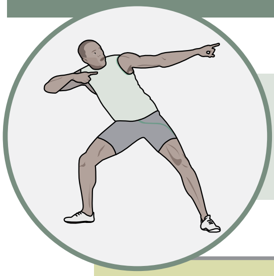
PHYSICAL AND MENTAL HEALTH

PHYSICAL INACTIVITY CAUSES DISEASE AND COSTS THE NHS HUNDREDS OF MILLIONS EVERY YEAR



WHILST USAIN BOLT RUNS 100 METRES (9.58 SECONDS), THE NHS SPENDS AROUND £10,000 ON TACKLING PREVENTABLE ILL HEALTH

The cost to the NHS in 9.58 seconds for five mental/physical illnesses

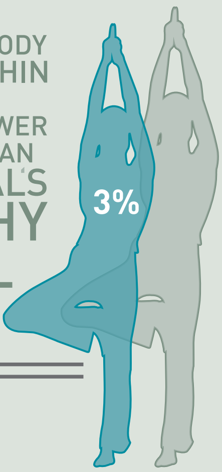
Obesity	1	£1,548
Diabetes	2	£2,740
Cardiovascular Disease	3	£4,370
Depression and Anxiety Disorders	4	£880
Dementia	5	£571

Total £10,109

THE EFFECT OF THIRTY MINUTES MODERATE INTENSITY PHYSICAL ACTIVITY FIVE TIMES A WEEK...

OBESITY

MAINTAIN A BODY WEIGHT WITHIN 3% OR LOWER OF AN INDIVIDUAL'S HEALTHY INITIAL WEIGHT



DEMENTIA

REDUCES RISK OF DEMENTIA BY 2-3x COMPARED TO LEAST ACTIVE

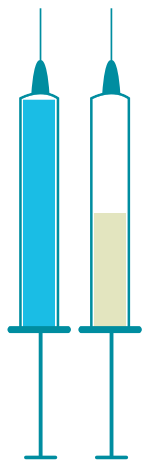
2-3x

CARDIOVASCULAR HEART DISEASE

REDUCTION IN THE RISK OF CARDIOVASCULAR DISEASE

DIABETES

REDUCED RISK OF DEVELOPING TYPE 2 DIABETES



30 minutes physical activity

diabetes medication

2x as effective as medication in preventing the disease amongst those at risk of type 2 diabetes

DEPRESSION AND ANXIETY DISORDERS

A VIABLE WAY TO TREAT MODERATE DEPRESSION AND ANXIETY

PHYSICAL ACTIVITY AND MENTAL HEALTH

INTRODUCTION

Mental illness is the single largest cause of disability in the UK; one in four people will experience a mental illness in their lifetime and one in six experience symptoms at any one time (Department of Health, 2012). There is also a strong relationship between mental ill health and physical ill health. People with long-term illnesses such as diabetes or hypertension have double the rate of depression in comparison to the general population, and where people have two or more long term physical illnesses the chance of depression is an alarming seven times higher. Furthermore, mental ill health increases the risk of physical ill health. For adults, depression doubles the risk of coronary heart disease and leads to a 50% increase in the risk of mortality. Schizophrenia and bipolar disorder reduce life expectancy by an average of 16-25 years and increase the likelihood of obesity and diabetes (Department of Health, 2011). Obesity and mental health also have a two way relationship: obese people have a 55% increased risk of developing depression over time when compared to people of a healthy weight, and people with depression have a 58% increased risk of becoming obese (Luppino et al., 2010).

It is thought that for every £8 of NHS expenditure on long term physical illness, £1 is linked to poor mental health, and where a patient with a long term condition also suffers mental ill health the average cost of NHS service per person rises from £3,910 to £5,670 a year (The Kings Fund and Centre for Mental Health, 2012). The Government has therefore identified that, *"the physical and mental health interface is where system efficiencies and savings can be found and improvements made across the patient pathway – to both prevent physical illness in those with mental illness and prevent mental illness in those with physical illness"* (Department of Health, 2011, p.15). Physical activity is able to address both physical and mental ill health simultaneously to reach this target as, *"what is good for our hearts is also good for our heads"* (Manoux et al, 2012; Richards and Brayne 2010; Viswanathan, Rocca and Tzourio, 2009).

The total cost of mental health problems in England in 2009/2010 was calculated as being £105.2 billion. This represents a 36% increase since 2002/03 despite the prevalence of mental health problems remaining unchanged at 23% of the adult population (Centre for Mental Health, 2010).

This includes NHS and social care costs of over £21 billion a year and sick leave absence and unemployment costs as high as £30 billion a year. Yet despite the evidence from research on the role of physical activity in both the treatment and prevention of mental illnesses, there is currently little precedent amongst GPs and healthcare professionals to prescribe this form of treatment. Infuriatingly, physical activity as an intervention didn't even make it in to a recent report on the economic case for preventing mental illness. This report calculates the return on investment per £1 of expenditure for a range of interventions such as social and emotional learning programmes to prevent conduct disorder (£83.73), workplace health promotion programmes (£9.69) and debt advice services (£3.55) (Knapp, McDaid and Parsonage, 2011); a similar document exploring the economic impact of physical activity interventions would be enormously useful. This highlights Callaghan's (2004) conclusion following a literature review of the role of exercise in mental health care, which states that exercise is a neglected intervention. Callaghan asserts that the existing evidence shows that exercise can improve mental health, wellbeing and overall quality of life; in particular it reduces anxiety and depression and can increase cognitive function. Meta-analysis and literature review based support for a positive relationship between physical activity and mental health has also come from Guszkowska (2004), Daley (2002) and Biddle et al. (2000) amongst others.

The most extensive meta-analysis is probably a review of several hundred studies on the influence of physical activity on mental wellbeing by Fox (1999). This review concludes that moderate, regular exercise is a viable way to treat depression and anxiety, and to improve mental wellbeing generally via improved mood and enhanced self-perception. He proposes four ways in which physical activity can do this: firstly as a form of treatment for a mental illness or disorder, secondly as a means of prevention, thirdly to improve the mood of those with a mental illness, and finally to improve mood within the general population.

DEPRESSION

It is estimated that depression costs England £7.5 billion a year in health service costs and lost earnings (Department of Health, 2011b), with the prescription of antidepressant drugs costing the NHS £1.63 billion in 2011 (The NHS Information Centre, 2011). Yet Blumenthal et al. (2007) have found that physical activity is as effective as medication in treating depression. A 16 week study of 202 men and women found that 45% of patients diagnosed with major depression no longer met the criteria for depression after exercising three times a week in a supervised group setting.

This is on a par with the 47% of patients who no longer met the criteria after taking antidepressants. Replacing some of the antidepressant prescriptions with physical activity-based treatment could therefore offer substantial cost savings to the NHS. It is thought that depression without anxiety is experienced by 2.6% of people in England and that a further 9.7% experience depression with anxiety (The NHS Information Centre, 2009). In 2010, 42.8 million antidepressants were prescribed in England with an ingredients cost of £220.4 million. Replacing just 10% of antidepressant prescriptions with an exercise-based prescription could save over £22 million in ingredient costs.

Blumenthal and colleagues also conducted research in 1999 comparing the effects of exercise with those of medication and exercise and medication combined on depression. 156 moderately depressed men and women were assigned randomly to one of these three groups for 16 weeks. The exercise prescription consisted of 30 minutes walking or jogging on a treadmill at 70-85% of heart rate reserve, three times a week. Whilst medication was shown to work quicker in reducing symptoms of depression, overall there were no significant differences among the three treatment groups, again indicating that exercise was as effective as medication. According to the Hamilton Rating Scale for Depression[23] the percentage of patients in remission from their depression at the end of the 16 weeks was 60.4% in the exercise group, 68.8% amongst the medicated group and 65.5% in the combined group. A ten month follow up also revealed that those who were in the exercise group had significantly lower rates of depression in comparison to the other two groups. 70% of the group who exercised had low rates of depression compared to 54% of the combination group and 48% of the medicated group (Blumenthal et al., 1999), indicating longer term benefits to physical activity in the treatment of depression. It is possible that undertaking an enjoyable activity contributes to a long term impact as enjoyment will increase the likelihood of both take-up and perseverance with an activity.

Craft and Perna (2004) similarly found physical activity to be beneficial for sufferers of depression, concluding that, *"many studies have examined the efficacy of exercise to reduce symptoms of depression, and the overwhelming majority of these studies have described a positive benefit associated with exercise involvement"* (Craft and Perna, 2004, p.105). A small sample of 30 moderately

23 The Hamilton Rating Scale for Depression is commonly used to measure the severity of depression. It typically has 17 questions and is conducted by a physician who asks the questions and observes the individuals symptoms

depressed men and women were assigned to an exercise intervention group, a social support group and a "waiting list" control group. Exercise was the most effective intervention, reducing depressive symptoms as measured by the Beck Depression Inventory [24] by 2.4 compared to 0.9 for the social support group and 0.4 for the control group. Further research showed that ten consecutive days of 30 minutes walking on a treadmill produced a statistically significant reduction in depression of 6.5 points from baseline according to the Hamilton Rating Scale for Depression (Dimeo et al., 2001, cited in Craft and Perna, 2004).

A review of existing research on the relationship between physical activity, depression and anxiety by Martinsen (2008) included the work of Blumenthal et al. (1999, 2007) and other research comparing a physical activity group with an antidepressant group. Martinsen also highlights two studies that explored the impact of physical activity as a form of treatment in clinically depressed patients who had been unresponsive to adequate levels of antidepressants. This research perspective raises interesting questions about the effectiveness of antidepressants. In recent years research has suggested that antidepressants may not be as effective as once thought (see Pigott et al., 2010, for an examination of the evidence around the efficacy and effectiveness of antidepressants and Ioannidis, 2008, for a critical analysis of the evidence for the effectiveness of antidepressants), and that alternative forms of treatment for depression are needed. Indeed the National Institute for Health and Clinical Excellence (NICE) recommends that exercise may be a better form of treatment for depression in patients with mild clinical depression because amongst this group the benefits of antidepressants have been seen to be poor whilst the risks are high (NICE, 2007). For example, in those aged under 25, selective serotonin reuptake inhibitor antidepressants (SSRIs) are thought to increase the risk of suicide. Although evidence isn't conclusive, it is considered significant enough for SSRIs to carry a warning regarding the potential for an increased risk of suicide (see Hall and Lucke, 2006, for a review of the evidence for and against this). Trivedi et al. (2006) and Mather et al. (2002) both found that physical activity was effective for improving depression amongst those who had not responded to medication (cited in Martinsen, 2008). Overall, Martinsen concludes that both aerobic and resistance training are effective in reducing depression when participated in at an energy expenditure of 17.5 kcal/kg/week – this is about on a par with the recommended Government guidelines for physical health of five

FURTHER RESEARCH SHOWED THAT TEN CONSECUTIVE DAYS OF 30 MINUTES WALKING ON A TREADMILL PRODUCED A STATISTICALLY SIGNIFICANT REDUCTION IN DEPRESSION

24 The Beck Depression Inventory is also widely used for measuring the severity of depression. It consists of 21 multiple choice questions that allow individuals to self-report on mental and physical symptoms of depression.

sessions of 30 minutes moderate intensity activity a week. The important factors for physical activity in the treatment of depression identified by Martinsen are that it should be regular, enjoyable and provide a sense of accomplishment with the ultimate goal of creating regular exercise as a habit.

