SPORT+ RECREATION ALLIANCE

GAME OF LIFE

HOW SPORT AND RECREATION CAN HELP MAKE US HEALTHIER, HAPPIER & RICHER

THE SPORT AND RECREATION ALLIANCE

The Sport and Recreation Alliance is the independent umbrella body for the national governing and representative bodies of sport and recreation.

Almost every recognised sport and recreation in the UK has its own governing or representative body – organisations like The Football Association, the Amateur Swimming Association, British Gymnastics and The Ramblers – who exist to organise, to set rules and to encourage more people to join their activity. The Sport and Recreation Alliance is their voice.

Where there is a problem affecting our members or where there is an opportunity to promote the work they do, our job is to speak up on their behalf and to advance their interests. We also help our members become more effective by providing them with a wide range of services and expert advice.

Established in 1935 and originally named the Central Council of Physical Recreation, the Alliance exists to protect, promote and provide for its members.

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This document can be found in the research section of
sportandrecreation.org.uk
This document is correct as of September 2012.

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EXECUTIVE SUMMARY

SPORT AND RECREATION ARE GOOD FOR YOU.

This statement instinctively feels right. After all, what could be better for you than fresh air, exercise, teamwork, nature, camaraderie?

But where is the evidence that underpins that feeling? We can claim that physical activity improves health, helps educational attainment and brings communities closer but can we support that claim? The answer is in these pages. The Game of Life brings together, for the first time, all of the best evidence to support those gut feelings we have about sport. But it is also even-handed, pointing out where the evidence is patchy or where more research is required.

In many cases the evidence proves the point outright; in others it points the way towards an answer without establishing it conclusively.

Put together, however, the case for leading a more active lifestyle is compelling – both personally and societally.

We are all aware of some of the potential problems looming like storm clouds over the UK. We know, for example, that there is an obesity crisis and that modern sedentary lifestyles are causing untold stresses on the NHS and society. We know that cardiovascular disease costs the UK economy over £30 billion per year and diabetes costs £9 billion.

Mental health problems cost the care system £21 billion and costs UK businesses £30 billion in sick leave absence and unemployment costs. Dementia costs society £23 billion per year and offending by young people costs £11 billion per year. All of these costs are rising and there is a consensus that our economy cannot continue to carry their burden.

Sport and recreation are not a panacea, but as this evidence volubly demonstrates, it can certainly be a significant part of the solution. This research outlines the evidence that exists that shows how more activity can have huge effects on our society. Burning 2000 kcal per week reduces coronary mortality by between a quarter and a third. For every 500 kcal of extra energy spent per week, your likelihood of type 2 diabetes is 6% lower. Exercise can be as effective as antidepressants for those with mild clinical depression. Elderly people with low physical activity levels have more than twice the risk of Alzheimer's. And at the other end of life, seven out of ten teenagers believe that antisocial behaviour occurs because they are bored.

For years interested parties have asked for a more joined-up approach to sport and recreation policy within Government, but such a coordinated approach has always been considered difficult to implement. However, if the evidence in this paper points to one thing, it is surely that coordinating the role of sport throughout Government departments should be moved from the "too hard to do" folder to the "too expensive to ignore". Politicians can no longer afford to ignore the magic bullet that sport and recreation provides to our policy-makers.

Whilst the evidence supporting change is clear, we don't underestimate the challenge of changing people's habits. Getting those in a habitual sedentary lifestyle to be more active is much easier said than done. The good news is that the research shows that there is a dose-based response to physical activity. In other words, even if you do just a little exercise, you will get some benefit, and the more you do, the bigger the improvement. Being overweight can ironically make exercise more effective and getting moving at any level helps.

What will also come as no surprise is that prevention is far better than cure and that habits developed when you are young tend to ingrain themselves. Studies in Scandinavia have shown that boys and girls who were active every day at the age of 14 are respectively four and three times more likely to be active at the age of 31 – a huge impact. Membership of a sports club also increased the likelihood of being active later in life and being part of a sports club also increases the likelihood of being active citizens – 81% of sports club members establish new relationships in the community compared to only 14% of gym users.

So the message is simple: we need to encourage people to be more active and to be more active from an earlier age. The Government's current emphasis on youth sport and school club links moves us in the right direction, but too slowly. Children younger than this target age group should be doing quality sport at school and teachers should be aiming to provide activities every day to ingrain good habits. Sports clubs should be playing an integral role in this provision because of the other benefits the evidence tells us they provide. And national governing bodies of sport and recreation are in the perfect place to deliver their activities through clubs if the Government ensures that this is their priority.

WE NEED TO ENCOURAGE PEOPLE TO BE MORE ACTIVE AND TO BE MORE ACTIVE FROM AN EARLIER AGE

INTRODUCTION

In 2000, Nelson Mandela stated that, "sport has the power to change the world. The power to inspire, the power to unite people in a way little else can". The eloquence of such a great man captured a less eloquent belief that "sport is good" that had been gaining significant momentum in government since the late 1990s and has continued to receive interest and support from a research and policy perspective. The unsurprising common themes to emerge from research and policy work in this area since then have been that firstly, more research is needed, and secondly, the Government should adopt a more joined up approach to delivering policy. The consensus is that sport cuts across many other sectors and has the widest and most beneficial impact when delivered with knowledge from these sectors. This is important because sport can also have a negative impact on society. There is evidence that at its best sport[1] can improve physical health and so reduce the risk of obesity, heart disease, cancer, osteoporosis and many other illnesses, treat depression, stress and anxiety, aid in the prevention of dementia, help rehabilitate offenders back into society, reduce youth crime, enhance social cohesion, play a role in the regeneration of communities, improve educational attainment and strengthen employment opportunities. However, it has also been seen that sport can enhance division, result in serious injury, and has the potential to encourage excessive drinking, drug use or gambling when not delivered intelligently.

There is now a considerable amount of work in existence on the impact that sport and recreational or physical activity can have in other areas of life. Research, reviews and papers predominantly explore the impact of physical activity on physical and mental health, crime prevention, educational attainment and social cohesion, although often not in one overarching document. Oughton and Tacon (2007) summarise a wide range of reports and resources on the additional social benefits of sport, but this breadth of coverage sometimes comes at the price of detail and facts around each piece of evidence. However, in some instances, this review provides a more balanced assessment with the inclusion, albeit briefly, of the negative effects sport can also have. For example, Oughton and Tacon highlight that evidence shows sport to aid the primary (reduces initial risk) and secondary (slows progression and promotes recovery) prevention of cardiovascular diseases, diabetes, obesity,

1 The focus of this review is on leisure time physical activity as opposed to occupational or domestic physical activity. The word "sport" is used here in the broadest sense, understood as incorporating "traditional" sports, outdoor recreation, water pursuits, movement and dance and mind games. For simplicity and consistency the expression "physical activity" is used throughout this report. Unless otherwise stated it is intended to include all forms of leisure time or recreational physical activity.

some cancers and osteoporosis. From a physical health perspective evidence also shows that street joggers and cyclists are at risk from traffic accidents, high levels of training may lower the efficacy of the immune system, undiagnosed cardiovascular conditions could lead to cardiac problems whilst exercising, and drinking or drug taking can occur either as part of the social side to some sports or through efforts to enhance performance. On balance, however, these risks are seen to be largely avoidable or controllable, and, for example, the risk of cardiac difficulties in someone with an undiagnosed cardiovascular condition is outweighed by the risk reduction in heart disease associated with regular physical activity.

Usefully, Oughton and Tacon draw a distinction between practical physical activities, such as walking up the stairs, and sport or leisure physical activities. The latter, they argue, are more enjoyable which increases the likelihood of frequent participation and brings about additional benefits to pure physical activity as a result of, "the salience of sport and sport's economic and social dimensions" (Oughton and Tacon, 2007, p.2). It is this additional quality that sport and leisure physical activities have that makes them so useful for enhancing other areas of social life and allows a variety of activities to serve a range of purposes.

Earlier work produced by the Sport and Recreation Alliance under its former name (CCPR) in 2002 has also explored the evidence for the wider benefits of sport and recreation for several social benefits. ***Everybody Wins, Sport and Social Inclusion*** is a short digestible report that explores the positive impact of sporting activity in different areas with a couple of case studies under each heading and a summary of the benefits of sport. However, as with much of the existing research, this document is missing hard facts and largely builds on the assumption that the notion of "sport is good" has already been accepted. Coalter (2007a) explores the historical and political context to this notion as well as examining the key areas where sport is thought to do good and the global evidence case for this. It is frustrating, but not surprising, to read Coalter's conclusion that robust evidence on the direct impact of sport is limited due largely to the difficulty of isolating the direct role sport plays.

This is not helpful for sport and recreation in a climate of evidence-based policy making. The Department for Culture, Media and Sport's Culture and Sport Evidence programme (CASE) has a wider remit than just sporting activities but nevertheless aims to gather an evidence base that can support the delivery of, *"high quality culture and sporting opportunities to the widest audience, generating positive outcomes for society."*[2]

2 DCMS website, http://culture.gov.uk/what_we_do/research_and_statistics/5698.aspx, last accessed 03.02.2012.

The broad scope of this website makes it difficult to pull out a coherent story for the value of sport, but there are a lot of resources and links to valuable information that can be explored in greater detail and the evidence focus of the programme is much needed.

Sport England also has an online resource for scoping the wider value of sport with their aptly entitled ***Value of Sport Monitor.*** This is the outcome of a joint initiative with UK Sport in collaboration with the University of Stirling and has very recently been updated (January 2012). This monitor is divided into seven categories and for each there is an overall summary of the evidence provided, mostly as a literature review.

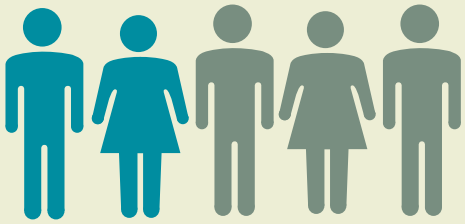
The categories are: Crime reduction and community safety; Economic Impact and regeneration of local communities; Education and lifelong learning; Participation; Physical fitness and health; Psychological health and wellbeing and Social capacity and cohesion. Each category then details and links to relevant research with a useful summary of findings and notes on methodology. This tool provides a wealth of really valuable information, the parameters of which are well set out and signposted. The Sport and Recreation Alliance is keen to complement rather than duplicate such existing work, however the summaries are extremely academic in focus and do not easily present clear facts and figures to demonstrate the value of sport, or simple statements on the wider role of sport. There is an enormous amount of material on the ***Value of Sport Monitor*** and some excellent recommendations are made, but it is difficult to find a clear message that can be utilised by national governing bodies or MPs.

It should also be noted that there are a number of journals that focus on sport and society as an overarching theme. As might be expected, the remit of these can best be described under the sociology of sport and the focus tends to be of an academic or theoretical nature to explore the dimensions of sport in society rather than simply the value that sport can bring. Whilst the journals unite the theme, the articles within them also tend to be specific in their focus. Some journals of note here include The European Journal of Sport and Society, The International Journal of Sport and Society, Journal of Sport and Social Issues and Sport in Society.

THERE IS AN ENORMOUS AMOUNT OF MATERIAL ON THE VALUE OF SPORT

THE IMPACT OF SPORT AND RECREATION ON SOCIETY

LEAVING SCHOOL WITHOUT FIVE OR MORE A*-C GCSEs



Number of people affected: **2 in 5**

9.8% of **16** to **18** year olds in England are categorised as **NEET**

Physical activity can cause changes in the brain which lead to enhanced neurochemical capacity for memory, learning and higher thinking.

£

THE CURRENT GENERATION OF NEETS WILL COST ★ 35 BILLION ★ OVER A LIFETIME

LINKS TO

ANTISOCIAL BEHAVIOUR
Men who have been NEET are 5x more likely to have a criminal record.

DEPRESSION
At age 23 men and women without qualifications are around twice as likely to be depressed.

UNEMPLOYMENT
In 2010, almost 1 in 4 (23%) 25-29 year olds without qualifications wanted paid work but didn't have it.

CARDIOVASCULAR DISEASE

180,000 DEATHS A YEAR

= 10,000

ANNUAL COST TO ECONOMY
£30.7 billion

ANNUAL COST TO NHS
£14.4 billion

150 minutes a week physical activity = 40% reduction in risk of cardiovascular disease.

PREVALENCE

Women under 75: **1 in 5**

Men under 75: **1 in 4**

OVERWEIGHT AND OBESITY

ANNUAL COST TO ECONOMY
£16 billion

ANNUAL COST TO NHS
£5.1 billion

6 IN 10 ADULTS

3 IN 10 CHILDREN

LINKS TO

PANCREATIC CANCER
Obesity doubles the risk of pancreatic cancer.

DIABETES
Obese women are 13 times more likely than non-obese women to develop type 2 diabetes, obese men are 5x more likely.

DEPRESSION
Obese people have a 55% increased risk of developing depression over time.

UNEMPLOYMENT

3 IN 10 PEOPLE IN ENGLAND ARE CURRENTLY UNEMPLOYED

ANNUAL COST TO ECONOMY

£15.5 billion

Youth unemployment alone

MAY 2012

2.63 million
people unemployed

1.59 million
claiming jobseeker's allowance

Research has shown the positive impact of participation in sport or recreation equates to around an additional year's worth of work when applying for jobs.

LINKS TO

ANTISOCIAL BEHAVIOUR

Being employed reduces the risk of offending by between a third and a half.

DEMENTIA

Aged 80 plus: **1 in 6**

Aged 65 plus: **1 in 14**

800,000
Sufferers in the UK

670,000
Acting as primary carers

ANNUAL COST TO SOCIETY

£23 billion

The risk of developing dementia is reduced by two to three times amongst the most active.

DIABETES

Number of people affected: **1 in 20**

2.9 million
people diagnosed

an estimated further

850,000
undiagnosed

ANNUAL COST TO NHS

£9 billion

150 minutes a week is twice as effective as medication at reducing the risk of developing type 2 diabetes.

LINKS TO

CARDIOVASCULAR DISEASE

Persons with diabetes are at least twice as likely to have cardiovascular disease than those without.

DEPRESSION

People with long-term illnesses such as diabetes have double the rate of depression in comparison to the general population.

PHYSICAL ACTIVITY AND PHYSICAL HEALTH

INTRODUCTION

The impact of sport and recreation on physical health is one of the easier relationships to explore. There has historically been a greater research focus on this relationship and physical health is more scientifically quantifiable than, for example, social cohesion, making it easier to isolate the role of sport and to explore causality and impact. The research focus in this area has however focused largely on the impact of physical activity on the health of people without disabilities. A 2010 review examined research published between 1986 and 2006 that focused on community physical activity interventions for persons with disabilities and were concerned with health outcomes. 80 studies were found with a range of methodologies and sample sizes covering 11 disability groups in total but predominantly focusing on stroke (20% of the studies), multiple sclerosis (15%) and intellectual disability (13%). Rimmer et al. (2010) concluded that research in this area is broad in scope with limited relevance to any specific disability group and a lack of consensus in findings, not helped by the small sample sizes of some of the disability groups studied. There is therefore a lack of research focusing on physical activity and specific disabilities, but where possible relevant studies have been included in this review.

Back in 2002 The Sport and Recreation Alliance produced ***Saving Lives, Saving Money***, a policy document detailing how physical activity represented a sound investment for public health and summarising data on the prevalence of inactivity, related illnesses and their costs. Much more recently Sport England has used existing research to estimate that if the UK had an additional 1 million people participating in sport once a week it would save £22.5 billion in health and associated costs[3]. Estimates such as this are possible partly as a result of research on the health costs of physical inactivity, although unfortunately these are not as up-to-date as they could be. The Government Office for Science ***Foresight*** report (2007) remains the definitive source for estimates on the economic cost of obesity and overweight and includes predictions for the year 2050.

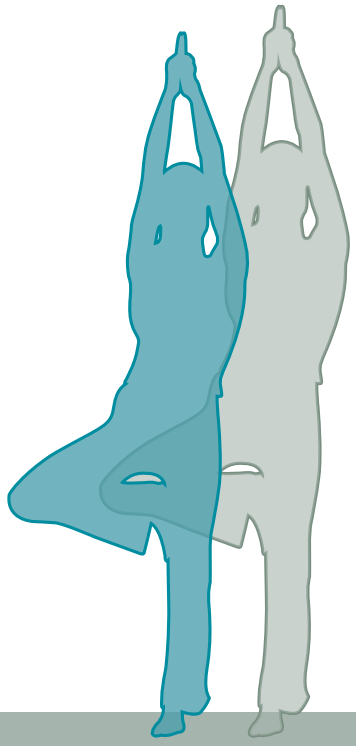
THE IMPACT OF SPORT AND RECREATION ON PHYSICAL HEALTH IS ONE OF THE EASIER RELATIONSHIPS TO EXPLORE

3 Sport England, *Sport's Role in Improving the Health of the Nation* http://www.sportengland.org/about_us/our_news/sport_and_healt/sport_and_health_statement.aspx, last accessed 03.02.2012.

Statistics on Obesity, Physical Activity and Diet, England 2011 (2011) provides the latest accessible numbers on the prevalence of obesity, although the data used is from the ***Health Survey for England*** (2009). These figures state that 23% of all adults are obese, and six in ten adults (61.3%) are either overweight or obese. The picture is not much better for children, with three in ten two to 15 year olds (29.5%) classed as overweight or obese. More recently in the August 2011 issue of The Lancet, Wang et al. have predicted the "Health and economic burden of the projected obesity trends in the USA and the UK", estimating that if current trends continue then by 2030 in the UK 41-48% of men and 35-43% of women could be obese. This would equate to 11 million more obese adults in the UK, with 3.3 million of these being over 60 years old, potentially creating a new problem of ageing obesity. This paper also builds on the 2007 ***Foresight*** report and utilises 2009 ***Health Survey for England*** data.

Two of the contributing factors to obesity are physical inactivity and poor diet (Government Office for Science, 2007; World Health Organisation, 2011). Prentice and Jebb (1995) argue that in the UK decreasing activity levels play a larger role than increasing calorie intake in our rising levels of obesity (cited in the Ramblers, 2010). Given that adults in the UK spend an average of six hours of their daily leisure time being sedentary, Prentice and Jebb could have a valid point. Only half (54%) of adults in the UK report that they partake in sport or exercise in their leisure time compared to nine in ten adults (89%) who watch television in their free time (Office for National Statistics, 2011). This demonstrates that there is enormous scope in the UK for increased physical activity to influence health, body mass and ultimately the obesity epidemic. Comparisons of the amounts and intensity of physical activity amongst 7,695 Americans showed that significantly more adults of normal weight engaged in moderate and vigorous intensity physical activity, and did so for longer durations, than their overweight or obese counterparts (Spees, Scott and Taylor, 2012). This lesson is not just one for the UK to learn, however, as physical inactivity accounts for 6% of deaths globally, making it the fourth leading risk factor for global mortality (World Health Organisation, 2010).

During the bidding process for the London 2012 Olympic and Paralympic Games, the Government committed to establishing Sport and Exercise Medicine as a new medical speciality. This has resulted in the production of a new NHS guide which outlines how sport and physical activity can deliver improved quality of care and productivity. The report, ***Sport and Exercise Medicine, A Fresh Approach*** (2012), argues for sport and exercise medicine to be commissioned across the NHS. As the findings in this chapter indicate, physical activity can reduce the risk of a range of illnesses from cardiovascular heart disease (around a 40% risk reduction) to dementia (by two to three times compared to the least active) and can be used in the management or treatment of others such as diabetes and obesity. Indeed, on a par with the findings in this review, the NHS report states that, *"the health benefits of physical activity are seen irrespective of age and social-economic group or cultural origin. There are also clear indirect benefits of physical activity to the wider economy. People who are physically active are more productive than those who are not. They take less time off work, consume fewer health care resources and are happier. The evidence that physical activity prevents major chronic disease is indisputable"* (Jones, Weiler, Hutchings et al., 2012, p.16).



LEVELS OF LEISURE TIME PHYSICAL ACTIVITY

It is thought that physically inactive individuals spend an average of 38% more days in hospital, make 5.5% more GP visits, access 13% more specialist services and 12% more nurse visits than an active individual (Jones et al., 2012). The British Association of Sport and Exercise Sciences utilised a panel of experts to produce a literature review and subsequent guidance on the relationship between physical activity and health in 2010. They highlight research from the 1950s and 1960s as early evidence of the empirical benefits of physical activity for health. O'Donovan et al. (2010) track the 1970s and 1980s as a time when research centred around high-intensity activity in the pursuit of aerobic fitness for health before the 1990s revealed that moderate-intensity activity also had significant health benefits and the question of how much activity is required for health benefits became popular. Using a meticulous and detailed methodology for experts within each topic to conduct literature and evidence reviews, this work is thorough. The headings addressed by experts were: physical activity and the prevention of overweight and obesity, physical activity and the prevention of type 2 diabetes, physical activity and the prevention of cardiovascular diseases, physical activity and the prevention of common cancers, physical activity and psychological wellbeing, minimal and optimal levels of physical activity and physical fitness, physical activity and health in children and adolescents, and the prevention of musculoskeletal injury. This is therefore arguably the most up-to-date and comprehensive paper on physical activity and health at present and as such is a useful reference to further research.

PHYSICAL ACTIVITY IS EFFECTIVE IN THE PRIMARY AND SECONDARY PREVENTION OF PREMATURE DEATH AND THE PREVENTION OF CHRONIC DISEASES

From reviewing existing cross sectional studies[4], experimental studies[5] and cohort studies[6], O'Donovan et al. highlight the difficulty of demonstrating causality[7] between physical activity and a reduction in risk from disease, and show that this in turn can lead to conservative estimates on the impact of physical activity. Nevertheless, O'Donovan et al. summarise from the cohort studies reviewed that after adjusting for confounding variables, inactivity results in a two-fold increase in the risk of cardiovascular disease, type 2 diabetes and overweight and obesity. The cohort studies also showed strong evidence that physical activity has a causal relationship with a reduction in the risk of post-menopausal breast cancer and depression, and moderate evidence that this is the case for colon cancer, psychological wellbeing, cognitive impairment and prostate cancer. This supports earlier findings from Warburton, Nicol and Bredin (2006a) who explored the evidence from over 150 pieces of observational[8] and randomised[9] research on the health benefits of physical activity. They found that existing research showed irrefutable evidence that regular physical activity is effective in the primary and secondary prevention of premature death and the prevention of chronic diseases including cardiovascular disease, diabetes, cancer, hypertension, obesity, depression and osteoporosis.

4 In this context, cross sectional studies compare risk factors for disease in those who exercise regularly as part of their lifestyle against sedentary counterparts at a given point in time.

5 Experimental studies assess risk factors for disease before and after a specific physical activity intervention whilst controlling for other influencing factors such as a change in diet.

6 Cohort studies are conducted over a long period of time and involve studying a large group of healthy people to observe the incidence of disease and death. This can then be compared by physical activity levels of individuals and groups.

7 A scientifically observable, predictable and reproducible relationship showing in this instance that physical activity directly results in a reduced risk from disease.

8 Observational research is not a scientific experiment with controlled parameters. It involves direct observation of participants in their natural environments, for example, observation of the physical activities undertaken by a sample of participants.

9 Randomised research is a scientific experiment. It takes the total number of eligible participants recruited and randomly assigns them to different intervention groups, such as running for 30 minutes a day or running for 60 minutes a day. A randomised trial assigns participants to different intervention groups only. A randomised controlled trial assigns some of the participants to a placebo group to increase the validity of a study.

Based on their review of the evidence, O'Donovan et al. (2010) propose that healthy adults (18-65 years) should participate in 150 minutes of moderate intensity aerobic exercise a week, or 75 minutes if it is of a vigorous intensity, with minimum bouts of ten minutes. This is echoed in the Government's current adult guidelines for physical activity which are at least 30 minutes of moderate intensity activity five times a week, and the acknowledgement that bouts of ten minutes or longer several times a day can have just as positive an impact (Department of Health, 2011b). For children (5-18 years), O'Donovan et al. recommend accumulating at least 60 minutes of moderate-to-vigorous intensity activity a day, which should include vigorous-intensity aerobic activities aimed at improving bone density and muscle strength. Again, this is supported by the Government guidelines, which elaborate to say that moderate-vigorous intensity physical activity should be at least 60 minutes and up to several hours a day and that muscle and bone strengthening exercises should be included at least three days a week, whilst extended periods of sedentary behaviour should be minimised.

Using data from the 2003-2004 American National Health and Nutrition Examination Survey, Strath et al. (2008) looked at body mass index, waist circumference and objectively determined levels of physical activity for 3,250 adults. Strath et al. compared the body mass index and waist circumference of those who reported 30 continuous minutes of moderate-to-vigorous intensity physical activity with those who had accumulated 30 minutes of moderate-to-vigorous intensity physical activity through bouts of ten minutes or more. Regression analysis showed a body mass index reduction of 1.2kg/m2 and a 2.7cm decrease in waist girth amongst participants who accumulated 30 minutes of moderate-to-vigorous intensity physical activity in bouts of ten minutes or longer when compared to all others. Those who had undertaken 30 minutes of moderate-to-vigorous intensity physical activity in one go had a body mass index reduction of 0.3kg/m2 and a 0.9cm decrease in waist girth. These findings suggest that there are in fact greater benefits for exercising at sufficient intensity for shorter time periods. However given that the analysis used previously gathered data that relied on people's self-reporting of activity levels, the true extent of the benefits of moderate-to-vigorous exercise for ten minutes or more needs further exploration.

Wen et al. (2011) explored the health impact of exercising less than the recommended 30 minutes five times a week. They concluded that 15 minutes of moderate intensity physical activity a day or 90 minutes over a week may be enough to bring about health benefits even in those who are at risk of cardiovascular disease.

In a prospective cohort study with 416,175 Taiwanese people between 1996 and 2008 (average follow up of 8.05 years), participants self-reported their amount of weekly exercise, which the researchers categorised into one of five levels of exercise intensity: inactive, low, medium, high or very high activity. These groups were then compared for their risk of mortality and life expectancy. The low level activity group was characterised by an average of 15 minutes physical activity a day and had a 14% lower risk of all-cause mortality and a three year longer life expectancy than those in the inactive group. Wen et al. found that every additional 15 minutes of physical activity beyond the initial 15 minutes resulted in a further 4% reduction in all-cause mortality and a 1% reduction in cancer mortality. These findings remained true when accounting for age, gender and risk of cardiovascular disease. This research suggests that some exercise is better for our health than none, but going beyond the current recommended daily guidelines can have further health benefits. It is possible, however, that for those who are already in good health, overtraining in an activity that involves resistance training can ultimately lead to a decrease in performance, greater fatigue and mood disturbance. It should be noted that this extreme is not easy to reach and happens when the balance between training and recovery isn't appropriate (Halson and Jeukendrup, 2004, cited in O'Donovan et al., 2010).

There is a significant body of further evidence that, as found by Wen et al., even relatively low levels of physical activity improve general physical wellbeing (for comprehensive overviews see Powell, Paluch and Blair, 2011, Pavey et al., 2011, Thompson, 2009 and Tuomilehto et al., 2005). Previously, Warburton, Nicol and Bredin's (2006a) examination of existing research on the health benefits of physical activity led them to conclude that overall health can be improved from low-intensity physical activity even when there is little or no change in physical fitness. Following this finding, Warburton, Nicol and Bredin (2006b) conducted further research into the intensity, time, type and frequency of physical activity and improvements in health. They conclude that there is no one solution for how much a given activity should be done at a set intensity and frequency; effective physical activity for physical health is dependent on the existing health of individuals and their health goals. For example, unfit sedentary people will see greater benefits from low intensity exercise than someone who is already very fit, and they will also be more easily able to participate in low intensity exercise and less likely to incur injury. In order for an individual weighing 60 kilograms to achieve the recommended daily energy expenditure from exercise (150-400 kcal), they could cycle vigorously for 15 minutes or dance (social or ballroom) quickly for 33 minutes. Someone weighing 130 kilograms would need to do half this amount (seven and 15 minutes respectively), but due to their weight may be more likely to meet the target through 23 minutes bowling or 28 minutes fishing from a boat (Warburton, Nicol and Bredin, 2006b).

A report from Substance (2012) on the social and community benefits of angling, in which the second chapter focuses on angling, health and wellbeing, also highlights the accessibility of angling for those who have previously led sedentary lifestyles or are recovering from an illness. With a range of case-study, anecdotal and quantitative evidence (the latter largely found in the previous chapter on participation) this report demonstrates that angling is not as physically demanding as, for example, football, and can be participated in at various levels of activity, from very low intensity, such as sitting by a canal having driven there in a car, to high intensity, as would be experienced when wading in a river and constantly casting and retrieving spinners.

The benefits of physical activity for health come from both increased fitness and a healthy body weight. A sample of 3,250 adults aged 20-49 years were tested on a treadmill for their cardiorespiratory fitness. Those who had high levels of leisure time physical activity, defined as 1,000 MET[10]-minutes/week or greater, were fitter than those who reported no physical activity or less than 500 MET-minutes/week activity. Men had VO2max[11] scores of 45 to 42 respectively and women VO2max scores of 37 to 34 (Wang et al., 2009). It should be noted that in this sense, it is possible to be both fit and overweight. Even small improvements in physical fitness are evidenced to reduce the risk of premature death, with previously sedentary people making modest improvements to their physical fitness seeing large improvements to their health. Research by Warburton, Nicol and Bredin (2006a) over a five year period found that those who went from unfit to fit in this time had a 44% reduction in their relative risk of mortality when compared to people who remained unfit. Brisk walking is an easy, accessible, cost free activity to increase fitness amongst sedentary people. The Ramblers (2010) highlight from a number of other sources that the best impact on health occurs when walking is brisk, as at this pace the performance of the heart, lungs and circulation will improve, blood pressure can be lowered and the risk of coronary heart disease and strokes can be reduced. In addition, regular walking at any pace can help to manage weight, reduce the risk of type 2 diabetes, reduce the risk of colon, breast and lung cancer, improve flexibility and strength of joints, muscles and bones, increase "good" cholesterol and boost the immune system. However, maintaining a healthy weight confers further health benefits. From analysing 19 existing cohort studies which included 1.46 million white (non-Hispanic) American adults and 160,087 deaths and accounting for confounding factors such as smoking or prevalent disease, Berrington de Gonzalez et al. (2010) identified a body mass index of between 20.0 and 24.9 as having the lowest risk of all-cause mortality.

REGULAR WALKING AT ANY PACE CAN HELP TO MANAGE WEIGHT, REDUCE THE RISK OF TYPE 2 DIABETES, REDUCE THE RISK OF COLON, BREAST AND LUNG CANCER

10 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.

11 VO2max is the maximum capacity that an individual's heart, lungs and blood has for transporting oxygen to muscles and the utilisation of this oxygen during exercise. It is used to measure cardiorespiratory fitness.

WEIGHT MAINTENANCE

From a review of existing research, the Department of Health (2011b) believes there to be strong evidence that aerobic physical activity at the recommended level (30 minutes moderate intensity activity five times a week) consistently has an effect on maintaining weight so that weight change is in a 3% or lower range of initial body weight; this has also been confirmed by Jakicic (2009) and Wing (1999). Physical activity contributes to weight maintenance by enabling an energy balance, but the difficulty comes with truly understanding the long-term effects of regular exercise, for which there is relatively little research.

