or arising over the long-term from simply knowing that a problem may be having an effect. Such stress is manifested through headaches, demoralisation, upset, perceived threats, declining quality of life and distrust of authorities. It is known that stress causes psychological effects, especially on autonomous nervous system, which becomes dysfunctional, and on endocrinological system. Thus stress has a negative feedback on health and well-being of individuals. Stress can be alleviated if the stressor is removed, if people are provided with a sense of control, and if the ways in which they perceive the source of the stress can be changed.

In the case of the Chernobyl accident, detailed empirical studies show that much greater mental and physical health problems have occurred from people's worries about the accident than have occurred from radiation itself. Some 45% of people in contaminated areas believe they have an illness due to radiation exposure, yet 30% of people in the unpolluted areas feel the same. Lee (1999) suggests, *"the widespread public anxiety and pessimism about the Chernobyl accident appears to be out of all proportion to the radiation-induced health effects"*. Moreover, UNESCO concluded *"there has been no increase in leukaemia, congenital abnormalities, adverse pregnancy outcomes or any other radiation induced effects"*. Yet there are clearly high levels of anxiety and pessimism. Researchers concluded that social support is needed to recover from this stress, and though the original stressor cannot be changed, it is possible to amend the way it is perceived.

The built and natural environment can, therefore, be therapeutic or harmful (Carter and Carter, 1979; Freeman, 1984). As Freeman puts it *"there is a need to restore human settlements the benefits of ... a social matrix in which a worthwhile quality of life and work can grow."* This sense of place is important, and many people have acknowledged positive 'affective sentiment' for specific places (Relph, 1976; Langenbach, 1984; Tall, 1996). Fredrickson and Anderson (1999) contend that *"place is not just the 'where' of something, but that the landscape itself embodies meaning."* Landscapes are full of stories and meaning (Nabhan and St Antoine, 1993; Okri, 1996; Schama, 1996). Metzner (2000) uses the term reinhabitation to describe the need to dwell in a place in a balanced way, with respect for the stories of the other inhabitants, and quotes Wallace Stegner, *"no place is a place until things that have happened in it are remembered in history, ballads, yarns, legends or monuments"*. Some argue that an important part of personal identity is created through interactions with specific places, and the attachments we then develop (Milton, 2002).

What do we know about these attachments? As Fredrickson and Anderson (1999) indicate *"past research on place and place attachment has typically focused in a one-way direction, that of individual to place; often overlooking the relationship of place to individual, that is, the affective appeal that place impresses upon the individual."* Thus we are partly shaped by the environment, by our attachments developed during specific experiences and interactions. The personal benefits include psychological well-being, self-image, and self-esteem, and the social ones

include family stability, community pride and cultural identity (Pretty, 2002). So, is contact with nature and place a fundamental part of the way we establish self-identity? Identity is a relationship in which something is shared, and linkage with nature and communities partially helps to do this (Fox, 1995; Milton, 2002). To a certain extent, who and what we are is constructed through relationships with people and with nature. Thus, if we lack these relationships and connections, we must lose a sense of personal identity and self-esteem.

People need nature or the otherness of nature – yet it has drained away through unwise management (Adams, 1996). A sense of identity emerges out of daily, or at least regular, personal contacts, whereby self is formed in relation to the other (Ingold, 1986; Naess, 1989). Some so further to argue that the rest of nature is therefore an extension of personhood (Milton, 2002). Naess (1989) indicates “*the identity of the individual that I am something’ is developed through interaction with a broad manifold, organic and inorganic.*” If we break the connections, the sense of identity is broken, so increasing the likelihood of ill-health. Deep ecologists suggest that separation from nature leads to greater alienation of people from each other, and increased likelihood of self-abuse (Seed *et al.*, 1988; Naess, 1989).

2.3 The Psychological and Healing Benefits of Nature

A growing number of researchers from a wide variety of disciplines have shown that contacts with the natural world can benefit mental and physical health. The contexts include the effectiveness of wildernesses in contributing to spiritually beneficial recreation and leisure experiences (Kaplan and Kaplan, 1989; Ulrich *et al.*, 1991; Fredrickson and Anderson, 1999; Whitehouse *et al.*, 2001; Williams and Harvey, 2001); the healing value of hospital gardens or of nature views from hospital or gaol windows (Moore, 1982; Ulrich, 1984); the benefits of community gardens and nature areas in urban settlements (Ulrich *et al.*, 1991; Weissman, 1995a, b; Armstrong, 2000); and the psychological benefits of companion animals and pets (Anderson *et al.*, 1984; Katcher and Beck, 1993; Katcher and Wilkins, 1993); and the benefits of consuming distinctive local foods coming from systems with known positive effects on nature and rural communities (Pretty, 2002).