Rothon et al. (2010) focused their research specifically on the impact of physical activity on the treatment of depressive symptoms in deprived adolescents. This focus on deprived adolescents is important given that adolescents are more likely to experience depression than young children and if untreated this could influence their educational attainment and life chances. Based on 2,789 pupils from East London who were multi-ethnic and deprived, Rothon et al. observed that there was an association between physical activity and depressive symptoms amongst adolescent boys and girls, with the likelihood of depressive symptoms decreasing by around 8% for every additional hour of exercise undertaken. The longer term effects during follow up were not conclusive: there was no statistically significant association, although the direction of the effect of physical activity on depression remained similar. Earlier longitudinal studies of depression specifically in adolescents (Sagatun et al., 2007, Ströhle et al., 2007 and Motl et al., 2004) have also found associations between physical activity and mental health but have been inconclusive on how this relates to a specific diagnosis or by gender.

We have already seen evidence that physical activity treatments are comparable with medication. A comparison of running and psychotherapy also showed aerobic physical activity to be equally as effective as psychotherapy as a form of treatment. Three 20 minute running group sessions for ten weeks caused a reduction in the mean depression score of 1.9 compared to a reduction of 1.6 for cognitive therapy treatment (Fremont et al., 1987, cited in Craft and Perna, 2004). However, therapy treats the underlying cause of the problem and will likely take longer to do so. Aerobic activity may be a good additional treatment that can lift mood in those who are depressed in the short term whilst waiting for the progress of therapy treatments. Shorter term improvements in mood brought about by exercise may also play a role in maximising the benefits of therapy through placing patients in a more positive frame of mind for tackling their problems.

What is unclear in all the studies detailed so far is the influence that the social element to the running group played in treatment. Dunn et al. (2005) conducted longitudinal research with 80 moderately depressed men and women to examine the relationship between physical activity and depression in a more isolated way and to quantify the amount of activity needed to have a positive impact. With the exception of a small sample size (53 out of 80 participants completed the study) this research was extremely thorough and tightly controlled, ensuring that exercising took place individually in rooms monitored by laboratory staff over the course of 12 weeks. Four exercise groups were created in addition to a control group. The four groups consisted of low dose energy expenditure on three days a week, low dose energy expenditure on five days a week, recommended public health guidelines of energy expenditure on three days a week, recommended public health guidelines of energy expenditure on five days a week, and a control of 15-20 minutes of stretching and flexibility exercises per session. Low energy expenditure was defined as seven kcal/kg/week, whilst under American public health guidelines the recommended energy expenditure was 17.5 kcal/kg/week – this is also equivalent to the UK Government recommendations.

Again using the Hamilton Rating Scale for Depression as the measure of depression, scores fell by an average of 47% in the two groups who took part in the recommended guidelines of energy expenditure. Those participating in the recommended public health guideline energy expenditure group five days a week went from a mean depression score of 19.1 at the beginning of the study to a mean score of 7.9 after the 12 weeks of exercising. Those participating at this intensity for three days a week had beginning and end mean depression scores of 19.1 and 9.0 respectively. For those in the two low energy expenditure groups there was a 30% decline, similar to the 29% decline experienced by the control group, indicating that physical activity is effective in treating moderate depression when there is sufficient energy expenditure. For those exercising a small amount three days a week the mean depression score fell from 19.3 at the start to 10.5 at the end, and for those exercising at this intensity for five days a week the change was from a mean score of 19.2 to 11.9. Interestingly, this shows that in both of the intensity groups, frequency of activity beyond the minimum three days a week does not appear to have made a significant difference. The control group fell from a mean depression score of 20.5 to one of 11.3, demonstrating that low doses of physical activity have the same effect as a placebo.

Whilst exercising at the recommended intensity for five days a week had the most impact in reducing depressive symptoms, this research found that exercising at the recommended intensity for three days a week was the most effective in reducing the depression scores of participants to seven or lower (identified as remission). Dunn et al. (2005) conclude that, *"the response and remission rates in the PHD group [recommended level of intensity, both for three days and five days a week] are comparable to other depression treatments… in the Collaborative Depression Study conducted by the National Institute of Mental Health rates of remission were 36% for cognitive behavioural therapy and 42% for antidepressant medication… similar to the 42% remission rate in this study… the public health dose of exercise is an effective monotherapy for mild to moderate major depressive disorder"* (Dunn et al., 2005, p.7). This research clearly suggests that physical activity at the intensity of 17.5 kcal/kg/week for a minimum of three days a week can be a successful treatment for moderate depression regardless of whether there is a social element to the exercise. Repeating such research on a larger scale and exploring the remission and response differences between three and five days at the higher intensity of exercise could help to produce definitive evidence for the impact of physical activity on mild depression in adults.

Although Dunn et al.'s (2005) controlled research successfully isolated physical activity from social benefit with regards to improving depression, from an observational study, Harvey et al. (2010) conclude that because of its social context and associated enjoyment, leisure time activity is beneficial for depression and anxiety in a way that is not replicated for workplace activity.. Research on 40,401 Norwegians aged 20-89 years old examined the association between levels of physical activity and depression and anxiety. Leisure time physical activity was measured as either light (not being sweaty or out of breath) or intense (sweating and/or breathlessness) at durations of not at all, less than an hour a week, one to two hours a week, or three hours or more a week. Work time activity was also recorded. Participants also completed the Hospital Anxiety and Depression Scale[25] (HADS). 4,080 individuals (10.1% of the sample) were classified as depressed, 6,129 (15.2% of the sample) as having symptoms of anxiety and 2,258 (5.6% of the sample) had comorbid depression and anxiety. After controlling for confounding variables, Harvey et al. found that doing no light or intense activity doubled the chance of depression compared to exercising for three hours or more a week (odds ratio 2.04 and 1.98 respectively, exercising three hours or more as reference with an odds ratio of 1).

25 The Hospital Anxiety and Depression Scale focuses on psychological and cognitive symptoms relevant to anxiety and depression. It is a self-report questionnaire with 14 questions that cover anxiety and depression over the past two weeks; all questions are answered using a four-point Likert scale. A cut-off score of 8 in each subscale indicates the existence of case-level anxiety and/or depression.

Lower rates of comorbid depression and anxiety were also evident amongst those who engaged in higher levels of light and intense leisure time physical activity, as were slightly lower levels of anxiety for those who engaged in light leisure time physical activity. However, workplace activities were not seen to have any association with either depression or anxiety, leading the researchers to hypothesise, in line with De Moor et al.'s (2008) population-based longitudinal study of 5,952 Dutch twins, that activity itself may not be the causal factor in the positive association between physical activity and mental health.

Women and adults of low socioeconomic position are at greater risk of both depression and inactivity. Teychenne, Ball and Salmon (2010) therefore explored the social context of physical activity with improvements in mental health for women from disadvantaged neighbourhoods. The sample consisted of 3,645 women living in socioeconomically disadvantaged areas of Victoria, Australia, aged between 18 and 45 years. Participants self-reported their levels of physical activity, including details of the social context, levels of sedentary behaviour and depressive symptoms. Women who accumulated more than 40 minutes of total leisure time activity a week had a lower chance of depression than those who accumulated less than 40 minutes a week: 44% of those exercising less than 40 minutes a week were at risk of depression compared to 33% of those exercising more than 40 minutes a week. Leisure time walking was also inversely associated with risk of depression, with 42% of those who didn't walk for leisure at risk of depression compared to 33% of those who did some walking. The proportion at risk was the same for between 0.1 and two hours a week of walking for leisure, and for more than two hours a week of walking for leisure. These results indicate that even a short walk could reduce depression for disadvantaged women.

Similarly, moderate and vigorous leisure time physical activity was inversely associated with risk of depression but the minimum level of activity needed was interesting. For moderate activity, between 0.1–1.33 hours per week was associated with the smallest risk of depression, and 28% were at risk compared to 38% of women who did no moderate leisure time activity. For vigorous intensity activity higher levels were associated with the smallest risk, and 30% of women who did more than 1.9 hours a week of vigorous activity were at risk of depression compared to 39% of those who did no vigorous leisure time activity. In accordance with other research around depression and physical activity, this research found no association for work-related physical activity or domestic physical activity and depression. Echoing Martinsen's (2008) finding that it is important that activity is enjoyable, Teychenne, Ball and Salmon (2010) propose that the type of physical activity may be the most important factor. These findings suggest that if the activity is enjoyable for an individual, around 1.3 hours of moderate activity leisure time a week is sufficient to bring mental health benefits for disadvantaged women. The evidence for this is not conclusive and therefore more research is required.

When exploring the social context of activities, Teychenne, Ball and Salmon found that women who did most (three quarters) of their exercise alone had a reduced risk of depression (28% compared to 37% of women who did all their activity alone and 32% who did all their exercise with a companion). A small three month intervention study with a sample of 32 depressed women used a social exercising intervention and a home-based exercising intervention in the treatment of depression. Craft et al. (2007) found that whilst both were effective at treating depression, there were no significant differences between exercising alone and exercising in a group. The work of Craft et al. (2007), whilst indicative that there are no differences between individual activity and social physical activity, has a small sample size. A larger review of 14 randomised controlled trials also found no indication that either social or individual interventions were more effective than the other, but found some support for activity to be supervised in some way. The authors concluded that three 30 minute sessions of aerobic exercise at an intensity of 60-80% of maximum heart rate should be the minimum prescription, and that this should be continued for at least eight weeks (Perraton, Kumar and Machotka, 2010).