Acknowledging this issue, Hankinson et al. (2010) conducted a cohort study over 20 years in order to evaluate the relationship between physical activity levels and changes in body mass index and waist circumference during this time. The sample consisted of 3,554 American men and women who at enrolment were aged between 18 and 30 years. At the beginning of the research and at follow up intervals of two, five, seven, ten, 15, and 20 years afterwards physical activity levels were measured in order to create a habitual physical activity level over the 20 years. Measurements of physical activity were calculated from answers to a questionnaire on 13 specific moderate and vigorous intensity activities over the last year, using an algorithm that assigned scores for activities based on intensity, frequency and duration. The outcome was a score expressed in exercise units to show the usual level of activity over the previous year and these were externally validated. A score of 300 exercise units was approximately the same as the Government guidelines of 150 minutes moderate intensity activity a week. Based on this, Hankinson et al. divided these activity scores into low, moderate and high habitual levels of physical activity by gender.

PHYSICAL ACTIVITY CONTRIBUTES TO WEIGHT MAINTENANCE BY ENABLING AN ENERGY BALANCE

They found that men who habitually maintained high levels of physical activity (more than 608 exercise units, equivalent to approximately 350 minutes of moderate intensity activity a week) gained 2.6 fewer kilograms a year than those with low levels of physical activity (less than 340 exercise units) and gained 3.1 fewer centimetres in waist circumference. Women with habitually higher levels of physical activity (at least 398 exercise units) gained 6.1 fewer kilograms than their low activity level (less than 192 exercise units) counterparts and had waist circumferences that were 3.8 centimetres smaller. These findings demonstrate a considerable difference by gender and indicate that in men, weight maintenance requires more than the Government's recommended levels of activity.

HIGH LEVELS OF LEISURE TIME PHYSICAL ACTIVITY SUCH AS SPORT AND RECREATION...WERE SEEN TO CORRELATE WITH A LOWER BODY MASS INDEX AND LOWER LEVELS OF BODY FAT

Hankinson et al.'s research also demonstrates that maintaining a high level of physical activity as a young adult (18-30 years) can lessen weight gain as middle age approaches, and that this is particularly the case for women. Evidence for weight maintenance through regular physical activity does appear to differ and to be somewhat contradictory with regards to effectiveness by gender. This is likely to be due to methodological differences such as relying on participants to self-report on their levels of activity, small sample sizes, reliance on participants to stick to exercise routines and so on. High levels of leisure time physical activity such as sport and recreation (as opposed to being active through cleaning, for example) were seen to correlate with a lower body mass index and lower levels of body fat amongst women in a sample of 1,302 Australians. After regression and controlling for variables, Ball et al. (2001) found that women who were moderately active were 2.3 times more likely than sedentary women to have a body mass index in the normal range for women and 2.4 times more likely to be in the lower body fat category. Women who were highly active were 2.6 times more likely to have a body mass index in the normal range and 2.9 times more likely to be in the lower body fat category. This research found no significant differences amongst men, however other research has found no difference between men and women. Mozaffarian et al. (2011) conducted a prospective study drawing on data from three other cohort studies in America. Their total sample consisted of 98,320 women and 22,557 men who at the beginning of the research were not overweight or suffering from a chronic disease. Over 20 years this research assessed weight gain and the role of lifestyle factors in this. Across the entire sample over the 20 year period the average weight gained was 1.2 stone or 2.4% of body weight every four years. Participants who increased their physical activity over time gained 0.13 stone less within each four year period, and these findings were similar for men and women.

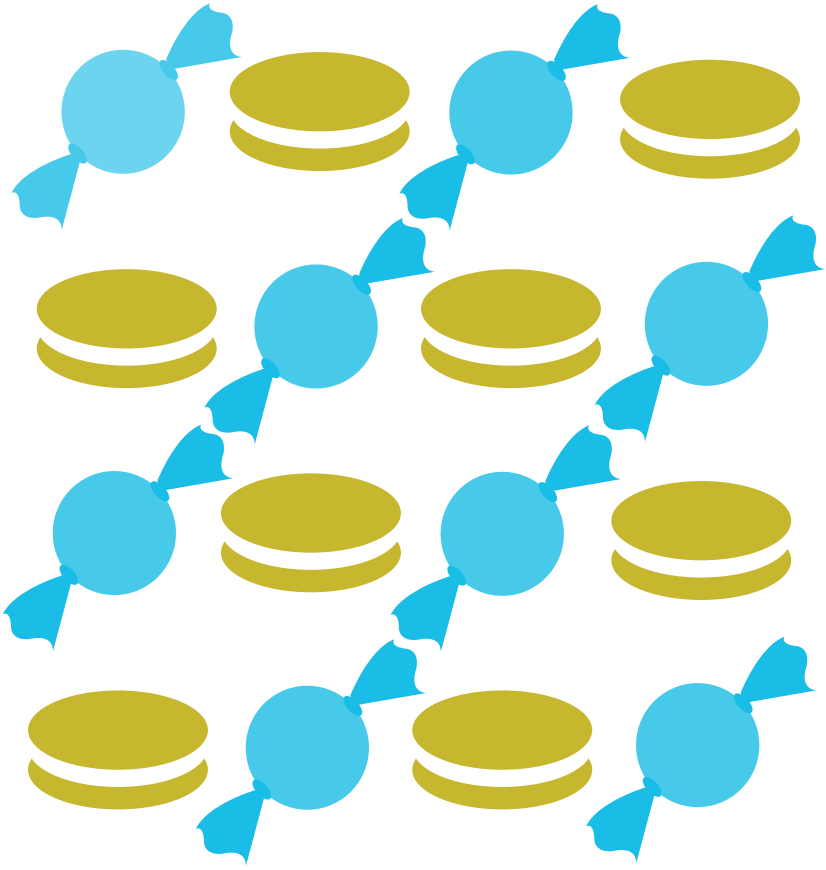
The National Weight Control Registry in America contains the details of individuals who have self-reported losing 30 pounds (just over two stone) and maintained this for a year. Analysis of the 784 men and women in this register by Klem et al. (1997) concluded that 2,800 kcal/week of leisure time physical activity was necessary for their weight maintenance, demonstrating that higher levels of activity may be necessary for those who have previously been overweight. 2,800 kcal/week or 400 kcal a day could be achieved through approximately 30 minutes of boxing or 30 minutes of cycling at 6mph. Alternatively, it could be achieved through 60 minutes playing basketball, swimming, hiking or fast ballroom dancing.

The Department of Health (2011b) also proposes that physical activity alone cannot cause weight loss greater than a 5% change from initial body weight unless undertaken in excessive proportions and/or combined with restricted calorie intake. This affects the energy balance that regular exercise maintains. Goodpaster et al. (2010) concluded from a one year randomised trial amongst severely obese adults in Pittsburgh, America, that physical activity and dietary intervention can successfully reduce obesity. This research examined the impact of a 12 month physical activity programme combined with dietary interventions against a 12 month dietary intervention with a physical activity programme only in the last six months. The physical activity programme consisted of moderate intensity activity such as brisk walking and was built up to 60 minutes a day, five days a week, although this could be accumulated in ten minute or more sessions. This level of activity is not extreme and could be incorporated into an existing lifestyle without too much difficulty. At completion 101 participants remained: nearly 30% of these achieved weight loss greater than 10% of their initial body weight and a further 10% had lost more than 20% of their initial body weight. Whilst at the end of 12 months there was no significant difference in weight loss between the two groups, those who had exercised for the entire 12 months lost significantly more weight in the first six months. 80% of those who exercised from the beginning had lost more than 5% of their initial body weight at the six month mark compared to 60% of those who were only following the dietary intervention at that point. At the end of the year the proportion of participants who had lost more than 5% of their initial body weight was 78% and 65% respectively (Goodpaster et al., 2010).

As evidenced by Goodpaster et al., research supports that if combined with a moderate restriction in diet, between 150 minutes and 250 minutes of exercise could be effective as a means of weight loss for those who are overweight or obese (Donnelly et al., 2009). Without a dietary change, research emphasises the need to go beyond the recommended guidelines for general health benefits to 250 minutes or more of moderate intensity activity a week. This additional level of activity would be equivalent to five sessions of 50 minutes a week, or 35 minutes every day. Although Hill and Wyatt (2005) suggest that actually 60 minutes of moderate intensity activity a day is needed to maintain a significant weight loss, this is echoed by Jakicic and Otto (2005), who conclude that evidence shows 60 minutes or more per day is needed in order to maximise and maintain weight loss.

In a randomised controlled trial, 52 obese Canadian men were observed for three months in one of four groups: diet-induced weight loss, exercise-induced weight loss, exercise without weight loss and a control group. Those who were exercising for weight loss expended 700 kcal a day through exercise and followed a weight maintenance diet that all participants had followed for four to five weeks beforehand. Those who were exercising without weight loss carried out the same amount of exercise but compensated for this through diet. For both exercise groups the exercise consisted of brisk walking or light jogging on a treadmill for the length of time it took to expend 700 kcal and every session was supervised. Participants who lost weight through exercise lost an average of 6.1kg of body fat compared to an average of 4.8kg for those who lost weight through their diet. The other two groups had no significant changes in body fat (Ross et al., 2000). Whilst the time taken to burn 700 kcal will vary dependent on weight and fitness, the average duration of exercise for participants who lost weight from exercise was 60 minutes. These findings are supportive of the notion that significant weight loss requires high levels of activity if diet remains unchanged, but also show both physical activity and dietary interventions to be effective. More moderate levels of activity with moderate changes in diet may therefore be the most effective approach to tackling overweight and obesity.

MORE MODERATE LEVELS OF ACTIVITY WITH MODERATE CHANGES IN DIET MAY THEREFORE BE THE MOST EFFECTIVE APPROACH TO TACKLING OVERWEIGHT AND OBESITY



Research on a sample of 6,215 male and female Scottish adults explored the impact of different levels of physical activity and sedentary behaviour on obesity. Obesity was considered in two separate instances, firstly as defined by a body mass index of 30kg/m2 or higher, and secondly as a waist circumference of 88cm or more in women and 102cm or more in men. Activity levels were categorised into inactive (no moderate-to-vigorous intensity activity), insufficiently active (less than 150 minutes of moderate-to-vigorous intensity activity), sufficiently active for general health benefits (between 150 and 420 minutes of moderate-to-vigorous intensity activity) and sufficiently active for obesity prevention (at least 60 minutes a day of moderate-to-vigorous intensity activity), whilst sedentary behaviour was considered to be time in front of the television and other screen-based entertainment. Stamatakis, Hirani and Rennie (2008) found that not only is physical activity associated with the prevention of obesity, but also that sedentary behaviour is independently associated with obesity, therefore, along with the right diet, physical activity should be encouraged whilst sedentary behaviour is discouraged.

Even when participants spent 150 minutes a week or more on moderate intensity activity, where participants had four or more hours a day of sedentary behaviour there was a greater chance of both types of obesity than when sedentary activity made up less than two hours of the day. 27.5% of respondents meeting these criteria were classified as obese from their waist circumference and 20% were classified as obese from their body mass index. This is compared to 12% and 11.5% respectively for those who spent 150 minutes a week or more on moderate intensity activity and had spent less than two hours a day being sedentary. However, even the researchers for this study acknowledge that there is a possibility that this finding is due to over-reporting of activity from obese participants, considering that studies have shown that, *"obese individuals have the tendency to over-report physical activity in general"* (Stamatakis, Hirani and Rennie, 2008, p.769).

Stamatakis, Hirani and Rennie (2008) differentiated between sports (approximately 90 sport and recreation activities), walking and domestic activity. Whilst no trend was found with domestic activity and obesity, walking and sports were strongly related to waist circumference obesity, and walking was significantly related to body mass index obesity. Domestic activity levels showed little (1%) difference in the prevalence of both types of obesity, around 25% for body mass index obesity and 34% for waist circumference obesity, regardless of how much time was spent undertaking domestic activity. Amongst those who participated in 30 minutes or more moderate intensity sport a day, 21% were waist circumference obese compared to 40% of those who spent no time participating in sport. Sports participation at a moderate intensity for 30 minutes a day and 30 minutes a day or more of walking were associated with half the level of waist circumference obesity. 19% of those who walked for 30 minutes or more were waist circumference obese, again compared to 40% of those who spent no time walking. For body mass index obesity, 20% of those who participated in 30 minutes or more of sport were obese compared to 29% of those who didn't participate in sports. With walking the findings were 16% and 30% respectively. It is possible that a relationship between sports participation and body mass index obesity was not established because those with high levels of absolute muscle mass, and so relatively low levels of body fat, will have been classified as overweight or obese by the parameters of this research. Physical activity has not just been associated with reducing levels of obesity in the general population – there is also solid evidence that regular physical activity can go as far as to offset genetic susceptibility to obesity. From further analysis of 45 studies generating a sample size of 218,000 adults, Kilpeläinen et al. (2011) found that the effect of the FTO gene (a gene associated with a 20-30% increased risk of obesity) was reduced by 27% more in those classed as physically active in comparison to their sedentary counterparts. This has led the Medical Research Council (2011) to confirm that physical activity can be beneficial even if there is a genetic predisposition to obesity. Similarly, Li et al. (2010) assessed the role of physical activity on a genetic predisposition to obesity in a UK population study with 20,430 participants. This research found that regular physical activity can lessen a genetic predisposition to obesity by about 40%. This conclusion was reached by examining the extent to which groups of genes (alleles) responsible for obesity susceptibility influenced the chance of obesity. In physically inactive individuals the odds were 1.158 per allele, whilst in physically active individuals they were 1.095 per allele.

In 2011 the direct costs associated with obesity were estimated to be £5.1 billion per year in the UK; it is thought that this will reach £6.4 billion by 2015. The indirect costs of obesity are also significant: excluding for the moment further disease or illness brought about by obesity (obese women are almost 13 times more likely than non-obese women to develop type 2 diabetes whilst men are five times more likely[12]), it is thought that between £2.35 and £2.6 billion a year in lost earnings can be attributed to obesity through either obesity-related premature mortality or obesity related sick days (estimated at around 16 million sick days). Overall, in 2007 the total cost of overweight and obesity to society and the economy was thought to be around £16 billion (Department of Health, 2011). Calderdale Council in West Yorkshire had 43,000 obese adults in 2010. In 2009 the council invested £130,000 in a lifestyle programme (dietary and physical activity interventions) to help 700 adults lose 5% of their body weight. The year two saving to the NHS from this intervention was estimated at £53,000, with a year three saving of £160,000 (Director of Public Health, 2010). In short, obesity is incredibly expensive for our nation, whereas interventions involving physical activity, comparatively, are not.

12 Department of Health Website (2012), *Facts and Figures on Obesity*, http://www.dh.gov.uk/health/2012/04/obesityfacts/, last accessed 23.08.2012.

An economic evaluation of the cost-effectiveness of exercise referral schemes concluded from the evidence available that such schemes are cost-effective interventions in sedentary populations with and without a medical diagnosis. Pavey et al. (2011) assessed four previous economic evaluations, three of which were trial-based economic evaluations and one of which was a model-based analysis; three were also UK-based whilst one was outside of the UK, and all focused on adults aged 40-60 years old, as therefore did Pavey et al.'s modelling. Previous to Pavey et al.'s analysis, research on the cost effectiveness of exercise referral schemes has been equivocal and approaches have often varied. Using the model of quality-adjusted life years (QALY)[13] to measure cost effectiveness, Pavey et al. considered the impact of exercise referral schemes on coronary heart disease, stroke and type 2 diabetes, as the relationship between physical activity and the incidence of these diseases is quantifiable and data already exists on the loss of QALYs from developing these conditions. This makes the calculations more robust but does not account for the entire potential impact of exercise referral schemes, which may also bring about benefits in other ways such as the prevention of musculoskeletal diseases and improved mental health. The cost effectiveness of exercise referral schemes is ultimately seen to lie in their ability to increase the probability of an individual becoming active as it is physical activity that is related to improved life expectancy and quality of life through reducing the risk of coronary heart disease, stroke and type 2 diabetes.

To give context to Pavey et al.'s findings, NICE guidelines are that a drug or intervention that costs up to £30,000 per QALY is justified. Pavey et al.'s work indicates that exercise referral schemes are more cost effective per QALY for those who already have a medical diagnosis. They found that the cost per QALY was £20,876[14] in sedentary individuals without a medical diagnosis, £14,618 per QALY in sedentary obese individuals, £12,834 per QALY in sedentary hypertensive patients, and £8,414 per QALY for sedentary individuals with depression. Analysis also showed that when short term benefits of physical activity, such as increased mood or greater motivation for activity, were included the cost in those without a medical diagnosis reduced to between £17,032 and £18,559 per QALY.

13 The QALY model is a measure of disease burden that accounts for both the quality and quantity of life lived; it is often used for assessing the value for money of a given medical intervention. The final QALY figure is calculated on the number of years of life that the medical intervention adds. A year of perfect health is represented by the value of 1.0 whilst death is represented as 0.0. Extra years not lived in full health are given values between 0 and 1 to account for the loss of health dependent on its extent. The lower the cost to the higher QALY saved, the more cost-effective a medical intervention can be deemed to be.

14 All financial figures from Pavey et al. (2011) are at 2010 prices.

Compared to usual care, this research finds exercise referral schemes on average to be £169.54 per person more expensive, however this results in greater gains of eight QALYs per 1000 people. It should be noted that there are some limitations in the data that Pavey et al. used to calculate these costs; the costs are best treated as conservative estimates as a result. Even accounting for this, the figures indicate that exercise referral schemes and the benefits of physical activity on health fall under the NICE guidance £30,000 threshold and therefore are financially viable as treatments.

Yet conversely, Van Baal et al. (2008) have argued that whilst tackling obesity can reduce the costs of obesity related diseases such as diabetes and heart disease, this cost reduction will be offset by the costs of diseases unrelated to obesity that are experienced in the life-years gained from no longer being obese. This argument highlights how difficult it truly is to calculate costs relating to inactivity. McPherson (2008) explores the contradictions of this argument: *"Obese people cost less because individuals die younger and hence with less chronic morbidity associated with old age... But is it worth knowing that obese individuals are cheaper than lean ones for the health sector in the long run?... We have to be clear, therefore, about the distinction between lower lifetime health costs associated with obese individuals and higher costs of obese populations."* (McPherson, 2008, n.p.). It is also worth considering taking Van Baalet al.'s argument to the extreme.

MORE RESEARCH IS NEEDED INTO BOTH THE SHORT AND LONG-TERM COST EFFECTIVENESS OF PHYSICAL ACTIVITY INTERVENTIONS FOR HEALTH.

Given that there is evidence that physical activity can increase life expectancy – 15 minutes a day can increase life expectancy by three years compared with doing little or no exercise (Wen et al.2011) – does this then mean that the overall lifetime health costs of these individuals will be higher, even if they have a higher quality of life, and how might this change if these individuals have fewer episodes of poor health and so make greater contributions to society and the economy?

It is clear that much more research is needed into both the short and long-term cost effectiveness of physical activity interventions for health. However, controlling for all parameters of interest for such research will be near impossible.

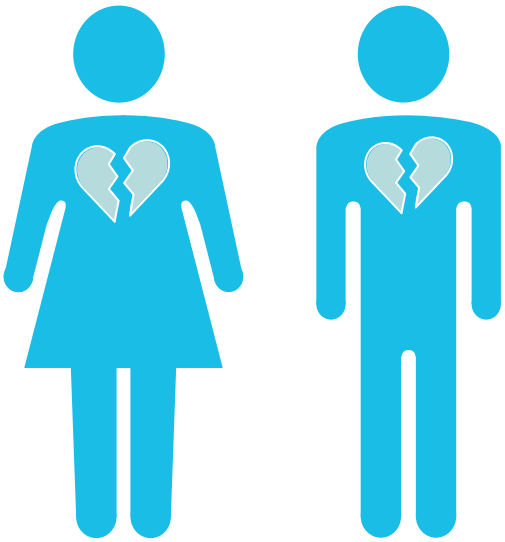
CARDIOVASCULAR DISEASES

We have already touched on an association between physical activity and a reduced risk of coronary heart disease. Almost half (46%) of the 180,000 deaths from cardiovascular diseases in the UK in 2009 were as a result of coronary heart disease. It is estimated that overall cardiovascular diseases cost the UK economy £30.7 billion a year (British Heart Foundation, 2011). It is thought that reducing cardiovascular disease in 1% of the population of England and Wales would save the National Health Service at least £30 million a year (Barton et al., 2011).

In the 1950s it was discovered that bus drivers in London were twice as likely to experience mortality from coronary heart disease as their counterpart bus conductors. This led to the hypothesis that the activity involved in the work of bus conductors, for example walking the length of the buses and going up and down the stairs on double-decker buses rather than remaining sedentary behind the wheel, protected bus conductors from coronary heart disease (Morris et al. 1953). The work of Paffenbarger and colleagues throughout the 1980s and 1990s is well known in this field of research as producing pioneering large scale, scientific studies aimed at understanding the relationship between physical activity and the risk of death from cardiovascular disease. Paffenbarger et al. (1986) assessed 16,936 male Harvard alumni from the ages of 35-74 to establish influences on rates of mortality from all causes and length of life. The sample completed questionnaires about their lifestyle characteristics, including physical activity, at start and follow up, which occurred after 12-16 years. During this time 1,413 alumni died. Physical activity in this research was defined as walking, stair climbing and playing sports. Burning 2000 kcal or more a week was seen to reduce all-cause mortality by between 22% and 27% and coronary mortality by 25%-33%. In addition physical activity was seen to increase life expectancy by an average of one to two years at the age of 80.

Later analysis by Warburton, Nicol and Bredin (2006a) of several studies found that mortality from a cardiovascular disease was 20% less likely following an increase in physical fitness of one metabolic equivalent (MET)[15]. Focusing specifically on the risk of heart failure in men, Kenchaiah, Sesso and Gaziano (2009) evaluated a prospective cohort of 21,094 male physicians from the American Physicians' Health Study. The sample had a mean age of 53 and no known coronary heart disease at the start in 1982. Data on participant demographics, medical history and lifestyle variables was gathered at the start through a questionnaire at six month intervals during the first year and then annually for the remainder of the study. After adjusting for confounding variables, compared to those who rarely or never undertook physical activity, men who exercised five to seven times a week had a 36% reduction in the risk of heart failure. The risk was 20% lower for those who exercised one to four times a week and 23% lower for those who exercised one to three times a month. The lower risk of heart failure in more active physicians held true within five years of follow up.

15 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.



Large scale analysis on men and women echo these findings. Shiroma and Lee (2010) outline the evidence for lower rates of cardiovascular disease and coronary heart disease amongst those who are physically active. Drawing firstly on an evidence review that supported the 2008 Physical Activity Guidelines for Americans, Shiroma and Lee highlight 30 prospective cohort studies published between 1995 and 2007 that use self-reported data on physical activity to explore the risk of coronary heart disease. Conducted in the United States, the United Kingdom, Finland, Sweden, Canada, Israel and Norway, these studies had a total sample of more than 141,000 men and more than 263,000 women in gender specific analyses and more than 50,000 men and women in combined gender analyses. The conclusion from these 30 studies was that compared to their inactive counterparts, on average the most active men and women had a 30%-35% reduced risk of developing coronary heart disease. The threshold of 150 minutes of moderate-intensity activity a week was clearly associated with a risk reduction, but even small amounts of activity were seen to have an effect on reducing risk. These findings were on a par with those for the relationship between physical activity and cardiovascular disease.

The evidence for cardiovascular disease came from 20 prospective cohort studies also published during the same timeframe. These studies were conducted in the United States, Finland, the United Kingdom, Germany, Sweden, Norway, Canada and China and had a total sample of more than 68,000 men and 347,000 women in gender specific analyses and more than 88,000 men and women in combined gender analyses.

Four further prospective cohort studies published since 2008 are identified by Shiroma and Lee (2010). These found an average risk reduction for cardiovascular heart disease and coronary heart disease of around 40% (range 25% to 50%) for physically active people. Shiroma and Lee note that these findings cannot be considered as evidence of a causal relation due to their observational methodology but highlight that there is strong evidence available to support causality and, more importantly, there are biological mechanisms to support causality that have been demonstrated in randomised clinical trials.

Sattelmair et al. (2011) conducted meta-analysis of 33 prospective cohort studies to identify how much physical activity is required to reduce the risk specifically of coronary heart disease. These studies provided 30 assessments of leisure time physical activity, ten of which included quantitative data. Across the studies physical activity was associated with a 26% risk reduction for coronary heart disease, although this ranged between a 6% and 51% risk reduction across the studies. The risk was more greatly reduced amongst women than men, with studies conducted on men showing a 22% lower risk for physically active people when compared with the least active, and studies on women showing a risk reduction of 33%. Data from all studies showed that greater leisure time physical activity was associated with a reduction in the risk of coronary heart disease. In terms of quantity of physical activity, those who met the recommended guidelines of 150 minutes of moderate-intensity activity a week,

equivalent to between 3 and 6 METs or 550 kcal a week, had a 14% lower risk of coronary heart disease compared to their inactive counterparts. 300 minutes of moderate intensity activity or 1100 kcal a week was associated with a 20% lower risk of coronary heart disease. Sattelmair et al. also found that, *"Additionally lower risks of moderate magnitude were observed among those with higher physical activity levels; e.g., there was a 25% lower risk for those active at 5 times the basic guideline"* (2011, p.792), indicating a dose-response relationship. This corresponds with the findings of O'Donovan et al. (2010), who argue that the evidence of a dose-response relationship between physical activity intensity and cardiovascular disease is compelling. Furthermore, the NHS believes there to be compelling evidence for a 40% reduction in the risk of ischaemic heart disease by being physically active.

From eight cohort studies with a combined sample of over 370,000, O'Donovan et al. conclude that activities characterised by more than 6 METs, typically described as vigorous intensity, are associated with a lower risk of cardiovascular disease than moderate intensity activities which are characterised by 3-6 METs. Unlike in Sattelmair et al.'s research, this appears to be more so for men than women. The intensity of an activity will vary by an individual's health, fitness, age, gender and the effort he or she is putting into the activity. Moderate activity can be gauged as that which raises the heart rate and breathing but so that it remains comfortable to speak conversationally, whilst vigorous activity results in a higher heart rate, more intense breathing and difficulty in holding a conversation. A huge range of sports are appropriate for allowing an individual to reach a moderate or vigorous intensity workout even as their fitness improves. These include, but are not limited to, tennis, running, cycling, brisk walking, badminton and dancing.

In a randomised control trial Flynn et al. (2009) found aerobic physical activity to also be beneficial for patients already suffering from heart failure. A sample of 2,331 medically stable outpatients with heart failure from 82 health centres in the United States, Canada and France were randomly split into two intervention groups. One group received usual care and aerobic exercise training, which was delivered through 36 supervised sessions and then home-based sessions. Exercises included walking, running and cycling at 60% to 70% intensity three times a week whilst under supervision and then five times a week at the same intensity at home. The other group acted as a control by receiving the usual care only. A questionnaire assessed health status with a score between 0 and 100, where higher scores indicated better health. These questionnaires were completed at the beginning of the research, every three months for the first year and then annually for up to four years. At three months health scores had improved by an average of 5.21 points for those who had been exercising and by 3.28 points in the control group, and this difference was statistically significant. Following this initial three months there was no decrease in this benefit but neither group experienced significant changes. At an individual level an improvement of five points or more was deemed to be clinically noticeable. After 12 months half (53%) of the patients who were exercising had an improvement of five or more points compared to just a third (33%) of the control group, leading Flynn et al. to conclude that, *"Exercise training conferred modest but statistically significant improvements in self-reported health status compared with usual care without training. Improvements occurred early and persisted over time"* (2009, p.1451).

In addition, research has shown that the progression of coronary heart disease can be halted by an additional energy expenditure of around 1,600 kcal per week and that additional energy expenditure of around 2,200 kcal has been associated with plaque reduction for those who already have heart disease (Warburton, Nicol and Bredin, 2006a).

Hamer and Stamatakis (2009) utilised data from the Scottish Health Surveys in 1995, 1998 and 2003 to identify 837 men and women with clinically diagnosed cardiovascular disease. Follow ups took place at an average of five years and found that 175 of the sample had died. Participating in sport for at least 20 minutes a week resulted in a 68% lower risk of all-cause mortality for patients with cardiovascular disease, whilst walking for 20 minutes or more a week resulted in a 26% risk reduction. The findings were similar for mortality from cardiovascular disease, showing that even low levels of physical activity can contribute to the secondary prevention of mortality and in particular mortality from cardiovascular disease.

The Changing the Physical Activity Landscape (CPAL) programme is an NHS County Durham initiative designed to encourage people aged between 40 and 74 with an estimated or actual risk of cardiovascular disease greater than 20% to increase activity levels though local partnerships with a range of sports and activities. The aim is to bring about a measured increase in the level of both structured and unstructured physical activity after six months and to reduce the risk of cardiovascular disease. The NHS has committed £4.5 million to the programme over three years.

Participants are offered a range of activities which are delivered by 23 different organisations from the public, private, voluntary and community sectors; these include the Rugby Football Union, Amateur Swimming Association, the Ramblers and England Athletics. The project covers more than 100 of the top 30% most deprived wards across County Durham and is on course to meet the targets set by the NHS. At the end of December 2011, 8,409 people had benefitted from CPAL. Using a financial model developed by an independent consultancy, the most recent evaluation suggests that at the half way point in the programme it is achieving a return on the investment to date of £1.26 for every £1 invested. The evaluation also concluded that the programme has the potential to deliver up to £2.63 for every £1 invested by the end of March 2013, and a far greater return (£3.62 for every £1 invested) in the target group of those who are most at risk of cardiovascular disease (County Durham Sport and NHS County Durham, 2012).

DIABETES

One risk factor for cardiovascular disease is diabetes: people with diabetes are at least twice as likely to have cardiovascular disease than those without[16]. 2011 saw 2.9 million people diagnosed in the UK with diabetes. In addition, it is estimated that there are a further 850,000 people in the UK living undiagnosed with diabetes. This equates to more than one in 20 people (Diabetes UK, 2011). In adults diagnosed with diabetes, approximately 90% have type 2 diabetes, whilst 85% of children with diabetes have type 2. According to Diabetes UK, *"Type 2 diabetes develops when the body can still make some insulin, but not enough, or when the insulin that is produced does not work properly (known as insulin resistance). In most cases this is linked with being overweight"* (2011, p.3). It would therefore be logical that physical activity could have an impact on reducing prevalence of type 2 diabetes. Indeed, it is estimated that physical inactivity is the principal cause of 27% of diabetes globally (World Health Organisation, 2009). Currently in the UK diabetes is costing the National Health Service £286 a second, or around £9 billion a year, and the cost of 37.7 million prescriptions relating to diabetes in England in 2010 was nearly £713 million (Diabetes UK, 2011).