Frumkin’s (2001, 2002) comprehensive reviews of the evidence that the natural world can benefit health concludes that contacts with animals, plants, landscapes and wildnesses can improve well-being. However, much of the evidence is somewhat anecdotal, and convincing empirical medical evidence is still needed. Some of the most convincing studies include:

- A comparison of prisoners in Michigan whose cells faced either farmland and trees or the prison yard, in which it was found that those with a view of nature had a 24% lower frequency of sick cell visits (Moore, 1982);
- A 10-year comparison of post-operative patients in Pennsylvania whose rooms looked out on trees or a brick wall, in which it was found that patients with tree views stayed in hospital for significantly less time, needed less strong or moderate medication and had fewer negative comments in the nurses’ notes⁵ (Ulrich, 1984);
- A comparison of pain experienced by bronchoscopy patients (during which a fibre-optic tube is inserted into the lungs), in which the group viewing a nature scene before the

⁵ Ulrich (1984) also notes that “*a built view such as a lively street might be more stimulating and be more therapeutic than many nature views*”.

treatment and listening to sounds of a bubbling brook during the proceedings had a 50% increase in the level of self-reported 'very good' or 'excellent' pain control (Lechtzein *et al.*, 2001, in Frumkin, 2002);

- Studies of pet owners, who were found to have lower blood pressure and cholesterol levels than non-pet owners in Australia (Anderson *et al.*, 1992) and to make fewer visits to doctors in the USA (Siegel, 1990); and of dog-owners suffering from myocardial infarction, who were six times more likely to survive a year after the trauma than those with no dogs (Friedmann and Thomas, 1995) (though curiously there was no effect for cat owners);
- Positive effects of animals on depressed and asocial patients, in which usually unresponsive patients interacted with animals by holding, stroking and hugging, smiling and laughing, and also talking to the animals and their carers (Katcher and Wilkins, 1993);
- A study of dental patients, in which those observing a live aquarium before treatment were more relaxed than control patients (Katcher *et al.*, 1984).

Some of this evidence should not be a surprise. Frumkin (2001) points out that "*hospitals have traditionally had gardens as an adjunct to recuperation and healing*", and 95% of people living in retirement communities say windows facing green landscapes are essential to well-being. Ulrich (1984) states this aesthetic preference for nature may be universally expressed across human cultures: "*one of the most clear cut findings in the literature is the consistent tendency to prefer natural scenes over built views, especially when the latter lack vegetation and water*". Beck and Meyers' (1996) study of pets and companion animals further concluded that "*preserving the bond between people and their animals, like enhancing good nutrition and exercise, appears to be in the best interest of those concerned with public health*". Of course, there may already be a substantial positive effects, as 56% of US households already have pets.

Frumkin (2002) also poses an important challenge. Intuition and experience seem to support that notion that nature contact should be seen as a positive health intervention, yet health professionals have not widely adopted horticulture, wilderness, nature or animal therapy. He suggests that "*much of the available research on the health benefits of nature do not meet prevailing standards of medical excellence*". It is, in other words, insufficiently evidence-based. Research is often non-randomised in its design, with inappropriate or no controls; interventions and health outcomes are often poorly designed; statistical power is rarely sufficiently strong to strong conclusions; and selection bias can undermine findings or relationships between cause and effect (Frumkin, 2002).

2.4 The Benefits of Wildernesses and Nearby Nature

There is also a large body of research to investigate the benefits of wilderness experiences, dating back to the testimony of 19th century writers such as John Muir and Henry David Thoreau (Muir, 1911, 1992; Thoreau, 1837-53, 1902). Muir's writing on the Sierra Nevada, and the importance of such 'wild' areas for well-being was instrumental in the establishment of the world's first national park at Yellowstone in 1872 (Pretty, 2002).

A number of studies have shown that people both seek and derive a variety of values when they visit wildernesses, in particular a desire for tranquillity and natural beauty, escape from

the stresses of urban life (Rossman and Ulehla, 1977), and the potential for dramatic 'peak experiences' (Scott, 1974) or transcendent moments (Williams and Harvey, 2001). Herzog *et al.* (2002) conclude that "the restorative potential of natural settings is probably underappreciated", as many people do not appreciate the full benefits of such settings – particularly in the face of competition for multiple other leisure and entertainment opportunities of modern life.