In observational and population-based studies causality between physical activity and depression may be difficult to isolate, given that symptoms of depression can include feeling tired and lacking in energy, physical aches and pains with no physical cause, poor motivation and creating distance from others[26] – all factors that would reduce the likelihood of undertaking exercise. It may also be for this reason that little research is able to demonstrate how effective physical activity is in preventing depression rather than treating it. The evidence for the effectiveness of physical activity in treating depression would suggest that there is also a role for prevention in the general population. There are, however, a number of physiological theories for how physical activity can influence mood, although more research is necessary to clarify the mechanisms by which physical activity reduces depression. The two most popular explanations relate to the production of serotonins and endorphins. The serotonin hypothesis suggests that physical activity causes the body to release serotonin, a neurotransmitter in the brain that regulates mood and stress, which is beneficial for patients with depression because low serotonin levels are associated with depression. The evidence in support of this theory is mixed, potentially because of difficulties in accurately measuring serotonin levels in the human brain (for a discussion of how exercise affects neurotransmitters and a proposal on how to better understand this see Sarbadhikari and Saha, 2006; for an overview of exercise as a means of increasing serotonin see Young, 2007). Despite this, the serotonin hypothesis has been influential in the provision of medication for depression with two forms of antidepressants targeting serotonin levels. Selective serotonin re-uptake inhibitors (SSRIs) create higher levels of serotonin by reducing re-uptake of existing serotonin. Serotonin–norepinephrine reuptake inhibitors (SNRIs) work in the same way and also work on an additional neurotransmitter in the brain, so as well as increasing serotonin, they also increase norepinephrine (a neurotransmitter and

26 Mind website, *Symptoms and Treatments of Depression* http://www.mind.org.uk/help/diagnoses_and_conditions/depression, last accessed 26.03.2012.

a stress hormone) levels. As already touched upon, the effectiveness of antidepressants has been questioned in a number of research papers, therefore the use of serotonin increasing medication in treating depression alone cannot provide a strong evidence base that low levels of serotonin are linked with depression.

The endorphin hypothesis proposes that physical activity causes endorphins to be released from the pituitary gland into the blood, and these can then produce feelings of euphoria and reduce pain. Greater scientific evidence exists to support this theory, however research has shown that relatively high levels of activity are needed to release endorphins and suggests a dose-response relationship. Boecker et al. (2010) explored 65 studies into physical activity and the release of endorphins that were conducted between 1982 and 2008. 59 of the 65 studies showed a significant increase in endorphins and that increases were greater with vigorous exercise. To complicate the evidence base slightly, whilst physical activity appears to be associated with releasing endorphins, this is not automatically associated with an increase in mood as many of the newly produced endorphins may not reach the brain. Based on this evidence the endorphin hypothesis does not explain how even low levels of activity can positively influence mood, although the serotonin hypothesis can.

In addition to physiological theories, it has also been proposed that physical activity can enhance mood through increasing self-esteem and providing a feeling of accomplishment. Rothon et al. (2010) summarises the ways in which the relationship between physical activity and depression can be explained through psychosocial factors. Firstly, the "distraction hypothesis" proposes that the benefits of physical activity come from taking the time out to undertake it rather than a biochemical or physiological mechanism involved in the process. On this basis, physical activity would have the same impact on improving mood as an equivalent period of relaxation, an argument for which there is some evidence. The "mastery hypothesis" posits that the sense of achievement associated with completing a task, in this instance a physical activity, leads to improvements in mood. Physical activity works well in this hypothesis because a sense of accomplishment can be felt when progress is made in mastering the skill of the game or overall fitness levels improve. Participation in physical activities with social elements, such as sports clubs or group exercise, has led to the proposition that improvements to mood are as a result of increased opportunities for social interaction.

59 OF THE 65 STUDIES SHOWED A SIGNIFICANT INCREASE IN ENDORPHINS AND THAT INCREASES WERE GREATER WITH VIGOROUS EXERCISE

Finally, it is suggested that physical activity can improve mood because of its relationship with self-esteem, through, for example, changes to body shape (this is further addressed in the section on self-esteem). It is clear that physical activity can enhance mood and relieve depression and there are several physiological and psychosocial theories to explain how this might happen, although more neuroscience research is necessary to clarify the exact process at play. If more is known about the mechanisms in the brain that are affected by physical activity then the most beneficial physical activity programmes can be prescribed with confidence for treating depression.

SELF-ESTEEM

As well as reducing overall quality of life, from a mental health perspective, low levels of self-esteem have been associated with an increased risk of eating disorders (Peck and Lightsey, 2008), depression (Ulrich et al., 2009) and social phobias (Acarturk et al., 2009), as these illnesses are particularly related to mood and self-belief. Additionally, low self-esteem has also been linked with a propensity to have unhealthy eating patterns, which can lead to overweight and obesity (Martyn-Nemeth et al., 2008) – the fifth leading risk factor for global mortality (World Health Organisation, 2003). What is more, people with mental health problems may experience low self-esteem as a result of feeling stigmatised from their illness. Increasing self-esteem can therefore be beneficial in the prevention and management of mental illnesses.

The most widely evidenced theory for the relationship between physical activity and self-esteem is that physical activity can indirectly increase general, or global, self-esteem[27] through the increase in physical self-esteem that is related to changes in body appearance and competence. Based on seminal work from Marsh and Shavelson (1985) that suggested that self-esteem is multi-dimensional and hierarchical, Sonstroem and Morgan (1989) developed an exercise and self-esteem model that was revisited by Sonstroem, Harlow and Josephs in 1994. These models have been widely researched and validated. The consensus is that physical activity brings about changes in fitness, weight and other physical parameters, and that these changes indirectly influence global self-esteem; research supports these findings. Gothe et al. (2011) conducted a one year randomised controlled trial with 145 older

27 Self-esteem refers to an individual's appraisal of his or her own worth. It can operate at a global or domain level, which encompasses the overall sense of worth we have about ourselves, or at sub-domain or domain specific levels, which relate to only one aspect of our life. It is possible to have high self-esteem in one sub domain and low self-esteem in another.

participants (mean age 66.4) to examine changes in self-esteem brought about by walking and exercises which improved flexibility, toning and balance. Both exercise groups met three times a week for around 50 minutes and were supervised. Changes in physical fitness were measured through VO2max scores and body mass index scores from measuring height and weight. Self-esteem was measured using Rosenberg's (1965) Self-esteem Scale, a series of ten questions established as a global index of self-esteem. The sub-domain of physical self-esteem was measured using part of Fox and Corbin's (1989) 30 Likert scale questions for their Physical Self-Perception Profile. The research found that for both groups, physical self-worth was dependent on perceived attractiveness, physical strength and condition. The exercise group had greater improvements in their perceptions of strength and attractiveness compared to the walking group, with the increase over time in perceptions of strength threefold for the exercise group and attractiveness double when compared to the walking group.

The findings from Gothe et al. (2011) build on the work of McAuley et al. (2000), who explored multi-dimensional self-esteem amongst 174 older adults with a six month exercise intervention of either walking or a stretching/toning programme and a six month follow up. The study found that perceptions of body attractiveness and physical condition were related to changes in physical self-worth, which were increased in relation to frequency of activity, changes in physical fitness, body fat and physical self-efficacy. However, increases in self-esteem declined in the six month follow up period during which participants were no longer exercising. Opdenacker, Delecluse and Boen (2009) also found evidence for the exercise and self-esteem model and examined the longitudinal fit of this model. 186 older adults (aged over 60) were divided into three groups for 11 months: a home-based lifestyle and physical activity intervention, a structured exercise intervention and a control group. The home-based intervention encouraged participants to integrate physical activity into their daily routines through, for example, active travel. Individualised physical activity programmes were designed and included endurance, strength, flexibility and balance exercises. Support was given to these participants through a total of 16 encouraging phone calls over the research period. The frequency of phone calls tailed off as time progressed with the aim of increasing autonomy for the participants and making them self-supportive. The participants in the structured exercise intervention group exercised in groups of ten, supervised by two instructors, three times a week for 60-90 minutes. Again, programmes were individualised and included endurance, strength, flexibility and balance exercises. As with Gothe et al.'s (2011) study, self-esteem was measured using Rosenberg's (1965) Self-esteem Scale and physical self-esteem was measured using Fox and Corbin's (1989) Physical Self-Perception Profile.

Immediately after the 11 month interventions there were significant improvements for the home-based lifestyle and physical activity group in self-perceived physical condition, sport competence, body attractiveness and physical self-worth. The estimated lifestyle and physical activity group mean scores for self-perceived physical condition were 2.18 before the intervention, compared to 2.43 afterwards, whilst in the control group it was 2.32 both before and afterwards. For sport competence the group mean in the lifestyle and physical activity group changed from 1.98 to 2.10 and amongst the control group it fell from 2.04 to 1.96. Body attractiveness increased for the lifestyle and physical activity group from an estimated mean of 2.27 to 2.52, whilst in the control group it changed slightly from 2.49 to 2.54. Physical self-worth amongst the lifestyle and activity group went from a mean of 2.24 to 2.56 and in the control group changed from 2.43 to 2.52. Those who undertook the structured exercise programme outside of the home had significant improvements in their physical condition (estimated group mean increased from 2.25 to 2.63) and sport competence (estimated group mean increased from 2.03 to 2.20). Global self-esteem changed significantly in the lifestyle activity group from an estimated group mean of 5.23 at enrolment to 5.52 immediately after the 11 month intervention. Overall for the improvements that were significant the effect sizes were classed as medium, ranging between 0.40 and 0.66. Follow up a year later revealed that the findings for the lifestyle programme remained significant for body attractiveness and global self-esteem, whilst participants from the structured group still had significant improvements in their physical condition, sport competence and body attractiveness.

Moore et al. (2011) found that a 12 week resistance exercise programme with 120 college age adults in America also supported the exercise self-esteem model, with significant improvements in self-perception found in the sample, although this research did not involve a control group for comparative purposes. A meta-analysis of 113 studies (71 of which were unpublished) focusing on exercise and global self-esteem in adults concluded an overall effect size of 0.23 for physical activity and self-esteem with the largest effects seen when physical fitness was improved (Spence, McGannon and Poon, 2005). This effect size is generally regarded as small and is lower than that evidenced in older adults by Opdenacker, Delecluse and Boen (2009).

Looking at the impact not on adults but on adolescents, Stein et al. (2007) found that physical activity was positively associated with changes in social and athletic self-perception regardless of gender, but that this was not the case for scholastic self-perception or global self-perception. In a sample of 8,670 girls and boys taken from the Growing up Today Study cohort, changes in physical activity between 1997 and 1999 were compared to changes in perception for confidence in the social, athletic and scholastic domains and for global self-worth over the same time period. In comparison to those who didn't change their activity levels, girls who increased their physical activity by a minimum of five hours a week were at least 44% more likely to have increased athletic self-perception and 33% more likely to have increased social self-perception. For boys, an increase of ten hours a week or more correlated with a 45% increased likelihood of increased social perception, whilst boys and girls who decreased their physical activity had higher chances of decreased self-perception scores. This does not explore the link between increases in physical self-perception leading to increases in global self-esteem, but does suggest that the biggest changes

PHYSICAL ACTIVITY WAS POSITIVELY ASSOCIATED WITH CHANGES IN SOCIAL AND ATHLETIC SELF-PERCEPTION REGARDLESS OF GENDER

in self-esteem will come from those who are the most unfit to begin with, and also those who are most likely to be overweight, for whom there will be more significant changes in appearance.