With regards to type 2 diabetes specifically, a prospective study of 5,990 men, 202 of whom developed type 2 diabetes, found that for every increase of 500 kcal of energy expenditure per week there was a 6% decrease in the incidence of type 2 diabetes (Helmrich et al., 1991, cited in Warburton et al., 2006a). In a randomised controlled trial over several years 3,234 non diabetic adults identified as at risk for type 2 diabetes were split into

16 World Heart Federation website (2012), *Diabetes*, http://www.world-heart-federation.org/cardiovascular-health/cardiovascular-disease-risk-factors/diabetes/, last accessed 23.08.2012.

three groups. One group took a placebo, the second took metformin and the third were prescribed a lifestyle modification programme that included a target of 7% weight loss and a minimum of 150 minutes of physical activity a week. Findings were that for every 100 person years in the placebo group the incidence of diabetes was 11.0 cases, for those taking metformin it was 7.8 cases, and for those with the physical activity lifestyle intervention it was 4.8 cases. In comparison to the placebo and prescribed drug, the lifestyle intervention was more effective in reducing the incidence of diabetes, having reduced it by 58% compared to 31% for metformin. The research concluded that, *"to prevent one case of diabetes during a period of three years, 6.9 persons would have to participate in the lifestyle-intervention program, and 13.9 would have to receive metformin"* (Knowler et al., 2002, p.393). This demonstrates that physical activity as part of a healthy lifestyle is twice as effective as drugs in preventing type 2 diabetes. It is also a fraction of the cost. Using the UK Diabetes data above, reducing type 2 diabetes in the UK by 6% through physical activity would not only enrich the lives of over 150,000 individuals but could save the NHS an estimated £4.9 billion a year[17].

Earlier academic research has focused on the specific biological changes brought about by physical activity that may be responsible for reducing diabetes. Ivy (1997) reviewed a range of epidemiological studies into the relationship between physical activity and both insulin resistance and type 2 diabetes. Highlighting that increased abdominal fat and a loss of muscle mass are associated with developing a resistance to insulin, Ivy concludes that regular physical activity can be beneficial in alleviating insulin resistance through causing fat loss around the abdomen. By preventing muscle atrophy and stimulating muscle development regular physical activity can also help to combat the reduced ability of insulin to stimulate muscle blood flow (as often occurs in insulin-resistant obese individuals and those with type 2 diabetes). Such benefits of muscle use and development would indicate that even when there is no weight loss, physical activity can be beneficial for type 2 diabetes. This was found by Balducci et al. (2010) in their 12 month randomised control trial. Balducci et al. concluded that physical activity, independent of weight loss, was associated with the reduction of hs-CRP[18] and other biological indicators of inflammatory and insulin resistance in patients with type 2 diabetes.

17 90% of 2.9 million people diagnosed with diabetes have type 2 diabetes; this is 2.61 million people. 2.9 million diabetics cost the NHS £9 billion a year, and this amounts to an average cost per person of approximately £3,100. 6% of 2.1 million people with type 2 diabetes is 156,600 people. 156,600 x £3,103.45 =£486,000,270

18 hs-CRP is a protein found in the blood. High base levels of hs-CRP are associated with an increased risk of diabetes.

Whilst there are benefits from physical activity generally, evidence shows that a combination of aerobic and resistance exercises is most beneficial for the management of type 2 diabetes. Church et al. (2010) explored the benefits of aerobic activity alone, resistance activity alone and both activities together on glycosylated haemoglobin[19]. The research consisted of a nine month randomised controlled trial with 262 men and women in Louisiana. All participants were sedentary, aged between 30 and 75, had type 2 diabetes and had glycosylated haemoglobin levels of between 6.5% and 11%. Alongside a control group that undertook stretching and relaxation classes, the participants were divided into an aerobic exercise group, a resistance exercise group and a combined exercise group, and all were supervised during exercising. The aerobic group undertook 150 minutes of moderate intensity exercise a week at a dose of 12 kcal/kg per week. The resistance group exercised three days a week, during which they carried out two sets of nine exercises. The combination group undertook resistance training of one set of the same nine exercises twice a week and carried out 150 minutes of moderate intensity aerobic exercise at a slightly lower dose of ten kcal/kg per week. Church et al. found that the aerobic group's exercise totalled between 623.7 and 681.9 MET/min per week whilst the combination group totalled between 532.0 and 572.8 MET/min per week.

In comparison to the control group, Church et al. found that there was a significant 0.34% reduction in glycosylated haemoglobin levels for those in the combination exercise group. The changes in the aerobic and resistance exercise groups were not significant compared to the control at a reduction of 0.24% and 0.16% respectively. Interestingly, when analysed by participants who had a glycosylated haemoglobin level of 7.0% or higher at the beginning of the research, aerobic exercise was seen to be effective in comparison to the control, with a reduction of 0.50% in glycosylated haemoglobin levels; for the combination group with this subset there was a 0.53% reduction. Using the measure of either a decrease in hypoglycaemic medication or a reduction in glycosylated haemoglobin levels of 0.5% without increasing medication as a primary outcome, Church et al. found that this occurred in 22% of the control group, 26% of the resistance exercise group, 29% of the aerobic exercise group and 41% of the combination exercise group. This means that type 2 diabetes patients who undertake 150 minutes of moderate intensity aerobic exercise and two resistance training sessions per week are 2.9 times more likely than their inactive counterparts to see an improvement in their levels of glycosylated haemoglobin.

A 2009 review of the evidence around exercise as a means of managing type 2 diabetes also explored the different impacts of aerobic and resistance exercise both independently and as combined factors. Zanuso et al. (2009) cite, amongst others, Kelley and Kelley's 2007 meta-analysis of seven studies which found that aerobic exercise reduced glycosylated haemoglobin and also reduced low-density lipoprotein[20] levels by around 5%. Kelley and Kelley (2007) focused on randomised controlled trials that had exposed participants with type 2 diabetes to supervised aerobic exercise for eight weeks or more. From seven studies in five different countries, the total sample was 220 men and women. Five of these studies had sufficient data to assess the impact of aerobic exercise on glycosylated haemoglobin; on average this was reduced by 0.4% in these studies.

The evidence on resistance exercise considered by Zanuso et al. supports the hypothesis that resistance exercises are beneficial for diabetes patients because they increase the skeletal muscle

19 Glycosylated haemoglobin can be used to measure average blood glucose levels over several months. Higher amounts of glycosylated haemoglobin indicate poorer control of blood glucose levels. Glycosylated haemoglobin levels of 6.5% or higher are associated with diabetes.

20 Low-density lipoprotein is a biochemical assembly that enables the transport of many different fat molecules, such as cholesterol, within the water around cells and within the water-based bloodstream. Increased concentrations of low-density lipoprotein particles are associated with the development of diabetes.

storage of glucose, which in turn improves glycaemic control. This aligns with the evidence from Ivy (1997) and Balducci et al. (2010) that shows physical activity can be beneficial for those with type 2 diabetes independent of weight loss. Early research highlighted by Zanuso et al. showed that whilst five months of progressive circuit resistance training didn't significantly reduce levels of glycosylated haemoglobin, it did prevent it from increasing, as a 0.4% rise was seen in the control group. This research also showed that resistance exercise reduced low-density lipoprotein cholesterol levels and reduced fasting triglyceride levels (Honkola et al., 1997, cited in Zanuso et al., 2009). Later, Castaneda (2002, cited in Zanuso et al., 2009) conducted a randomised controlled study with 62 older adults who either undertook high intensity progressive resistance training or were assigned to a non-exercise control group. Those who participated in resistance exercise had a 31% increase in muscle glycogen storage and a 1.1% reduction in glycosylated haemoglobin levels. Castaneda (2002) also found that medication for diabetes was reduced by 73% for those in the resistance exercise group compared to just 3% in the control group.

As Church et al. (2010) also found, Zanuso et al. conclude that evidence supports the notion that combined exercise is the most effective for patients with type 2 diabetes. Much of the research considered by Zanuso et al. (2009) is conducted with small samples. However the key findings largely hold true across the range of studies considered, including numerous other meta-analyses. As echoed by the findings of Church and colleagues, Zanuso et al. conclude that, *"the benefits of aerobic exercise are well documented and their effects in patients with type 2 diabetes are widely perceived to be beneficial for glycaemic control, weight loss, and the control of lipids and lipoproteins"*, and that *"resistance training has been shown to be beneficial with type 2 diabetic patients in a number of studies"*, whilst, *"a combined training program of strength and aerobic exercise could induce positive adaptations on glucose control, insulin action, muscular strength and exercise tolerance... Combined exercise training seems to determine additional change inHbA1c [glycosylated haemoglobin] that can be seen significant if compared with aerobic training alone and resistance training alone"* (Zanuso et al., 2009, pp.20-21).

It should be noted that the evidence assessed here by Zanuso et al. is not as robust as for aerobic and resistance exercise independently. Two studies focus only on the impact of combined programmes on postmenopausal women, and all but two have sample sizes smaller than 30. Of the two with larger sample sizes, one allowed for the

120 participants to self-select into an exercise or non-exercise group and no report was made on the post-intervention change between the two groups. This leaves only the work of Sigal et al. (2007) that stands up to scrutiny. Sigal et al. conducted a randomised controlled trial with 251 men and women aged 39-70 years and with type 2 diabetes. Participants were placed into an aerobic exercise group, a resistance exercise group, a combined exercise group and a no exercise control group. Those who were exercising did so three times a week and progressed in intensity and duration. For the aerobic group workouts progressed from 15-20 minute sessions at 60% of heart rate reserve to 45 minutes at 75% of heart rate reserve. The resistance group completed seven different exercises, progressing from two to three sets at the maximum weight that could be lifted for seven to nine repetitions. Participants in the combined exercise group did the full training of both the aerobic and resistance group. Glycosylated haemoglobin levels reduced significantly in the combined and resistance exercise groups, with 0.51% and 0.38% reductions respectively when compared to the control group. However, there was no statistically significantly difference between the groups for changes in blood pressure and lipid values.

The UK now has an ageing population due to increased life expectancy and a fall in birth rates. By 2035 it is thought that 23% of the UK population will be aged 65 or older, and it is estimated that 3.5 million of these will be aged 85 or over (Office of National Statistics, 2012). Alongside social, economic and political considerations there are of course significant health implications of this. Demakakos et al. (2010) found that for adults aged 70 and over, low intensity physical activity at least once a week was associated with a reduced risk of type 2 diabetes, whilst for adults aged between 50 and 69 the activity needed to be of moderate-vigorous intensity at least once a week. A sample of 7,466 men and women across England who did not have diabetes at the beginning of the research

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were followed on average for 45 months. After analysing the data by age, the research showed that the risk of type 2 diabetes was almost halved (hazard ratio 0.53) by low-intensity physical activity at least once a week for those aged 70 and over, whilst at this level of activity the odds remained around the same for those aged 50 to 59 years and 60-69 years (hazard ratio 1.09 and 1.15 respectively). But when those aged 50 to 59 years undertook moderate-vigorous intensity activity once a week or more, the risk of type 2 diabetes was reduced by half (hazard ratio 0.51). A risk reduction from moderate-vigorous intensity activity was still present in those aged 60-69, but was not as strong (hazard ratio 0.86). Interestingly, an increase in intensity of activity for those aged 70 and over did not have much of an effect on their risk of type 2 diabetes, with a hazard ratio amongst this group of 0.57.

MUSCULOSKELETAL HEALTH

Evidence shows that low intensity exercise and exercise that focuses on muscular strength and endurance can benefit health in people of all ages by helping in the treatment and maintenance of musculoskeletal conditions including osteoporosis, which causes one in three women and one in 12 men to develop broken bones during their lifetime (National Osteoporosis Society, 2004). Physical activity can lower the risk of falls and fractures, reduce pain, improve muscle strength and stamina, and improve balance, posture and morale. This is, however, also particularly relevant for the ageing population in the UK, as greater musculoskeletal health in old age facilitates independence amongst elderly people, and, furthermore, in the first year after a hip fracture the mortality rate for elderly individuals is 15-20% (Schurch et al., 1996, cited in Kohrt et al., 2004). There are two widely accepted strategies for musculoskeletal health: firstly to maximise bone mineral density during the first 30 years of life, and secondly to minimise decline in bone mineral density after the age of 40, when bone mass decreases by 0.5% a year or more (Kohrt et al., 2004).

Cardiovascular or aerobic activities alone are not thought to be the most effective for musculoskeletal health. Kohrt et al. (2004) propose that, in accordance with the principles of exercise training, overloading forces applied to bones stimulate an adaptive response, and in order for this to continue the overload must be increased progressively. This stimulation is the physical deformation of bone cells as opposed to metabolic or cardiovascular stress that results in increased fitness as measured by VO2max[21]. Nybo et al. (2010) divided 36 untrained men into three exercise groups and a control. One exercise group completed 12 weeks of intense interval running training for a total of 40 minutes a week, the second group participated in prolonged running for 150 minutes a week and the third group spent 150 minutes a week on resistance exercises. Despite the shorter exercise time, those who had carried out intense interval training had a 14% increase in VO2max compared to a 7% and 3% for prolonged runners and the strength training group respectively. However, interval running and prolonged running had no significant impact on total bone mass/skeletal health and muscle mass, whilst resistance exercises improved total bone mass from an average of 3.31kg before to 3.37kg afterwards and bone mass in legs increased from 1.29kg to 1.32kg. Whilst this sample is small and the research period relatively short, these findings on the nature of activity needed to improve bone health are generally supported by other research in the area.

For example, Kohrt et al. (2004) considered small randomised controlled trials and large observational studies on both animals and humans to determine the relationship between physical activity and bone health. They found sufficient evidence that activities such as tennis, jogging, stair climbing (characterised as weight-bearing), volleyball, basketball and other activities involving jumping and resistance exercise or weight lifting can preserve bone health in adulthood, but that gains in bone mineral density do not appear to remain if regular exercise stops.

21 VO2max is the maximum capacity an individual's heart, lungs and blood has for transporting oxygen to muscles and the utilisation of this oxygen during exercise. It is used to measure cardiorespiratory fitness.

Kohrt et al. propose that these activities need to be of moderate-to-high intensity and that weight-bearing activities should be undertaken three to five times a week, with resistance exercises undertaken two to three times a week.

Janssen and LeBlanc (2010) examined ten experimental studies on changes in bone mineral density in response to exercising amongst children. They concluded that when combined with general weight bearing aerobic activities known for cardiovascular benefits, such as jogging or football, as little as ten minutes of moderate-to-high impact activities a day, two or three times a week can have an effect on bone mineral density. High impact activities are those where both feet leave the ground simultaneously creating high-intensity ground-reaction forces, such as jumping, skipping, gymnastics and ballet. Jumping, for example, can create a ground-reaction force 6-8 times an individual's body weight, whilst gymnastics includes moves that can generate a force 10-15 times an individual's body weight. Walking, on the other hand, typically generates a force 1-2 times an individual's body weight (McNitt-Gray, 1993, cited in Kohrt et al., 2004).

A four year longitudinal study assessed the impact of jumping on bone mineral content in children. Gunter et al. (2008) studied 107 girls and 98 boys with an average age of 8.6 years at enrolment. The children were from a number of schools and were randomly assigned to an intervention group that incorporated jumping into the PE curriculum, and a control group that ran a similar PE curriculum without any jumping. The intervention lasted seven months but the effects were followed up for three years. Bone mineral content was assessed for the whole body, total hip, femoral neck and lumbar spine; all were found to be improved for the intervention group and the effect was greatest immediately following the seven month intervention. Total hip bone mineral content was 8.4% higher for the intervention group compared with the control, lumbar spine bone mineral content was 7.9% higher, femoral neck 7.7% higher and whole body 7.3% greater.

After controlling for confounding variables, the three year follow up also found greater bone mineral content for those who had jumped as part of their PE curriculum. Femoral neck bone mineral content was 4.4% greater than the control, total hip 3.2%, whole body 2.9% and lumbar spine 2.3%. The research concludes that, *"short-term high impact exercise in pre-puberty has a persistent effect over and above the effects of normal growth and development. If the benefits are sustained until BMC plateaus in early adulthood, this could have substantial effects on fracture risk"* (Gunter et al., 2008, p.710).

Moayyeri et al. (2010) analysed data from the European Prospective Investigation of Cancer – Norfolk Study to explore the risk of fractures in relation to leisure time physical activity and non-leisure physical activity such as housework. 14,903 men and women from the original data were analysed at an average age of 63 years amongst the 6,514 men and an average age of 61.5 years for the 8,389 women. Amongst these there were 504 fractures of any type, including 164 hip fractures. Information on physical activity was only gathered through self-completed questionnaires at the start of the Norfolk study in 1998, but included four sections of activity: activity in and around the home, during work, transportation to work and recreational physical activity. After adjusting for confounding variables, Moayyeri et al. found a positive association between levels of leisure time physical activity and broadband ultrasound attenuation[22]. High levels of leisure time physical activity were associated with an increase of 0.76 in broadband ultrasound attenuation levels, whilst conversely higher levels of physical activity in the home saw reductions of 0.42 in broadband ultrasound attenuation levels, demonstrating additional benefits when physical activity is undertaken recreationally.

This research found a U-shaped association between total levels of physical activity (in all scenarios) and risk of fracture amongst men. That is, the lowest and highest levels were associated with an increased risk whilst moderate levels of activity were not. This was similarly found with the risk of home and leisure time activities on hip fractures in women. However, more than 300 MET-h/week of leisure time physical activity significantly reduced the risk of hip fractures in men. Walking for less than 90 minutes a week, either for leisure or transport, was associated with a reduction in risk for any type of fracture in women (hazard ratio 0.71), and for hip fractures specifically the risk reduction was greater with a hazard ratio of 0.56.

22 Broadband ultrasound attenuation is an indirect measure of bone mineral density.

When genders and duration of walking were combined, analysis showed an overall reduction in the risk of fracture from walking (hazard ratio 0.74).

In addition, 2,623 of the participants recorded participation once a month or more in high-impact exercises such as mountain climbing, aerobics, running competitively, rugby, hockey, horse-riding and wrestling amongst others. Only six of the 164 hip fractures occurred in this population, and all were in women. Floor exercises, including yoga and dancing, were not associated with risk of fracture at all in this sample. Moayyeri et al.'s research does not seem to be conclusive (for example, higher broadband ultrasound attenuation levels did not translate to estimates for the risk of fracture) but it does suggest that moderate leisure time physical activity is beneficial for the prevention of fractures in men and women, but that there are gender differences in the optimum type and intensity of activity. The findings also indicate that activities like yoga and dance can reduce the risk of fractures, whilst high impact activities do not increase it.

Michaëlsson et al. (2007) conducted a longitudinal population-based study with 2,205 men aged 49-51 to explore the relationship between leisure time physical activity and an osteoporotic fracture over a 35 year period. 482 men had at least one fracture during this time. Michaëlsson et al. found that 20.5% of the men with low physical activity levels suffered a hip fracture in comparison to 8.4% of those with high physical activity levels. The researchers conclude that, *"according to the estimation of population-attributable risk, one third of all hip fractures could be prevented by participation in regular sports activities"* (Michaëlsson et al., 2007, n.p.). Currently it is thought that there are 70,000 instances of hip fractures in the UK each year and that the overall associated costs are almost £2 billion a year (National Hip Fracture Database, 2011). By Michaëlsson et al.'s estimations, over 23,000 of these could be prevented through sport, which could potentially equate to a saving of over £600 million.

Community dwelling older adults at risk of falls and subsequent injuries can reduce this risk through general exercise, muscle strengthening and balance programmes or Tai Chi according to Gillespie et al. (2009). 111 randomised and quasi-randomised trials on interventions to prevent falls gave a sample of 55,303 participants, mostly aged 60 and over, from 15 countries. 43 trials explored the effect of exercise on falls and in all but two trials exercises were supervised to some extent. Exercise interventions included walking, gait balance and functional training, strength/resistance training,

Tai Chi and square stepping. Gillespie et al. found that exercise classes that combined two or more categories of exercise significantly reduced both the rate of falls (pooled rate ratio 0.78) and also the risk of falling (pooled rate ratio 0.83). The studies also showed Tai Chai, which combines strength and balance training, to be effective in reducing the rate of falls (pooled rate ratio 0.63) and the risk of falling (pooled rate ratio 0.65). Gait, balance or functional training was seen to significantly reduce only the rate of falls (pooled rate ratio 0.73) but not the risk of falling, whilst other exercises had no significant impact. Additionally, data from Korpelainen's 2006 study showed a lower risk of fracture amongst women who exercised compared to the control group, with a 7% and 20% incidence of fracture respectively, although the sample size here was fairly small (160 participants). These findings suggest that activities that incorporate a combination of exercises are most beneficial for reducing the risk of falls for the elderly as they facilitate increased strength and better balance.

CANCER

The relationship between cancer and physical activity has been much examined, with the overall conclusion that routine physical activity can reduce the incidence of breast and colon cancer in particular. Globally it is estimated that physical inactivity is the principal cause for approximately 21-25% of breast and colon cancer (World Health Organisation, 2009). Professor Martin Wiseman, medical and scientific adviser for the World Cancer Research Fund (WCRF), has estimated that in Britain around 80,000 cases of cancer every year could be prevented if people ate better, maintained a healthy weight and exercised regularly (cited in The Daily Telegraph, 13 September 2010). The WCRF (2009) have concluded from their analysis of secondary data and a literature review that, *"regular sustained moderate and vigorous physical activity protects against colon cancer and probably against postmenopausal and endometrial cancer. It also protects against overweight and obesity and thus the cancers of which these are causes. It further protects against cardiovascular disease and a range of other chronic physical diseases, is good for psychological health, and improves general wellbeing."*

This statement indicates several relationships between physical activity and cancer. Evidence shows that regular exercise can reduce the incidence of breast and colon cancer and may reduce the risk of prostate, endometrial and lung cancer (Rajarajeswaran and Vishnupriya, 2009), reduce overweight and obesity – estimated to contribute to between 14 and 20% of all cancer-related mortality in the United States (Calle et al., 2003, cited in Kushi et al., 2012), enhance survival rates amongst breast, colorectal and pancreatic cancer patients and increase quality of life in all cancer patients.

BREAST CANCER

Eliassen et al. (2010) cite 11 studies on the association between physical activity and risk of breast cancer as finding between a 10-30% risk reduction for women with the highest levels of physical activity when compared to those with the lowest levels. The American Nurses' Health Study has previously found that moderate-to-vigorous intensity activity was associated with a lower risk of breast cancer. Using the same data, Eliassen et al. conducted further analysis to determine the importance of long-term and recent activity, changes in activity and specific types of activity. A sample of 95,396 married registered nurses aged 30 to 55 years at enrolment in 1986 completed a questionnaire in 1986, 1988, 1992, 1996, 1998, 2000 and 2004. The questionnaire recorded average time per week spent on each activity: walking/hiking outdoors, jogging, running, cycling, lap swimming, playing tennis, calisthenics/aerobics/aerobic dance/ rowing machine and squash or racketball. Usual walking pace (easy/casual, less than 2 miles per hour; normal/average, between 2 and 2.9 miles per hour; brisk, between 3 and 3.9 miles per hour; very brisk/striding, more than 4 miles per hour) and number of flights climbed daily were also recorded. From this information MET hours per week (MET-h/week) were calculated.

Follow up recorded 4,782 cases of breast cancer. Higher levels of activity were associated with significantly lower risk of breast cancer, with 27 MET-h/week or more associated with a hazard ratio of 0.85 compared to women who did less than 3 MET-h/week (hazard ratio 0.98). This was also the case with body mass index, and those with a body mass index of less than 25 had lower risk of breast cancer compared to those with a body mass index of 25 or higher (hazard ratios 0.88 and 0.91 respectively). Looking at changes in activity over time, Eliassen et al. found that women who increased their activity from less than 9 MET-h/week at menopause to at least 9 MET-h/week afterwards had a reduced risk of

THE AMERICAN PROSPECTIVE NURSES' HEALTH STUDY HAS PREVIOUSLY FOUND THAT MODERATE-TO-VIGOROUS INTENSITY ACTIVITY WAS ASSOCIATED WITH A LOWER RISK OF BREAST CANCER

breast cancer compared to women who did less than 9 MET-h/week throughout (hazard ratio 0.90). Similarly, those who did 9 MET-h/week or more at menopause and continued at this level had a lower risk (hazard ratio 0.93). However, women who did 9 MET-h/week or more at menopause and did not continue at this level or higher did not have a reduced risk (hazard ratio 0.97), indicating that the benefits of physical activity on the risk of breast cancer require regular and continued physical activity of at least 9 MET-h/week. From an activity-specific perspective, whilst no activities resulted in an increased risk of breast cancer, only brisk walking was statistically significant in its association with reduced risk. Five hours a week (20 MET-h/week) of brisk walking resulted in a hazard ratio of 0.91.

Eliassen et al. highlight that other prospective studies with samples larger than 500 have predominantly observed a lower risk of breast cancer from physical activity (nine studies in favour to three against). Their research confirms this and expands on the importance of recent activity and the impact of specific activities. Lynch, Neilson and Friedenreich (2011) support Eliassen et al.'s findings, concluding from 73 studies across the world that high levels of physical activity were associated with a 25% reduction in the risk of breast cancer compared to low levels of activity, and that leisure time physical activity, sustained activity both over a lifetime and or after menopause, and moderate-to-vigorous intensity activity performed regularly had the strongest associations. Whilst all participants in the Nurses' Health Study were married and marriage has been associated with mental and physical health benefits (see Rendall, Weden, Favreault and Waldron, 2011, for an up-to-date review), it should be noted that the consensus amongst research on marital status and risk of cancer is that there is little evidence of an association (for a discussion of relevant research see Helgeson and McUmber, 2010).

Patel et al. (2003) used data from the American Cancer Society Cancer Prevention Study II Nutrition Cohort to explore the association between physical activity levels and postmenopausal breast cancer risk. The final cohort consisted of 72,608 postmenopausal women without cancer in 1992 when the study began. They completed a self-administered questionnaire at the beginning of the study and at regular intervals throughout the five year follow up period, during which time 1,520 incidents of breast cancer were identified. Women who took part in more than 42.0 MET-h/week of physical activity in 1992 had a 29% lower incidence of breast cancer compared to women who did less than 7.0 MET-h/week. This threshold of 42.0 MET-h/week is considerably higher than the 27 MET-h/week explored by Eliassen et al. (2010). The UK guidelines of 150 minutes of moderate intensity activity would equate to around 7.5 MET-h/week. 60 minutes of moderate intensity activity a day, or 420 minutes a week, is equivalent to around 21.5 MET-h/week. From Patel et al.'s study, reducing risk of breast cancer by 29% would require two hours of moderate intensity activity a day, a goal that is not realistic for many. Patel et al. hypothesise that physical activity causes this reduction in risk by influencing ovarian hormone production. This aligns with other research that has shown a higher risk of breast cancer with higher circulating oestrogen and androgen levels (Eliassen et al., 2006, Kaaks et al, 2005, Missmer et al., 2004 and Key et al., 2002, cited in Eliassen et al. 2010).

The work of Eliasson et al. (2010) and Patel et al. (2003) shows considerable variation in the amount of recreational activity required to reduce breast cancer risk. 9 MET-h/week appears to be the minimum level of activity required to reduce risk of breast cancer (hazard ratio 0.90 compared to less than 9 MET-h/week), which can typically be covered by 30 minutes of vigorous activity three times a week or 60 minutes of moderate intensity activity three times a week.

However, 20 MET-h/week expended through five hours of brisk walking has been shown to reduce the risk of breast cancer with a hazard ratio of 0.91, whilst 27 MET-h/week or more, equivalent to around a minimum of 75 minutes of moderate intensity activity a day, reduces the risk further (hazard ratio 0.85 compared to less than 3 MET-h/week). In addition, two hours of moderate intensity activity can reduce the risk by 29%. These differences are likely to be heavily influenced by the cohort methodology and reliance on self-reporting of physical activity levels. A brief look at some of the other large cohort studies between 2003 and 2010 highlights further discrepancies in activity levels. Tehard et al. (2006) studied 90,509 French women aged between 40 and 65 years at the start of the research. Between 1990 and 2002 there were 3,424 cases of breast cancer in the cohort. Women who spent more than five hours a week doing vigorous leisure time physical activity had a relative risk of breast cancer of 0.62 compared to their counterparts who were inactive during leisure time. Analysing their data by total leisure time MET-h/week, Tehard et al. noted a relative risk of 0.88 for 22.3-33.8 MET-h/week compared to inactivity, and 0.81 for 33.8 MET-h/week or more. Leisure time activity reduced risk more than domestic physical activity. McTiernan et al. (2003) studied a sample of 74,171 women aged 50-79 years across America. During the period of the study (1993 -1998), 1,780 cases of breast cancer occurred. Women who walked at a brisk pace for between 75 and 150 minutes a week had an 18% decreased risk of breast cancer (relative risk 0.82) compared to their inactive counterparts, this amounts to between 5.1 and 10 MET-h/week. However, women who exercised at a rate of more than 40 MET-h/week had a 22% reduction in risk (relative risk 0.78).

Cohort studies therefore show that physical activity is effective in reducing breast cancer risk by between 10% and 30%, and this is particularly so for postmenopausal women. Longer duration or higher intensity activity such as 60 minutes of vigorous intensity or two hours of moderate intensity activity a day brings about the most benefits, but moderate activity like brisk walking for several hours a week can also be beneficial. Findings from case control studies considering total activity (domestic and leisure time) have found greater associations: in a review of 17 studies including case control and cohort studies, Rajarajeswaran and Vishnupriya (2009) concluded that there is convincing evidence that physical activity reduces the risk of breast cancer by an average of 30-40%. Monninkhof et al. (2007) considered the evidence on physical activity and breast cancer risk from 19 cohort studies and 29 case control studies and also found that it was convincing, citing a 20-80% risk reduction in postmenopausal breast cancer, and an overall reduction of 15-20% from physical activity.

A recent case control study on 800 women in Tunisia conducted by Awatel et al. (2011) supports the trend for greater associations evidenced from case controlled studies. 400 women aged 25-75 years had breast cancer, the other 400 did not. All women completed a questionnaire on the types of physical activity they undertook and the duration, frequency and intensity of these. Women with breast cancer had lower lifetime averages in total physical activity than the control group; this was the case when measured in actual hours of exercise and MET hours. High levels of total physical activity led to a significant reduction in risk of breast cancer compared to low levels (odds ratio of 0.27 for high levels of activity and 0.42 for low levels). Postmenopausal women who were physically active had a greater reduction in risk (68%). Similarly, Ratnasinghe et al. (2010) conducted a multinational case control study with 1,463 breast cancer patients and 4,862 controls without breast cancer and after adjusting for confounding variables found that physical activity once a week or more gave women a 50% lower risk of breast cancer than those who exercised less than once a week.

Across all ethnic groups in the study (Caucasian-Americans, African-Americans, Hispanic-Americans, Tunisian-Arabs and Polish-Caucasians) physical activity of more than 30 minutes a week led to a minimum of a 35% reduction in risk.

COLON CANCER

There is also convincing research evidence for physical activity levels leading to a reduced risk of colon cancer. Wolin et al. (2009) conducted meta-analysis on 52 case control or cohort studies with a colon cancer end point. Physical activity in these studies included leisure time, domestic, occupational and commuting activity. Results showed a significant 24% reduction in the risk of colon cancer and little difference by gender (relative risk for men was 0.76 and for women was 0.79) or the structure of the studies. Ten case control studies and 16 cohort studies had data specifically on leisure time physical activity; these showed a similar risk reduction with a relative risk of 0.77 but this was greater in the cohort studies examined (relative risk 0.82) compared to the case control studies (relative risk 0.69) examined.