Frumkin (2001) reviews wilderness therapy studies for their potential benefits for psychiatric patients, emotionally disturbed children, bereaved people and patients with cancer and others suffering various stresses and ailments. Positive effects on both physical and mental health are found in many studies, but it was not clear the extent to which benefits are also accruing from participation in organised programmes and trips, nor whether people's exposure to other forms of non-wilderness nature was having a distorting effect.

Fredrickson and Anderson (1999) explored the effects of a wilderness experience on two groups of women in two wild areas of Minnesota and Arizona. Participants stated that benefits arose from both individual contact with nature, and from connections with their social group sharing the experiences. Personal testimony showed that the experience left a lasting impression on most participants, particularly as these experiences were so different to those of their daily lives at home. Many spoke of renewed hope, a reawakening of emotions and a new sense of identity (Box 2). The authors found that person-person interactions were just as important as person-place connections: "the affective appeal of a particular place setting has as much to do with the social interactions that occur there, as with the overall visual appeal of the landscape itself". The researchers concluded that these wildernesses contributed substantially to participants' well-being.

Box 2. Selection of comments from female participants of wilderness experiences in USA

"It was so incredible being able to hear the birds... Just the crunching of animals all around us... The sounds of the forest, the snapping of twigs, hearing the tiny sigh of the wind through the treetops at night."

"I noticed more, I felt more. I felt more connected to myself and even to other people on the trip."

"I can't even fully capture in words what happened to me when I was out there... It's like the spirit is burning deep inside me again, and I'm looking at my life a little differently."

"Instead of sitting back and observing it [the landscape], it's like I was moving into it... some way, or rather it was moving into me. I couldn't deny its effect on me."

Source: Fredrickson and Anderson (1999)

Similar experiences to those recorded by Fredrickson and Anderson (1999) have been noted by Williams and Harvey (2001) in the forests of Australia, where so-called 'transcendent' experiences were found to provoke a sense of harmony, freedom and well-being that were sufficiently long-lasting to change long-term attitudes to the environment. Several other studies have noted the value of natural and wilderness experiences and their therapeutic potential (Kaplan, 1995; Herzog *et al.*, 2002), and the additional role that physical hardship can play in triggering more profound experiences (Mitchell, 1983; Fredrickson and Anderson, 1999).

Young and Crandall (1984) used Abraham Maslow's (1968) concept of self-actualisation – a term to describe well-being, self-esteem and an enriched life (cf Rogers, 1951) – to test whether wilderness users were more 'self-actualised' than non-users. They found that users were significantly more self-actualised, though the differences were not great, and that regular use did not increase self-actualisation over infrequent use. However, they only tested for people's connections to a legally-defined type of nature – a specific wilderness in Minnesota. As indicated by other studies, non-users of the wilderness could have been deriving benefits from access to other types of local and companion nature, such as in community or back gardens or churchyards (McBey, 1985; Cooper, 2000; Armstrong, 2000) or from companion animals (Katcher and Wilkins, 1993). Moreover, it may be that self-actualised people were more likely to use wildernesses, and so causation may have been reciprocal.

Wildernesses are not the only natural settings or places that can confer benefits. Healing gardens are acknowledged to be beneficial for patients of hospitals (Cooper-Marcus and Barnes, 1999; Whitehouse *et al.*, 2001). Such benefits appear to have been recognised as early as the Middle Ages, with garden cloisters and vegetable gardens used as part of the healing process. In the Victorian period, gardens were routinely located in hospitals for the benefit of patients, and hospitals themselves located in pleasant surroundings. Some argue that modern health systems, with a focus on treatment of diseases rather than patient comfort and care, have abandoned useful principles regarding connections with nature and place (Lindheim and Syme, 1983). Empirical studies have shown that patients and staff with windows overlooking gardens have reduced stress (Ulrich, 1984; Verderber, 1986), and patients regularly report positive changes in mood when visiting gardens (Cooper-Marcus and Barnes, 1995).

Whitehouse *et al.* (2001) found that a healing garden at a children's hospital in California had positive effects on users, with 54% reporting they were more relaxed and less stressed, 12% refreshed and rejuvenated, 18% more positive and able to cope, and only 10% having no difference in mood. Even very short visits were beneficial, as nearly half of all observed visitors spent less than five minutes at a time in the garden. However, a majority of adults and children in the hospital did not know of the garden nor knew of its potential.

Such principles are being applied in the Eden Alternative nursing homes (EA, 2002), healing gardens, greenhouses, atriums and plants have been deployed in five homes in Texas. After conversion, there were 57% fewer bedsores, an 18% reduction in patients restrained, a 60% reduction in behavioural incidents, and a 48% reduction in staff absenteeism. The costs of such nature-based treatments are expected to be much less than expenditure for drugs and surgery to achieve the same outcomes.