The hypothesis that physical activity will have the most impact on those who have the lowest self-esteem and/or the most to gain physically was explored by Fox (2000, 2001). From reviewing 37 randomised controlled studies, Fox (2000) found that 78% of them showed exercise participation to be associated with positive changes in self-esteem and that changes were more likely for those with low self-esteem scores at the beginning of the research. A randomised controlled study of a ten week primary care exercise referral intervention with 142 adults aged between 40 and 70 found that whilst physical activity interventions resulted in significant improvements in physical self-esteem for middle-aged and older people, the changes were associated with reductions in body fat as opposed to increased fitness (Taylor and Fox, 2005), therefore supporting the exercise self-esteem model. From this perspective it may also be possible that physical activity could be counterproductive in raising self-esteem if personal targets in physical appearance aren't met. This specific aspect has not been the focus of much research, but the existing evidence does not show it to be the case as studies suggest that regardless of personal targets relating to appearance there is a positive relationship between physical activity and self-esteem. This means that it is possible that there are other elements at play in this relationship. Fox (2000) proposes that there is a psychological element unrelated to changes in physical appearance or even fitness which could, for example, be related to a sense of achievement in mastering an activity. Whilst Opdenacker, Delecluse and Boen's (2009) research supports the exercise self-esteem model, it also suggests that autonomy over the activity may have a part to play in increasing self-esteem. The authors note that only the improvements in active travel were associated with improvements in the physical self and global self-esteem. They propose that this may be because changes in active travel are clearly visible on a daily basis and require stronger motivation by replacing an effortless behaviour with one that is physically active. Alternatively, they hypothesise that the majority of psychological outcomes evidenced may not have been related to changes in physical activity and fitness. There is clearly a need for greater research to understand the relationship between physical activity and self-esteem; other theories propose that increases in self-esteem may come from greater personal autonomy, a sense of belonging or the social status of an activity, but evidence for these is less conclusive.

Using data from 127 male and female elementary school, high school and university students in Canada, Frost and McKelvie (2005) explored the relationship between levels of exercise, global self-esteem, body satisfaction and body build by gender and age. All students completed a physical activity questionnaire and were categorised as either high exercisers or low exercisers. High exercisers were defined by physical activity on five to seven days a week amounting to at least four hours a week for at least the previous two years. Low exercisers were defined by physical activity on one day a week for less than four hours for the last six months. However, the criteria for low exercisers wasn't met by many participants so additional participants were selected based on the lowest overall activity scores from the physical activity questionnaire. It should be noted that the activity questionnaires accounted for both organised sports and recreational physical activities. As found in other research, those classed as low exercisers reported lower self-esteem than the high exercisers, with mean self-esteem scores of 18.7 and 20.8 respectively.

In addition, there were no significant differences by gender or age at a global self-esteem level, demonstrating that the positive relationship between physical activity and self-esteem may be generalisable.

This notion is supported by research from Scarpa (2011) that compared physical self-concept and global self-esteem in adolescents and young adults with and without physical disability. 1,149 male and female participants aged between 13 and 28 were divided into four groups: those without a disability who practised sport, those without a disability who didn't practise sport, those who were physically disabled and practised sport and those who were physically disabled but didn't practise sport. The threshold for practising sport was between 60 and 90 minutes on two or three occasions a week on average. Scarpa highlights that young people with disabilities can have more negative self-concepts, poor body image, fewer friends and experience more loneliness, but that research has shown that regular physical activity can lead to higher levels of physical self-esteem than in sedentary individuals without a disability. Overall, the research supports a positive effect from physical activity on the physical self-concept of those with physical disabilities. It has been shown to improve physical condition such as strength and endurance, to enhance psychological wellbeing and to create meaningful social interaction (Martin, 2006, Martin and Smith, 2002, Blinde and McClung, 1997 and Campbell, 1995, all cited in Scarpa, 2011).

The findings from Scarpa's study support those from earlier research. The highest scores for elements of physical self-description came from the two sports practising groups, but there was little difference between these two groups on ten of the 11 scales. The mean scores for endurance in those without a disability who practised sport was 4.1; for the physically disabled sports practising group the score was 4.2. For flexibility the scores were 3.8 and 3.9 respectively amongst these two groups and appearance scores were 4.1 and 4.2 respectively, whilst global physical self-perception was 4.6 in those without a disability practising sport and 4.4 amongst the physically disabled sports practising group. Global self-esteem scores were 4.7 and 4.9 respectively. Veselska et al. (2011) asked 3,694 Slovakian male and female schoolchildren with a mean age of 14.3 years about their frequency of physical activity, socioeconomic status as measured by parents' educational level and self-esteem as measured by Rosenberg's self-esteem scale.

RESEARCH HAS SHOWN THAT REGULAR PHYSICAL ACTIVITY CAN LEAD TO HIGHER LEVELS OF PHYSICAL SELF-ESTEEM THAN IN SEDENTARY INDIVIDUALS WITHOUT A DISABILITY

THERE MAY ALSO BE A SOCIAL ELEMENT TO PHYSICAL ACTIVITY THAT BRINGS ABOUT POSITIVE CHANGES IN SELF-ESTEEM

The researchers found that higher socioeconomic status was associated with physical activity on 5 or more days a week and higher reported self-esteem. Furthermore, regression suggested that part of this association occurs as a result of self-esteem. These findings tell us nothing conclusive about the relationships between physical activity and self-esteem but suggest that there is some positive association worthy of further research.

Slutzky and Simpkins (2008) utilised data from four waves of the Childhood and Beyond Study to examine three cohorts of elementary school aged children in America, their parents and their teachers. The total sample size was 987. The research found that in young children team sports rather than individual sports led to children reporting higher sport self-concept, which was associated with higher self-esteem. No variance was evident by gender, sporting ability, beliefs about the importance of sport or peer acceptance. This would suggest that there may also be a social element to physical activity that brings about positive changes in self-esteem. However, Birkeland et al. (2011) found that physical activity levels at age 13 was one of three significant predictors for self-esteem at age 30; body image was another, which may be related to physical activity, but a social element was less prominent.

In approaching the research from a different angle in order to explore causality, Trainor et al. (2010) found that for adolescents, leisure time activities are related to psychological wellbeing. From a sample of 947 Australian students with a mean age of 15.2 years, Trainor et al. saw that adolescents with low self-esteem and low life satisfaction tended to participate in unstructured and unchallenging activities in their spare time, whilst those with higher self-esteem participated in more structured activities, which would include sport and exercise. These results suggest that unproductive and undirected use of leisure time is negatively related to self-esteem, rather than physical activity boosting self-esteem. Whilst not adding much clarity to the relationship, this study also loosely supports the hypothesis that levels of self-esteem could be an influencing factor on uptake and continuation of physical activity.

There are also interesting implications for self-esteem as an influencing factor for young people to begin and continue with physical activity, particularly amongst girls. A longitudinal study utilising data from 641 children (aged 11-15 years) in the Physical Activity in Scottish Schoolchildren study found that for older boys the odds of being physically active were 3.8 times greater for those who had high perceived confidence compared to those with low perceived confidence. In girls, high levels of exercise self-efficacy were associated with 5.2 times greater odds of being physically active (Inchley, Kirby and Currie, 2011). Understanding more about self-esteem as a motivating factor for participation in physical activity could help national governing bodies of sport to increase participation levels.

ANXIETY AND GENERAL WELLBEING

Anxiety historically plays a key part in human survival through its influence on our "fight or flight" reaction to situations perceived to be physically dangerous. In modern life, this unpleasant feeling may also be aroused in situations that are stressful but that do not necessarily consist of a physical threat. Whilst everyone experiences anxiety at one point or another, for some people anxiety can become excessive and uncontrollable; some may experience anxiety in very specific situations frequently referred to as a phobia, and ultimately high levels of anxiety can lead to panic attacks. Remaining anxious over the long term has been shown to have negative effects on physical health and quality of life. In addition, cardiovascular disease has been associated with anxiety problems (Goodwin et al., 2009, cited in The King's Fund and Centre for Mental Health, 2012) and panic disorder is up to ten times more common amongst people with chronic obstructive pulmonary disease compared to the general population (Livermore et al., 2010, cited in The King's Fund and Centre for Mental Health, 2012).

From the Health and Social Care Information Centre's household survey of adult psychiatric morbidity in 2007 (2009), data suggests that at the time of surveying, general anxiety disorder was prevalent in 4.4% of the adult population (aged 16 and over), whilst mixed anxiety and depressive disorder is more common and was evidenced in 9% of the adult population. The King's Fund (2008) make a similar estimate, suggesting prevalence is between 17 and 95 per 1,000 people depending on age.

They also estimate that in 2007 there were 2.28 million people with anxiety disorders and that this will rise to 2.56 million in 2026. The King's Fund propose that the total cost of the 49% of people with anxiety disorders who are engaged in services was approximately £1.2 billion in England in 2007, and when lost employment is included in this calculation it rises to £8.9 billion. The predicted costs for 2026 are £2 billion and £14.2 billion respectively. Often anxiety is combined with depression, so the positive role of physical activity for improving depression may benefit people suffering from anxiety too, whilst relieving symptoms of anxiety may improve quality of life for those with depression.

A systematic review of 40 studies exploring physical activity, chronic illness and anxiety was conducted by Herring et al. (2010). The studies generated 75 measurable effects from a total sample of 2,914 patients with a mean age of 50, who undertook physical activity an average of three times a week for 42 minutes as part of the intervention, which lasted for an average of 16 weeks. Analysis showed that exercising significantly reduced anxiety scores in patients with a chronic illness, with a mean effect size of 0.29 compared to no treatment. Programmes between three and 12 weeks in duration were seen to be most effective (mean effect size 0.39 compared to 0.23 for programmes that lasted more than 12 weeks), potentially because of adherence issues with longer programmes, whilst sessions lasting longer than 30 minutes had a larger impact than sessions that lasted between ten and 30 minutes (mean effect size of 0.36 and 0.22 respectively). Interestingly, whilst not widely researched, there has been some evidence that physical activity can also reduce signs of anxiety and depressive symptoms in children with attention deficit hyperactivity disorder (ADHD). Using parent reports of mood and behaviour, Kiluk, Weden and Culotta (2009) compared 65 children between the ages of 6 and 14 who were diagnosed with ADHD with 32 children diagnosed with learning disorders. Only evident amongst the children with ADHD was a reduction in symptoms of depression and anxiety amongst children who participated in three or more sporting activities compared to those who participated in fewer than three.

Utilising the Scottish Health Survey, Hamer, Stamatakis and Steptoe (2008) explored the dose-response relationship between physical activity and mental health benefits. 19,842 Scottish men and women self-reported on physical activity and completed a General Health Questionnaire; 3,200 participants were identified as having psychological distress.