Using a sample of 83,767 female participants in the Nurses' Health Study, Wei et al. (2009) explored risk factors for incidence of colon cancer before the age of 70. 701 cases of colon cancer occurred in the sample between 1980 and 2004. Being consistently physically active at a level of 21 MET-h/week (around 60 minutes of moderate intensity activity a day) was associated with a 49% risk reduction in comparison to activity levels of 2 MET-h/week. Wolin et al. (2010) found further support for regular, high levels of physical activity and an inverse relationship with colon cancer. In a 156,331 mixed gender cohort from the American Cancer Society Cancer Prevention Study II Nutrition Cohort, 1,863 incidents of colon cancer and 846 fatal colon cancers were identified. This prospective study looked at changes in activity levels over ten and 15 years. Whilst changes in levels over time were seen to have no association (potentially due to only 4% of the sample increasing their activity levels over four years), at the ten year follow up, participants who had regularly exercised for 30 MET-h/week or more were 30% less likely to develop colon cancer compared to their inactive counterparts. Although no relationship for risk was seen at 15 years, further analysis revealed that consistent activity over time was still beneficial, as after 15 years these participants had a significantly reduced risk of death from colon cancer (hazard ratio 0.45).

CANCER AND OBESITY

Patel et al. (2005) also examined data from the American Cancer Society Cancer Prevention Study II Nutrition Cohort to assess the relationship between recreational physical activity, obesity and pancreatic cancer; they found that obesity was associated with double the risk of pancreatic cancer. The final cohort consisted of 145,627 men and women aged between 50 and 74 in 1992 when the study began. At enrolment, participants completed a ten page self-administered questionnaire that amongst other things gathered information on height and weight (for calculating body mass index) and frequency, type and intensity of physical activity undertaken; from 1997 onwards this questionnaire was sent out every two years for participants to self-complete. Patel et al. conducted their analysis from seven years of follow up, in which time there were 242 incidents of pancreatic cancer.

Taking a body mass index of over 30 as indicating overweight or obesity, Patel et al. found that compared to men and women of normal weight (defined by a body mass index of between 18.5 and 24.9), those with a body mass index of more than 30 had a relative risk of pancreatic cancer of 2.08. Furthermore, a body mass index of more than 23 at the age of 18 meant a 33% greater risk of pancreatic cancer in comparison to those with a body mass index of less than 21 at age 18. Patel et al. note that their findings on body mass index obesity and the risk of pancreatic cancer aligned with seven of eight previous studies observing large samples and the impact of a body mass index higher than 30. These seven studies found an increased risk of pancreatic cancer ranging from 20 to 180% for this group, with the eighth reporting no association, although the researchers noted that other additional studies had evidenced no association and that these differences were likely to be a result of methodology. However, Patel et al.'s study found no statistically significant relationship between leisure time physical activity levels and the risk of pancreatic cancer. This was confirmed by Bao and Michaud's (2008) systematic review of physical activity and the risk of pancreatic cancer and O'Rorke et al.'s (2010) systematic review and meta-analysis on the topic.

Parr et al. (2010) did not find obesity to increase the risk of pancreatic cancer amongst a large, diverse Asia-Pacific cohort (Asia, Australia and New Zealand), but did find it to increase all cancer overall and seven specific types of cancer. From 39 cohort studies Parr et al. analysed pooled data for 424,519 male and female participants with a mean age of 48 years. The final sample of 401,215 participants experienced 4,872 cancer deaths. Analysis adjusted for confounding variables found an increased risk of all-cause cancer mortality in obese (defined by a body mass index of 30kg/m2 or more) participants at a hazard ratio of 1.21 compared to those with a normal weight (defined by a body mass index between 18.5 and 24.9kg/m2). When explored, the risk of mortality was higher for seven specific cancers. Hazard ratios for obese participants compared to normal weight participants were 4.21 for cervix cancer, 2.62 for ovary cancer, 1.68 for rectum cancer, 1.66 for leukaemia, 1.63 for breast cancer in women aged 60 or over, 1.50 for colon cancer and 1.45 for prostate cancer. Overall, there was very little evidence of differences in risk by regions.

However, UK-based research on the Million Women Study found increased body mass index was associated with a significantly increased risk in ten of the 17 most common types of cancer. Reeves et al. (2007) conducted a prospective cohort study with 1.2 million women aged between 50 and 64 at enrolment. The participants were followed up for cancer incidence (average 5.4 years) and cancer mortality (average 7.0 years). 45,037 cases of cancer occurred and there were 17,203 mortalities. Reeves et al. concluded that amongst postmenopausal women in the UK, around 6,000 cases of cancer a year are attributable to being overweight or obese, which equates to 5% of all

cancers in the UK. Compared to those of a normal weight (defined in this study as a body mass index between 22.5 and 24.9kg/m2), the relative risk for all cancers for those with a body mass index of 30kg/m2 or more was 1.12, and the relative risk of mortality from all cancers was 1.14. Of the specific cancers where an increased risk was evidenced for those with a body mass index of 30kg/m2 or more, the highest risks were for endometrial cancer (relative risk 2.73), adenocarcinoma of the oesophagus (relative risk 2.54) and kidney cancer (relative risk 1.52). For risk of a cancer-specific mortality the highest risks were also seen with these three cancers: adenocarcinoma of the oesophagus, relative risk 2.75, endometrial cancer, relative risk 2.28, and kidney cancer, relative risk 1.71.

It has already been documented that 250 minutes or more of moderate intensity physical activity can help address overweight and obesity (Donnelly et al., 2009). We have now also seen clear evidence that this in turn can reduce the risk of multiple types of cancer. This is not taking into consideration the influences that other obesity related conditions, such as diabetes, can have on risk of cancer and the impact of physical activity on these risk factors.

CANCER PATIENTS AND SURVIVORS

Physical activity is also held to be beneficial for improving the health and quality of life for people diagnosed with cancer. Traditionally, rest was thought to be beneficial for patients recovering from cancer, however research shows that physical activity is important for treating symptoms such as anxiety, fatigue and impaired mobility, improving quality of life in cancer patients and increasing chances of survival. As a result, Macmillan Cancer Support (2011) has calculated that of the 2 million cancer survivors in the UK, 1.6 million are not currently physically active to recommended levels.

Recommended levels in the UK for cancer patients are the same as those for the general population at 150 minutes of moderate intensity activity a week, but this should be gradually built up. The American Cancer Society recommends a higher dose of 150-300 minutes of moderate-to-vigorous intensity activity a week but the general consensus is that any level of physical activity is preferable to sedentary behaviour (Davies, Batehup and Thomas, 2011). From a range of evidence Macmillan concluded that, *"physical exercise for people with a cancer diagnosis is vital"* (2011, pg.4). A 12 week physical activity programme with 200 cancer survivors in Bournemouth found that in year one 100% experienced a boost in their self-image, 97% reported improved wellbeing, 94% felt less tired, 93% had improved cardio fitness and 59% lost weight. In addition, for those with high blood pressure, 90% experienced a decline, demonstrating clear health benefits (Macmillan, 2011).

Research carried out at the University of Hong Kong supports the Macmillan findings. Fong et al. (2012) conducted analysis on results from 34 different trials that assessed the effects of physical activity for adult cancer patients. Trials had an average of 93 patients who had suffered from one of six types of cancer. It was concluded that patients who had received breast cancer treatment and then taken part in physical activity programmes had improved health with regards to their blood sugar control, BMI and body weight, physical functions (such as limb strength), psychological outcomes (such as depression) and quality of life. Patients who had received treatment for other types of cancer had improved health with regards to their BMI, body weight, physical functions (such as oxygen consumption), depression and quality of life.

Davies, Batehup and Thomas (2011) conducted a literature review on the role of physical activity and diet in breast, colorectal and prostate cancer survivors to update a 2010 literature review they undertook for the National Cancer Survivorship Initiative. They concluded that *"regular physical activity is associated with improved cancer prognosis for breast, prostate and colon cancer survivors... Overall, the evidence suggests that the physical activity recommendations of the Department of Health (2011) are sufficient for cancer survivors – a total of at least 30 min a day of moderate-intensity physical activity on 5 or more days of the week"* (2011, n.p.). This echoes the more limited findings of a 2010 systematic review on physical activity and cancer survival, which considered only ten prospective cohort studies but nonetheless concluded that, *"patients diagnosed with cancer demonstrated a trend toward increased survival with greater levels of physical activity"* (Barbaric et al., 2010, p.25).

Examining the evidence for each type of cancer individually the research summarised by Davies, Batehup and Thomas is compelling; Irwin et al. (2008) found that women with breast cancer who were physically active at a level of 9 MET-h/week or more two years after diagnosis were considerably less likely to die (hazard ratio 0.33) than women who were inactive before and after diagnosis. Irwin et al. also found that whilst women who increased their physical activity levels after diagnosis almost halved their risk of mortality (hazard ratio 0.55), for those who decreased activity levels, the risk of mortality increased fourfold (hazard ratio 3.95). Similarly Holick et al.'s (2008) prospective study of 4,482 breast cancer survivors found that physical active of 2.8 MET-h/week was associated with a 35-49% reduction in risk of mortality from breast cancer.

More recently, Patterson et al. (2010) systematically reviewed leisure time physical activity and breast cancer survivors and concluded an association of a 30% decreased risk of mortality, whilst meta-analysis of six small studies from Ibrahim and Al-Homaidh (2011) found post-diagnosis activity reduced mortality from breast cancer by 34%, all-cause mortality by 41% and disease recurrence by 24% (all cited in Davies, Batehup and Thomas, 2011).

The evidence drawn on by Davies, Batehup and Thomas for physical activity and prostate cancer survivors includes Kenfield's (2010) prospective study of 2,686 men from the Health Professionals Follow-Up Study. Kenfield found that engaging in more than 3 MET-h/week after diagnosis reduced risk of all-cause mortality by 35% compared to those who did less activity. In addition, walking for 90 minutes a week at a normal-brisk rate was associated with a 51% reduction in risk of all-cause mortality in comparison to men who walked at an easy pace less than 90 minutes a week. However, in order to reduce the risk of cancer-specific mortality, men needed to engage in more vigorous activity. A more recent randomised controlled trial (Bourke et al., 2011, cited by Davies, Batehup and Thomas, 2011) showed that patients who received a 12-week lifestyle programme of aerobic and resistance exercise combined with dietary advice had increased quality of life compared to the control group. Although the sample was small at 50 men, the lifestyle programme group had improved exercise behaviour, dietary fat intake, total energy intake, fatigue, aerobic exercise tolerance and muscle strength.

For colorectal cancer survivors, the evidence from Davies, Batehup and Thomas is not as substantial, although it includes interesting findings from Haydon et al.'s (2006) observational study of 526 colorectal cancer survivors. Haydon et al. saw that at least one session of physical activity a week prior to diagnosis was associated with a greater chance of survival post-diagnosis – giving a 73% chance of five year survival compared to 61% for those who were active less than once a week.

Meyerhardt et al. (2009) also used data from the Health Professionals Follow-Up Study. From 661 male participants with colorectal cancer there were 88 colorectal cancer specific deaths and a further 170 deaths. Participants were divided into the following physical activity categories: 3 MET-h/week or less (15.4% of participants), 3.1-9 MET-h/week (18.9% of participants), 9.1-18 MET-h/week (15.3% of participants), 18.1-27 MET-h/week (12.3% of participants), and more than 27 MET-h/week (38.1% of participants). In comparison to men who expended 3 MET-h/week or less, men reporting between 18.1 and 27 MET-h/week had a hazard ratio of 0.76 for mortality from colorectal cancer and 0.74 for all-cause mortality. Expending more than 27 MET-h/week had a greater impact, with a hazard ratio of 0.47 for colorectal cancer mortality and 0.59 for all-cause mortality.

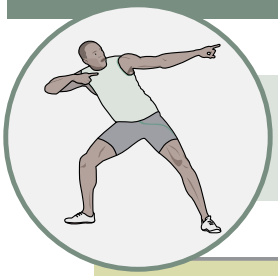
Further analysis by Meyerhardt et al. revealed that between 6-12 MET-h/week were beneficial for protection from mortality, whilst after 35 MET-h/week no additional benefits were seen. At a five year follow up, the proportion of men free of colorectal cancer mortality who engaged in less than 3 MET-h/week was 85.2% compared to 87.4% of men who engaged in between 3 and 27 MET-h/week and 92.1% for men engaging in more than 27 MET-h/week. At a ten year follow up, the proportions were 79.4%, 81.2% and 88.3% respectively.

CONCLUSION

The physical health benefits of leisure time physical activity are considerable. For optimum gain a range of activities – aerobic, resistance and weight bearing – should be undertaken regularly. For many health benefits, such as reducing the risk of cardiovascular disease and mortality and the risk of breast and colon cancer, a dose-response relationship has been evidenced. This highlights that some physical activity is better than none, and actually gains can be made up to a point by going beyond the recommended Government guidelines of 150 minutes of moderate-vigorous intensity a week. In order to tackle the obesity epidemic, physical activity is best combined with a dietary intervention and once weight is lost it is extremely effective for weight maintenance. Whilst obesity itself is a major health issue, there are health benefits such as musculoskeletal strength and improved management of type 2 diabetes that appear to come from improved fitness rather than a lower body weight or body mass index.

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

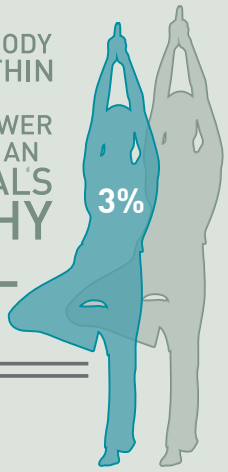
Obesity	1	£1,548
Diabetes	2	£2,740
Cardiovascular Disease	3	£4,370
Depression and Anxiety Disorders	4	£880
Dementia	5	£571

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 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

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

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.

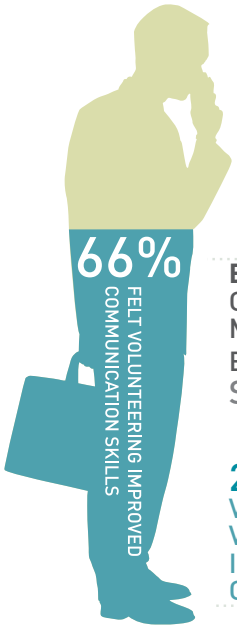
From the findings of the project, Neumark-Sztainer made five recommendations aimed at health care providers to aid in the prevention of adolescent obesity and eating disorders. Of interest are the first and fourth recommendations. The first was that healthy eating and physical activity behaviours that 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.

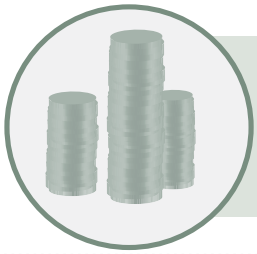
CONCLUSION

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.

PHYSICAL ACTIVITY, EMPLOYMENT & EDUCATION





30 MINUTES 3 X A WEEK COULD TRANSLATE TO
C.7.5%
INCREASE IN EARNINGS

EMPLOYERS IDENTIFY COMMUNICATION AS THE MOST IMPORTANT SKILL FOR EMPLOYMENT (AVERAGE SCORE OF 8.8 OUT OF 10)

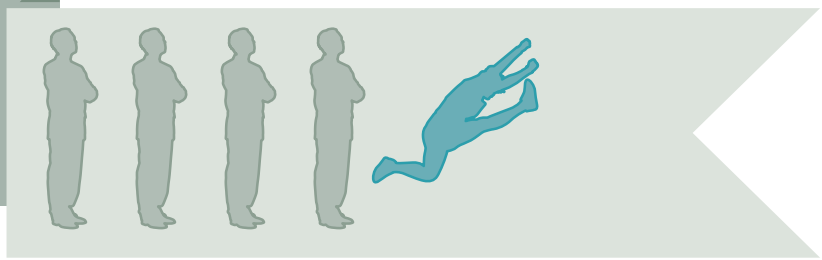
2 IN 3 EMPLOYEES WHO VOLUNTEER (66%) FELT VOLUNTEERING HAD IMPROVED THEIR COMMUNICATION SKILLS

1 IN 10
16-18 YEAR OLDS = NEET

AVERAGE COST IN PUBLIC FINANCING PER NEET OVER A LIFETIME
= £56,000

80%
EMPLOYERS VALUE VOLUNTEERING ON A CV
AND
9 IN 10 (87%)
EMPLOYERS BELIEVE THAT VOLUNTEERING CAN HAVE A POSITIVE EFFECT ON CAREER PROGRESSION

THE AVERAGE SPORTS CLUB HAS
20 VOLUNTEERS.
OF THE **23.7%** OF ADULTS IN ENGLAND WHO VOLUNTEER
1 IN 5 VOLUNTEER IN SPORTS AND RECREATION.



EMPLOYERS AREN'T SATISFIED WITH THE SKILLS OF SCHOOL/COLLEGE LEAVERS:

- EMPLOYERS NOT SATISFIED WITH GRADUATES' SELF-MANAGEMENT SKILLS — **61%**
- EMPLOYERS NOT SATISFIED WITH GRADUATES' PROBLEM SOLVING SKILLS — **46%**
- EMPLOYERS NOT SATISFIED WITH GRADUATES' TEAM-WORK SKILLS — **32%**

CHILDHOOD MEMBERSHIP OF A SPORTS CLUB INCREASES LIKELIHOOD OF BEING ACTIVE AS AN ADULT

AGE 14

20 MINUTES
SPORTS AND RECREATION
ONCE A DAY

EDUCATION AND YOUTH PARTICIPATION IN SPORTS AND RECREATION A+

PHYSICAL ACTIVITY POSITIVELY EFFECTS COGNITION IN CHILDREN.

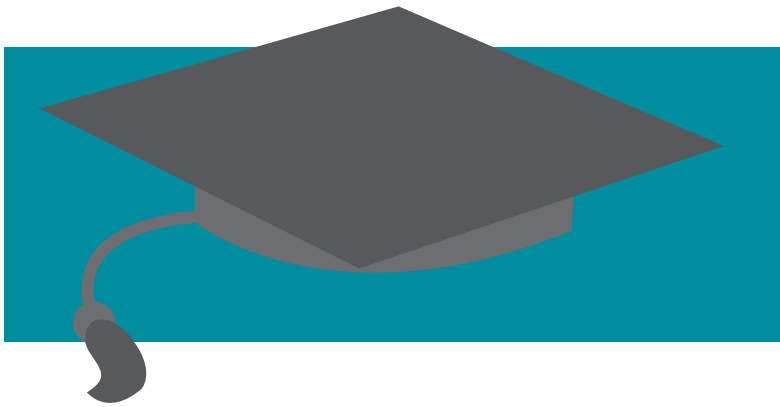
BEING PHYSICALLY ACTIVE RELEASES HORMONES, NEUROTRANSMITTERS AND A PROTEIN RESPONSIBLE FOR LEARNING, MEMORY AND HIGHER THINKING.

SPORT AND RECREATION CAN ALSO LEAD TO INCREASED SELF-ESTEEM AND THE DEVELOPMENT OF MOTIVATION AND DETERMINATION - THESE SKILLS ARE USEFUL FOR ACQUIRING NEW INFORMATION FOR PASSING EXAMS.

AGE 31

MEN:
4 X MORE LIKELY TO PARTICIPATE IN SPORT AND RECREATION FOR **20 MINUTES 4 X A WEEK +**

WOMEN:
3 X MORE LIKELY TO PARTICIPATE IN SPORT AND RECREATION FOR **20 MINUTES 4 X A WEEK +**



PHYSICAL ACTIVITY, EDUCATION AND EMPLOYMENT

EDUCATION: INTRODUCTION

Education is compulsory for children aged five to 16 in the UK and is essential for tackling poverty and social exclusion. Basic educational attainment will help in finding well paid employment in adulthood, but the children of those in poverty are less likely to reach this level, thus contributing to intergenerational poverty (New Policy Institute, 2011). In addition, leaving school without qualifications doubles the likelihood of depression as young adults. At age 23, men without qualifications have a 7% chance of being depressed compared to a 3% chance in all men, whilst women at this age without qualifications have a 17% chance compared to a 9% chance amongst all women (London School of Economics, 2007).

In 2010/11 58% of pupils achieved five or more A* to C grade GCSEs or equivalent, including maths and English (Department for Education, 2012a), meaning that two in five pupils are leaving school at 16 without five good GCSEs. This has contributed to disengagement amongst 16 to 18 year olds who leave school with no direction and minimal qualifications and find themselves not in employment, education or training (NEET). The first quarter of 2012 saw one in ten (9.8%) 16 to 18 year olds in England categorised as NEET (Department for Education, 2012b). In an economic climate where the rate of youth unemployment is 21.9% (Rhodes, 2012) and an average of 73 students are thought to be applying for every graduate position (Association of Graduate Recruiters, 2012), young people need to arm themselves with all the educational qualifications and training they can.

Being NEET seriously influences the long term life chances of individuals, reducing earnings over a lifetime and increasing the likelihood of mental illness and a criminal record. For example, over their lifetime, men who have experienced time as NEET are five times more likely to have a criminal record and three times more likely to have depression. Furthermore, the cost to society over a lifetime will be significant. It is estimated that each young person classed as NEET in 2008 will go on to cost an average of £56,000 in public finance costs (e.g. welfare payments, loss of tax, etc.) and £104,000 in opportunity costs (e.g. loss to the economy, welfare loss to individuals and their families, etc.). The total estimated lifetime costs for this cohort is more than £35 billion (Audit Commission, 2010).

The National Curriculum states that children should participate in PE but doesn't specify how many hours PE or out of hours school sport children should be taking part in. In the academic year 2009/2010, just over half (55%) of pupils in Years one to 13 participated in at least three hours of PE and out of hours school sport (Quick et al. 2010). Yet in addition to the physical and mental health benefits physical activity is proven to have, evidence also suggests that physical activity can benefit academic performance and behaviour in class. For example, a 12 week study with 243 schoolchildren aged nine-ten years old found that daily ten minute physical activity breaks significantly increased on-task behaviour by 8% on average, and that the average was a much higher 20% for the least on-task pupils, whilst those who took a ten minute break without being physically active demonstrated a 3% reduction in on-task behaviour (Mahar et al., 2006).

The brain is high in plasticity during childhood and adolescence as functions and structures change alongside individual development. It is not suggested that physical activity in itself can make children cleverer, but that physical activity releases hormones, neurotransmitters and a protein which are responsible for learning, memory and higher thinking. Physical activity also increases cellular components that (amongst other things) support the systems in the brain that are responsible for learning, decision making and memory. Increased physical activity can also lead to increased self-esteem as a result of better body image and accomplishing physical achievements. This can help children to develop motivation and determination, skills which are particularly useful in acquiring new information for passing exams.

IMPACT ON ACADEMIC ATTAINMENT

An association between school sports and academic achievement was first proposed in 1934 by Davis and Cooper. There is now a wide range of research into this relationship with the consensus that in the majority of instances physical activity enhances school performance and that where it has not been evidenced to do so, school performance has not suffered conversely. In considering the additional benefits of physical activity (such as physical and mental health) it is therefore still a worthwhile and beneficial inclusion to the curriculum. The most recent review of the evidence around physical activity levels and school performance focuses on ten observational studies and four intervention studies conducted between 1990 and 2010. These involved children aged between six and 18 with sample sizes varying from 53 to over 12,000 and durations of between eight weeks and five years. Singh et al. (2012) conclude that there is a positive relationship between participation in physical activity and academic performance in children but that many studies into this relationship are not of a high enough quality and that the dose-response relationship is not sufficiently understood.

An earlier meta-review of 14 studies conducted between 1967 and 2006 with a total sample of almost 60,000 students found that in 11 of the studies regularly participating in physical activity had a positive association with academic performance (Active Living Research, 2009). One study cited was carried in out in the United States in 2006 with almost 12,000 students and found that participation in PE and team sports at school or playing sports with parents was associated with a 20% increase in the likelihood of achieving an A* in maths or English when compared to sedentary peers (Ibid).

INCREASED PHYSICAL ACTIVITY CAN ALSO LEAD TO INCREASED SELF-ESTEEM

A cross sectional study of 1,820 Spanish adolescents (aged between 13 and 18.5 years old) measured cognitive performance and participation in leisure time physical activities. Verbal, numeric and reasoning abilities were tested to determine an overall cognitive performance score. Leisure time spent studying, watching television, playing video games and participating in physical sports were self-reported by participants at levels of not at all, three hours a day or less and more than three hours a day. Participants were also assessed for cardiorespiratory and muscular fitness and were categorised by weight (underweight, normal weight, overweight or obese). Ruiz et al. (2010) found that independent of potentially confounding variables (such as socioeconomic status), participating in physical activity was significantly associated with better cognitive performance, with an overall cognitive performance effect size of 0.32 (classed as a medium effect). Interestingly, this research found that neither fitness nor weight were related to cognitive performance, suggesting that the physiological processes related to the activity itself have more of an impact on ability to learn than overall fitness does. The researchers found that physical activity was the only leisure time activity to have an association with cognitive performance – even studying during leisure time wasn't seen to influence cognitive performance.

The study also found no relationship either way between participating in physical activity in leisure time and spending time studying, in that being active did not detract time from studies or make children more likely to spend time studying. However, it did find that being active lowered the odds ratio for watching television for three or more hours a day (odds ratio of 0.63 for those who participated in physical activity compared to a non-participant reference point of 1). This suggests that physical activity in adolescents can contribute to preventing the detrimental effects of time spent being sedentary.

Sedentary behaviour, rather than being the converse of physical activity, is time spent being largely inactive, such as sitting watching television or socialising with family. The negative effects of sedentary behaviour are thought to be independent of participation in physical activity and include an increased risk of type 2 diabetes, cardiovascular disease and mortality. It has been argued that childhood is a key time for targeting and reducing sedentary behaviour given that evidence shows sedentary behaviour patterns to be fairly stable over time during childhood and adolescence. Children in England aged between four and seven spend a total of between six and seven hours a day sedentary, and this increases to between eight and nine hours at age 12 to 15 (British Heart Foundation, 2012). Given that it is possible for someone to spend high levels of time being both physically active and sedentary, the relationship found by Ruiz et al. (2010) is encouraging as it indicates that amongst adolescents physical activity precludes sedentary behaviour. Not only could physical activity interventions increase educational attainment amongst young people, there is also the potential that they could help to establish good habits for reduced sedentary behaviour, which would be beneficial over a lifetime.

In fact, longitudinal and cohort studies have found that participation in sport and recreation at school age influences levels of physical activity as adults. A Finnish sample of 7,794 men and women was surveyed at age 14 and 31 to understand the type, intensity and duration of physical activity they participated in. Tammelin et al. (2003) then classified respondents into one of four activity level groups defined as very active, active, moderately active and inactive. The very active group was characterised by brisk exercise for a minimum of 20 minutes four times a week or more, whilst the active group exercised at the same level on two to three occasions a week. Moderately active participants were those who were active once a week at a brisk level, or more often than once a week but for less than 20 minutes at a time, or in light physical activity on four or more occasions, whilst the inactive group participated in brisk activity less than once a week and light activity less than four times a week.

The researchers found that in comparison to those who participated in activity less than once a week at age 14, men who were physically active at least twice a week at this age and women who were active at least once a week were more likely to be active or very active at age 31. Men who were physically active every day at aged 14 were around four times as likely to be very active at age 31 compared to the least active, and women almost three times as likely. Interestingly, membership of a sports club as a child increased the likelihood of continuing to be active as adults amongst this sample. This was also found by Kjønniksen, Anderssen and Wold (2008) in their smaller study based in Norway. The researchers conducted a longitudinal study over ten years with a final sample of 630 people, assessing activity levels and engagement with physical activity eight times between the ages of 13 and 23. They too found that levels of organised physical activity in childhood positively influenced participation in leisure time physical activity as a young adult and that membership of a sports club, the age of initial involvement in physical activity and the duration of involvement in physical activity as a child influenced activity levels as a young adult, concluding that membership of organised youth sports at an early age continued through adolescence increased the likelihood of being physically active at age 23.

Taras (2005) reviewed the association between physical activity and student performance at school. He states that it has widely been perceived as common sense that physical activity helps children perform better in school. This is based on the evidence that physical activity improves circulation and blood flow to the brain, thus raising levels of norepinephrine and endorphins which may reduce stress, improve mood and have a calming effect, thereby increasing academic performance. From reviewing 14 pieces of research conducted between 1987 and 2003, again with a total sample of almost 60,000 school aged children (aged between five and 18 years old), nine studies were seen to show a significant relationship between physical activity level and academic performance, although often this was weak, and the remainder showed no correlation. Evidence was focused more on the immediate effects of physical activity on learning, such as improved concentration directly following activity, as opposed to any longer term benefits from physical activity.

Concerns have been expressed in the past by teachers and parents alike that time spent undertaking physical activity at school results in less time spent undertaking academic studies and will therefore negatively impact academic performance. An increasing body of evidence is showing that whilst participation in physical activity means that less time is spent studying, the rate of academic learning is higher so the same results are achieved with less time studying. Some of the earliest studies to explore this are covered by Shephard (1996).

The main study considered by Shephard involved 546 primary school students in Québec who were followed from grade one until grade six and who received an additional one hour of physical activity a day. The classes directly preceding and succeeding these students were used as a control group; they spent 13%-14% more time learning academically than the physical activity students. 2,282 report cards were evaluated to give an overall student performance score for the year. Initially, students in the control group had better grades but in grades two through to six, students who were exercising for an hour a day significantly outperformed the control students. For example, in maths the average score was 23.8 amongst the active participants and 18.5 in the control group. However, languages and overall intelligence were not seen to improve (Shephard et al., 1984, cited in Shephard, 1996). In another study conducted on school students in Paris, half of each school day was assigned to physical activity, described as gymnastics, swimming, physical training, sport and athletics. The students who participated in these levels of activity received 26% less academic teaching time than the control group, but this was found to have no detrimental impact on academic attainment (Hervet, 1952, cited in Shephard, 1996).

In a broad literature review into the impact of physical activity, nutrition and obesity on cognitive ability and school performance, Burkhalter and Hillman (2011) conclude that the evidence supports a positive association between physical activity participation and increased cognitive health and function, and, furthermore, that obesity is associated with poor cognitive health. The review concludes that evidence for the relationship between physical activity and cognitive health either shows a positive relation or none at all, but that on balance because participating in physical activity doesn't detract from educational performance and has additional health benefits, the relationship can be perceived as a positive one. This supports the findings of Trudeau and Shephard's (2008) review of school-based physical activity, school sport, physical education and academic performance. From their review the researchers conclude that, *"physical activity can be added to the school curriculum by taking time from other subjects without risk of hindering student academic achievement. On the other hand, adding time to 'academic' or 'curricular' subjects by taking time from physical education programmes does not enhance grades in these subjects and may be detrimental to health"* (Trudeau and Shephard, 2008, n.p.).

Concerned only with research that involved sports or physical activity within a school context, Trudeau and Shephard identified seven quasi-experimental studies with a total sample of 2,560 pupils and ten cross-sectional studies with a total sample of more than 15,500 pupils. Although causality can't be proven with quasi-experimental studies, the findings are positive. Children who spent less time on academic tuition in order to spend more time being physically active achieved at least equal scores, and in some instances better scores, as the control children, despite the reduction in teaching time. This again suggests an increase in learning efficiency. For example, 287 nine to 11 year old students in British Columbia spent 47 extra minutes a week participating in a variety of physical activities for 16 months, and this time was previously spent in academic lessons. Academic performance was measured by the Canadian Achievement Test, the scores for which didn't show a correlating decrease to the reduction in time spent learning academically. Instead the average test score for schools that participated in the intervention rose from 1,595 to 1,672 (Ahamed et al., 2007, cited in Trudeau and Shephard, 2008).

From the cross-sectional studies reviewed, Trudeau and Shephard found that six of the ten supported a significant positive association between physical activity and academic performance, whilst two showed no association and the remaining two a negative association.