Private and community gardens provide another direct link to nature for many people, and are particularly valuable in urban settings. In the UK, there are now some 300,000 occupied allotments on 12,000 hectares of land – down from 120,000 hectares in the 1940s. These allotments yield some 215,000 tonnes of fresh food each year. But more importantly, they provide an opportunity for regular contact with nature. There are now several hundred city farms or community gardens in the UK (Garnett, 1996; Pretty, 1998). They provide of food, especially vegetables and fruit, for poorer urban groups, and a range of other natural products such as wood, flowers and herbs. They add some local value to produce before sale. They sometimes mean that derelict or vacant land is transformed into desirable areas for local people to visit and enjoy, resulting in the creation of quiet tranquil places for the community that can increase wildlife. The involvement of schoolchildren can mean a reduction in

vandalism, as well providing local children with an educational opportunity to learn about farming and animals. They also provide the opportunity for mental health patients to engage in work that builds self-esteem and confidence, and for unemployed people to use their time productively in their own community.

A good example of what these tiny patches of nature can do is provided by the 1.6 ha Elder Stubbs garden in Oxford (Pretty, 1998). It was started in 1989 on derelict allotments, and links food production with developing the self-esteem and confidence of 24 mental health patients working at the gardens. It grows vegetables, flowers, fruit and willow coppice. Produce is sold to loyal buyers in the local community through regular deliveries by horse and cart. Value is added by making baskets from the willow, and jams and chutneys. There are positive links with the local community, and it shows what people with mental problems can do. Local school children come to the site regularly to help with work, and vegetables are sold to local people. But perhaps the greatest benefits have been in the rebuilding of social capital. Keith Birnie says *"it is not just about work here, it is about socialising, and learning to get on with each other"*.

The American National Gardeners Association estimates that some 35 million people are engaged in growing their own food in back gardens and allotments. Their contribution to the informal economy is estimated to be about \$12-14 billion per year. Private gardeners cultivate mostly to produce better tasting and more nutritious food, but also to save money, for exercise and for therapy. It makes them feel better. This is particularly true of community gardens and farms which, by contrast, seek to enhance both food production and social benefits. In New York, 87% of community gardeners invest their time in gardening so as to improve the neighbourhood, 75% for fresh vegetable production, 62% for fun and self-esteem, and 42% to save money (Weissman, 1995a, b). Their testimony indicates the value of these community gardens (Box 3). Many of the recently established Community Supported Agriculture (CSA) farms, with direct links to their consumers, not only provide weekly food boxes but also run horticultural therapy and educational sessions (Pretty, 2002).

In a survey of 20 community gardens in New York State, it was reported that people participated primarily to access fresh foods, to enjoy nature and for mental and physical health benefits (Armstrong, 2000). In more than half the cases, the gardens had changed the attitudes of residents about their neighbourhood, and in a third, had led to collective action to address local issues.

An important unanswered question for those concerned for sustainability is to what extent do the benefits of wildness experiences continue off-site? Do they provoke long-term changes in thinking, which could lead to deep social and political transformations? It is also true that people with a certain set of positive environmental values may be predisposed towards the restorative potential of nature (Kaiser *et al.*, 1999), and that these values help to shape environmental attitudes (Kals *et al.* 1999; Schultz and Zelezny, 1999). As Barnes (2000) has put it: *"The future of the planet depends on your enjoyment."*

Box 3. The contribution of community gardens to local communities

Ruth Fergus, Madison Community Garden

"When we first began our community garden, it meant changing an eyesore of a burnt-out building into something beautiful. Now, each morning I wake up to a dream come true. It also changed our mischievous teenagers to a positive junior block association, learning parliamentary procedure and conducting their own meetings instead of destroying the block".

Bertha Jackson, 127th St Block Association, Central Harlem, 1995

"This is the beauty. Yearly we got two or three bushels of peaches from the tree. People have come from near and far for Harlem grown peaches from our garden tree. The peach that grew in Harlem".

Glenn Bader, Mount Eden, Bronx

"No one believed it could be done. Everyone told us that the students were failures. Students that had a history of violence and trouble could add nothing to their community. We fooled them".

Tito Arroyo, Bronx

"The landlord to the right of the garden said 'this makes this block, my building, more valuable and more beautiful'.

Mary Scales, in a letter in the New York Times (30 Jan, 1997)

"Our community garden was created by students, staff, neighbours, community workers and environment groups. Together we managed to have the lot cleared, a fence erected and a garden created. The students, along with our neighbours, have improved the environment, which has made East New York a more beautiful place to work and live. Flowers bloom, vegetables are harvested, the smell of barbecues fills the air and the students learn. They enjoy learning outside... and our gardens are an oasis of beauty in the deserts of urban decay".