After adjusting for confounding variables, daily physical activity in any guise was associated with a lower risk of psychological distress and a dose-response relationship was apparent with a minimal threshold of 20 minutes a week. Whist domestic activities and walking were associated with lower odds of psychological distress (between 13% and 20% risk reduction), sporting activities had the strongest impact with a 33% risk reduction.

DAILY PHYSICAL ACTIVITY IN ANY GUISE WAS ASSOCIATED WITH A LOWER RISK OF PSYCHOLOGICAL DISTRESS

Looking at the general population rather than diagnosed sub sections, Pressman et al. (2009) explored the impact of enjoyable leisure time activities on psychological and physical wellbeing. The researchers propose that voluntary activity undertaken during free time can help to serve as a break or diversion from stressors in life or may have a restorative effect when individuals have been under stress as a result of increasing social and physical resources. A total of 1,399 participants aged between 19 and 89 years sourced from four studies were assessed for participation in ten leisure activities and assessed for positive and negative psychosocial states. Included in the activities assessed were sports and hobbies. Other activities included spending quiet time alone, doing fun things with others, communing with nature and going on holiday. All participants completed the Pittsburgh Enjoyable Activities Test by stating on a four point scale, ranging from 'never' represented by 0 to 'every day' represented by four, how many times over the previous month they were able to spend undertaking the ten specified activities (there was also a not applicable/do not enjoy option). A total score of 40 could therefore be achieved from the Pittsburgh Enjoyable Activities Test. Higher scores on the Pittsburgh Enjoyable Activities Test were associated not only with greater physical activity, but also greater life engagement and satisfaction and lower levels of depression and negative psychosocial states. Further analysis showed an association with high levels of leisure time activity, better physical functioning and better sleep. Whilst this study did not consider leisure activities in isolation and doesn't consider the role of sport as an enjoyable leisure activity alone, it demonstrates a link between enjoyable leisure time activities, of which physical activity is one, and enhanced physical and psychological wellbeing overall.

The effect of leisure time physical activity more specifically on wellbeing was focused on by Stubbe et al. (2006) using data from the Netherlands Twin Registry. Just over 8,000 participants aged between 18 and 65 answered questionnaires on leisure time physical activity, life satisfaction and happiness.

Answers relating to leisure time physical activity participation were categorised into METs[28] and those classed as exercisers participated in at least one activity at a minimum intensity of 4 METs at least once a month. Exercise had a significant effect on life satisfaction and happiness, with mean scores for life satisfaction an average of 0.77 higher amongst exercisers than non-exercisers and mean scores for happiness an average of 0.53 higher. The work of Pressman et al. (2009) and Stubbe et al. (2006) helps to generate an understanding of causality in the relationship between physical activity and improved wellbeing. Although a relationship is evident between the two, distinguishing whether participating in physical activity increases wellbeing, or whether high levels of wellbeing result in more motivation and participation in physical activity, is another question. Stubbe et al. propose from analysis of different sub groups of twin types and non-related participants that there may also be a genetic factor involved in an association between wellbeing and likelihood to exercise. Much more research is needed into this but if a genetic element is present there could be serious implications for public health policy.

GREEN EXERCISE AND IMPROVEMENTS TO GENERAL WELLBEING

Green exercise activities are those that take place in the presence of nature. The Faculty of Public Health (2010) champions the ability of green spaces to reduce health inequalities. From a sample of 336,348 UK patients, those who live in areas with high levels of green space demonstrated significantly fewer health inequalities between rich and poor groups in comparison to those living in areas with less green space. The mental health charity Mind produced a report in 2007 based on data from two studies at the University of Essex to demonstrate that participating in green exercise activities provides substantial benefits for health and wellbeing, but it isn't clear what role physical activity plays in this process and what role exposure to nature plays. Being present in green space is automatically associated with an increase in physical activity, and the Mind report found that 90% of 108 people who took part in green exercise activities said that the combination of nature and exercise was the most important factor in determining how they felt. 94% reported that green exercise benefited their mental health and 90% said it benefited their physical health.

More recently, researchers at the University of Essex have conducted a meta-analysis on ten studies and a total of 1,252 participants in order to determine the optimum amount of nature and green exercise for improved mental health.

GREEN EXERCISE ACTIVITIES ARE THOSE THAT TAKE PLACE IN THE PRESENCE OF NATURE

28 MET is the estimate of a person's resting metabolic rate. It is how much energy he or she expends when sitting quietly. 1 MET can be defined as 1 kcal per kilogram per hour, or 3.5ml of oxygen per kilogram per minute.

Using mood and self-esteem as measures of mental health, Barton and Pretty (2010) found that benefits to mental health could be seen after five minutes of participating in green exercise, being close to water increased the benefits, although the statistical significance of this finding was questionable, and improvements to self-esteem were greatest amongst those who self-reported as suffering from mental health problems. Despite drawing these conclusions from analysis of ten studies, the sample size is relatively small, all originated from the University of Essex and all were self-reported, making the validity of this research questionable. If exercising outdoors and close to water are beneficial for mental health then sports such as canoeing, yachting, sailing, windsurfing and so on may offer greater benefits to someone with low mood, but no studies currently address this specifically. Further research is needed into the role of water-based outdoor exercise on general wellbeing and mood. The European Centre for Environment and Human Health is a research focused organisation seeking to document the health benefits of recreational and occupational use of the environment. Of particular relevance is their Blue Gym research on the value of natural water environments (blue space) for health and wellbeing. Acknowledging that there is little evidence for the benefits of blue space at present, the Blue Gym aims to conduct research that will demonstrate the benefits of natural water environments. Their early research is indicative that there is a restorative element to blue space, whilst a project currently being undertaken focuses on the psychological and physiological effects of indoor cycling when viewing images and sounds for a coastal environment, countryside environment, town and a blank wall to act as the control. The Blue Gym are also utilising secondary data to map environmental, socioeconomic and health data and understand more about the relationships between environmental conditions and health outcomes. The findings of the work being conducted by the Blue Gym should help to give further direction to research in this area.

One potential explanation behind the increases in mood seen when exercising outdoors is that like physical activity (see the subsection on depression within this chapter), it is hypothesised that exposure to bright light increases the production of serotonin, as is supported by the use of light boxes in treating seasonal affective disorder (Young, 2007). Physical activities that take place outside may therefore lead to double the chance of an increase in the production of serotonin, which can positively influence mood. Another possible explanation is that the natural environment helps to repair the mental fatigue caused by the demands of contemporary living in our largely built up and artificial societies.

This healing power of nature has been summarised by Ulrich (2002), who concludes from existing research evidence that hospital patients heal quicker when they are able to see gardens and plants, and that patients and the general population recover from stress quicker when their view is dominated by a natural environment including greenery, flowers or water when compared to built environments lacking nature.

Often considering the health benefits of the outdoor environment includes a specific focus on the benefits of walking; outdoor activities almost invariably involve an element of walking or are centred around walking. Alongside well documented physical health benefits to walking (see the chapter on physical health) there is also evidence that regular walking can reduce anxiety, improve mood and self-image and aid sleep (Mind, 2008, Department of Health 2004 and Walking the Way to Health, 2009, all cited in the Ramblers, 2010). In addition, it is easy to incorporate a social element to walking, which can help to tackle feelings of isolation often experienced as part of poor mental health (Dawson et al., 2006, cited in the Ramblers, 2010).

An on-going scheme run by the Ramblers in partnership with Travel Actively has ***Get Walking Keep Walking*** projects to engage inactive people in urban areas with the aim of improving mental and physical health through regular walking and increased independence. Each project is structured over 12 weeks with a local information and motivation plan including led walks and other activities. There is also a national online version for people to follow the plan independently. In 2010, Get Walking Keep Walking reached over 56,000 people with the help of 249 volunteers. Follow up research with 1,720 of those who registered to a project found that nine out of ten participants (88%) noted improvements to their mental wellbeing and half (51%) saw improvements in their social wellbeing. The mental health benefits of the project were calculated to be £4 million (The Ramblers, 2011).

Coon et al. (2011) conducted a systematic review to compare participation in indoor physical activity with that of outdoor physical activity to assess which has the greater effect on physical and mental wellbeing. Eleven trials involving walking or running inside and outside, with a total of 833 participants, were selected and evaluated through 13 mental health outcome measures and four attitude to exercise outcome measures. Nine trials showed mental wellbeing improvements on at least one of the outcome measures. Compared to exercising indoors, when participants exercised outdoors they were more likely to self-report feelings of revitalisation, a decrease in tension, confusion, anger and depression, and an increase in energy. These findings alone are not conclusive, largely because the studies considered were not particularly robust in their methodology, however the findings do accord with self-report data from Natural England who found that 97% of visitors to the natural environment enjoyed their experience, 86% felt calm and relaxed as a result and almost the same amount (85%) report feeling refreshed and revitalised afterwards. And indeed, the second most cited reason for visiting the natural environment is for health or exercise (38%), whilst the third reason is to relax and unwind (26%) (Natural England, 2011).

The findings of Bowler et al.'s (2010) systematic review prior to that of Coon et al. (2011) also support the hypothesis that there is a positive association between the natural environment and wellbeing. Again focusing on studies that involved walking or running outside and inside, Bowler et al. conducted a meta-analysis on 25 studies, ranging from between three and 943 participants, most of which also used a self-report methodology.

More research needs to be conducted on outdoor exercise and mental health. It should be large scale, include control groups and consider long term effects including adherence to physical activity participation. In the meantime, existing studies support the notion that there are benefits to green exercise and therefore active travel and outdoor recreational activities should be well suited to treating anxiety and increasing general mental wellbeing amongst both the general population and those diagnosed with a mental illness.

DEMENTIA

Dementia refers to a set of symptoms that occur when the brain is damaged by diseases such as Alzheimer's disease or damaged by, for example, a series of small strokes. The symptoms include memory loss, changes in mood and difficulties with communicating and reasoning and will gradually get worse due to the progressive nature of dementia. As of 2012 there are 800,000 people in the UK with dementia, thought to cost society £23 billion a year. Around 97% of people with dementia are aged 65 or over and two thirds of people with dementia live in the community. It is thought that there are 670,000 people acting as primary carers for people with dementia but even so, one third of all people with dementia are living alone in their homes in the UK (Alzheimer's Society, 2012). Given that by 2035 it is thought that 23% of the UK population will be aged 65 or older (Office of National Statistics, 2012), dementia is an increasing issue on the political agenda. In fact, the Alzheimer's Society (2012) estimate that by 2020 there will be over 1 million people in the UK living with dementia. There is currently no known treatment for dementia, and prevention is therefore crucial moving forwards. It may be for these reasons that the World Health Organisation, alongside Alzheimer's Disease International, have made dementia a public health priority, or this may be because dementia is a major cause of disability in later life, accounting for 11.9% of the years lived with a disability as a result of a non-communicable disease, and dementia is the leading cause for dependency among older people in high income countries (World Health Organisation, 2012).