It should be noted, however, that it is difficult to control for any potential bias with cross-sectional studies, and in particular the researchers highlight socioeconomic status as a potential confounder given that it is a strong predictor of both academic achievement and participation in physical activity for children. Nevertheless, in the studies where confounding variables were controlled the results remained true. A cross-sectional survey of 9,000 Australian schoolchildren aged between seven and 15 found that academic achievement was positively associated with physical activity and that this was statistically significant for girls and boys (Dwyer et al., 2011, cited in Trudeau and Shephard, 2008).

With a large sample of 884,715 students in the 5th, 7th and 9th grades in Californian schools, Grissom (2005) found that students with the highest scores in a fitness test also had the highest scores for maths and reading in SAT tests and that greater benefits could be seen amongst girls. This study does not assess for many confounding variables or establish causality so the findings should be treated with some caution. However, follow on research using the same methodology but with a smaller sample size of 259 younger students controlled for more variables and also supported the relationship between physical fitness and academic test performance, although only the aerobic activity component of physical activity was found to be significant in this relationship (Castelli et al., 2007).

Focusing on overweight children (as defined by BMI scores) aged seven to 11, a randomised controlled trial explored the impact of exercise on executive function, defined as the supervisory control of cognitive functions for achieving a goal. As part of the process for achieving goals the brain will need to allocate attention and memory and engage in response selection and inhibition, goal setting, self-control, self-monitoring and strategising (Davis et al., 2011). 171 children were randomised to either a low dose 20 minutes a day aerobic exercise programme, a high dose 40 minutes a day aerobic programme (delivered as two 20 minute sessions) or a control group for an average of 13 weeks. The exercise programmes took place after school with an emphasis on enjoyment and intensity rather than competition or skill enhancement. Activities included running games, modified football and basketball and jump rope, and children wore heart rate monitors and were rewarded for keeping their heart rate above 150 beats per minute. Davis et al. (2011) assessed cognition and academic achievement before and after the interventions, with testers being unaware of which group the children had been assigned to and as many conditions as possible (tester, time of day, location of test, etc.) remaining constant for both tests in the majority of cases. The research found that there was a positive dose-response relationship for aerobic exercise on cognitive function, with higher planning and maths scores in the low and high dose exercise programs when compared to the control group. For example, the mean planning scores were 3.8 points higher in the high-dose exercise group when compared to the control group. Whilst the positive relationship between exercise and cognition was anticipated, such a clear dose-response relationship wasn't. Further research into this dose-response relationship and how it differs by weight would provide greater insight into the body of evidence that suggests that children's physical and mental health can benefit from regular physical activity.

Also focusing on overweight and obese children but with a different type of physical activity intervention, Donnelly et al. (2009) conducted a three year cluster randomised controlled trial aimed at promoting physical activity and reducing overweight and obesity amongst young children in 24 primary schools. On completion the sample consisted of 1,490 children, 698 of whom were controls. The intervention involved 90 minutes a week of academic lessons across the curriculum including physical active of moderate-to-vigorous intensity.

These activity bouts were delivered intermittently throughout the school day in addition to the existing 60 minutes of physical education the children were receiving each week. This study was primarily concerned with changes in body mass index but also explored secondary outcomes, including changes in academic achievement. In a sub sample of 203 children, 86 of whom acted as controls, academic achievement was assessed through a robust and established test that measured reading, writing, maths and oral language skills to produce an age-based score allowing comparisons over time. The data shows significant improvements in academic achievement in all areas, and particularly in maths, for those who participated in physical activity across the curriculum. At an overall level the more active students saw a 5.5 point increase in their academic scores compared to a decrease of 0.5 for the control students. In maths there was an 8.0 point increase for the active students compared to 1.4 for control students, whilst reading and spelling saw increases for the active students compared to decreases amongst the control groups. Again, this research demonstrates that increasing the academic curriculum time spent on physical education doesn't have an adverse effect on learning.

In contrast to Ruiz et al. (2010), earlier research by Chomitz et al. (2009) using a cross-sectional study found that physical fitness supports academic attainment. The study used 2004 to 2005 public school data in North Eastern America in order to generate a sample of 1,841 students between grades four and eight, inclusive. 'Fitness Achievement' was measured by how many fitness tests were passed out of five, covering cardiovascular endurance, abdominal strength and agility. Academic achievement was measured through English and maths proficiency using annual tests conducted with all public school students in Massachusetts known as the MCAS. Chomitz et al. found that the likelihood of passing the maths and English achievement tests increased with the number of fitness tests passed, and that this relationship was stronger for maths. 35% of those who passed no fitness tests passed maths, compared to 80% of pupils who had passed all five fitness tests. Further analysis calculated that after controlling for variables, the odds of passing the maths test increased by 38% for each increase in number of fitness tests passed. For English, 73% of pupils who didn't pass fitness tests passed English compared to 93% of those who passed the five fitness tests. Again from further analysis the researchers calculated that after controlling for variables, the odds of passing the English test increased by 24% for each increase in number of fitness tests passed. Unfortunately the research gives us no understanding of why maths performance was more positively affected by physical fitness and cannot establish causality, but it may be that individuals who are more motivated to achieve academically are also more highly motivated to achieve in fitness tests.

It is also worth noting that the majority of studies included here use maths and English performance as a measure of overall academic performance. This may not be a true reflection of children's academic abilities, however these subjects are essential for good prospects for the future and other studies included within this chapter highlight the evidence for improvements to attitude and attention span in younger children as a result of being more physically active; these improvements would apply to any subject being studied. More detail around the impact of increased physical activity levels across different subjects in the curriculum could provide further insights as to how physical activity can influence better performance in schools and academically. One of the most prominent theories suggests that academic performance is enhanced because of physiological changes in the brain that result from the physical changes in the body associated with exercise. Another proposes that the process of physical activity provides children with learning experiences and the opportunity to develop mechanisms that aid proper cognitive development and which can be transferred into other areas of life (Sibley and Etnier, 2003).

PHYSIOLOGICAL CHANGES

The chapter on mental health evidences that physical activity is beneficial for general wellbeing and can help to reduce the risk of dementia, which has been shown to be two to three times higher amongst the least active. For example, Kramer, Erickson and Colcombe (2006) reviewed 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[39] and protein levels of brain derived neurotrophic factor[40] are increased through exercising; these may contribute to the neurogenesis[41] seen in the dentate gyrus[42]. In addition, neurotransmitter systems[43] 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. It is therefore not surprising that physical activity can also bring about benefits in the cognitive development of children and adolescents, whose brains have high levels of plasticity, meaning that they are highly able to change and adapt through learning and experience.

PHYSICAL ACTIVITY CAN ALSO BRING ABOUT BENEFITS IN THE COGNITIVE DEVELOPMENT OF CHILDREN AND ADOLESCENTS

Although many studies are not able to establish causality and not enough is understood about the neurocognitive function in young adults, the cardiovascular fitness hypothesis proposes that physical exercise improves cognitive performance because of cardiovascular fitness. The physiological process of cardiovascular fitness is thought to increase the circulation of a number of substances that have a positive impact on brain plasticity and cognitive function. One of the most established meta-analyses of the relationship between physical activity and cognition in children was conducted by Sibley and Etnier (2003). Taking 107 effect sizes of physical activity on cognition from 44 studies, Sibley and Etnier found a mean overall significant effect size of 0.32, which can be classed as medium. The effect size was even greater when looking at mentally or physically disabled students, 0.43 and 0.40 respectively, but the sample sizes were very small amongst these groups.

39 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.

40 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.

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

42 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.

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

More recently, Hillman, Erickson and Kramer (2008) examined the positive effects of aerobic physical activity on cognition. Drawing on animal and human studies they explored the molecular, cellular, system and behavioural level changes to brain functioning resulting from aerobic physical activity in both young children and older adults.

From a thorough assessment of human studies involving neuroimaging, the researchers believe there to be sufficient evidence for physical activity enacting a number of changes in the brain. Studies support physical activity being able to influence baseline functioning of electrical activity in the cerebral cortex[44] and hence influence cognitive functioning. Increased brain volume in the prefrontal and temporal grey matter[45] and the anterior white matter[46] has been evidenced in people with high levels of fitness and in older adults this has been a predictor of performance. Furthermore, variations in the decision making component (P3) for responding to stimulus (known as event related potential) has been proven to be particularly sensitive to changes in physical activity levels and aerobic fitness in terms of the amount of the P3 component and the time taken between a stimulus and the response to it. The P3 component is thought to be generated by a network of neural structures that are involved in cognitive operations such as processing stimuli and updating memory. There is strong evidence across a range of cognitive tasks for larger amounts of P3 and shorter response to stimulus times in those with high aerobic fitness when compared to unfit participants.

In addition to the changes evidenced through neuroimaging, further light is cast from animal studies, which allow for more direct examination of changes in the brain. In support of Kramer, Erickson and Colcombe (2006), Hillman, Erickson and Kramer (2008) found that the evidence is consistent for increased growth and survival of cells in the dentate gyrus, and that this can occur at many stages of development – two studies even found that newborn rat pups from mothers who had carried out aerobic activity during pregnancy showed a higher number of surviving cells in the hippocampus than pups born from sedentary mothers (Kim et al., 2007 and Lee et al., 2006, cited in Hillman, Erickson and Kramer, 2008). It is thought that these newborn cells could facilitate learning, although the functional significance in relation to physical activity and cognition is not well

44 The cerebral cortex is a sheet of neural tissue and is where information processing occurs in the brain. It is vital for memory, attention, perceptual awareness, thought, language and consciousness.

45 Grey matter is part of the central nervous system and contains neural cell bodies. This part of the brain is involved in process and cognition, for example, tasks such as muscle control and sensory perception.

46 White matter is also part of the central nervous system. It transmits signals around the brain and affects how the brain learns and dysfunctions.

understood. This research also further supports earlier work with the evidence that physical activity increases hippocampal volume through higher circulation levels of insulin-like growth factor 1[47], brain derived neurotrophic factor[48] and vascular endothelial growth factor[49].

Taking this as their starting point, Åberg et al. (2009) carried out a cohort study on 1,221,727 Swedish men born in 1950 through to 1976 who were enlisted in military service at age 18. Using data on physical fitness and intelligence from conscription examinations along with other national data on school achievement and socioeconomic status, the researchers found that after adjusting for confounding variables, cardiovascular fitness was positively associated with overall intelligence, and in particular logic and verbal intelligence, but that muscle strength was not. For comparison purposes, fitness and intelligence scores were calculated using a stanine scale, which places test scores between one and nine with a mean score of five. The data shows that an increase of 1 stanine unit in cardiovascular fitness was associated with a change of 0.22 stanine units in overall intelligence. Additionally, analysis revealed that changes in cardiovascular fitness between the ages of 15 and 18 years predicted cognitive performance at age 18, in that an increase in cardiovascular fitness during this time was associated with an increase in intelligence, and that cardiovascular fitness at age 18 predicted educational achievements and occupation later in life. This large study is focused only on men, however, making it difficult to know if the same relationship would be evidenced in women.

47 Insulin-like growth factor 1 is a protein similar in structure to insulin and is an important hormone in children for growth.

48 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 which are key for learning, memory and higher thinking (the hippocampus, cortex and basal forebrain). It is particularly important for long term memory.

49 Vascular endothelial growth factor is a signal protein that contributes to restoring the oxygen supply to tissues when blood circulation is not sufficient. It creates new blood vessels and new muscle after exercise.

By analysing data for the twins within the cohort the researchers have evidenced that environmental factors are responsible for the association between increased cognition and higher levels of fitness. Given that the researchers found no association between muscle strength and intelligence, this research supports the cardiovascular fitness hypothesis and the evidence seen in animal studies.

A limited number of studies have focused on the effects of physical activity on academic engagement for children with autism spectrum disorder, although understandably sample sizes in such studies are smaller. From a review of seven studies, Petrus et al. (2008) examined data from 25 children: 22 were aged between six and 15 and the remaining three were aged between three and five, and all had a disorder on the autism spectrum. Predominantly the studies explored the role of physical activity in increasing on-task behaviour and reducing stereotypic behaviours[50] which can distract from learning. However, three studies did also measure academic performance following physical activity, two of which found improvements in academic responses following 20 minutes of jogging (Rosenthal-Malek and Mitchell, 1997; Kern et al, 1982, cited in Petrus et al., 2008). Findings across all seven studies showed a decrease in stereotypic behaviours from aerobic activities and hydrotherapy, although the impact was temporary. Findings were not conclusive about the impact of physical activity for increasing on-task behaviour. In the studies reviewed, higher intensity activities such as jogging had a positive impact on reducing stereotypic behaviours but less vigorous activities such as walking and ball playing didn't. Petrus et al. therefore propose that aerobic exercise may cause physiological changes that can control stereotypic behaviours in those with autism spectrum disorder.

50 Stereotypic behaviours are found in people with intellectual disabilities including autism spectrum disorder. They involve repetitive movements or speaking such as rocking or spinning the body, finger licking or flapping hands and arms.

The studies assessed by Petrus et al. are however limited in their quality and the dates of publication ranged from 1980 to 2003. Much more research of better design is therefore needed in this field in particular into the impact of longer interventions and longer term effects and the possibility of exercise as a prescription for children with autism spectrum disorder. A more recent and scientific study has monitored activity in the brain for people with an intellectual disability following moderate running for 30 minutes. Researchers found that activity in the brain demonstrated enhanced self-confidence, social acceptance and positive mood from this activity, but no noticeable changes relating to cognitive tasks (Vogt et al., 2011). Increased motivation and self-esteem however are both attributes that are beneficial in the classroom in approaching learning and exams.

Chaddock et al. (2010) attempted to better understand the neurocognitive benefits of physical activity that have been evidenced in animal studies and with older adults by investigating aerobic fitness, hippocampal volume and memory performance in preadolescent children. To do so, the researchers utilised magnetic resonance imaging to assess differences in hippocampal volume amongst nine and ten year old children with low and high levels of fitness. These differences were then explored for a relationship with performance on an item and relational memory task on the basis that relational memory is primarily supported by the hippocampus whilst item memory is not. Whilst the methodology of this research is sophisticated, the sample was fairly small, with 28 children in the lower fitness group and 21 in the higher fitness group; in each group ten of the children were male. It should also be noted that confounding variables such as genes or nutrition were not controlled for in this study. Fitness levels were determined by VO2max scores, heart rate and perceived exhaustion during a treadmill session running at a constant speed with grade increments of 2.5% every two minutes until the child expressed exhaustion. A VO2max score above the 70th percentile according to already established normative data classified the child as being of high fitness, whilst a score below the 30th percentile was classed as low fitness; children with scores in between were excluded from the study.

As hypothesised, Chaddock et al. found that children with higher levels of fitness clearly showed greater hippocampal volumes on both sides and performed significantly better in the relational memory task than the lower fitness children but that no relationship with item memory was evident. Children with higher fitness levels had a mean total hippocampal volume of 7,772.60mm^3 compared to 6,854.09mm^3 for those with lower fitness levels.

Whilst there were no differences in response speed for either memory test, those in the higher fitness group were more accurate on the relational memory test with a mean accuracy of 61% compared to 54% accuracy for the lower fitness group. The researchers found a positive relationship between hippocampal volume on both sides and accuracy in the relational memory task. Further analysis and linear regression showed that hippocampal volume mediated the relationship between aerobic fitness levels as measured by VO2max scores and relational memory, whilst no relationship was seen for aerobic fitness, nucleus accumbens volume[51] and memory, suggesting that aerobic fitness directly affects the structure and function of the hippocampus in children, and this is responsible for greater cognitive performance. There is a lack of well-designed experimental research in this area with this work providing some of the most robust evidence for the ability of physical activity to bring about positive effects in the brains of young children. Developing the methodology to include a larger sample with randomisation and controls to account for potential selection bias could produce conclusive and compelling evidence for the relationship between aerobic fitness and hippocampal structure/function in children. Further avenues for research would be around the frequency and duration of activity over a longer time period and the impacts of different types of physical activities on the brain.

AFTER SCHOOL PROGRAMMES AND SCHOOL-CLUB LINKS

Sport and recreation activities are typically enjoyable for the children who participate in them, particularly when the activities are team-based with their friends and peers. Much in the same way that antisocial behaviour and crime can be tackled by using sport as a hook for teaching other life skills (see the chapter on antisocial behaviour and crime), physical activity programmes run in conjunction with schools can operate as an incentive to encourage students to complete homework, attend a certain proportion of their classes or put in the work to achieve target grades. This utilises the desire to participate in the sporting activity to create greater commitment to schoolwork, which can lead to better learning and overall academic performance. This was found by Hritz et al. (2010) in their evaluation of an American after school football programme (further details in the chapter on physical activity, antisocial behaviour and crime). This approach is in fact particularly popular in America where three common academic eligibility standards are used with additional sports or recreation participation.

These are the pass-to-play approach, a minimum requirement for grade point average and a cap on the number of failing grades one student can have (Callari, 2002).

Two initiatives aimed at improving attendance, behaviour and attitude at school in the UK were evaluated by Sandford et al. (2008). The HSBC and Outward Bound project was a five year residential outdoor and adventure activity programme with pupils from five schools in London Docklands. This resulted in improvements to baseline profiles and outperformance of pupils compared with the control group. Alongside this the researchers evaluated the Youth Sport Trust and BSkyB Living for Sport programme, which was nationwide and which encouraged schools to run their own activity-based programmes. The principles underpinning the Living for Sport programme are that any structured physical activity can help students to increase their confidence and self-discipline and build self-esteem and self-awareness. In addition, students learn important skills for transferring to other areas of life such as loyalty, teamwork and leadership. The final advantage to after school sporting programmes is that they provide a new means of communication for teachers and students, in particular disruptive or demotivated students. The most recent evaluation of the Living for Sports Programme has shown that students who participated have on average performed 14% higher in English compared to the national average, which they were previously in line with, and 4% higher in maths. In addition, almost nine in ten (87%) demonstrated positive improvements in their self-confidence and self-esteem and eight in ten (83%) positively improved their attitudes to learning[52].

The FairPlay programme run by the Rugby Football Union (RFU) in conjunction with Barclays Spaces for Sport and Wooden Spoon (a children's charity for rugby) utilises rugby to improve behaviour amongst disruptive pupils and create school-club links. The two year programme targeted hard to reach young people through rugby in order to work on their behaviour and social skills. It ran 99 eight week sessions with a total of 1,058 young people, of which 69% (729) attended a minimum of 75% of the sessions. Participants were aged between 14 and 18, had been excluded from mainstream education and were attending Pupil Referral Units (PRUs). These units are run by local authorities for children who are unable to attend or who have been excluded from mainstream schools. Local authority data suggests that it costs between £13,000 and £18,000 a year to send one pupil to a PRU compared to £5,200 per pupil at a mainstream secondary school (Corporate Citizenship, 2012). The cost per pupil for the FairPlay programme was £311, which went up to £451 when looking only at those who completed the programme – a fraction of the cost of Pupil Referral Units.

Significant increases were seen in a number of skill areas, with 60% of participants reporting quite a bit or a lot more knowledge of anger management after the programme compared to 31% beforehand. Knowledge of problem solving similarly increased from 38% to 64% of participants, whilst asking questions increased from 41% to 66% and getting on with people from 46% to 71%. In addition, half of the pupils reported feeling better about themselves (49%) and feeling more confident (47%) as a result of participating. Improvements in these behavioural traits can translate into better attitudes and behaviour in class, which can result in better opportunities for learning. Given the behavioural problems with pupils in referral units, any gains in behaviour can be treated very positively. Staff at the Pupil Referral Units assessed the performance and behaviour of those who participated in the programme. Staff noted positive changes but recorded levels of sustained progress were perceived as being quite low.

52 Sky Sports Living for Sport, *Proven Results* http://livingforsport.skysports.com/whats-our-goal/proven-results, last accessed 17.08.2012.

Given that the intervention lasted only eight weeks this is not surprising, but is suggestive that for the biggest benefits from sport and recreation programmes in schoolchildren they should be fully integrated into the timetable rather than delivered in short bursts.

Chance to Shine was launched by the Cricket Foundation in 2005 to increase participation in cricket at state schools, 4,000 of which now run the programme. Although national in its focus, projects are delivered at a local level via County Cricket Boards across England and Wales, involving up to eight primary and secondary state schools and a local cricket club in each project. Structured coaching from professionals and a competition programme are offered to children, with programmes running for a minimum of five years. 2011 saw 347,390 pupils taking part in Chance to Shine, around half of whom were girls (46%), one in ten (12%) of whom were from BME backgrounds and 5% of whom had special educational needs. Over 66,326 hours of coaching were delivered across the year, with the majority of coaching (79%) taking place during curriculum time (2011, Chance to Shine). This programme is thought to be valuable to children because the game of cricket promotes leadership, teamwork and strategic awareness, teaches respect and how to cope with setbacks and is inclusive. In addition, cricket as a hook for engaging children has been taken one step further with the development o f a cricket-based online education resource aimed at improving literacy, numeracy and IT skills through concrete examples relating to cricket that interest and engage the children involved with the programme for effective learning. Disappointingly, this resource doesn't appear to be too widely used at present, with a survey of teachers in 2011 finding that one in four were unaware of it (Institute of Youth Sport, 2011).

For 2011 there have been two evaluations of the Chance to Shine programme: an operations report from the programme itself and an independent evaluation conducted by the Institute of Youth Sport. Both have been primarily qualitative in their focus when considering the impact on children and in local communities. Quantitative data exists only for such elements of the programme as number of sessions delivered, hours of coaching held and club links made. Whilst useful in understanding the delivery of the programme, this data doesn't help us to understand the overall impact on young people. Qualitative feedback from teachers about children's classroom behaviour and performance is however very positive.

THE GAME OF CRICKET PROMOTES LEADERSHIP, TEAMWORK AND STRATEGIC AWARENESS, TEACHES RESPECT AND HOW TO COPE WITH SETBACKS AND IS INCLUSIVE

The evidence suggests that after breaks or lunchtimes when children played cricket, they returned to the class in a calmer mood and there was less conflict in the classroom than when other sports had been played. Furthermore, children demonstrated increased confidence and motivation, which teachers believed to be the result of improvements to self-esteem from performing well in cricket competitions or coaching sessions. Children themselves also reported that their teamwork skills had increased as a result of playing cricket.

Some schools involved in Chance to Shine also stipulated that in order to participate in competition, children had to have a clean record of behaviour in lessons. This was seen by teachers to directly improve behaviour across the curriculum and attitudes towards school as children wanted to be able to participate. The primary benefit for teachers, however, was that skills and motivations learnt through an activity the children were engaged in could help their performance in other areas of school life. In particular, female participants reported that from engaging in Chance to Shine they had a stronger sense of identity and self-direction.

"*What we are trying to do is find something that children are good at and therefore raise their self-esteem whether that be in cricket or art and that gives them a more positive self-image and that then will hopefully transfer onto their other areas of learning*" (Primary head teacher, cited in Institute of Youth Sport, 2011, p.13). This perspective is supported by Cooper et al. (1999) and Marsh (1992), who propose that physical activity programmes with school links increase motivation and investment in schools and subsequently improve academic performance (both cited in Trudeau and Shephard, 2008). Similarly, Eitzen and Sage (2003) propose that the cultural values embodied within sport align winning with success and institutionalise conflict through competitions. This can translate into a good work ethic back in the classroom.

It is also possible that physical activity programmes linked to the schools can improve academic performance by reducing absenteeism, again as a result of either increased engagement with the school or the development of better relationships with teachers and peers, and also through contributing to better levels of fitness and overall health and therefore lower levels of illness. The Texas Youth Fitness Study covered more than 2.4 million students at schools across Texas and found that the children who were physically fit not only performed better academically but also had better attendance rates and lower instances of disciplinary referrals. During the school year 2007-2008, pupils in American grades three to 12 in 6,532 schools were assessed through six tests covering five areas of physical fitness: body composition, aerobic capacity, muscular strength, endurance and flexibility. Cardiovascular health as measured by a walking/running test was found to have a higher correlation to school success than body mass index, demonstrating the importance of not just maintaining a healthy weight but being physically active and fit too (Welk et al., 2010).

EMPLOYMENT: INTRODUCTION

Around 70% of the UK population (aged 16 to 64) are in paid work or employment; this means that unemployment[53] levels are amongst the highest they have been for more than 15 years, with 2.63 million people unemployed as of May 2012 and 1.59 million of these claiming Jobseeker's Allowance (Office for National Statistics, 2012). It is therefore not surprising that the total estimated cost of benefits for unemployed people in 2009-2010 was significant at £4.9 billion (Jin, Levell and Phillips, 2010).

1.02 million of the UK's unemployed are aged between 16 and 24, equating to an unemployment rate of 21.9% for young people (Rhodes, 2012). Statistics for those in this age bracket who are not in education, employment or training (NEET) also reveal that during the first quarter of 2012 one in ten (9.8%) 16 to 18 year olds fell into this category (Department for Education, 2012b). Gaining suitable education, qualifications and training increases the chance of employment; for example almost one in four (23%) 25-29 year olds without qualifications wanted paid work but didn't have it (ONS, 2011 cited on The Poverty Site[54]). Employment also improves life chances: for example being employed reduces the risk of offending by between a third and a half (Social Exclusion Unit, 2002). Unemployment is therefore both an indicator of social exclusion and also a driver, in that unemployment can lead to other aspects of social exclusion such as poverty, homelessness, social capital and poor physical and mental health. Conversely, these aspects of social exclusion can also be a barrier to employment (Bradshaw et al., 2004), thus creating a cycle of social exclusion that can be difficult to break. Given the complex and interrelated nature of the aspects of social exclusion, any interventions that can tackle multiple disadvantages should be well supported and promoted. Physical activity is one such example as, amongst other things, it has the potential to improve physical and mental health, build social capital and increase employment opportunities and prospects.

SOCIAL CAPITAL

One way in which leisure time physical activity may contribute to increased employment opportunities is via its positive influence on accruing social capital (for more information see the chapter on social cohesion). Networking is regarded as being a key component

53 Unemployment is used here as a term to capture people without a job who have been actively seeking one and are available to start working if a job is offered to them. It does not account, for example, for people in full time education or the long-term sick.

54 The Poverty Site, *Impact of Qualifications on Work*, http://www.poverty.org.uk/31/index.shtml, last accessed 20.08.2012.

of contemporary business: not only does it facilitate working relationships within a job, it also provides a means of matching up vacancies with potential candidates. Claims for the importance of networking in job hunting range from being responsible for filling 28% of vacancies to 99%, with the most frequently cited as being around the 60% mark. There is little robust research in the area given that those interested enough to survey on this topic tend to be involved in social networking or recruitment. An American recruitment agency analysed data from over 50,000 clients to find that networking was the number one means by which people secured jobs, with two in five (41%) places made through networking in 2010[55]. A 2011 poll of 402 LinkedIn users found that 34% got their last job through a personal contact who informed them about it[56], however the sample may be biased towards greater engagement with networking given that they were recruited through an online workplace networking site. The influence of networking on job placements, whilst likely to be lower than spuriously stated statistics suggest, does however still seem to be significant.

Out of work social interactions in places such as sports clubs provide one of the main opportunities for people with different employment backgrounds to interact socially – at work the interaction is defined by employment and at home people tend to live in areas of similar income and economic status. This potential for interaction is particularly true once someone becomes unemployed when interaction with those in a variety of employment positions is most beneficial for job seeking. However, the benefit has been evidenced to apply only in the short-term as employees are not willing to recommend people of insufficient skill for vacancies in case it reflects badly on them, and unemployed people lose links with employed people and suitability in their eyes over time (Bramoullé and Saint-Paul, 2004).

Based on the argument that participating in voluntary organisations allows for the formation of social capital, which can facilitate better employment prospects, Ruiter and De Graaf (2009) assessed the socioeconomic impact of involvement in voluntary associations in the Netherlands. Using data from the Family Survey of the Dutch Population 2000, the researchers found that members of voluntary organisations are more likely to start new jobs, have higher earnings and be employed in jobs with a higher status than non-members. Additionally they found that volunteering in general is beneficial when entering the labour market for the first time and that where members belong to associations with high status co-members, the likelihood of starting a new job is higher, and the new job will be of a higher status too. These findings indicate that social capital plays a significant part in employment prospects for sports club members who are actively involved with the club.

55 Forbes online, *Networking is Still the Best Way to Find a Job Survey Says*, http://www.forbes.com/sites/susanadams/2011/06/07/networking-is-still-the-best-way-to-find-a-job-survey-says/, last accessed 22.05.2012,

56 Career Horizons, *Career Poll: How Did You Get Your Last Job?* http://careerhorizons.wordpress.com/2011/09/22/career-poll-biggest-mistake-on-resumes/, last accessed 22.05.2012,

VOLUNTEERING AND EXTRACURRICULAR ACTIVITIES

As noted earlier in this review, more people volunteer in sport than any other activity, both at a club level and in supporting major sporting events, and this volunteering can be beneficial for employment prospects. Whilst there has been little research solely on the benefits of volunteering in sport on employability, there is evidence for the impact of volunteering more generally. Almost nine in ten (87%) employers believe that volunteering can have a positive effect on career progression, whilst 97% of volunteering organisations have experienced this happening. For example, employers identify communication and teamwork as the most important skills for employment (average importance scores of 8.8 and 8.6 out of ten respectively) and 88% of employers believe that both of these skills can be developed through volunteering (V, 2008).

Research on 546 employees from 16 companies in the UK has examined the business case for volunteering. With the support of their employers, the employees were all involved in volunteering for an educational initiative. The research concluded that there is strong evidence for volunteering to help with the development of business skills and competencies in employees. Two in three employees (66%) felt that volunteering had improved their communication skills, and almost the same amount reported that it had improved their ability to help others (65%), whilst more than half (54%) reported increased adaptability and around two in five felt their influencing/negotiating skills (45%) and their team working (43%) had improved as a result of volunteering (Corporate Citizenship, 2010). Furthermore, analysis of the National Citizen Service Pilots found that the proportion of young people who felt confident being the leader of a team increased by 16% (from 47% to 63%) amongst National Citizen Service Participants compared to a 3% increase in the control group (NatCen Social Research et al., 2012).

Three in five (61%) employers in 2012 state that they aren't satisfied with school/college leavers' self-management skills, almost half (46%) say they aren't satisfied with their problem solving skills and around a third (32%) of employers are not satisfied with school/college leavers' teamwork skills (CBI, 2012). Extracurricular activities such as volunteering or taking part in sport and recreation provide opportunities to improve these and other skills that are valued by employers, such as communication.

In particular team sports and outdoor adventure activities are perceived by employers to foster desirable skills and demonstrate outgoing personalities, and more unusual activities have the advantage of catching a prospective employer's attention and demonstrating a passion for life (Stuart et al., 2009). From a sample of 3,000 employers and employees across the UK, it was found that four out of five (80%) employers value volunteering on a CV[57]. In addition, for people with an intellectual disability, who are underrepresented in the paid work force and encounter many barriers to employment, volunteering can offer a meaningful alternative (Trembath et al. 2010). Volunteering can also benefit those with fewer qualifications by providing them with experience and training opportunities.