Sources: Weissman. 1995a, b

3. Physical Activity as Determinant of Emotional Well-Being

As we have indicated earlier, there is now compelling evidence that regular physical activity is good for health – not only in preventing important diseases and conditions, but in prolonging life. We are also interested in the extent to which physical activity can positively affect mental well-being and self-esteem (Scully *et al.*, 1999).

3.1 Self-Esteem, Sport and Exercise

According to Campbell (1984), self-esteem is an awareness of good possessed by self. Self-esteem is a self-rating of how well the self is doing. This worth is dictated by both the individual and the primary culture in which a person operates. It is, therefore, both a personal attribute based on the things that are valued most, and a societal attribute, based on the things which individuals value the most.

There are several reasons why good or high self-esteem is important. It is seen as a key indicator of emotional stability, and adjustment to life demands is seen as one of the strongest predictors of subjective well-being (Deiner, 1984). High self-esteem is valued and is associated with healthy behaviours and it is therefore important to consider it in relation to health. It also seems to be a concept that the general public seems to understand (it is now part of the National Curriculum).

The symptoms of low self-esteem include depression, anxiety, neuroses, suicidal ideation, sense of hopelessness, lack of assertiveness, and low perceived personal control. Clearly the consequences of these are likely to be negative in both the short and long term. With the possible exception of the mania component of manic depression (which involves heightened self-esteem), most mental health problems are related to reduced self-esteem either as a consequence or a cause of the illness. If self-esteem could be improved, then it may be that underlying problems could also be solved. Thus in addressing self-esteem, this could be used as a marker to identify whether we are helping to solve underlying problems.

The evidence suggests that aerobic exercise can improve self-esteem (Fox and Corbin, 1989) as well as have an antidepressant effect (McDonald and Hodgdon, 1994). However, like the research on the benefits of nature (cf Frumkin, 2002), much of the evidence is correlational rather than causal (there have not been many well-designed experiments).

The evidence base for different groups differs. In children and adolescents, exercise is an effective medium for developing positive self-esteem. It is very good for those with low self-esteem and is powerful if it also encourages mastery and self-development (Marsh and Peart, 1988; Calfas and Taylor, 1994; French *et al.*, 1995). In middle-aged adults, it is very important, though for older adults, there is little research.

The evidence suggests that exercise affects an undetermined psycho-physiological mechanism, leads to improved fitness and/or weight loss, more autonomy and personal control, and a better sense of belonging and significance. However, there is much about the underlying mechanisms that is not known (Box 4).

Box 4. Factors affecting the role of exercise on self-esteem (Hill, 1965)

1. Strength of association (is depression associated with a lack of exercise) – there is an association but not as strong as with coronary heart disease
2. Consistency (yes this putative relationship does often occur)
3. Specificity (how “tight” is the relationship? – not well researched)
4. Temporal sequence (does inactivity precede onset of depression? – not well researched)
5. Dose response (how much is enough -not clear – not well researched)
6. Plausibility (it does seem plausible that a biological mechanism exists which could explain this effect)
7. Coherence (it seems probable that this mechanism would fit with other known mechanisms)
8. Experimental evidence (some but not enough and not enough of high quality).

3.2 Physical Activity and Body Image

Various studies have discovered that physically-active men and women evaluate their physical appearance more positively and are significantly more satisfied with various parts of their bodies compared with those who are not physically active (Davis, 1997; Lowland, 1998, 1999; Guinn *et al.* 1997). Bartlewski *et al.* (1996) found women who enrolled in an aerobic exercise class showed a decrease in social physique anxiety throughout the duration of their attendance. Social physique anxiety is a bodily self-consciousness resulting from perceived evaluations by other people, and it did not change significantly for non-exercising control subjects.

Lox (1995) investigated the effect of exercise on subjective well-being in HIV-1 infected men over a period of twelve weeks. They were assigned to either an aerobic exercise training group, a resistance weight-training group or a control group. Both exercise groups demonstrated improvements in perceived physical ability and subjective physical appearance, while the control group exhibited decreases in these two measures. The aerobic exercise group displayed greater increases in perceived physical appearance than the weight-training group.