Physical inactivity has been identified as a risk factor for dementia; it is estimated that tackling physical inactivity could prevent 12.7% of Alzheimer's disease cases globally (World Health Organisation, 2012). From reviewing meta-analysis of randomised controlled trials, the World Health Organisation (2012) concludes that evidence for the protective role of physical activity against dementia is inconclusive but positive, with aerobic exercise being seen to bring about

cognitive benefits such as increased hippocampal[29] volumes, improved neural network connectivity and reduced age-related grey matter volume loss. Indeed, a meta-analysis of 30 trials with a total of 2,020 participants aged 65 and over found that physical activity increased fitness, physical and cognitive function, and positive behaviour in those with cognitive impairments and dementia, with an overall mean effect size of 0.62 between exercise and non-exercise groups (Heyn, Abreu and Ottenbacher, 2004). This effect size can be considered as large.

The most recent research on physical activity and Alzheimer's disease found that elderly people with low levels of physical activity had more than twice the risk of Alzheimer's disease when compared to their physically active counterparts. Buchman et al. (2012) measured leisure and domestic physical activity in 716 elderly adults (average age 82) without dementia over four years. Unlike the majority of studies that measure physical activity through self-reporting, the accuracy of which can be questionable, Buchman et al. measured physical activity objectively. The researchers used an actigraph monitoring device, which consisted of a motion sensitive band worn on the dominant wrist for up to ten days and a small computer to record activity. Participants had their cognitive abilities measured through 19 tests on an annual basis. During the research period, 71 participants developed Alzheimer's disease. Analysis showed that higher daily physical activity was associated with risk reduction for Alzheimer's disease, with a hazard ratio of 0.48 after adjusting for confounding variables. Exercise was seen to be the most beneficial form of physical activity, but any domestic physical activity such as washing dishes, cooking, or playing cards was beneficial. This research shows that physical activity at any age can help to stave off Alzheimer's disease and that the benefits of a more active lifestyle can be seen even if formal exercise programmes are not in place.

Etgen et al. (2010) conducted a community-based prospective cohort study with 3,903 men and women over the age of 55 years in Germany. Based on responses to a questionnaire, participants were allocated to either a no regular physical activity group, a moderate physical activity group (less than three times a week) or a high physical activity group (3 times a week or more). This research was concerned only with leisure time physical activity. Cognitive function was measured through a test known as 6CIT, which involves six questions that test memory and logic. A score higher than seven is associated with cognitive impairment whilst those between zero and seven are considered normal. At enrolment 418 participants had cognitive impairment.

29 The hippocampus is found in the human brain and is used in spatial navigation and the processing of information from short term memory to long term memory.

Prevalence rates were three times higher amongst those in the no activity group (21.4%) than for those in the high activity group (7.3%) and twice as high as those in the moderate activity group (10.5%). It should be noted that these figures cannot demonstrate causality: these findings could be because people with dementia may be less likely to exercise. At two years follow up, excluding those with a cognitive impairment at enrolment, there were 207 further developments of cognitive impairment. Cognitive impairment was twice as likely in the no activity group (13.9%) than in the moderate activity group (6.7%) and two and a half times as likely when compared to the high activity group (5.1%). Adjusting for confounding variables did in fact show a significant association between moderate or high activity levels and a reduced risk of cognitive impairment when compared to physically inactive counterparts.

Further evidence for regular physical activity and a risk reduction of dementia was found by Larson et al.'s (2006) prospective cohort study. From the Adult Changes in Thought study, 1,740 participants older than 65 and without cognitive impairment at enrolment were followed up at an average of 6.2 years. Physical activity was assessed through a questionnaire asking the number of days per week activities were undertaken for at least 15 minutes over the last year. The activity categories were: walking, hiking, cycling, aerobics/calisthenics, swimming, water aerobics, weight training/stretching and other exercise. Exercising three times a week was classed as regular exercise. Out of the 1,740 participants, 158 developed dementia, of which 107 were diagnosed with Alzheimer's disease, a further 276 patients died and 121 withdrew from the research. Analysis adjusted for age and other confounding variables and found an incidence rate of dementia of 13.0 per 1000 person years amongst regular exercisers (15 minutes or more three times a week), compared with 19.7 per 1000 person years for those who exercised less than three times a week. After adjusting for age and gender, regular exercisers had a dementia hazard ratio of 0.68. Focusing specifically on Alzheimer's disease the hazard ratio was 0.69 amongst those who exercised regularly. This 32% reduction in the risk of dementia is similar to that found by Heyn, Abreu and Ottenbacher's (2004) meta-analysis. Larson et al. found no evidence for a dose-response relationship, however their measurement of physical activity was not detailed enough for this, having analysed participants merely as regular exercisers or not and with no measurement on intensity or duration of exercising past the threshold of 15 minutes.

The researchers hypothesise that their findings can be explained through other studies that have shown physical activity to improve higher-order cognitive functions, such as memory, that are typically affected in the early stages of dementia. In addition, greater physical fitness has been associated with greater hippocampal volume (Pereira et al., 2007), and Alzheimer's disease affects the hippocampus early on.

THE EVIDENCE SHOWS THAT REGULAR EXERCISE CAN REDUCE THE RISK OF DEMENTIA BY UP TO A THIRD

The largest known genetic risk factor for late onset sporadic Alzheimer's disease is the presence of the gene ApoE E4. Rovio et al. (2005) considered the presence of this gene in their investigation of midlife leisure time physical activity and the later development of dementia and Alzheimer's disease. Midlife data came from four earlier population-based studies in Finland. Participants were randomly selected from these studies to take part with 1,449 people agreeing to take part ranging in age from 65 to 79 (mean age 71.6) at follow up and 39 to 64 (mean age 50.6) at midlife. Follow up occurred after an average of 21 years. Active participants were those who at midlife undertook a leisure time physical activity lasting between 20 and 30 minutes at an intensity which causes breathlessness and sweating two or more times a week. 515 participants were categorised as active whilst 736 were categorised as sedentary. Prevalence of dementia was almost twice as high in the sedentary group (5.2% compared to 2.9% of the active participants), as was prevalence of Alzheimer's disease (4.3% of the sedentary group compared to 2.0% of the active group). After adjusting for variables including the ApoE E4 gene, the odds ratio for dementia in the active group (compared to the sedentary group) was 0.47, and for Alzheimer's disease was 0.35. Further analysis showed a stronger association between physical activity and subsequent risk of dementia and Alzheimer's disease in carriers of the ApoE E4 gene: the odds ratio for dementia in physically active carriers was 0.38 in comparison to sedentary carriers of the gene, and for Alzheimer's disease it was 0.18, demonstrating more pronounced effects. Rovio et al. suggest that this may be because individuals with the ApoE E4 gene are more dependent on lifestyle-related factors to protect them against dementia as they have less effective mechanisms for protecting and repairing neurons. This suggests that even where there is a genetic predisposition to Alzheimer's disease, physical activity can be effective in reducing the risk.

The evidence shows that regular exercise can reduce the risk of dementia by up to a third, yet relatively little research has been conducted into exactly how physical activity helps stave off dementia. Steiner et al. (2011) conducted research using mice to explore how mitochondria[30] are produced in muscles and the brain during exercise. Steiner et al. found that regular exercise in mice increased the production of mitochondria in the brain as well as in muscles, and they conclude that this has important implications for diseases that are characterised by mitochondrial dysfunction such as dementia and other central nervous system diseases. Their research examined the brain and muscle tissues of mice that ran on a treadmill for an hour a day, six days a week at a set pace and incline during an eight week research period, against a control group of mice who experienced sedentary conditions over this time. Steiner et al. found that in most brain regions and in muscles, exercising increased levels of the protein that regulates the genes involved in energy metabolism, increased the presence of the gene that controls calorie restriction, and showed higher levels of cirate synthase (a marker of mitochondria) and mitochondrial DNA itself. Following the eight week exercise programme mice from both groups also ran on treadmills until fatigued. Mean times for this increased from 74 minutes to 126.5 minutes in the mice who had participated in exercise, demonstrating the impact of these biological changes.

In trying to gain further insights into the relationship between physical activity, cognition and the human brain in older adults, Kramer, Erickson and Colcombe (2006) comprehensively reviewed the existing evidence from relevant human epidemiological studies, randomised controlled trials and animal research. Highlighting a number of epidemiological studies that suggest that physical activity can have a protective effect on the brain, which can help to prevent dementia in older age, Kramer, Erickson and Colcombe reiterate that causality cannot be established in studies using this methodology. Drawing on two meta-analyses of randomised controlled trials, the researchers propose that randomised controlled trials present tentative evidence for a causal relationship between increased fitness and improved cognition, greater efficiency in brain function and spare brain volume in older adults. Again, it is concluded that more research is needed to understand the impact of different types, intensity and duration of activity. A 2003 meta-analysis by Colcombe and Kramer examined 18 randomised controlled studies of nondemented older adults that involved an aerobic fitness training group and a control. A moderate effect size of 0.48 was seen for fitness training having a positive influence on cognition. In particular, the largest effects were seen for what are known as executive control processes; these include such tasks as planning, scheduling, working memory and multitasking, which are often seen to decline with age. Colcombe and Kramer observed that training programmes that combined aerobic activity with strength and flexibility training were the most effective, suggesting that the combination of activities could bring about more varied brain changes (cited in Kramer, Erickson and Colcombe, 2006). Animal studies offer a means of evaluating the effects of exercise with fewer confounding variables. Kramer, Erickson and Colcombe review a number of studies focusing on the effects of exercise in old and young rats or mice. The evidence is clear that in both young and old animals physical activity increases cognitive performance. Levels of mRNA[31] and protein levels of brain derived neurotrophic factor[32] are increased through exercising; these may contribute to the neurogenesis[33] seen in the dentate gyrus[34].

30 Mitochondria are tiny structures within cells that provide the body with energy.

31 mRNA stands for messenger ribonucleic acid. Ribonucleic acid is one of three main very large molecules essential for life. Messenger ribonucleic acid is a molecule of ribonucleic acid that carries a genetic code for a protein which it will be translated into when it reaches the cells that synthesise protein chains (a ribosome). mRNA is used by all cellular organisms to carry genetic information for synthesising proteins.

32 Brain derived neurotrophic factor is a secreted protein found in the brain. Alongside other proteins it induces the survival, development and function of neurons – the cells responsible for processing and transmitting information. Specifically, brain derived neurotrophic factor acts on neurons in the central and peripheral nervous system and is active in the areas that are key for learning, memory and higher thinking (the hippocampus, cortex and basal forebrain). It is particularly important for long term memory.