Using a cohort sample of graduates from 27 UK universities and colleges, Blasko, Brennan and Shah (2002) analysed data on 2,997 students to assess the employment prospects of students from socially disadvantaged groups. The research begins with an analysis of the factors that determine graduate employability regardless of student background. The findings support the hypothesis that involvement in extra-curricular activities can improve employability by helping graduates to gain a range of important skills, and that employers perceive participation in extracurricular activities positively. The employment success of graduates is measured by a range of factors including lack of unemployment, salary, level of occupation, skill and competency assessment and the possibility for promotion. The proportion of successful graduates was almost twice as high (22%) amongst those who spent more than ten hours a week on extracurricular activities when compared to those with no involvement (13%), and even those who spent between one and ten hours a week involved with extracurricular activities were slightly more successful than those with no involvement (16% and 13% respectively). Incidentally, participation in extracurricular activities was also associated with increased benefits for employment amongst graduates from socially disadvantaged groups, although members of this group were less likely to participate in such activities.

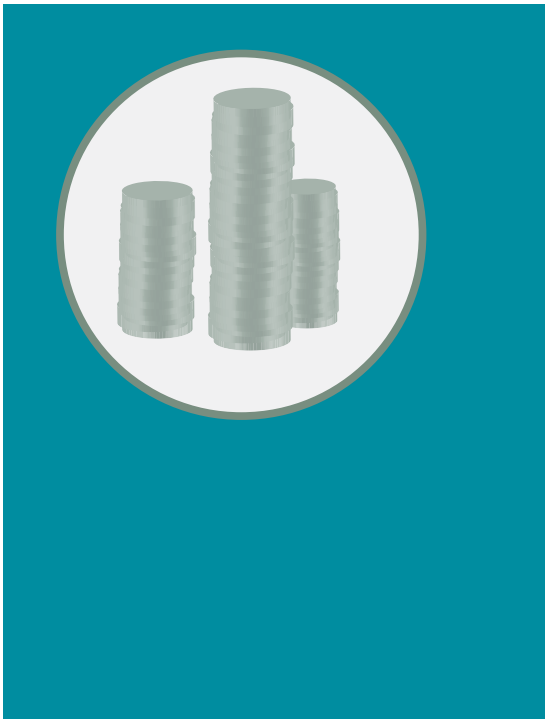
Small scale qualitative research with 40 young adults retrospectively assessed involvement in regular competitive sport on the formation of life skills. The researchers conclude that competitive sport provided an educational context for learning life skills but that interactions with parents, peers and coaches in this context were crucial for how they acquired life skills through sport. Of these, peer interactions were the most important (Holt et al., 2009).

57 TimeBank *Key Facts* available online http://timebank.org.uk/key-facts, last accessed 07.08.2012.

This would accord with Rooth's (2011) interesting findings relating to perceptions of leisure time physical activity by employers; when recruiting, the leisure time physical activities most valued by employers were sociable activities such as football and golf as opposed to more fitness orientated individualised activities such as swimming or running, suggesting that leisure time physical activities that indicate social skills are appealing to employers. Using data on 450,000 Swedish individuals about their physical fitness at age 18 and their adult earnings, assessed by control variables, Rooth found that those with a higher level of fitness had 4-5% higher earnings but that this falls to 2% after controlling for non-cognitive skills, suggesting that higher earnings are linked to higher fitness and higher soft skills. In addition to this analysis, Rooth sent more than 8,500 fictitious job applications to real job openings advertised in Sweden with randomly selected variations in types of leisure time physical activity undertaken. Similarly, Rooth found that general participation in leisure time physical activity didn't equate with a hiring premium as would be expected if participation was a sign of better health and employers were seeking healthy employees. Instead, occupations classed as physically demanding valued health related fitness focused activities whilst other occupations valued leisure activities for their social and soft skills, which appeared to equate to around an additional year's worth of work experience.

LIKELIHOOD OF EMPLOYMENT AND POTENTIAL TO EARN

By exploring levels of physical activity and rates of employment in 25 European countries, Kavetsos (2011) explores the probability of an individual being employed in relation to their participation and frequency in physical activity. The data suggests that there is a causal effect for physical activity on employment, and that this is especially the case for men. In a fascinating paper Lechner (2009) also explores the effect of individual participation in leisure time physical activity on individual labour market outcomes in the long run, this time in Germany. He considers three means by which positive effects may be produced: firstly through greater productivity as a result of improved health and wellbeing, secondly through the social capital and networks formed by group participation and thirdly through suggesting to employers that the individuals are healthy and motivated and thus will perform highly in their jobs. Lechner concludes that over a 16 year period regular active participation in sport and recreation (at least once a month versus less than once a month) increases earnings by around 1,200 Euros a year, which equates to a 5% to 10% increase in earnings – the equivalent of an additional year in education.



The research is based on data gathered from the German Socio-Economic Panel Study between 1984 and 2006 with 6,751 individuals aged between 18 and 45 at enrolment and considers both selection bias and confounding variables in the analysis in a sophisticated way.

Forthcoming research led by Cleveland State University, America has found that moderate exercise such as brisk walking, along with jogging, swimming or weight lifting three times a week could be related to a salary increase of between 6% and 9% in comparison to inactive counterparts. Salary increases were still evident for those exercising one to three times a month compared to inactive counterparts. As the research is currently unpublished the full methodology is not known, but the findings are based on two data sets with over 12,000 people assessed for levels of physical activity and their salaries. The researchers propose that higher energy levels, improved cognitive function and improved psychological function as a result of regular exercising are responsible for higher earnings (Kosteas et al., forthcoming).

As suggested by Lechner (2009), the higher earnings and better career progression of more physically active individuals could be because these individuals tend to be healthier and therefore more productive and more likely to be perceived by employers as motivated and hard working. As part of being healthy, regularly active people are far less likely to be overweight or obese – regular physical activity in accordance with the Government recommendation of thirty minutes five times a week can keep an individual within 3% of their initial body weight (Department of Health, 2011b; Jakicic, 2009; Wing, 1999) (see the chapter on physical health for the role of physical activity in obesity prevention and weight maintenance).

A 2004 study, carried out as part of a wider investigation into chronic diseases and work performance, sought to test associations between work performance and lifestyle-related modifiable health risks, such as physical inactivity, obesity and poor cardio respiratory fitness. A sample of 683 workers in four American cities was assessed for health risks and work performance. Pronk et al. (2004) found that moderate physical activity was related to improvements in the quality of work performed and overall job performance, whilst vigorous physical activity was only related to overall job performance. In addition, obese employees showed significantly less ability to get on with colleagues and had higher rates of absenteeism.

An association exists within the workforce between obesity and lower skills. Whether this association is real or perceived, evidence suggests that it is preventing obese people from securing well paid positions or promotions (see Puhl and Brownell, 2001, for a comprehensive review of obesity related prejudice and inequality in the workplace); Lundborg et al. (2010) term this the obesity penalty. Using data on 450,000 Swedish men enlisting for the military, Lundborg et al. found an 18% reduction in earnings amongst obese people, theorised by the researchers to be as a result of a negative association between obesity and skill level, with obesity seen to correlate with low cognitive and non-cognitive skills. More influential however was the relationship evidenced between obesity and poor physical fitness. Obesity is therefore a marker of skills and fitness and as such is used by employers to discriminate against obese members of the workforce – further evidence for this comes from the fact that obese people are more likely than people within the normal weight range to report discrimination in the workplace (Carr and Friedman, 2005).

High levels of physical fitness are perceived favourably by employers because they are associated with greater productivity, the ability to work longer hours and less sick leave. A few studies have begun to examine the short and long term impacts of obesity on absence from work, and there is a weak consensus emerging that obesity is a risk factor for short and long term absence from sickness. Harvey et al. (2010) conducted cross sectional and prospective analysis on London Underground staff, with a total sample size of 1,489. Participants were assessed for height, weight, physical and mental health and sick days taken for short term illness (defined as less than ten days) and long term illnesses. Obese individuals took an average of four extra sick days a year than their colleagues within the normal weight category. Workers with a healthy body mass index took an average of six sick days a year whilst obese workers took an average of nine and a half days and very obese workers an average of 11 days. Harvey et al. found that obesity related chronic medical conditions were responsible for increasing the risk for long term sickness absence but that this could not explain all the increase in short term sickness absence.

Not only is it thought that keeping fit and healthy influences an employer's decisions around hiring, promoting and level of pay, evidence from one small study also suggests that exercising during lunchtime at work increases productivity. A sample of 201 volunteers from three Bristol-based workplaces with onsite exercise facilities completed mood diary questionnaires and had their exercise habits recorded; they also completed work-performance grids at the end of each day and three focus groups were held with participants to explore performance related topics. The researchers reported 79% of the participants had improved mental and interpersonal performance on days where they exercised, 74% managed their workload better and 72% managed their time better. In addition, on days when they had exercised, 41% reported feeling more motivated to work, 27% more able to deal with stress calmly and 21% reported higher concentration on work. All indicators of performance were higher on exercise days regardless of the amount or intensity of exercise undertaken and inductive analysis of the focus groups revealed this to be linked to changes in mood with tolerance and resilience higher on exercise days (Coulson, McKenna and Field, 2008). This research is limited by its small, self-volunteered sample, the majority of whom (67%) were female, however the combination of a trial and a focus group makes it more robust than many other trials of this nature that rely on participants to self-report.

Evidence is suggestive that sport and recreation during the working day makes employees more productive and increases motivation; team activities have also been shown to boost staff morale and workplace activity programmes have been associated with increased job satisfaction, a reduction in staff turnover and reduced absenteeism. A thorough meta-analysis of physical activity interventions in the workplace looked at the results from over 38,000 participants across more than 100 studies, concluding that such interventions can improve both individual health and workplace outcomes. For example, the analysis found significantly positive effects for fitness (effect size of 0.57), job stress (effect size of 0.33) and work attendance (effect size of 0.19) when comparing those involved in interventions with the control participants (Conn et al., 2009). These findings support the Health, Work and Well-being Programme (2008), which states that physical activity programmes at work can also reduce absenteeism by up to 20% and on average physically active workers take 27% fewer sick days (cited in National Institute for Health and Clinical Excellence, 2008a), although this can be higher depending on the situation within each organisation before any intervention. For example, encouraging better physical and mental health amongst staff at Stockport Council led to a 44% reduction in sick days which equated to a saving of £1.58 million (Business in the Community, 2009).

Other studies have found that well run workplace interventions focusing on staff wellbeing can increase employee job satisfaction and reduce staff turnover by between 10% and 25% on average (PWC, 2008, cited in National Institute for Health and Clinical Excellence, 2008a). These findings demonstrate significant benefits to employers of physical activity, as well as those that we have established it has at an individual level.

Introducing an Active Workplace intervention for the 540 employees of the Ginsters factory in Cornwall not only reduced sickness, stress-related illness and accidents at work, but also led to a 14% reduction in health premiums, a 14% reduction in staff turnover and a drop in recruitment advertising costs from £55,000 to £15,000 over three years (Hudson, 2010). Working with Sport England and the local council to encourage active travel, create physical activity opportunities in the workplace and build links with local sports clubs, which allowed employees and their families to trial new activities at new clubs, the employees of Ginsters are far healthier and more positive about their jobs and the reputation of the factory has grown considerably. This initiative has offered a really broad range of activities to not just employees but their families too: everything from self-defence to scuba-diving. In addition, they have introduced healthy eating programmes and free fruit, aimed at creating a total shift in attitude around being active and healthy.

In the hospitality sector staff turnover amongst frontline hotel employees is thought to be around 60%. Based on their research findings, Magnini, Lee and Kim (2011) suggest that physical activity should be encouraged amongst employees as a means of increasing overall job satisfaction and strengthening commitment to the organisation. It is thought that the role of physical activity in contributing to overall general wellbeing and reducing levels of anxiety (see the chapter on physical activity and mental health for an overview of the evidence here) contributes to greater life satisfaction, which in turn is an indicator of wellbeing and can also translate into increased job satisfaction (Judge and Watanabe, 1993). It is also possible that increases in self-esteem from participating in physical activity can contribute to overall greater life satisfaction (Stubbe et al. 2006; Pressman et al. 2009). Magnini, Lee and Kim (2011) highlight that when overall wellbeing is increased and anxiety levels are reduced, our capacity for emotional intelligence is higher, and this is particularly beneficial in the hospitality industry in a general sense and also increases job satisfaction by increasing happiness and optimism.

210 hotel employees from nine hotels in South Korea were asked how often per week they exercised, with answer options ranging from less than one hour per week to more than seven hours a week. Measures of trust, emotional intelligence, overall job satisfaction and organisational commitment were also taken. Higher levels of physical activity were found to lead to higher levels of emotional intelligence among hotel workers.

HIGHER LEVELS OF PHYSICAL ACTIVITY WERE FOUND TO LEAD TO HIGHER LEVELS OF EMOTIONAL INTELLIGENCE AMONG HOTEL WORKERS

Amongst employed people, it is thought that 60% of their waking hours are spent at work (National Institute for Health and Clinical Excellence, 2008a), making it a prime setting for encouraging greater levels of physical activity. Recognising this, the National Institute for Health and Clinical Excellence (2008) has produced guidance and recommendations on encouraging physical activity in the workplace alongside tools for implementing the recommendations, stating that, *"the benefits are significant and far outweigh any initial costs"* (National Institute for Health and Clinical Excellence, 2008b, p.9); one such tool explores the business case for promoting physical activity in the workplace. This tool allows for employers to plug in the numbers of employees, their salary cost, sick days taken, recruitment costs and so on against the costs of any physical activity interventions to calculate the potential savings that could be conferred as a result. It is simple enough to use but provides an interesting example of how investing in physical activity opportunities for employees could significantly benefit employers in the long term.

CONCLUSION

The fitness and health benefits of regular leisure time physical activity appear to extend beyond the physical. The physiological processes that occur during exercise are related to increased capacity for learning, more energy and better concentration. As a result, keeping active can facilitate increased productivity. This occurs not only in the classroom and workplace, influencing educational attainment, employment prospects and earning potential, but is also a factor considered by many employers when recruiting. The overwhelming conclusion is that replacing academic time with increased time on physical activity in school leads to either improved or equal academic performance. Therefore, given the additional health benefits of increased activity, this approach is a positive one to be supported.

Relatively few studies have explored the impact of participating in sport and recreation at school on adult participation level, but those which have suggest a positive relationship, indicating that not only can being active at school help academic productivity, it may also set up good habits for life which will be beneficial for future physical and mental health, employment prospects and creating social capital. Although only a relatively small number of studies exist into the impact of regular physical activity and earnings, those that do are suggestive of higher earning potential for the most active. More research, and in particular more UK-focused research, would be welcomed. If early findings are indicative of a true pattern then sport and recreation can not only help people live longer, healthier lives, they can also help people earn more whilst they do so and save employers money – truly a win-win situation.

CRIME AND ANTISOCIAL BEHAVIOUR

Sport and recreation programmes can prevent boredom, teach important life skills, divert young people from crime and foster social inclusion

YOUNG OFFENDERS COST THE ECONOMY AROUND

£11 BILLION

A YEAR

DIVERTING 1 IN 10 AWAY FROM CRIME WOULD SAVE OVER

£113 MILLION A YEAR

ASBO

7 OUT OF 10 TEENAGERS BELIEVE ANTISOCIAL BEHAVIOUR OCCURS BECAUSE YOUNG PEOPLE ARE BORED

75%

of **10** to **17** year olds

WHO COMPLETE A CUSTODIAL

SENTENCE

are reconvicted within

ONE YEAR OF RELEASE

JUNE 2010 TO JUNE 2011

68,200

10 TO 17 YEAR OLDS CONVICTED OF A CRIMINAL OFFENCE

£1

INVESTMENT

=£££

££££

£7 FOR THE STATE AND COMMUNITY

NEW ELTHAM

66% reduction

one mile radius

Kickz uses football to work with hard to reach young people in deprived areas across the UK. In New Eltham, youth crime has been reduced by 66% within a 1 mile radius of the Kickz site. Every £1 invested has generated £7 of value for the state and local community.

PHYSICAL ACTIVITY, ANTISOCIAL BEHAVIOUR AND CRIME

INTRODUCTION

Antisocial behaviour and crime have an enormous impact on our society. The 2011 London, Birmingham and Manchester riots exemplify how antisocial behaviour and crime can ruin people's lives and threaten an area's sense of safety. The definition of antisocial behaviour is broad, including criminal and non-criminal activities such as noise pollution, aggressive behaviour, vandalism and drug dealing. The Crime and Disorder Act (1998) defines antisocial behaviour as action that *"caused or was likely to cause harassment, alarm or distress to one or more persons not of the same household as himself [the perpetrator]"*. Between January and November 2011 there were 2.6 million recorded instances of antisocial behaviour in England and Wales. This accounts for two fifths (41.2%) of all crime, with 6.4 million other instances of crime recorded for this time period (UK Crime Stats, 2012). These statistics may not be an accurate picture of the scale of the problem given that it is thought that up to 80% of some types of antisocial behaviour go unrecorded and it is possible that a single incident can be recorded more than once through different agencies (Audit Commission, 2009).

Of the 1,664 antisocial behaviour orders (ASBOs) issued in 2010, a third (32.2%) were to people aged between ten and 17 (ten is the minimum age of criminal responsibility in England and Wales) (Ministry of Justice, 2011b). For the 12 months ending June 2011 there were 1.3 million offenders convicted of a criminal offence and 68,200 were aged between ten and 17 (Ministry of Justice, 2011a). Yet when it comes to physical activity and antisocial behaviour or crime, the focus tends to fall with young people and young offenders. Perhaps this is because it is easier to modify behaviour in young people or because 75% of those aged 10-17 who have completed a custodial sentence are reconvicted within a year of being released (Independent Commission on Youth Crime and Antisocial Behaviour, 2010), and three in four (75%) 18-20 year old men are reconvicted

within two years of being released (Natale, 2010a). In short, when exploring the issue of young people and crime or antisocial behaviour it's all about life chances, and the sooner changes can be affected the better the overall impact.

Scott et al. (2001) conducted a longitudinal study with 142 individuals who had antisocial behaviour in childhood to assess the financial costs of these individuals over time. They concluded that, *"antisocial behaviour in childhood is a major predictor of how much an individual will cost society. The cost is large and falls on many agencies, yet few agencies contribute to prevention, which could be cost effective"* (Scott at al., 2001, n.p.). Similarly, the London School of Economics' examination of the costs of youth disadvantage in the UK proposes that, *"becoming a young offender can be a one-way ticket to further exclusion. Young offenders are much more likely to be unemployed than their peers and, as a result, more likely to re-offend. Multiple exclusions stalk young offenders, even those with the best intentions to reform, severely damaging their chances of a decent future. The total bill for youth crime is therefore something that plays out over a number of years, with costs compounding with every conviction and reconviction"* (London School of Economics, 2007, p.28). In 2009 offending by young people was thought to cost the economy between £8.5 and £11 billion (Ministry of Justice, 2010). It is estimated that if one in ten young offenders received effective support to divert them away from a life of crime it would save over £113 million a year (Audit Commission, 2009). Diverting young people away from crime also has health benefits for young people. Men aged 16-19 years old who have been sentenced are six times more likely to be depressed than the general population at this age: 6% of all men aged 16-19 have depressive symptoms compared to 36% of sentenced male young offenders. For women of this age group the chances are five times higher for offenders, with 11% of women in the general population at this age suffering depressive symptoms compared to 51% of sentenced female young offenders (Office for National Statistics, 2000).

38% of people believe that the Government's main priority for sport funding should be targeted at using sport to reduce crime and improve education. More people believe this than believe that sport funding should be used in any other area (YouGov, 2011, cited in Centre for Social Justice, 2011). Youth crime and antisocial behaviour are complex social issues and there are many different identified risk factors including social and economic disadvantage, low educational attainment, poor social and emotional skills, living in a deprived area, poor parenting and poor parental mental health (Independent Commission on Youth Crime and Antisocial Behaviour, 2010; Audit Commission, 2009; Stevens, Kessler and Gladstone, 2006). Sport and physical activity alone clearly cannot completely solve something with so many interrelated risk factors. The evidence available shows that physical activity and sport can influence youth crime and antisocial behaviour in a number of ways. On one hand, physical activity can create a diversion from undertaking in criminal behaviour – the most famous example of this (covered later in this section) is probably the Midnight Basketball programme in America which took off in the 1990s. Seven out of ten teenagers believe antisocial behaviour occurs because young people are bored, and six out of ten say that there isn't enough for young people to do in their area (Nestlé Family Monitor, 2002 and 4Children, 2007, cited in Audit Commission, 2009).

Physical activities have the advantage of both creating a diversion from boredom and providing an engaging setting in which to work on improving the other risk factors relating to crime and antisocial behaviour, for example through providing workshops to enhance employability and develop emotional skills. Physical activity can also help to increase self-esteem, develop relationships and social skills, foster discipline and teach commitment. Such values may ultimately lead to modified behaviour amongst individuals who have previously committed crimes (see Oughton and Tacon, 2007). In addition, long term activities and programmes can lend themselves to progression as a volunteer or coach, which can increase an individual's confidence, self-esteem, sense of community and belonging and enhance employment prospects (Centre for Social Justice 2011; Audit Commission, 2009). Finally, it should be noted that elite sport is able to promote positive messages and support or run programmes that young people will value and respect.

PHYSICAL ACTIVITIES HAVE THE ADVANTAGE OF CREATING A DIVERSION FROM BOREDOM

What is clear is that in order to reach these goals and so influence antisocial behaviour and crime, physical activities must be delivered in a way that is structured and relevant to the needs of the problem. All of the routes outlined above require sport and recreation to be targeted appropriately to those either at risk of committing a crime or act of antisocial behaviour or those who have already done so. As a result research in this area is largely focused on specific sporting or recreational intervention programmes as opposed to membership of a sports club, independent exercise or randomised controlled trials.

CASE STUDIES OF PHYSICAL ACTIVITY INTERVENTIONS

Following the 2011 riots in the UK, the Chief Cultural and Leisure Officers Association produced guidance on the role of culture and sport in reducing crime and antisocial behaviour on the grounds that, *"focused work with young people on the cusp of offending or involved in low level offending can significantly reduce enforcement costs"* (Chief Cultural and Leisure Officers Association, 2011, p.9). They argue that sport and culture are ideally placed to engage young people at risk of committing crime and acts of antisocial behaviour because they lend themselves to informal, short-term activities and create a natural environment for interaction between different generations. Furthermore, there is evidence (as discussed in the chapter on social cohesion) that physical activity can contribute to cohesive communities by bridging divides and challenging fears. Whilst the Chief Cultural and Leisure Officers Association paper doesn't deal with the effectiveness of sport and culture separately, it includes seven case studies for each to demonstrate the evidence base for the contribution sport and culture can make.

Focusing on the sports projects included, the most detailed analysis comes from a project run by Broxbourne Council. Broxbourne in Hertfordshire suffered high levels of antisocial behaviour, with 20% of all crime in the area accounted for by criminal damage. The Council supplemented existing skate parks with a network of kickabout courts and introduced informal sports sessions at the new venues; attendance at these venues was reported to be 27,348 young people in 2010/2011. Focusing on an 800 metre buffer zone around the places where diversionary activities had been installed, in comparison to the five months prior to the installation antisocial behaviour had reduced by an average of 5%. The summary argues that when compared to changes in antisocial behaviour at an overall county level there is no correlation suggesting that reductions near to intervention sites have occurred independently and are therefore attributable to the activities and facilities offered. However, one site actually saw an increase in antisocial behaviour incidents and another only a decrease by one incident whilst the other two sites saw a decrease of 131 and 53 incidents, suggesting disparity between the facilities and activities. Further research exploring this range in impact may give a greater indication of what the most successful elements of the project were. Additionally, greater analysis of changes in crime and antisocial behaviour in the rest of the borough might provide useful insight for refining future projects. From the information detailed it appears that the intervention in Broxbourne was largely successful because it provided a facility for young people to use within their community which they respected and didn't want to vandalise, rather than as a result of any long-term changes in behaviour or attitude.

In 27 target locations within Eastleigh Borough Council, Park Sport 2011 provided 334 sessions during a five week period of the summer holidays in which 16 activities (including BMX, football, skateboarding and laser clay) were on offer to young people aged between eight and 16.

Analysis of the 2009 programme showed a 29% decrease in antisocial behaviour in identified hot spots. The Chief Cultural and Leisure Officers Association do not give data for 2011, unfortunately. Another programme targeting crime hot spots is the Cheshire-based Street Sports, which has had over 24,000 young people attend since 2007. During the period that Street Sports offered activities in one area the reported number of antisocial behaviour incidents in one month fell from 24 to three. A target group of young offenders also reduced their involvement in crime, with one individual who had committed three crimes in the five months prior to the programme having no further apparent involvement in crime. Some participants also volunteered in the running of sessions, with over 3,000 voluntary hours given during the programmes existence. This volunteering experience led to a number of the participants gaining sports qualifications and entering paid employment. Whilst the numbers presented in this case study are quite vague and it is uncertain what the long term changes to behaviour are, a programme that enhances opportunities for employment can be enormously beneficial in the prevention of crime given that 67% of offenders are unemployed at the time of imprisonment (Department for Innovation, 2009, cited in Natale, 2010b).

Another Street Sports project offered tag rugby to 8-12 year olds in areas of deprivation in Aylesbury during a ten week period in the summer of 2010. 670 people attended the sessions in total and reports of antisocial behaviour fell by between 10.5% and 35% in the targeted areas when compared to the same time period in 2009. Interestingly, the two areas with the lowest participation rates saw the lowest reduction in antisocial behaviour, suggesting more of a relationship between taking part in activities and antisocial behaviour reduction than evidenced with the Broxbourne council project.

Disappointingly, however, most of the case studies selected in the Chief Cultural and Leisure Officers Association guidance are neither robust nor evidence the impact that sport and recreation can make on reducing crime and antisocial behaviour. One example summarises a four day dance project with eight prisoners in Stoke Prison. The recorded outcomes are that 90% felt they had learnt new skills, 50% received a confidence boost, 75% had discovered something they liked doing and 50% felt an improvement in their physical fitness. Given the small sample and short duration of the intervention, these statistics are not particularly meaningful. Furthermore, there is no evidence of how, or even if, these correlate with an improvement in chances of re-offending. A cricket programme in Essex, using the game as a hook to engage young people, is analysed through anecdotal evidence and feedback from coaches and police. It was observed that the behaviour of the participants had improved during the programme as they began to be more punctual and address the coaches by name rather than as "Geezer". No information about sample size is given but there are now over 100 Street20 cricket teams thought to demonstrate the appeal of the sessions.

These case studies demonstrate the all too common issues with evaluating physical activity projects aimed at reducing crime and/or antisocial behaviour, that, *"even the projects with well-trained and dedicated coaching staff, whose efforts are widely appreciated by both participants and key stakeholders, have difficulty showing their effectiveness to the levels that are often required by evaluators"* (Centre for Social Justice, 2011, p.28). Not only does evaluation and monitoring not tend to fall into the design or budget of the project, it is also difficult to isolate the specific impact of the programme. The only scientific way to do so would be through randomised controlled trials, which would place some people in a control group for comparative purposes. However, with interventions for affecting the life chances of potential young offenders, randomised controlled trials are ethically questionable. A full and thorough evaluation would also need to be longitudinal to assess the impact of the programme on the life chances and risk of offending in the future. Little data on specific projects to this extent currently exists due to the fairly recent trend to both fund and evaluate sports-based programmes for reducing youth crime, although some scientific studies have focused on understanding the relationship between physical activity and antisocial behaviour and these are covered later in this chapter.

Qualitative evidence provides a richness and depth of understanding of the circumstances of those involved. It can be fascinating and insightful, but alone it cannot provide concrete or generalisable results about the effectiveness of a programme. The Centre for Social Justice (2011) has attempted to better understand and demonstrate the value of sporting programmes for improving crime and antisocial behaviour amongst young people. They identify two categories of barriers to proving the effectiveness of sports programmes: political and technical. Politically they highlight that when trying to secure funding, project managers can over-emphasise the potential benefits of their programme. This can then lead to unrealistic expectations of the effectiveness that the programme needs to demonstrate. A lack of clarification in the objectives of the programme can also be an issue, particularly if due to changes in government priorities the key objectives need to change. Finally, and perhaps critically, the desire for funders to have quantifiable results encourages projects to focus on easy measures such as number of courses run and number of attendees rather than what is important to measure like reductions in crime or improvements in life opportunities. The Audit Commission (2009) highlights that when a project sets a number of objectives to satisfy a number of funders then likelihood of measuring, yet alone achieving all of them is reduced. From a technical perspective, The Centre for Social Justice also argues that there are difficulties with identifying a point in time when the impact of a project should become clear and with isolating this impact from other factors. Finally, a lack of funding or resources for evaluating can prevent it from taking place properly or even taking place at all. Based on these political and technical barriers, the Centre for Social Justice emphasises the importance of sports programmes, clearly defining the problem they are tackling and how they aim to do so using sport.

This approach is also key in ensuring that programmes are appealing and relevant for those most likely to commit crimes and acts of antisocial behaviour. If a project doesn't appeal to the very people it's trying to engage then it is unlikely to be successful.

MIDNIGHT BASKETBALL

One of the earliest and most well-known programmes to utilise sport in a targeted and appealing way to combat crime and antisocial behaviour was the Midnight Basketball programme in America, which took off in 1989. This programme was conceived by an American named Standifer, who believed that the solution to inner city crime was to provide poor, young, predominantly black men with something safe and constructive to do between 10pm and 2am – the "high crime" hours. The original Midnight Basketball was targeted at men aged 17-21, took place only after 10pm and required the presence of two uniformed police officers during each game. Although kick-started under George Bush, the idea gained political momentum with Bill Clinton's support in the mid-1990s and became the focus of several research papers (Farrell et al., 1996; Derezotes, 1995; Mendel, 1995) and much media coverage at the time. The notoriety of Midnight Basketball emerged because the idea was new, relatively low cost, practical and easily possible in existing facilities. It was also claimed to be enormously successful, with Standifer crediting it for a 30% drop in crime in Glenarden, Maryland during the first three years (cited in Hartmann and Depro, 2002) and Farrell et al. (1996) claiming the same level of reduction in crime from the Milwaukee programme.

However, the early analysis of Midnight Basketball was largely qualitative, reporting the benefits of participation as including enjoyment, reduced inter-gang violence, building new relationships, skills development and new work and scholarship opportunities (Derezotes, 1995). Where claims of reductions to crime rates had been made they were not based on robust evaluations and could therefore not be considered conclusive. In addition, during the 1990s there was a global trend of declining crime levels and the small numbers impacted by Midnight Basketball could not have been causing the overall effect (Hartmann and Depro, 2002). Vocalisations of these criticisms led to a development of the Midnight Basketball programme into a more rounded intervention with workshops on important life skills and counselling. More than 20 years later Midnight Basketball programmes in one guise or another are running across the globe – from the UK to Australia. More work has also been done on identifying the effectiveness of Midnight Basketball. In 2002 Hartmann and Wheelock carried out ethnographic and qualitative research on a Minneapolis Midnight Basketball programme, which was not the success they had originally hoped for but which still produced some valuable findings. Hartman and Wheelock (2002) proposed four potential explanations for why the basketball programmes were successful. The first was that sport is character building in that basketball teaches self-discipline and bestows self-esteem, cultivating the virtues of being hard-working and abiding by the rules amongst a group that previously lacked these. The second was that sport is a catalyst for social mobility through the opportunities it can present: opportunities such as academic scholarships, coaching qualifications and work officiating games. Thirdly, sport is a medium for social control because it emphasises discipline and surveillance at a time when otherwise the participants would be committing crimes; ultimately this could lead to a new moral code in participants. Finally, sport is a hook for young men to be connected with educational and employment opportunities.