Marsh (1998) examined the physical appearance self-concept among elite athletes and non-elite athletes by using the PSDQ appearance scale. This comprises a total of eleven subscales: appearance, strength, condition/endurance, flexibility, health, coordination, activity, body fat, sport, global and physical. A combined analysis gives total physical self-concept. There were large between group effects favouring elite athletes and significant group x gender interactions for total physical self-concept. Elite athletes scored more favourably than non-elite athletes across all the PSDQ sub-scales except health concept, while there were no significant group x gender interactions for appearance, body fat or global physical self.

Individuals who have physical disabilities often elicit a stigmatised response, as they fall outside the range of what is considered to be ‘normal’. They are assumed to differentiate from conventional standards of body build and attractiveness. Taub *et al.* (1999) explored the possible alteration of the image of a disabled body through involvement in sport and physical activity. Males with a variety of disabilities including paraplegia, quadriplegia and cerebral palsy were included in the study. The majority of participants perceived participation in physical activity as a positive experience, and they believed they had an

enhanced bodily appearance as a result. They also considered sport and physical activity to be compensatory to stereotypical perceptions about the appearance of a disabled body.

The importance of the participation experience itself rather than the type or intensity level of the physical activity was emphasised. Dekel *et al.* (1996) also examined self-esteem and body image in adolescents with postural deformities, who were diagnosed as having structural and non-structural Adolescent Idiopathic Scoliosis (AIS). Again, individuals who engaged in physical activity perceived their bodies more positively than those who did not.

However, not all studies have found a positive relationship between body image perception and physical activity. Marsh *et al.* (1995) did not find any significant differences in physical appearance self-concept between athletes and non-athletes, even though they did find differences in self-esteem. Baldwin and Courneya (1997) found a significant correlation between exercise participation and global self-esteem in women who had been treated for breast cancer, but physical acceptance was not correlated significantly with exercise participation.

Davis *et al.* (1993) investigated physical appearance with particular regard to men. Although they hypothesised that appearance anxiety would be inversely related to physical activity participation, this association was only weak. Upper body esteem accounted for nearly half the variance in appearance anxiety, suggesting that male body dissatisfaction is most notable for the chest and waist.

3.3 The Relationship Between Body Image and Self-Esteem

The body's appearance is a focal point in many people's lives as its characteristics are openly displayed. By the age of eleven children have begun to rate themselves on particular aspects of their appearance, and have already formed an opinion about whether or not they are attractive. As shown in Table 6, certain features become important as well as consistently relating to self-esteem. It indicates that the perception of appearance is the strongest correlate of self-esteem for both boys and girls (0.61 and 0.69 respectively) compared to other areas of life. The body is also of great importance to the self at times of life other than childhood. This is evident from peoples' willingness to undergo self-presentation strategies that are often unhealthy or expensive, such as cosmetic surgery and the use of sunbeds. The use of steroids by body builders and the adoption of dysfunctional eating habits in young girls in order to look slim can also be viewed as self-presentation strategies (Fox, 1997).

Table 6. Correlates of self-esteem in 12-year-old boys and girls (Page and Fox, 1997).

	Boys (n=113)	Girls (n=130)
Appearance	0.61 (p<.01)	0.69 (p<.01)
Athletic ability	0.44 (p<.01)	0.28 (p<.05)
Close friends	0.59 (p<.01)	0.43 (p<.01)
Social competence	0.52 (p<.01)	0.38 (p<.01)
Scholastic competence	0.25 (p<.05)	0.43 (p<.01)
Clothes concern	0.01	0.19
Face dissatisfaction	0.39 (p<.01)	0.50 (p<.01)
Hair dissatisfaction	0.28 (p<.05)	0.38 (p<.01)
Looks preoccupation	0.08	0.33 (p<.01)
Weight dissatisfaction	-.023	-.049

Secord and Jourard (1953) speculated that if an individual's status and security were dependent on their attractiveness, and they did not consider themselves to be attractive, they would exhibit a loss in self-esteem. They found intercorrelations between body image scores and self-concept scores of students, which were 0.58 and 0.66 ($p < .01$) for males and females respectively. This suggests individuals have a moderate tendency to cathect their body and self in the same direction and to the same degree. Guinn *et al.* (1997) also found a negative relationship between self-esteem and body fatness in female adolescents. Body image exerted a stronger influence over subjects' self-esteem scores than exercise.

Gender differences are important. In both athletes and non-athletes, men have been found to have significantly higher self-esteem ($p < .01$) and physical appearance self-concept ($p < .01$) than women (Marsh *et al.* 1995). Marsh (1998) found that group effect (elite/non-elite athletes) was substantially larger than gender effect for total physical self-concept and most scales on the PSDQ, with the exception of appearance, body fat and global physical scales. For these scales the gender effect (favouring males) was substantially larger than the group effect. Lowland (1998, 1999) discovered inactive and active women were more concerned with appearance and weight and were less satisfied with weight and most parts of their bodies than their male counterparts.