33 Neurogenesis is the process of generating new neurons in the brain.

34 The dentate gyrus is a brain structure consisting of three layers of neurons. It is found in the hippocampal formation – the area of the brain responsible for memory, spatial navigation and control of attention. Amongst the roles of the dentate gyrus is the formation of new memories. High rates of neurogenesis are possible in the dentate gyrus.

In addition, neurotransmitter systems[35] are positively affected by physical activity. All of these processes demonstrate that physical activity can cause changes in the brain that lead to enhanced neurochemical capacity for memory, learning and higher thinking.

The conclusions of Kramer, Erickson and Colcombe's (2006) meta-analysis are echoed by Rockwood and Middleton's (2007) paper on physical activity and its capacity to maintain cognitive functioning. They further believe that evidence of a dose-response relationship exists, suggesting that even a small shift from sedentary to active can be beneficial in preventing dementia, as also suggested by Buchman et al. (2012) and Paillard-Borg et al. (2009). Ploughman (2008) also confirms the role of physical activity for generating new neurons in the brain, enhancing memory and learning and protecting against injury to the nervous system. Focusing on youth with disability, Ploughman goes on to argue that this evidence also suggests an important role for physical activity amongst young people with brains that are highly susceptible to physiological changes in the nervous system and amongst young people with a physical disability. If physical activity can positively change the brain's capacity for learning then there are advantages not just for preventing dementia but also for influencing an individual's potential for educational attainment and possibly also for influencing the way that learning disability is dealt with.

PLOUGHMAN (2008) ALSO CONFIRMS THE ROLE OF PHYSICAL ACTIVITY FOR GENERATING NEW NEURONS IN THE BRAIN, ENHANCING MEMORY AND LEARNING AND PROTECTING AGAINST INJURY TO THE NERVOUS SYSTEM

Research largely identifies a protective effect on cognitive function from mental activity, which is related to larger mental reserves. Although a greater understanding is needed around the relationship of mental activity and mental reserves, the hypothesis that frequent cognitive activity can reduce the risk of dementia and Alzheimer's disease is now widely accepted (see Stern and Munn, 2011, for a meta-analysis of observational studies focusing on cognitive leisure activities and Valenzuela and Perminder, 2009, for a systematic review of randomised controlled trials testing cognitive exercise training), and furthermore, evidence also suggests that there are benefits at reducing the effects of mild cognitive impairment for those already diagnosed (see Gates et al., 2011, for a meta-analysis and discussion of cognitive and memory training with mild cognitive impairment). Wilson et al. (2007) followed a sample of 700 elderly people for five years. They found that cognitively inactive people in their sample were 2.6 times more likely to develop Alzheimer's disease than their cognitively active counterparts.

35 Neurotransmitter systems transmit signals from a neuron to a target cell through a synapse in the nervous system.

2,832 elderly participants (aged 65-94) participated in Ball et al.'s (2002) large randomised controlled trial assessing the effect of cognitive training interventions. Participants were allocated to either a memory training group, a reasoning training group, a speed or processing group or a control group and cognitive function was measured at enrolment, immediately after the training and at a two year follow up. Training involved ten 60-75 minute sessions in small groups spread over five to six weeks. For those who received training, 60% of each training group were randomly selected for four 75 minute booster training sessions at 11 months; these were spread over three weeks. The results showed the training to be effective for targeted improvements in cognitive ability but no differences were evident for everyday functioning, possibly because two years is too short a time period for any significant decline to occur. Immediately after the training sessions, cognitive improvement was seen in 87% of the speed training group, 74% of the reasoning group and 26% of the memory training group. Greater gains were seen for the speed and reasoning groups if participants had attended booster sessions, and these held at the two year follow up. 92% of the speed training group who had received booster sessions had improved cognitive ability compared to 68% of those who didn't attend additional sessions. For reasoning the proportions were 72% and 49% respectively. In another large scale randomised controlled trial of very similar design to Ball et al. (2002) and utilising the same database, Willis et al. (2006) also found cognitive training to have positive and lasting effects, this time up to five years after the intervention, which included limited evidence that daily function improved from cognitive training.

Given this evidence for the benefits of mental activity in relation to dementia, sporting and recreational activities that require greater levels of mental activity or the learning of a new skill can be further beneficial in reducing the risk and effects of dementia. For example, the problem solving and memory skills required during a game of chess cause activation on both sides of the brain in the areas associated with attention, short-term memory, planning and motivation (the frontal lobe), sensory information, knowledge of numbers and the manipulation of objects (the parietal lobe), and vision, spatial awareness and orientation (Atherton et al., 2002). It is thought that the mental agility associated with being able to plan six moves ahead in a game of chess should be sufficient to stave off premature mental decline[36].

36 Archana Singh Manoux cited in *The Independent*, 'Life ends at 45... Study reveals when our mental powers start to diminish' http://www.independent.co.uk/life-style/health-and-families/health-news/life-ends-at-45-study-reveals-when-our-mental-powers-start-to-diminish-6285644.html, last accessed 6 January, 2012.

Learning the choreography of dance routines can also enhance cognitive function in the elderly. Kimura and Hozumi (2012) conducted a randomised trial in Japan. 34 participants aged 65 to 75 years were assigned to either a free style aerobic dance workout group which consisted of patterns of movement, or to a combination aerobic dance workout group, where the patterns of movement were joined to form a choreographic routine. Both groups worked at a light intensity for 40 minutes and executive cognitive performance[37] was assessed immediately before and after exercising. The researchers found that dance involving choreography had a positive effect on cognition in the elderly. In a slightly larger study of 488 adults aged 75-85 years who were dementia free at enrolment, Verghese et al. (2003) observed the impact of leisure activities on dementia at an average follow up of 5.1 years. 124 participants developed dementia during this time and a further 361 died, whilst 88 had dropped out, leaving only 20 active participants. The research showed that frequent participation in dance resulted in considerably lower risk of dementia with a hazard ratio of 0.24 in comparison to those who danced rarely or not at all. Although existing studies into dance therapy and dementia have been conducted with very small base sizes, making it difficult to draw conclusive findings, what exists suggests that dance therapy can calm agitation, improve liveliness and agility in dementia patients and help their interaction skills through providing a means of self-expression.

SCHIZOPHRENIA

Schizophrenia is a psychotic disorder that affects feelings and thoughts and subsequently behaviour. It is associated with an inability to differentiate intense personal thoughts, ideas and perceptions from reality and is believed to affect one in every 100 people during a lifetime (Royal College of Psychiatrists, 2010). People with schizophrenia are twice as likely to be obese in comparison to the general population (Chwastiak et al., 2009); amongst schizophrenic patients there are therefore higher levels of cardiovascular mortality and other obesity-related physical health problems that decrease quality of life. It is thought that this is the result of a combination of unhealthy lifestyles and the psychotropic medication prescribed for schizophrenia, which can cause a propensity for weight gain through metabolic side effects (De Hert et al., 2009). Vancampfort et al. (2011) carried out a study to compare exercise capacity between schizophrenia patients and the general population. The sample consisted of 25 normal weight patients, 25

SCHIZOPHRENIA IS A PSYCHOTIC DISORDER THAT AFFECTS FEELINGS AND THOUGHTS AND SUBSEQUENTLY BEHAVIOUR

37 Executive cognitive function is the process relating to the organisation of thoughts and activities, prioritising tasks and making decisions. It can be impaired in people with dementia.

who were overweight and a further ten patients who were obese. These were compared with 40 healthy participants. Exercise capacity was assessed through a six minute walk test and physical activity levels were measured with a questionnaire, whilst physical self-perception was recorded using a physical self-perception profile. All patients walked a shorter distance than the control healthy participants and shortness of breath was only evidenced amongst the patients and was greater with weight. 90% of the obese patients were short of breath compared to 40% of overweight patients and 27.3% of the normal weight patients. Body mass index, perceived sports competence and condition, physical self-worth, level of sports participation and smoking behaviour were responsible for 59% of the variance in walking distance between patients and healthy participants. Vancampfort et al. (2011) conclude that exercise capacity for patients with schizophrenia is reduced by a sedentary, unhealthy lifestyle and reduced physical self-perception in addition to obesity and perceived discomfort.

Physical activity can help those with schizophrenia by reducing the symptoms of depression and anxiety, which are frequently present in patients with schizophrenia. Whilst the evidence is relatively weak, it does suggest that physical activity can also increase some elements of psychological wellbeing for patients with schizophrenia. In addition, physical activity can increase physical health by helping weight management, which in turn will contribute towards tackling comorbidity. Holley et al. (2011) systematically reviewed existing evidence for the psychological benefits of physical activity in those with schizophrenia. The review focused on 12 quantitative studies and a further three qualitative studies that involved physical activity interventions lasting between three and 20 weeks. Despite differences in design and effect measures across the studies preventing an overall statistical analysis, the researchers conclude that there is a positive association between physical activity and elements of psychological wellbeing for individuals with schizophrenia. Although Heggelund et al. (2011) found no evidence of psychological improvements from high aerobic intensity training in schizophrenia patients, they saw fitness and peak oxygen uptake increase. On three occasions a week for eight weeks, 12 patients participated in four sets of four minute interval training sessions on a treadmill at 85-95% peak heart rate, interspersed with three minute active resting periods at 70% peak heart rate. A second group of seven patients spent the same amount of time training to improve their skill playing the computer game Tetris. Peak oxygen uptake increased by 12% amongst the aerobic group but no improvements were seen for symptoms as measured by the Positive and Negative Syndrome Scale. This research, as with many other studies in this field, has a very small base size and whilst the study was controlled, patients were not randomised into the groups, creating the potential for motivation bias.

Additional light can partly be shed on Heggelund et al.'s (2011) findings by drawing on the work of Pajonk et al. (2010), although again the sample size is small. Using a randomised controlled study with eight male participants each in a control aerobic exercise group, schizophrenia patient aerobic exercise group and schizophrenia patient non-aerobic exercise group, this research aimed to determine whether hippocampal volume would increase with exercise. Hippocampal volume is lower in schizophrenia patients than in the general population and appears to be related to decreases in the size and effectiveness of neurons and the loss of certain areas of the nervous system known as neuropil. Exercising patients participated in 30 minute aerobic exercise training three times a week for 12 weeks. The non-aerobic exercise group spent the same amount of time playing table top football which was thought to have a comparable level of stimulation but would not improve aerobic fitness. Pajonk et al. found that aerobic exercise increased hippocampal volume significantly in patients and healthy participants by 12% and 16% respectively, whilst no change was evidenced amongst the non-aerobic exercise group of patients. These changes appeared to correlate with increases in aerobic fitness. In addition, schizophrenia patients had a 34% increase in short term memory scores following the aerobic intervention and further analysis revealed this to be correlated with changes in hippocampal volume (although not significantly).