It was intended by Hartmann and Wheelock that their research would identify what the crucial components from these models were for the success of the programme, but they were unable to do so due to the poor delivery of the particular programme they were evaluating. The findings instead were almost as interesting. The Minneapolis program was poorly orchestrated because ultimately a lack of resources resulted in unsatisfactory planning and the accompanying life skills curriculum was so ineffectively delivered that for all intents and purposes it wasn't delivered at all.

This in itself was revealing, as where resources were limited, the primary focus had to be on delivering the basketball activity itself: this was why people were there, and why people returned to the programme week on week. As a result, the basketball league was very successful but paradoxically the bait that brought young men in to teach them positive behaviour wasn't followed up with positive behaviour. High degrees of satisfaction with the programme weren't related to the non-basketball prevention elements but to the opportunity for recreation and physical activity. In the context of the ten full court basketball playgrounds closed down in Minneapolis parks during the time of the programme, this is unsurprising. Other identified benefits of playing basketball were the networks people were able to develop, the opportunities for social interaction and an environment of support and encouragement. Although Hartmann and Wheelock didn't examine it, the choice of basketball as the particular midnight sport might also be important. Firstly it is a team sport, it is fast and inclusionary, suitable for all skill levels and only requires basketball courts and a ball to be played. Furthermore, as the Australian programme points out, not only does Midnight Basketball take place when young people could be getting into trouble, it also continues sufficiently late into the night to exhaust them rather than send them back out onto the streets pumped with energy[58].

Hartmann and Depro returned to the topic in 2006 to conduct analysis on the relationship between Midnight Basketball programmes and crime rates and dispel scepticism surrounding the intervention. After accounting for demographic variables, Hartmann and Depro found that cities with Midnight Basketball programmes experienced a 5% greater decrease in property crime compared to cities that did not run programmes. This was only found with property crime and not violent crime.

58 http://www.midnightbasketball.org.au/Pages/AboutUs.aspx

Hartmann and Depro concluded that, *"midnight basketball is somehow associated with decreased city-level property crime rates"* but that, *"a good deal more research must be conducted before we would want to argue that this relationship is stable and causal"* (Hartmann and Depro, 2006, p.192).

THE IMPACT OF PHYSICAL ACTIVITY INTERVENTIONS

So far we have seen mostly inconclusive evidence as a result of insufficient evaluation and analysis. The 2009 Audit Commission report ***Tired of Hanging Around*** is a comprehensive policy examination of how sport and leisure activities can prevent antisocial behaviour by young people aged 8-19 years old. Insufficient analysis was a concern for the Audit Commission too as it found that half (48%) of 20 projects used as case studies had no evidence or only anecdotal evidence of their outcomes, whilst only 27% collected evidence in a way that meant a value for money assessment was possible and only 14% gathered quantitative and qualitative data matched to their objectives. As a result, *"councils, children's trusts and crime and disorder reduction partnerships lack the performance data to make intelligent commissioning decisions about new or repeat schemes"* (Audit Commission, 2009, p.3).

Smith and Waddington (2004) sought to assess whether sporting schemes aimed at reducing crime, delinquency and drug abuse among young people are effective. They also noted a lack of built-in monitoring or evaluation for such programmes and highlight that where successes

MIDNIGHT BASKETBALL TAKES PLACE WHEN YOUNG PEOPLE COULD BE GETTING INTO TROUBLE

occur it is often difficult to pinpoint the elements of the programme responsible. Citing Robins (1990) and Coalter (1989, 2001), Smith and Waddington demonstrate that these evaluative issues are not new to programmes and projects aimed at tackling delinquency or antisocial behaviour through physical activity. This is one of the main reasons why Smith and Waddington conclude that there is little evidence for the effectiveness of sport programmes in reducing crime or drug use and that where benefits can be shown, analysis of the cost-benefit ratio is missing. For example, Taylor et al. (1999) analysed the parameters of 54 physical activity programmes for young offenders who were under probation supervision in England and Wales. They explored the cost of these programmes but unfortunately not the benefits. The average cost per participant who completed the programme was £730, however there is no indication of re-offending rates for these participants to estimate the cost effectiveness of such programmes.

The recently finished two year 2nd Chance programme has examined cost-benefit to some extent. 2nd Chance used sports coaching in rugby and football to help young offenders build relationships, improve behaviour and receive guidance from mentors once released. The programme sessions lasted 12-15 weeks and qualified the prisoners with either a Level One football coaching qualification or a Level Two in First Aid and the RFU Rugby Ready coaching award. In evaluating the success of rugby and football projects at Portland Young Offender Institution, Meek (2012) has thoroughly explored the implications and effectiveness of the physical activity initiatives and reviewed the academic research context around physical activity and crime reduction. 81 prisoners participated in the 2nd Chance programme and the research; 50 of these had been released from prison in the 18 months prior to the end of the programme. 41 of the released prisoners had not re-offended at the time of the report, giving a re-offending rate of 18% for those who had been convicted of a new offence or returned to prison for breaching their licence conditions. In comparison to the wider population at Portland Young Offender Institution, the re-offending rate within one year is 48% (2011 data based on 542 prisoners), demonstrating that re-offending is reduced for the 2nd Chance prisoners (Meek, 2012). However, the small number of participants who have been in the community for a year or more from the 2nd Chance sample makes this comparison questionable, but over time more concrete data could, and if possible should, be gathered. The comparison is strengthened slightly by a close similarity in participants' offence profiles (the crime they had been convicted for) compared to the national offence profile of young adult males in prison.

Meek calculates from Ministry of Justice data that the average cost to hold someone in a Young Offender Institution is £47,137, but that this calculation is conservative given that it excludes the social costs and the actual cost of the criminal offence committed by each individual. Over two years and working with 81 prisoners, the 2nd Chance project cost £183,000 or £91,500 a year. Therefore, preventing two prisoners in one year from re-offending would result in a cost saving from the 2nd Chance programme. Taking the 50 participants who have returned to society and comparing the programme's currently evidenced re-offending rate with that of Portland Young Offender Institution at large, the nine participants who have re-offended represent a cost of £424,233, whilst 48% of the participants re-offending would have cost over £1.1 million, representing a potential saving of over £600,000 from the 2nd Chance intervention.

The success of the 2nd Chance programme seemingly comes from its integrated structure. Alongside the intrinsic activities of rugby and football themselves, the support of coaches and programme leaders, sociability with other inmates and the opportunity to learn something new were all also important factors for participants.

"I'M PLAYING FOOTBALL AND I'M PLAYING FOOTBALL EVERY DAY. AND EVERYTHING THAT IS IN MY MIND IS BEING PUSHED ASIDE"

Qualitative analysis revealed that the programme improved prisoners' experiences whilst in prison through providing a means of physical and mental release, an incentive for good behaviour and a positive way to deal with the routine of prison. Participating also gave prisoners a goal to focus on and a sense of achievement as they progressed. The sports themselves seem to be key for these changes as they enhanced fitness, were enjoyable to undertake and gave prisoners a new activity to focus on.

"My time in Portland wasn't the best time, I got into a lot of trouble. But as soon as I got into the academy it's like something sparked, I'm playing football and I'm playing football every day. And everything that is in my mind is being pushed aside. So once I was in the academy my behaviour started to change, you could see the change in my behaviour." (2nd chance programme participant, cited in Meek, 2012, p.23).

Physical activity specifically as the focus for this programme was also very successful because sport lends itself easily to an appropriate qualification. Leaving prison with a qualification can provide a prisoner with greater opportunities when they return to society and demonstrating proactive use of their time and skill acquisition whilst inside will make a former prisoner more appealing to employers on the outside (CIPD, 2007). In fact, one participant actually lined up a job coaching football at a club before leaving prison. The ongoing individual support of the 2nd Chance transition worker also appears to have been crucial in the positive impact of 2nd Chance, and may not have been accepted without the sporting programmes breaking down barriers. This support was in the form of letters, phone calls and visits both in custody and once released, aimed to ensure a successful move back into society for prisoners. Meek believes that these opportunities and experiences combined can reduce criminogenic factors (for example attitudes to offending, aggression management and victim empathy) in prisoners, and indeed the early evidence suggests this.

The Kickz programme, co-ordinated by the Football Foundation, also uses football to reduce crime and antisocial behaviour. However, it is an intervention rather than a rehabilitation programme and therefore targets 12-18 year olds at risk of offending in deprived areas across the UK. On three or more evenings a week Kickz sessions are delivered by a professional football club and will focus on football coaching, coaching in other sports and a range of workshops, from drug awareness and weapons to healthy eating and careers. As of 2011, more than 50,000 young people have engaged

with Kickz programmes across the UK delivered by 43 professional football clubs. On average young people involved experience 72 hours of contact time with Kickz, with the vast majority (91%) of projects taking place on a Friday and/or Saturday evening. Since the programme began in 2006 it has created 5,052 volunteers, accredited 6,827 young people and secured employment within the clubs for 398 people (Kickz, 2011).

Analysis of Kickz in Elthorne Park (North London) found that every £1 invested in the programme generated £7 of value for the state and local community, largely by reducing youth and gang violence. Since the Elthorne Park Kickz programme started, within a one mile radius of the site there has been a 66% reduction in youth crime (New Philanthropy Capital, 2011). Kickz works in both a preventative and supportive way for young people. The programme keeps the participants engaged and active during the evenings when they could otherwise be causing trouble or committing crimes, creates an opportunity for positive relationships between youth workers, the police and young people, and offers an influential way of communicating preventative messages. For young people who have or are already offending, football can foster increased confidence and the aspiration and skills to move away from crime. There are also sports qualification, volunteering and employment opportunities through the programme to give disadvantaged young people an alternative future. As with the 2nd Chance programme, having the right staff to support the programme and participants is vitally important, and so those involved in the delivery of Kickz at Elthorne Park were trained youth workers.

Whilst the New Philanthropy Capital evaluation of Kickz cannot say what changes would or wouldn't have happened in Elthorne Park without the programme, it concludes that the reduction in the area's youth crime is a result of prevention rather than diversion, even if it isn't possible to directly attribute all of this to Kickz. They propose that if Kickz was simply a diversion then youth crime would be higher on the nights when no sessions are held, however youth crime was the same on any night of the week after the introduction of Kickz (New Philanthropy Capital, 2011). It therefore appears that the integrated approach of Kickz improves the behaviour of young people across the board, suggesting that the benefits may be likely to be long term.

PHYSICAL ACTIVITY AS 'A HOOK'

The success of the integrated approaches seen in the 2nd Chance and Kickz programmes could lead to the conclusion that physical activity itself is not integral to reducing crime and antisocial behaviour, although we have seen with Midnight Basketball that there are benefits even when additional elements are not delivered. What it actually highlights is that certain conditions and the inclusion of key stakeholders enhance the positive outcome of physical activity interventions, and that due to its appealing and engaging nature physical activity is the hook for other sessions and workshops that result in positive behavioural change (Sherry, 2010; Perkins and Noam, 2007; Martinek, 2005). In this sense physical activity can be a mechanism for personal and social development. Physical activity works as a hook because it appeals enough for people to give it a go in the first instance, and it is sufficiently engaging for people to continue participating. The additional advantage to physical activity over another activity in this scenario is the moral element contained within physical sporting activities: this includes fair play, teamwork, safety, leadership and determination. Such skills then help participants to feel grounded in community life. Organised sporting programmes for at risk youths therefore need to be structured so that they encourage young people to feel competent, empowered and connected (Gatz et al., 2002 and King et al., 1998, cited in Carmichael, 2008). To achieve this it helps for programmes to utilise activities where there is a skills base, team focus and plenty to learn (Diana 2000, cited in Carmichael, 2008). Where programmes emphasise winning at all costs and unequal access to participation they are more likely to encourage problems amongst young people at risk (Hawkins, 1998, cited in Carmichael, 2008).

Angling, for example, easily lends itself to celebrating successes and mitigating failures, which works well for vulnerable young people with low self-esteem and for those who do not want to participate in mainstream sports subject to peer competition. For example, whilst it is possible for a novice angler to catch a fish, the "failure" of not catching a fish can be mitigated through reference to environmental variables as opposed to a personal lack of skill. Angling-related Youth Intervention Programmes (AYIPs) utilise the characteristics of angling to provide a diversion from crime and antisocial behaviour, develop personal and social skills and increase education and employment attainment. Another advantage to angling in particular is that it is highly flexible for acting as a hook to other methods of self-improvement. The diversity of angling activities and locations makes it easy to participate in situations that can aid personal and social development and relationship building through teamwork and one-to-one development. Young people can also be presented with new challenges and a new environment for learning in. Angling also takes part in community spaces and more specifically adult spaces. Because of the proximity of water responsible behaviour is needed and whilst young people are angling they have a meaningful engagement with the community, which may be conducive to reducing antisocial behaviour (Substance, 2012).

The FairPlay programme run by the Rugby Football Union (RFU) in conjunction with Barclays Spaces for Sport and Wooden Spoon (a children's charity for rugby) used rugby as a hook and includes an analysis of the costs involved. The two year programme targeted hard to reach young people through rugby in order to work on their behaviour and social skills. It ran 99 eight week sessions with a total of 1,058 young people, of which 69% (729) attended a minimum of 75% of the sessions. Participants were aged between 14 and 18, had been excluded from mainstream education and were attending Pupil Referral Units. These units are local authority-run schools for children who are unable to attend mainstream schools or have been excluded from them; as a result the teacher to student ratio is higher.

It has been estimated that the cost of sending one pupil to a Pupil Referral Unit is between £13,000 and £18,000 per year compared to around £5,200 per year to send one pupil to a regular secondary school (Corporate Citizenship, 2012). The cost per pupil for the FairPlay programme was £311, which went up to £451 when looking only at those who completed the programme – a fraction of the cost of Pupil Referral Units. Significant increases were seen in a number of skill areas, with 60% of participants reporting quite a bit or a lot more knowledge of anger management after the programme compared to 31% beforehand. Knowledge of problem solving similarly increased from 38% to 64%, whilst asking questions increased from 41% to 66% and getting on with people from 46% to 71%. Interestingly, the areas where the least significant improvements were seen were those furthest removed from the rugby field such as presentation skills and interview skills. This highlights the difficulty in using a physical activity to act as the hook for further training, as partly seen with the Midnight Basketball sessions explored by Hartman and Wheelock (2002), and also illustrates that benefits can be experienced from participating in the activity itself: for example, half of the pupils reported feeling better about themselves (49%) and feeling more confident (47%) as a result of participating.

Staff at the Pupil Referral Units also assessed the performance and behaviour of those who participated in the programme. Whilst positive changes were recorded, levels of sustained progress were perceived as being quite low. Given that the intervention lasted only eight weeks this is not surprising, but any improvements, short term or otherwise, were seen to be extremely positive given the nature of the pupils involved. However, one of the advantages to this programme was that as a result of being run partly by the RFU, the participants were introduced to local rugby clubs in order to continue engaging with the sport and reaping the benefits of participation.

Where national governing bodies are able to help deliver programmes and facilitate this it is easier to establish a long term impact. Follow up research indicated that 180 participants (17%) went to a rugby club at least once after participating in the programme and at least 79 were still playing three months later, although it is suspected that more remained involved. It would be interesting to follow this up in more detail and find out what factors influence take up and drop out in the short, medium and long term.

Positive Futures is a Home Office funded national initiative aimed at ten to 19 year olds and run by the young people's charity Catch 22. Launched in 2001 between Sport England, the Youth Justice Board and the United Kingdom Anti-Drugs Coordination Unit, Positive Futures identified itself not as a sports development project but as a relationship strategy. The strategy was that sport acted as the hook for establishing relationships with socially marginalised young people who are typically alienated from figures of authority. The scheme is currently set to run until March 2013 and now includes activities in visual arts, music and film, education and dance as well as sports. In accordance with the approach of Midnight Basketball, Positive Futures ensures that in areas identified as high crime and high levels of antisocial behaviour activities occur on a Friday and Saturday night. Unfortunately the available evaluations of Positive Future projects make it difficult to distinguish between the impact of physical activity and other programmes, and focus more on case study reports and attendance numbers rather than the differences made to society and the life chances for the young participants.

However, the Positive Futures initiative does highlight the beneficial function that positive authority figures or role models can have. Often young people at risk of offending lack positive relationships with pro-social members of the community.

Physical activity programmes provide a way of creating a natural opportunity for young people to engage with positive role models outside of their usual circles of acquaintance, such as coaches, volunteers or even assigned mentors. This is important because role models can influence socialisation. Rhodes (2002) proposes that mentoring helps young people by enhancing their social-emotional development, providing a role model and improving cognitive development through dialogue and listening. These processes combined can lead to improvements in academic performance, risk behaviour and psychosocial development (cited in Stevens, Kessler and Gladstone, 2006).

However, the benefits of mentoring are likely to only be as good as the mentor and the quality of the relationship. Rowley (1999) focuses on mentors who support new teachers to detail the qualities necessary for a good mentor. These qualities are applicable to all mentors and state that a good mentor is one who is committed, is empathetic, is a continuous learner, is skilled at supporting and instructing, is effective in different interpersonal contexts and is able to communicate belief in the person they are mentoring. Not everyone who wants to be a mentor will naturally possess all of these qualities, which is why training mentors is a useful and important way of maximising their potential to have a positive impact. In addition, a close and enduring connection is needed between the mentor and young person in order to encourage positive developmental change (Rhodes and DuBois, 2008). Physical activity programmes create an environment through which connections can be easily established and built upon. Often it will be coaches or volunteers who outline the values or rules of the activity being participated in. This sets the mentor figure as someone who is there to help and inform for the benefit of the young person, and as someone who can demonstrate achievement and thus be inspiring. This will increase the likelihood of the young person listening to the volunteer or coach on other topics and about other advice.

Furthermore, coaches or volunteers who have progressed to this role after joining the programme as a participant make it easy for new participants to recognise that they can emulate the coach or volunteer who is in a similar position to themselves but with more experience. This also allows coaches and volunteers to have greater empathy with the young people, which will help in building positive and effective relationships (for an understanding of factors influencing identification of a role model and their ability to influence see Bandura's theory of social learning, 1986).

A good sports coach is able to help mental development as well as physical development; this applies in any setting but is even more meaningful when young offenders or at risk youth are involved. A coach can encourage self-motivation through helping the player to set goals that they want to achieve, supporting them in this process and helping to break down any barriers to achieving the target. They can encourage problem solving and decision making and open up pathways of communication (Bell, 1997). For young offenders this self-belief and the skills learnt can be carried over into other areas of their lives. Coaches can also demonstrate belief in the player and their abilities, and for young people at risk of offending it can be extremely valuable for them to have an independent adult place belief in their abilities.

With regards to the building of relationships, physical activity programmes are seen to be beneficial in the community for breaking down barriers between young people and those in positions of authority, such as Police Constable Support Officers, and also for tackling the hierarchies of power and complex relationships that may be established in prisons where it can be hard to demonstrate leadership without violence. Quantitative evidence for these impacts is difficult to find but case studies and qualitative comments from programme participants indicate that this does occur.

For example, a 2009 Cumbria Police Tag Rugby Programme concluded that, *"The programme has been essential in breaking down barriers of both pupils and community groups by using 'fun' as the vehicle which has driven the success of the scheme"* (RFU, 2009, p.2).

In addition, The Centre for Social Justice (2011) has argued that often when programmes are delivered by professional sports clubs it is the name and prestige associated with the club and its branding that lures participants in and makes them more willing to listen. Given that the 2nd Chance programme in Portland Young Offender Institution was supported by Chelsea FC and the Kickz programme in Elthorne Park was delivered by Arsenal FC, it is possible that club prestige played a part in the success of these projects, although this is yet to be confirmed by research. Similarly, a scheme run by the Metropolitan Police but held at Tottenham Hotspur's ground is thought to reinforce positive messages to 1,800 year six pupils a year through the stadium's local and national profile (Audit Commission, 2009).

In North Devon, a consultation concluded that water and outdoor adventure activities were in young people's top three most desirable activities to do. This also applied to young people who were not at that time engaged with any out-of-school sports, with 60% of this group stating that water sports was the activity they most wanted to do (McCaie, 2009). It may therefore be that adventurous activities in particular can act as a "hook" for other sessions around improved behaviour; they often fit the model of a skills base, team focus and plenty to learn outlined above. The mental and physical challenges found in adventurous activities differ to those in team sports or training programmes. Often there is a more immediate sense of achievement (for example, from climbing up a wall as opposed to improving in fitness over 12 weeks of playing matches), teamwork may be needed for problem solving, there are usually many elements so that everyone finds something enjoyable and activities tend to take place outdoors in an entirely new environment. There is, however, a danger that if structured incorrectly, taking a group of young people at risk of offending who have previously offended and isolating them in a new environment exacerbates their behaviour through creating a normalising environment with offenders. It is possible that this risk can be reduced by running programmes targeted at those not at risk as well as those at risk. This creates positive peer influence for young people at risk (Morris, Sallybanks and Willis, 2003).

ADVENTUROUS AND ADRENALINE ACTIVITIES

Lubans et al. (2011) conducted a systematic review of outdoor adventure programs, sport and skill-based programmes and general physical activity and fitness programmes and their impact on the social and emotional wellbeing of at risk young people. The phrase "at risk youth" refers to adolescents who are living in a negative environment and lack the skills and values that are needed to become responsible members of society; young people in this group are likely to suffer depression, low self-esteem and disaffection which may lead to social isolation. 15 studies were included in the review: seven covered outdoor adventure programmes, six covered sport and skill-based programmes and the remaining two focused on general physical fitness programmes.

The outdoor adventure programmes considered had samples of between 12 and 177 adolescent offenders or at risk adolescents and controls (with the exception of one study). They lasted from between four hours to three months and included a range of activities such as rock climbing, horse riding, orienteering and sailing. Two programmes had an additional therapy element in the form of family training to support positive relationships.

Between five studies there was evidence that outdoor adventure programmes resulted in significant improvements in self-worth, self-concept, resilience, perceptions of alienation and self-control, but the methodology was not always rigorous. Two studies found no improvements in social and emotional wellbeing; one of these involved 17 at risk adolescents undertaking a one hour horse riding session once a week for eight weeks. The other provided a three month programme to 45 adolescent offenders and the outdoor adventure programme made up only three days of this programme overall. It is possible that the frequency of the interventions was insufficient in these two studies to have an effect, however a four hour adventure programme with 106 at risk adolescent boys was seen to positively influence resilience. With different outcomes measured, different samples (at risk and offenders) and different study structures, comparisons and conclusions are difficult, but a general trend of a positive impact appears to be evidenced. This was also found by West and Crompton (2001) in their review of the impact of adventure activity programmes and at risk youth. 14 studies explored reductions in undesirable behaviour following the outdoor adventure intervention. Eight of these showed a reduction, and 14 out of 16 studies showed a significant positive change in self-concept, although again the authors highlight that many of the study designs make the validity and generalisability of the findings questionable. It is not clear from either review how adventurous activity programmes contribute to improved behaviour or what the long term affects are.

OUTDOOR ADVENTURE PROGRAMMES RESULTED IN SIGNIFICANT IMPROVEMENTS IN SELF-WORTH, SELF-CONCEPT, RESILIENCE, PERCEPTIONS OF ALIENATION AND SELF-CONTROL

Recognising the need for quantitative measures of the impact of adventure activity programs aimed at improving wellbeing and life chances for young people, New Philanthropy Capital have recently developed a wellbeing measure. The measure aims to provide a means of recording traditionally difficult to quantify soft skills in order to provide an evidence base for the difference a project is, or isn't, making. The measure consists of a number of statements that young people (aged 11 to 16) have to say how strongly they agree or disagree with. Statements include for example, *"I feel my life has a sense of purpose"*, *"other people think I am a good person"* and *"I wish I lived somewhere else"*. The questions are asked before the activity or programme is embarked on, and again a couple of weeks after completion. Analysis is done at a group level by creating a score for each of the eight areas of wellbeing which will fall between zero and 100, and the before and after scores can then be compared. The areas of wellbeing covered are self-esteem, emotional wellbeing, resilience, satisfaction with friends, satisfaction with family, satisfaction with community, satisfaction with school and life satisfaction.

The group only level of analysis available with this tool makes it problematic for use with projects that don't have many participants and may confound results if the sample includes a mixture of young people at risk of antisocial behaviour and not at risk and comparative analysis isn't undertaken. However, the overall approach of attempting to quantify wellbeing could be a useful step forward for this sector. Whilst usage of the tool is not widespread, the Outward Bound Trust used it with a sample of 691 young people undertaking a five day Adventure and Challenge course. They saw a 14% increase in life satisfaction, a 9% increase in self-esteem and a 7% increase in resilience after completing the course (The Outward Bound Trust, 2011).

Other physical activities that share characteristics of outdoor adventure activities can be offered in more immediate settings for young people. Skateboarding has been tagged as an "adrenaline sport" and is also a sport that typically fosters young people to group together which can lead to a gang environment. It involves being outdoors, mastering new skills and risk-taking. The opening of an Active England funded skate park in Skegness in 2006 saw a year one reduction in crime rates of 17%. The park is aimed at 10-18 year olds and in 2007 had 670 annual members and 6000 monthly members (Sport England, 2008).

It has also been hypothesised that adventure activities work with young offenders because they provide them with a sense of excitement and challenge that they had previously turned to crime and antisocial behaviour for. The established psychologist Theodore Millon, renowned for his work on personality disorders, proposed that there are five types of antisocial personality disorder: covetous, reputation-defending, risk-taking, nomadic and malevolent (Millon et al., 2002). For those whose antisocial behaviour is motivated by negative risk-taking, adventure activities may offer a suitable alternative for this thrill through positive risk-taking. Cronin (1991) assessed sensation seeking in 20 mountain climbers with an average of four years' experience and 21 control volunteers. Mountain climbers had higher thrill and adventure seeking scores (0.86) and sensation seeking scale scores (0.58) compared to the control group, leaving Cronin to conclude that participating in mountain climbing was a means through which the desire to take risks could be enacted positively.

PHYSICAL ACTIVITY AS A MEANS OF ADDRESSING RISK FACTORS FOR CRIME AND ANTISOCIAL BEHAVIOUR

The risk factors for becoming a young offender have been highly profiled and documented. It is logical that tackling the risk factors can contribute to a reduction in crime and antisocial behaviour, and there is a role for physical activity to play in this process. For example, in the chapter on physical activity and mental health it is evidenced that physical activity can contribute to increasing self-esteem in adolescents, whilst low self-esteem is associated with aggression, antisocial behaviour and delinquency (Donnellan et al., 2005). Furthermore, low educational attainment can be a risk factor, but physical activity can have a positive impact on capacity to learn – this is covered in the education and employment chapter.

Hansen and Breivek (2001) found that adolescents who weren't challenged and who had a poor social background were more likely to engage in negative risk-taking behaviour. This raises an interesting point around the likelihood of participating in leisure time physical activity for those most at risk of committing antisocial behaviour and crime. The factors that place a young person into the at risk category, such as low self-esteem or poor social and emotional skills, do not lend themselves to voluntarily participating in a sporting activity. Whilst the focus of research tends to be on physical activity as a targeted means of improving behaviour amongst at risk groups, or on improving the behaviour of offenders, participation in sport and recreation in the general population of young people may help to foster traits that contribute to keeping them out of the at risk category.

Mutz and Baur (2009) found that membership of a sports club was not associated with the occurrence of violent behaviour as a form of antisocial behaviour, but that sex, education, social background, immigrant background, family violence, media violence and peer-group attitudes had significant effects. Their analysis was conducted on a sample of 33,000 15 year olds with data gathered from the German sub-sample in the Programme for International Student Assessment. However, participating in physical activity at a sports club is different from having high levels of participation in physical activities. It may be that the sense of community associated with involvement in a sports club plays a role, or that the difference is between individualised activities and team sports, which are more likely to involve a sports club. Unfortunately the researchers were not able to distinguish between different sports. It would also have been interesting to see what impact sports club membership had after controlling for the other factors seen to have stronger influences.

Research from Moesch, Birrer and Seiler (2010), on the other hand, provides evidence that there is some sort of relationship between violence and sports participation in adolescents. Moesch, Birrer and Seiler examined data on sport engagement, violent behaviour and cognition, self-concepts, wellbeing and stress perceptions gathered through self-report questionnaires from 832 adolescents (aged 12-18 years old). Individuals were categorised into one of five levels of violence: non-violent adolescents, adolescents at risk, violence supporters, psychological harassers and violent adolescents. The fourth cluster of psychological harassers were seen to be mostly male and with an immigrant background, aligning with the findings of Mutz and Baur (2009). In addition, Moesch, Birrer and Seiler found that psychological harassers spent the most time participating in sport and there were high levels of prevalence amongst those who played elite sport. Those who were classed as violent adolescents were more likely to take part in team sports that involved body contact, and non-violent adolescents were less likely to do so. However it's difficult to establish causality from these findings. For example, do individuals with more violent tendencies choose to play contact sports or does contact sport encourage violence in individuals?

Caruso (2011) used a panel dataset (size unknown) from the Italian national statistical office for the twenty Italian regions between 1997 and 2003 to empirically study the relationship between sports participation and three types of crime: property crime, violent crime and juvenile crime (all crime by individuals aged 18 or younger). A 1% increase in sport participation was found to reduce juvenile crime by approximately 0.8% and property crime by approximately 0.3%, leading Caruso to conclude that there was a robust negative association between participating in sports and juvenile crime, and for sports participation and property crime. A positive association was seen between sports participation and violent crime, which accords with the findings of Moesch, Birrer and Seiler (2010), but the significance of this finding was weak and Caruso hypothesises that football hooliganism has skewed this.

Low educational attainment, poor social skills and low self-esteem are all risk factors for antisocial behaviour. An American after school football programme for at risk young people was evaluated by Hritz et al. (2010) for its impact on self-esteem, social skills and academic success. 31 eight to ten year old students who were identified by teachers as being at risk participated in the after school football programme once or twice a week for several months. The football sessions were designed to be delivered in a way that provided a clear structure with enforced rules and expectations, caring and supportive relationships, opportunities for meaningful group inclusion, positive social norms, self-empowerment and expression, skill building and integration with family, school and the community.

Prior to each session students' schoolwork would be reviewed and if anything was outstanding it had to be completed before they could begin to play or practice. Complete data was collected for 25 students and included teacher ratings of prosocial and social competence skills, teacher ratings of cognitive function of classroom behaviours, student perceptions of self-esteem and reading and maths scores.

15 of 19 statements on the student's prosocial skills showed a significant difference following the after school football programme. The greatest improvements were seen in children being able to accept not getting their own way, producing work of acceptable quality, responding to teasing or name calling constructively and using their free time appropriately. The scale to answer these questions ranged from one, which indicated never, to five, which indicated frequently. The before and after programme mean scores for being able to accept not getting their own way were 3.36 and 4.33 respectively, for producing work of acceptable quality they were 3.40 and 4.33 respectively, for constructive responses to teasing the mean scores were 2.84 and 3.71 respectively, and for using free time appropriately they were 3.48 and 4.29 respectively. Classroom behaviour was also seen to improve, reflected in higher scores for maths and reading aptitude, which may help to further increase self-esteem. The group mean reading score increased from 240.84 to 250.19 after the programme, whilst the mean maths score increased from 245.60 to 256.29. The after school programme was overall a success and is particular interesting given that the audience was in a sense captive. The additional requirement of completing all school work before being able to participate was a clever and constructive way to not only improve educational progress but also to motivate the young people at risk and to give them a sense of reward and achievement for their hard work. Links between sports clubs and schools to form after school programmes or training sessions could utilise similar mechanisms to address multiple risk factors and furthermore would work well at integrating young people with their community.