Secord and Jourard (1953) did not find any significant differences between means of scores on the Body Cathexis Scale for the two sexes, although women did cathect their bodies more highly than men indicating a poorer perception of body image. In an exploratory study of motives for exercising and body image satisfaction, it was discovered that women who experienced the most body dissatisfaction exercised for appearance and weight control. Women also exercise for appearance-related reasons more than men (Smith *et al.* 1998).

3.4 Using Sport, Exercise and Physical Activity to Reduce Depression

There is good evidence to support the idea that physical activity has a positive effect on self-esteem and depression, but clearly more research is required. One key problem lies in defining clinical depression. Many people say they have clinical depression (emphasising the term 'clinical') to ensure that others understand that they are more than just unhappy. In one way, individuals are clinically depressed if they see a doctor who evokes an intervention, i.e. they are given time off work, prescribed drugs, and/or told to see a counsellor or therapist. The issue of definition is important because many of the studies cited as evidence that exercise beats depression were not with clinically-depressed patients or at least its not clear that that was the case.

There are, however, objective ways to categorise clinical depression, including scoring 16 or above on the Beck Depression Inventory (BDI) (Beck *et al.*, 1961); using the DSM-IV (the Diagnostic and Statistical Manual of Mental Disorders) or the ICD-10 (International classification of diseases; using the Research Diagnostic Criteria (RCD) (Spitzer *et al.*, 1978). Studies using these kinds of measures would be more convincing that just with self-diagnosed individuals.

There is also some epidemiological evidence (Martinsen *et al.*, 1989; Morgan, 1994). Fitness levels were lower for psychiatric patients than non-hospitalised controls. Patients who had short (up to 61 days) hospital stays had higher levels of muscular endurance on admission than those who stayed longer (at least one year) even though they had similar initial levels

of depression. But it is not clear whether lack of exercise causes depression, or depression causes lack of exercise.

There are several key studies in which statistical adjustments have been made for confounding variables such as age and socio-economic background. Farmer *et al.* (1998), in a study of 1497 people over an eight year period, showed that women who did little or no activity were twice as likely to develop depression as those who engaged in 'much' or 'moderate' activity. But this was not true for men, but for those men who were depressed at the baseline inactivity was a strong predictor of depression at the 8 year follow up. In a study from a baseline point, then nine later and a further nine years after that, Camacho *et al.* (1991) found a relationship between inactivity and depression. The relative risk of depression was greater for both genders in those who had low physical activity.

Also if the amount of activity decreased (in active individuals) the risk of depression increased. Paffenbarger *et al.* (1994) found that men aged 23-27 years who engaged in three hours or more of sporting activity at a baseline point had a 27% reduction in the risk of developing depression at follow up compared to those who did an hour or less. There was also some important evidence for a dose response. Those who expended 2,500 kcal or more per week were 28% less at risk of developing clinically recognisable depression than those expending less than a 1000kcal wk⁻¹. And those who expended between 1000 and 2499 had a 17% risk reduction compared to those in the least active group.

There have been several meta-analyses, in which North *et al.* (1990) and McDonald and Hodgdon (1994) show that exercise does have an anti-depressant effect, though neither used clinically depressed subjects. Calfas and Taylor (1994) also found links in healthy and at-risk adolescents, though the number of studies involved was small. Craft and Landers (1998) performed a meta-analysis of only clinically depressed subjects in thirty studies, and showed a difference in levels of depression following exercise in moderate to severe depression. Disman (1995), though, concluded that there were too many dissimilarities between studies for such meta analyses to be meaningful.

We conclude that although there have been insufficient studies in this area, exercise programmes can reduce clinically-defined depression, and that this can happen as quickly as 4-6 weeks. Most studies had good internal and external validity, though larger sample sizes, controlling for the effects of positive characteristics of an exercise leader, conducting long-term follow-ups, and managing the non-treatment group were all required in future analyses.

4. Synergies from Green Exercise and Policy Implications

In Figure 1, we set out a framework for the roles of diet and physical activity as primary determinants of mental and physical health. We also suggested that linkages with nature and social communities plays a secondary role in influencing health. It is therefore feasible to hypothesise that there may be a synergistic benefit in adopting physical activities whilst at the same time being directly exposed to nature. We call this 'green exercise'. There is, as yet, little empirical evidence for such benefits arising from both sources concurrently.