Takahashi et al. (2012) examined the role of sports participation on weight gain, psychiatric symptoms and brain activation in patients with schizophrenia. The sample size was small, with 13 schizophrenia patients participating in a three month physical activity and lifestyle intervention and ten control schizophrenia patients studied over this time, and all patients took antipsychotic medication during this time. The intervention consisted of physical activity, nutrition education and medication counselling. The physical activity element involved walking, jogging, muscle stretching and basketball for between 30-60 minutes delivered twice a day, six days a week. The intensity of sessions ranged from light to hard as judged subjectively by the patients. Participating in the lifestyle intervention reduced body mass index and improved psychiatric symptoms. Amongst the intervention group mean body mass index fell from 28.5 to 27.8 compared to a small increase in the control group (26.3 to 26.5) over the three months. General psychopathology scores measured by the Positive and Negative Syndrome Scale fell from 37.4 to 35.0 for the active patients compared to little change amongst the control group (35.4 to 35.8). This research is supportive of a positive role for physical activity in schizophrenia patients but cannot be generalised given the small sample, the specific focus of the intervention and the potential role of individual motivation as participants were not randomised. It would be interesting to conduct similar research with a larger, randomised sample and to explore the impact that different durations of physical activity have, as well as different activities themselves. As Takahashi et al. themselves highlight, the neuroscience behind any positive impact of exercise on the symptoms of schizophrenia is poorly understood.

EATING DISORDERS

Eating disorders are characterised by persistent and severe disruptions in eating habits and attitudes that interfere with daily functioning. There are eight categories of eating disorder under the International Classification of Diseases 10th Revision, and three main subtypes identified by the Diagnostic and Statistical Manual of Mental Disorders fourth edition. These three subtypes are the most researched and widely known eating disorders and are categorised as anorexia nervosa, bulimia nervosa and eating disorder not otherwise specified (a combination of symptoms which do not allow for classification as either anorexia nervosa or bulimia nervosa). It is thought that eating disorders not otherwise specified are the most common, followed by bulimia nervosa and then anorexia nervosa, accounting for approximately 60%, 40% and 10% of eating disorders respectively[38].

38 Beating eating disorders website, *Facts and Figures* http://www.b-eat.co.uk/about-beat/media-centre/facts-and-figures/, last accessed 20.04.2012.

Figures from a household survey of adult psychiatric morbidity suggest that in the UK 6.4% of adults (almost 4 million people) have an eating disorder and that women are more likely than men to suffer, with 9.2% of women and 3.5% of men estimated to have eating disorders (The Health and Social Care Information Centre, 2009). Prevalence is also higher amongst younger people, however a true picture is difficult to form given that there is a general under-detection of eating disorders both in society and clinically, and the household survey focuses only on those aged 16 and over. Eating disorders seriously affect the mental and physical health and wellbeing of those who suffer from them and can be life-threatening. Psychological distress, gastrointestinal problems and osteoporosis are all common amongst people diagnosed with eating disorders, and research has suggested that eating disorders have the highest mortality rate amongst psychiatric disorders (The Health and Social Care Information Centre, 2009).

Historically there has been a negative relationship between physical activity and eating disorders, with compulsive exercise a recognised problem within the eating disorder framework (sometimes referred to as Anorexia Athletica) and eating disorders and disordered eating thought to be more prevalent amongst elite athletes than in the general population and even more so in ballet dancers and female athletes (World Health Organisation, 2004). From a sample of 1,620 Norwegian athletes and 1,696 controls, Sundgot-Borgen and Torstveit (2004), found that 13.5% of athletes had an eating disorder compared to 4.6% of the control group, and that in female athletes the prevalence was as high as 20.1%, whilst in male athletes it was still significantly higher than the general population at 7.7%.

However it should be noted that there are other factors at play in causing eating disorders than just being an athlete. Research does suggest that many of the individual risk factors identified for eating disorders are also frequently found in individuals who strive for sporting excellence, for example perfectionism, self-control, self-drive, self-sacrifice and goal orientation. Petrie et al. (2009) examined differences in personality and psychological factors amongst female college athletes to identify predictors of eating disorders. From analysing 204 female college athletes in America the researchers categorised the participants as symptomatic of, or diagnosed with, an eating disorder and asymptomatic. Between the two groups there were no differences in perfectionism, optimism or exercising for fitness/health but there were significant differences in scores relating to self-esteem, appearance orientation and exercising to improve appearance and be more attractive. This research didn't, however, focus on elite athletes or male athletes, and other studies have shown that perfectionism is a risk factor for eating disorders. From a sample of 261 women, Peck and Lightsey (2008) found that decreased self-esteem and increased perfectionism were associated with increasing severity of eating disorders, whilst Lethbridge et al. (2011) compared 238 women with eating disorders to 248 control women and found that self-orientated perfectionism, dichotomous thinking and conditional goal setting were pronounced in the sample diagnosed with eating disorders.

Given that physical activity can raise global and physical self-esteem (related to improvements in body image) and improve overall mood in the general population and amongst those with depression, in theory, the psychological benefits of exercise could also be beneficial for treating eating disorders. A study of 539 normal weight university students in America who were not at risk of eating disorders supports this hypothesis. Cook et al. (2011) evaluated drive to be thin, quality of life, exercise habits, risk of exercise dependence and risk of eating disorders in their sample. The research found that although the physical effects of exercise were not beneficial for reducing the risk of eating disorders, the psychological benefits were. Physical activity therefore may not be a useful treatment initially for those who are underweight from eating disorders, but may be able to challenge negative psychological elements that contribute to increased risk of an eating disorder when incorporated into a long term recovery or treatment plan. This supports earlier work that concluded from a review of six studies examining exercise interventions in people with eating disorders that exercise may improve biopsychosocial outcomes for people with eating disorders but that more research was needed (Hausenblas, Cook and Chittester, 2008).

A small randomised controlled trial on the impact of individualised yoga sessions for eating disorder treatment also had positive results. Carei et al.'s (2010) sample consisted of 50 girls and 4 boys aged between 11 and 21 and was randomised into two groups: standard care alone and standard care combined with one on one yoga sessions (one hour twice a week) for eight weeks. Amongst the yoga group eating disorder symptoms were seen to decrease more than amongst the standard care only group. In addition, the decreases in the yoga group lasted over time whilst initial decreases in the standard care only group didn't last when followed up four weeks after the intervention. Participants completed a standardised and well-established Eating Disorder Examination with a modified question on food preoccupation, were assessed for depression using the Beck Depression Inventory and completed a State Trait Anxiety Inventory. Mean global Eating Disorder Examination scores started at 2.06 in the yoga group, fell to 1.94 after the eight weeks of practising yoga, and fell again to 1.70 at the 12 week follow up point. In comparison, the standard care only group had a mean score of 2.32 at enrolment, which fell to 1.86 in week 9 but rose to 2.26 at the 12 week follow up. Similar patterns were seen for the individual elements of the Eating Disorder Examination (restraint, weight concern, shape concern and eating concern) and also with depression, state anxiety and trait anxiety.

The researchers hypothesise that the reductions in weight and shape concern are largely responsible for the changes in the global Eating Disorder Examination scores and that this may be a result of focusing attention not on food preoccupation but on yoga poses. Amongst this sample, in the short term yoga appeared to improve quality of life without effecting body mass index. Due to methodological limitations such as a small sample size and a lack of biological measures, these results, whilst promising, are only indicative of the potential positive role yoga could play in treating eating disorders alongside standard care. Considerably more research is needed in this area as those with eating disorders can have complex relationships with excessive exercise, making it a serious issue (Bratland-Sanda et al. 2009; Mond and Calogero, 2009; Cook and Hausenblas, 2008), and any physical activity related treatment would need to be delivered and managed in such a way that it did not encourage relapses or dependency on physical activity. This has been highlighted by Douglass (2009), who explored the use of yoga as a treatment for eating disorders in addition to therapy and concluded that although there was potential for yoga to be misused, when supported by other treatments yoga could increase self-awareness, reflection and ability to self-soothe in the treatment of eating disorders.

Physical activity has also been advocated for preventing eating disorders in adolescents. Managing a healthy weight through diet and physical activity during adolescence can help negate some of the risk factors for eating disorders. Although anorexia tends to be the most commonly thought of eating disorder due to the media attention it receives, it is thought that more people with eating disorders are overweight or obese than underweight (The Health and Social Care Information Centre, 2009). Neumark-Sztainer (2008) examined the findings of Project EAT (Eating Among Teens) in America. Project EAT was a large population-based study of eating habits and weight related issues amongst adolescents.

From the findings of the project, Neumark-Sztainer made five recommendations aimed at health care providers to aid in the prevention of adolescent obesity and eating disorders. Of interest are the first and fourth recommendations. The first was that healthy eating and physical activity behaviours that can be maintained over the long-term should be encouraged and supported. The fourth specifies that families should do more at home to facilitate physical activity and healthy eating rather than focusing on weight. Incorporating physical activity into children's lifestyles at a young age may be able to reduce the risk of developing an eating disorder later in life by maintaining healthy body weights and contributing to levels of global self-esteem. With more research in this area will come a greater understanding of how physical activity can be used in the treatment of eating disorders; early evidence is suggestive that there could be a role for incorporating physical activity into the treatment of eating disorders in the later stages of therapy or other forms of treatment.

CONCLUSION

Regular leisure time physical activity can improve quality of life in the general population and amongst those with a mental illness. The evidence around the benefits of physical activity is less substantial for mental health than physical health, but it is clear that 150 minutes a week of moderate intensity exercise is a viable way to treat depression and anxiety and improve general mental wellbeing via improved mood. Exercising outdoors may bring additional benefits, with research suggesting that as little as five minutes of outdoor activity can cause participants to feel refreshed, revitalised and calm, however much more research is needed into the benefits of green exercise. There is strong evidence that regular moderate intensity aerobic exercise can reduce the risk of dementia through increased cognitive function, improved memory and better maintenance of brain connectivity; here research is suggestive of a proportional relationship. Evidence also shows that regular activity improves cognitive function and positive behaviour in those who already have dementia.

Whilst sport and recreation have been shown to improve mental health, few studies have found a positive relationship between domestic or work-based physical activity and mental health. Sport and recreation are beneficial because they are enjoyable and often sociable. For some the social element of sport and recreation activities can help to tackle feelings of isolation often experienced as part of poor mental health, however where research has isolated activities from psychosocial factors the findings show that a social element is not essential for the positive impact. Moderate evidence exists for further mental health benefits but more research is needed to produce conclusive findings and better understand dose-response relationships. It should not be forgotten that there is a strong, well evidenced relationship between mental ill health and physical ill health. There are proven and significant physical health benefits from sport and recreation, therefore prescribing physical activity for mental health is more beneficial than might be initially apparent.