The behaviour of many groups of people seems to suggest that they already appreciate the benefits of protecting the environment, undertaking physical activity, and combining the two. Despite the increased daily disconnections between a predominantly urban population and nature, and the increase in sedentary lifestyles imposed or adopted by the majority of the population, people still express their values in a variety of direct and indirect ways, through:

- i) Membership of environmental and wildlife organisations;
- ii) Visits to the countryside and the growth in national and international eco-tourism;
- iii) Membership of gymnasiums and of sports and outdoor organisations.

There is clear evidence that membership of environmental and wildlife organisations is growing (eg National Trust > 3 million; RSPB > 1 million; Wildlife Trusts > 400,000; Ramblers Association >170,000). Some of these activities and memberships already have a 'green exercise' component, such as organised rambling in the countryside, fell-running and orienteering, mountaineering, and work days on nature reserves.

Each year, some 551 million day visits are made to the UK countryside (433 m) and seaside (118 m), and these visitors spend more (£14 billion) than gross income earned by farms for the food produced in the landscape (CA, 2001; Pretty *et al.*, 2003). A substantial proportion of these day visits involves significant physical exercise, including 110 m days on outdoor sport and leisure, 104 m days on hiking and walking, 77 m on pony trekking, mountaineering and shooting, and 32 m on cycling (Table 7).

There is also evidence that membership of private and public gyms and health clubs has increased in recent years, as urban people look to local opportunities to engage in physical activity. In 2001, there were 4059 public and private health and fitness clubs, up from about 2200 in 1980 (DCMS, 2002). Some 5.4 million people are members of these clubs (though this does not mean they all take regular advantage of their membership). The UK has a network of some 110,000 community amateur sports clubs run by 1.5 million volunteers. Large numbers of people regularly engage in physical activity in their communities – for example, 400,000 people play football each weekend in 33,000 registered amateur football clubs. There are, however, concerns that organised local sports are under threat from loss of playing fields for development, and the DCMS (2002) estimates that the numbers of sports clubs has declined by 40,000 since 1996.

Green exercise has important public and environmental health consequences. At a fundamental level, a fitter and emotionally more content population costs the economy less. Obesity already costs more in public health terms, and will overtake smoking as Britain's biggest killer in 10-15 years if current trends persist. If trends continue, other diet- and

physical inactivity related diseases will also increase. Increasing the support for and access to a wide range of green exercise activities for all sectors of society will produce substantial public health benefits and avoided costs.

Table 7. Green exercise in UK countryside, and days spent on each activity (1998)

Activity	Proportion of day visits on each activity (%)	Number of days per year (million) on each activity (total of 551 million)
Outdoor sport and leisure	20%	110.2
Hiking, walking and rambling	19%	104.7
Swimming (of which 31% is outdoors)	16%	88.2
Pony trekking, riding, shooting, hunting, mountaineering, rock climbing, theme parks	14%	77.1
Heritage attractions	13%	71.6
Cycling	6%	33.1
Sailing	5%	27.6
Fishing/angling	5%	27.6
Fields and nature	4%	22.0

Source: Pretty et al. (2003), using data from CA (2001) and ETC (2000) UK Leisure Day Visits Survey and UK tourism surveys

Getting the policy context right will also help, and the 2001 report of the National Audit Office (2001) on obesity suggests that gyms at GP surgeries, healthy walks projects, exercise on prescription, healthy school environments, and healthy travel to school projects can all help. To these can be added the benefits of green views in hospitals, protection and support for city farms and community gardens, less anonymous food (with substantial health benefits if there are increases in fruit and vegetable consumption), and more support for ecotourism, outdoor leisure activities, and visits to the countryside. Policy responses thus require huge changes in the existing paradigm for public health (Lang and Heasman, 2002), some suggesting the need for a more ecological or holistic approach (Egger and Swinburn, 1997; Mortlock, 2001).

These ideas, though, still remain on the margins of public health and environmental policy. Clearly much more could be done by promoting behavioural changes to reduce the intake of inappropriate foods as well as increase physical activities to burn excess calories. If everyone ate five pieces of fruit and vegetable per day, and engaged in 30 minutes of moderate physical activity five times per week, and ensured that calorie burning matched consumption in food and drink, then a significant proportion of the annual £10 billion costs of obesity, coronary heart disease and physical inactivity could be avoided.

The DCMS (2002) indicates that a 10% increase in adult physical activity would benefit England by £500 million per year, also saving 6000 lives. The emotional benefits and mental well-being would be additional to these benefits, and could indeed outweigh them. If these benefits are also achieved through activities that provoke long-term changes in attitudes to nature and the environment across society, then the possibilities for transformations and actions to support sustainability outcomes will be all the more likely to occur.

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