A lack of self-regulation has been linked to substance abuse and criminal behaviour amongst other negative behaviours (Baumeister et al., 1994, cited in Oaten and Cheng, 2006) and potentially it can play a role in someone's adherence to an exercise programme or participation in a sport. Oaten and Cheng (2006) therefore tested the role of regular physical exercise in increasing self-regulation or regulatory strength. The ability to self-regulate is believed to be a result of sufficient self-regulation resource and motivation; it is thought that it's possible to increase the resource through exercises in self-regulation. 24 sedentary Australian undergraduate students aged 18-50 years volunteered for the research and were divided into three groups. One group went straight into a two month exercise programme of aerobic classes, free-weights and resistance training three to four times a week in a combination tailored to individual needs by gym staff. The other two groups acted as controls by being placed on a waiting list for two months before beginning the same exercise programme for two months. All participants self-reported on regulatory behaviours every four weeks, emotional distress, perceived stress, self-efficacy, cigarette smoking, alcohol and caffeine consumption and other everyday regulatory behaviours were measured by questionnaire. In addition, participants' self-regulation abilities were tested by the researchers using a visual tracking task before and after a thought suppression task.

Participants appeared better at controlling their behaviour following the exercise programme, showing an increase in healthy eating and a decrease in junk food consumption, impulse spending, overspending and loss of temper. At enrolment, participants reported healthy eating two to three times a week; after two months of exercising healthy eating was occurring daily, and sometimes more than once a day.

WHILST JUNK FOOD WAS CONSUMED DAILY AT THE BEGINNING OF THE RESEARCH, FOLLOWING TWO MONTHS OF EXERCISING, JUNK FOOD CONSUMPTION FELL TO ONE TO THREE TIMES A WEEK

Whilst junk food was consumed daily at the beginning of the research, following two months of exercising, junk food consumption fell to one to three times a week. Participants reported impulse spending had fallen from a daily occurrence to once a week, whilst overspending and loss of temper used to happen several times a week and fell to less than once a week. Seeing friends instead of studying, missing appointments and putting things off until later changed from occurring daily to less than once a week. Reports of watching television instead of studying and leaving dishes in the sink also declined.

Some of these areas of self-regulation are related to adhering to an exercise programme, for example, committing yourself to regular exercises is likely to increase consumption of healthy food over junk food, regulate alcohol intake more and create better mood, making people less likely to lose their tempers. However, the majority of these areas are not related and still show an increase in self-regulation. The tasks tested by the researchers show that participants improved their regulatory stamina with time spent exercising. This was evidenced by a reduction in the impact of the thought suppression task (regulatory depletion) on ability to perform in the visual tracking test (self-regulation test). Throughout the research, the initial error rate for the visual tracking test was around 11%. At enrolment the thought suppression task resulted in a 24% error rate for the visual tracking test. After one month of exercising this fell to 17%, and after two months it was 14%. Whilst participants were on control waiting lists, no changes were evidenced at all, suggesting that these improvements were not a result of multiple testing. It is worth noting that perceived stress and emotional distress were reported as being reduced but no changes in self-efficacy were recorded. Oaten and Cheng therefore conclude that the improvements in self-regulation seen from participating regularly in physical activity were a result of a reduced vulnerability to regulatory depletion and its effects.

The findings of Oaten and Cheng and their implications for behaviour modification are very interesting, but much more research is needed to understand the relationship properly. This research is also limited by its small sample size: 24 participants took part in total but only those who recorded doing each area of self-regulation at all at the beginning of the research were considered in analysis. Base sizes aren't given for the areas of self-regulation but many of them would have had fewer than the full 24 participants included – it's highly likely that some participants would never have left dishes in the sink, smoked cigarettes or missed appointments for example. Nevertheless Oaten and Cheng's findings suggest that physical activity interventions may be able to improve long term behaviours of those at risk of offending or who have been previously convicted by enhancing their ability to self-regulate.

It is likely to be more successful for those who truly want to change their behaviour as an element of self-regulation will need to be present initially. Further research is needed to understand the full implications, but it is possible that where young people are keen to change but has returned to an environment that tests their willpower, enhanced self-regulation through physical activity could help them to control negative behaviours.

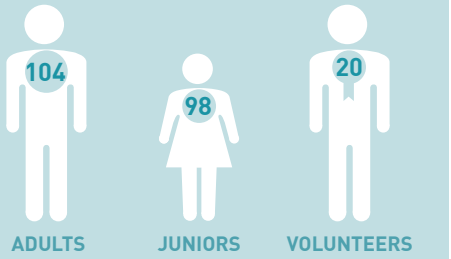
CONCLUSION

The exact relationship between physical activity and crime reduction is not clear. Anecdotal evidence supports generally positive effects whilst a small number of studies (such as the 2nd Chance programme or Kickz) have been able to prove the short term value of their work. Little longitudinal evidence for programmes exists, making it difficult to understand the real impact that physical activity interventions have on chances of offending or re-offending. This is something that should be examined, given the significant way in which committing crime or acts of antisocial behaviour influences a young person's life chances. There are several theories as to how physical activity can be beneficial in tackling antisocial behaviour and crime: as a diversionary activity, through providing a hook for teaching emotional and career skills or through behaviour modification and building self-esteem, but no consensus exists as yet. However, it has been established that whilst delivering physical activity programmes for at risk young people and offenders, it is important that the activity appeals to the participants, the programme is developed by relevant experts to be targeted at the people involved and their specific situations, and that coaches, mentors and others involved in the running of the programme need to be well trained. Little research focuses on the influence of physical activity programmes for adult offenders or for the protective role that membership of a sports club may have in increasing community involvement and so reducing the chance of committing a crime or behaving antisocially.

SOCIAL COHESION AND EXCLUSION

1 IN 3 PEOPLE (32%)

STATE THEY HAVE ONLY ONE OR TWO CLOSE FRIENDS. SPORTS CLUBS CAN HELP TO CREATE NEW SOCIAL CIRCLES; THE AVERAGE SPORTS CLUB HAS A MEMBERSHIP OF



MEMBERSHIP CARD

81%

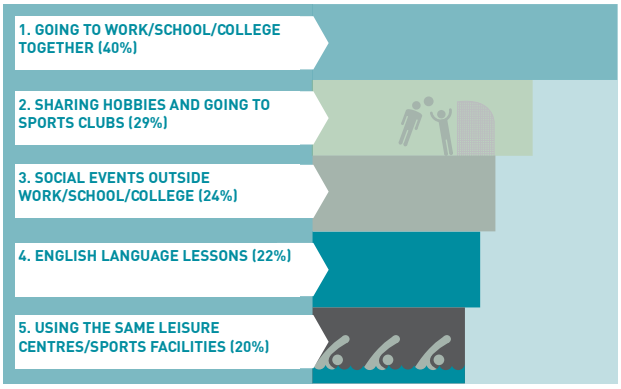
4 IN 5 SPORTS CLUB MEMBERS SAY THEY MAKE FRIENDS THROUGH THEIR EXERCISING

COMPARED TO JUST **14%** OF FITNESS CENTRE USERS

7 IN TEN PEOPLE (71%) SAY THE PERFORMANCE OF TEAM GB AFFECTS THEIR NATIONAL PRIDE

WHILST 6 IN 10 (58%) PEOPLE STATE THEY TAKE PRIDE IN BRITISH SPORTING ACHIEVEMENTS MORE GENERALLY

THE ENGLISH PUBLIC THINK THAT PEOPLE FROM DIFFERENT BACKGROUNDS CAN BE ENCOURAGED TO MIX MORE BY:



THOSE LIVING IN THE POOREST AREAS OF ENGLAND DIE ON AVERAGE 7 YEARS EARLIER THAN THOSE WHO LIVE IN THE RICHEST AREAS - REGULAR PARTICIPATION IN SPORT AND RECREATION CAN HELP TO INCREASE LIFE EXPECTANCY.

= 3 YEAR INCREASE IN LIFE EXPECTANCY

ONE STUDY FOUND THAT 90 MINUTES OF MODERATE INTENSITY PHYSICAL ACTIVITY A WEEK RESULTED IN A THREE YEAR INCREASE IN LIFE EXPECTANCY WHEN COMPARED TO INACTIVE COUNTERPARTS

150 MINUTES MODERATE INTENSITY SPORT OR RECREATION A WEEK IS EFFECTIVE AT TREATING MILD AND MODERATE DEPRESSION

PHYSICAL ACTIVITY PROGRAMMES AT WORK CAN REDUCE ABSENTEEISM BY UP TO 20%

POOR PHYSICAL AND MENTAL HEALTH

90 MINUTES MODERATE INTENSITY SPORT OR RECREATION A WEEK CAN REDUCE THE RISK OF ALL-CAUSE MORTALITY BY 14%

LOW LEVELS OF SOCIAL CAPITAL

UNEMPLOYMENT

POVERTY

124 ADULTS (MEMBERS AND VOLUNTEERS) AT THE AVERAGE SPORTS CLUB TO BUILD LINKS AND MAKE FRIENDS WITH

HOMELESSNESS/ FURTHER SOCIAL EXCLUSION

REGULAR PARTICIPATION HAS BEEN ASSOCIATED WITH AROUND 7.5% GREATER EARNINGS THAN INACTIVE PEERS

29% OF THE 381 HOMELESS PEOPLE WHO TOOK PART IN THE 2007 HOMELESS WORLD CUP FOUND EMPLOYMENT WITHIN 6 MONTHS OF THE EVENT

PHYSICAL ACTIVITY AND SOCIAL COHESION

INTRODUCTION

Social cohesion refers to the bonds that bring society together and is a deliberately broad title for this section in order to focus on the role of sport and recreation with regards to social inclusion and exclusion and in relation to social capital. An independent report submitted to the Government in 2006 outlines the dimensions of social cohesion which should be understood as being interrelated but not synonymous with each other. It proposes that the base for social cohesion is formed from material conditions such as employment, income, health, education and housing, which facilitate good relations between and within communities. It is these factors that form the social fabric of society and indicate social progress. On top of this base comes social order, tolerance and safety, creating a harmonious society; positive interactions and networks between individuals and communities, thus offering support, information and trust; and social equality with regards to access to opportunities or material circumstances (Parkinson et al., 2006).

As the millennium approached and social theorists took stock of the world there was a growing concern that technological developments and globalisation were leading to increasing individualisation and that this would erode social cohesion (see de Beer and Foster, 2009; Putnam, 2000; Beck, 1992; Giddens, 1991). More recently, the global recession, mounting unemployment, increased immigration, the apparent absence of opportunities for young people and their disengagement from society have ensured that social cohesion has remained on the policy agenda. Indeed, the Coalition Government's Big Society programme is aimed at bringing people in society together and empowering them, and community and voluntary organisations – such as sports clubs – are at the forefront of this effort. This isn't surprising given that after going to work/school/college together (40%), sharing hobbies and going to sports clubs (29%) was the most frequent public response for how people from different backgrounds could be encouraged to mix more (Department for Communities and Local Government, 2011).

Data from the latest Citizenship Survey suggests that three quarters of people (76%) felt a strong sense of belonging to their neighbourhood and local area but only half (50%) felt that many of the people in their neighbourhood could be trusted and four in ten people (38%) are worried about being a victim of crime (Department for Communities and Local Government, 2011), suggesting that social cohesion could be stronger in the UK.

In a literature review of the evidence for how leisure time physical activity contributes to community development, or social cohesion, Long and Sanderson (2001) detail the most commonly noted benefits as being: enhanced confidence and self-esteem, empowering disadvantaged groups, improving the capacity of the community to take initiatives, reduction in crime, vandalism and delinquency, increased social integration and co-operation, encouraging pride in the community, improving employment prospects, generating employment and income, increasing productivity through a fit and healthy workforce, improving health, and improving the environment. These improvements are difficult to isolate and formally quantify and are often neglected by project evaluations, so, as a result, much of the relevant literature is theoretical only. However, other chapters in this review evidence how sport and recreation can contribute to better physical and mental health, positively influence education and employment and contribute to reducing antisocial behaviour and crime – all factors that contribute to social cohesion.

Researching the contribution of sport and recreation to social cohesion is fraught with methodological difficulties given the differences in the definitions of social cohesion, the conceptual nature of the parameters that need measuring and problems comparing research from other countries where societies operate differently. For example, a Japanese study compares the effect on social capital of two types of sports clubs that are found in Japan: comprehensive and traditional community sports clubs. Comprehensive clubs include non-sporting activities and have a broad age range for members whilst traditional clubs are single sports focused and more inclusive, making members more alike. The former type of club had significantly higher aspects of social capital (Okayasu, Kawahara and Nogawa, 2010). Whilst these findings suggest a positive relationship of some degree, it is difficult to relate them to sports clubs in the UK, which are different in structure.

The United Nations Sport Development for Peace International Working Group (2008) produced a policy document on harnessing sport for development and peace. It recommends that sport is included in government strategies as a way of addressing the challenges faced by excluded populations and to prevent conflict arising as a result of these. The report highlights that sport can be used to build relationships, connect individuals to communities, act as a communications platform and create a space for dialogue, but that there is also the possibility for sport to be used to promote conflict through hooliganism or terrorism. Ultimately, however, the report concludes that, *"when Sport for Development and Peace initiatives are well-designed, holistic and sustained they can help marginalised people to acquire the skills and self-confidence needed to both overcome personal barriers and advocate for the elimination of structural barriers to their full participation in community life"* (Sport Development for Peace International Working Group, 2008, p.213).

SPORT AND RECREATION CLUBS AND SOCIAL CAPITAL

Social capital[59] is essentially the beneficial result of networks and relationships; it is the totality of actual and virtual resources accrued from having a resilient network of relationships that are mutual and positive and of differing extents of formality. Key components of social capital are trust, reciprocity and engagement and there are different types of social capital with respect to the relationships formed. Bonding social capital provides a sense of belonging and occurs with family and friends to help ease daily life; bridging social capital links with those who are outside of our usual circle and can help to progress opportunities; and linking social capital occurs with people in positions of power, which is useful for accessing support from formal institutions. The more cross cutting bonds that exist between different individuals in society, and the stronger these bonds are, the more cohesive a society will be. These various relationships are able to translate into opportunities and support for people, therefore a lack of social capital results not only in a lack of opportunities but also in the modern day malaise: loneliness. Nearly half (45%) of people aged 75 and over think of the television as their main form of company whilst 6% of all adults say that they have no close friends and a further 32% state they have only one or two close friends (Cabinet Office, 2010). It is important to note that typically social capital is accrued in an unconscious way and is not a motivating factor in individuals' actions; it will also have different benefits and impacts on different people.

Putnam (1995, 2000) is renowned for his work exploring social capital in America. He argues that through face to face interactions with people from a diversity of backgrounds, trust is established in society. Putnam suggests that civil and social organisations such as sports clubs play a key role in creating associations and so are important for creating social capital precisely because they are a form of what Putnam terms associational life – a way of committing to social cooperation and public wellbeing. In one of his most famous papers, ***Bowling Alone: America's Declining Social Capital*** (1995), he hypothesises that social capital is declining in America, as evidenced by declining membership in voluntary organisations and clubs. In particular, Putnam cites the rising number of Americans participating in bowling alongside a decline in bowling club membership to show increasing individualisation as people must be bowling alone.

59 Social capital has historically been widely theorised by Bourdieu who describes it as, *"the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition"* (Bourdieu & Wacquant, 1992, p.119).

In response to Putnam's 1995 paper, Hall (1999) examined the situation in Britain, claiming that membership of voluntary or associational organisations, including sports clubs, was high in Britain and equivalent social erosion was not occurring here, although social trust was declining (from 44% to 30% between 1990 and 1995) as a result of changing values, government policies and social integration. However, there are significant gaps in Hall's analysis, which, for example, focuses on participation only amongst employed members of society. Grenier and Wright (2001) argue from a critical review of Hall's analysis that in fact Britain may well have experienced a similar decline in social capital as depicted in America by Putnam, with participation concentrated in the more affluent social classes and gulfs between minority ethnic groups and the majority population in Britain largely being overlooked.

Using European data, Delaney and Keaney (2005) examined the relationship between sports club membership in the UK and social capital. They found that membership has an equivalent effect on life satisfaction and happiness as moving up approximately one and a half household income categories – around £3,600 – and that sports club members in the UK are more likely than non-members to be politically engaged, meet socially with friends and have trust in civil institutions, all indicators of social capital. Similarly, research utilising data from 1,589,266 America adults and their self-reported life satisfaction found that life satisfaction is greater amongst those who participate in physical activity and that these benefits come from an initial joy during participation in the activity and from the longer term health benefits (Huang and Humphreys, 2012). The average sports clubs has a membership of 104 adults and 98 juniors (Sport and Recreation Alliance, 2011), but networks extend beyond the members alone to parents and supporters of other participants and volunteers at the club – the average club has 20 volunteers (Ibid).

Unlike many other forms of volunteering in a sports club, many volunteers will not only volunteer to support other people but will also work alongside other volunteers and in a number of roles, creating additional opportunities for interaction and the acquisition of social capital.

There is not enough research evidence into the relationship between sports club membership and social capital to understand causality fully. Coalter (2007b), for example, concludes that the contribution of sports clubs to social capital and the formation of social capital in sports clubs is unclear. Similarly, Delaney and Keaney (2005) could not establish whether sports club membership made individuals more trusting or if this higher level of trust made someone more inclined to be a member of a sports club. Seippel (2006), on the other hand, found that membership in a Norwegian sports club involved social capital that was conducive to trust and political commitment, however it is difficult to compare Seippel's findings given that Norway is very different from the UK socioeconomically and this will significantly influence social cohesion, trust in society and political commitment. It has been argued that Scandinavian countries have particularly high levels of social capital as a result of high degrees of economic equality, low levels of corruption and strong welfare system (Rothstein and Stolle, 2003).

THE AVERAGE SPORTS CLUB HAS A MEMBERSHIP OF 104 ADULTS AND 98 JUNIORS

This may partly explain Seippel's finding that membership of a sports club has less impact on social capital than membership of other voluntary organisations, and that the impact was greatest when individuals had memberships in additional organisations – a greater diversity of relationships. A similar finding was made by Stolle (1998) when looking at voluntary associations in Germany and Sweden, where more diverse and more engaged organisations were associated with people who were more trusting.

VOLUNTEERING AND SOCIAL CAPITAL

Volunteering can play an important role in creating new networks and relationships for people by bringing together individuals from diverse backgrounds whose paths may never otherwise have crossed and creating trust and reciprocity between them. The life experience, confidence and knowledge gained through volunteering opportunities can also make it easier for people to access any resources and opportunities that may come their way. There are more volunteers in sport and recreation than any other sector (Office of the Third Sector, 2007): between April and December 2010, 23.7% of adults in England had volunteered and 19.8% of these volunteered in sport (Department for Culture, Media and Sport, 2011). The economic value of sports volunteering in England is estimated to be just under £2 billion a year[60] – this is what it would cost to employ full time workers to carry out the work of sports volunteers, based on the median hourly wage.

Harvey, Lévesque and Donnelly (2007) examined a sample of 271 Canadian sports volunteers to establish the relationship between social capital and volunteer involvement. Social capital was measured through access to people with different social statuses or occupations and the resources available to an individual through their social networks. Volunteer involvement was measured through the number of months in the previous year in which the participant had volunteered, and the average duration of volunteer involvement per month during the previous year and over their lifetime. Whilst it was not possible for the researchers to establish causality, they found that long term volunteer involvement was related to social capital as relationships and networks needed time to develop and accumulate. Interestingly, relationships accumulated over time were less diverse than those from short term volunteer involvement, but were also stronger and associated with greater resources.

60 Based on calculations from data within NCVO (2010) *The UK Civil Society Almanac 2010.*

Volunteering also allows for the acquisition of skills that can be reinvested in society (see the chapter on education and employment for more details); an obvious example within sport and recreation is coaching qualifications but all the traditional skill acquisition associated with volunteering also remains applicable. It is widely believed that volunteering can lead to community engagement and greater citizenship, embodied by the Conservative Government's National Citizen Service initiative. This scheme, in its early stages at present, aims to ensure that all 16 year olds take part in a two month summer programme involving volunteering and will be delivered by independent charities, social enterprises and businesses. Noting a growing emphasis on the value of volunteering for young people, Kay and Bradbury (2009) focused on youth sports volunteers in the Step into Sport Volunteer Training Programme to examine the impact on personal and skill development and community involvement. The programme offered five different progressive courses for people aged 14 to 19. Training and experience in sports leadership and volunteering could be gained through sport education, level one sports leadership, top link, level two community sports leadership and community volunteering. All courses were facilitated by physical education teachers at school with the support of the Youth Sport Trust and SportsLeaders UK. Additionally, the programme involved building capacity to place volunteers within local networks. With regards to the community volunteering course, secondary analysis was conducted with data from 160 of the participants (all aged between 17 and 20) and this was expanded by ten qualitative volunteer interviews and 33 qualitative interviews with sport and education professionals.

Three in ten volunteers (29%) completed 200 hours of volunteering whilst one in three (34%) completed 100 hours. Levels of volunteering did however range from just seven hours to more than 200, and the median across participants was 113 hours.

In support of Harvey, Lévesque and Donnelly (2007), Kay and Bradbury (2009) found that the greater benefits were seen with higher levels of volunteer involvement of 100 hours or more, however additionally the researchers saw benefits from the most diverse volunteer involvement at a number of venues or for a number of activity types. Overall, a large majority of the participants reported increases in leadership skills (87.5%), confidence (85%) and communication skills (80%). Half of the participants demonstrated a greater sense of altruism and increased citizenship in their quantitative answers, with 49% stating that participating had made them want to do more voluntary work and the same amount stating that it had made them think more about people in different groups. Qualitative data from the experts involved in organising and delivering the training supported the notion of increased social connectedness from the volunteer placements. The researchers conclude that the programme was, *"effective in facilitating 'bonding' and 'bridging' social capital: teaching staff reported that young people interacted more with their own peers than previously, and young people themselves spoke of the benefits and satisfaction from helping others in their community. These forms of capital formation were rarely singularly manifest or mutually exclusive, but, rather, were subject to a range of competing identity constructions and the contextual framework in which volunteering took place"* (Kay and Bradbury, 2009, p136).

From secondary analysis on data from 653 participants in the American Survey of Midlife Development, an increased sense of community was seen to be associated with an increased likelihood to volunteer amongst American 60-74 year olds (Okun and Michel, 2006). This is an interesting finding given that the sample was older participants. It is possible that volunteering is associated with high levels of social capital because only those who already have a strong sense of community will volunteer, however this does not explain the affect that a youth programme such as Step into Sport can have.

It may be that there is a possibility that such programmes can create higher levels of social capital and contribute to social cohesion, and this will increase the likelihood of these young people volunteering later in life and thus further contributing to their, and others' social capital.

The association between volunteering and social capital and subsequent effects on social cohesion needs to be better understood, and this understanding will require evidence-based analysis as well as theoretical considerations of the issue. Given that there is considerable divergence within social capital theory already, this is far easier said than done. The methodology used by Harvey, Lévesque and Donnelly (2007) in their research of social capital in Canadian sports clubs would make a good starting point if conducted with a sample drawn from both participants and volunteers from sports clubs in the UK. It would be fascinating to compare similarities and differences in social capital by those who are simply members of clubs and those who volunteer too, and additionally by those who are involved with more than one sports club.

SOCIAL EXCLUSION AND SOCIAL INCLUSION

Social exclusion and social inclusion are the converse of each other. Social inclusion is a value-based goal of how society could ultimately be; it is about people being able to realise their full potential and participate in society in the fullest sense. Donnelly and Coakley (2002) describe the "cornerstones" of social inclusion as value recognition, human development, involvement and engagement, physical and social proximity and material wellbeing. Social exclusion on the other hand is a result of actual inequalities and the unequal opportunities in society, for example because of education, employment, health, discrimination or poverty. It can be helpful to think of social exclusion and inclusion on a vertical continuum with a mid-point of social cohesion: being too near social exclusion creates inequality and prevents social progress, whilst being at the extreme of social inclusion runs the danger of an overly regulated society.

SOCIAL INCLUSION IS A VALUE-BASED GOAL OF HOW SOCIETY COULD ULTIMATELY BE

In the European Year for Combatting Poverty and Social Exclusion, the Coalition Government in the UK stated that, *"addressing poverty and inequality in Britain is at the heart of our agenda for Government. It is unacceptable that, in one of the wealthiest nations in the world, millions of adults and children are living in poverty. Whole communities are existing at the margins of society, trapped in dependency and unable to progress. In these areas aspiration and social mobility disappear, leaving disadvantaged children to become disadvantaged adults"* (Iain Duncan Smith, Secretary of State for Work and Pensions in Cabinet Office, 2010, p.3).

This begins to paint a picture of the extent of social exclusion in the UK, as do facts such as 5.3 million people in the UK suffer from multiple disadvantage or that nearly one in ten people (8%) live in persistent relative poverty (Cabinet Office, 2010), creating a risk of social exclusion and poor health. Perhaps more shocking still is the fact that the richest 10% of the British population are more than 100 times wealthier than the poorest 10% (National Equality Panel, 2010). This divide and the notion of an unequal Britain are not new news, but following the global economic recession and significant changes to the Government budget, in the UK unemployment and income inequality are currently extremely prominent on the policy agenda. Unemployment levels in the UK are amongst the highest they have been for more than 15 years with 2.63 million people unemployed as of May 2012 (Office for National Statistics, 2012). Not only is unemployment an indicator of social exclusion, but it also drives other aspects of social exclusion such as poverty, homelessness, social capital and poor physical and mental health. Conversely, these aspects of social exclusion can also be a barrier to employment (Bradshaw et al., 2004).

In addition to unequal employment opportunities and uneven income distribution, other factors affecting social exclusion include ethnicity, gender, disability and health. For example, in 2008/2009, black and ethnic minority families accounted for 11% of the total population in England but 27% of all households found to be homeless[61]. We have already reviewed the evidence for physical activity being able to improve physical and mental health, and given that people who live in the poorest areas in England die on average seven years earlier than those living in the richest areas (Cabinet Office, 2010), the value of addressing poor health through affordable physical activities is significant and should not be ignored.

61 Shelter website, *Homelessness*, http://englandshelter.org.uk/campaigns/why_we_campaign/the_housing_crisis/homelessness, last accessed 14.05.2012.

For example, one study found that 15 minutes of moderate intensity physical activity a day or 90 minutes over a week resulted in a three year increase in life expectancy compared to inactive counterparts (Wen et al., 2011). For those who are excluded from society, sport and recreational activities are able to promote a shared sense of belonging and participation and can represent a valuable opportunity for inclusion and support. The rules that govern sport and recreational activities are not based on faith or belief systems, therefore participation in sport or recreation easily opens itself to creating links between people from different cultures, countries and backgrounds (European Commission, 2009). This in itself is beneficial as the most commonly cited barrier to cohesion in a Government review was lack of social contact of meaning with people from different backgrounds (25%) and different standards or values (15%) or cultures (13%) (Department for Communities and Local Government, 2010). Sport and recreation can be used to reach out to at risk groups in society (as evaluated in the chapter on antisocial behaviour and crime), integrate immigrants and refugees with other members of society and can play a role in promoting gender and disability equality. For example, more than 90% of the 61,175 young people who took part in Change 4 Life School Sports Clubs stated that they, *"respected other people regardless of their ability"* and also that they, *"felt respected"* (Canterbury Christ Church University, 2011).

Donnelly and Coakely (2002) identify six broad benefits that sport and recreational activities have for those who are socially excluded, unintentionally or otherwise. Firstly, they can provide a safe environment and create a philosophy of nonviolence, even when it may be a contact activity. Secondly they provide an opportunity to develop skill and demonstrate competence; where the activity is in a community setting this is even more beneficial as participants can translate their physical success and confidence boost into society at large – the place where they are traditionally marginalised.

As covered under the section on social capital, leisure time physical activities also provide opportunities to create networks that can not only be supportive but also helpful for introducing new opportunities. Fourthly, where activities are delivered through specific programmes, moral and economic support can be provided: as seen in the chapter on antisocial behaviour and crime, utilising sport as a hook can ensure young people are taught valuable life skills. Fifthly, participants are given autonomy and control in the activity and this is something that is typically lacking in the lives of those who are socially excluded. Finally, it can create hope for the future where previously it did not exist – evidence supports that multiple disadvantage is intergenerational, with 27% of children from families where the parents have six or more disadvantage indicators experiencing three or more indicators of disadvantage compared to just 4% of families where parents experience none of the factors of disadvantage (Cabinet Office, 2010).

Some 100 million people worldwide are estimated to be homeless, with the United Kingdom having one of the highest levels of homelessness in Europe[62]. In England in 2010/2011, 65,000 households were accepted as homeless with another 50,000 in temporary accommodation (Aldridge et al., 2011). The Homeless World Cup first took place in 2003 and aims to energise homeless and excluded people to change their own lives by using football as a catalyst – their impact analysis reports that over 70% of players significantly change their lives. The tournament takes place at an international level after players are selected from grass roots level street teams and all participants are given access to support and services. Men and women who are homeless or in substance abuse programmes are eligible to participate and be in with a chance of representing their country. The Homeless World Cup Foundation explains that football specifically was chosen because it facilitates communication and relationship building with others, working as teammates, trusting, sharing and taking responsibility for attending training sessions and games. All of these skills and attributes are transferable to daily life and demonstrate to homeless people that they can change their lives[63]. For example, 29% of the 381 homeless people who took part in the 2007 Homeless World Cup found employment within six months of the event, whilst 32% went into education[64].

62 The Homeless World Cup website, *Homeless Statistics* http://www.homelessworldcup.org/content/homelessness-statistics, last accessed 14.05.2012.

63 The Homeless World Cup website, *Why Football* http://www.homelessworldcup.org/why-football, last accessed 11.05.2012.

64 The Homeless World Cup website, *Copenhagen 2007* http://www.homelessworldcup.org/our-impact/impact-research/copenhagen-2007, last accessed 11.05.2012.

Drawing on the benefits outlined by Donnelly and Coakely (2002), the Homeless World Cup amongst other things clearly demonstrates how through recreational physical activity participants can be given autonomy, confidence, useful skills and, perhaps most importantly, hope for the future.

Not only does this event change the lives of the homeless players involved, but spectator feedback from the 2011 Homeless World Cup revealed that 80% of their 129 spectator sample (not representative) were interested in sport as a means of social inclusion, whilst 97% agreed that the event promotes good values and 90% agreed that it breaks down stereotypes about the homeless community (O'May, 2011). The staging of the events as part of the Homeless World Cup therefore also aims to break down barriers and perceptions around homelessness to work towards a socially inclusive society. This was explored by Sherry, Karg and O'May (2011), whose research focused on changes in social capital and spectator attitudes as a result of the Melbourne 2008 and Milan 2009 Homeless World Cups. The evaluative data from the Homeless World Cup Foundation could be more detailed and robust, with a greater focus on the outcomes for participants in order to demonstrate the true value of the work they do. Academic interest in the role of the Homeless World Cup in tackling social exclusion provides additional insights but only utilises existing data. For example, Sherry (2010) has focused on how the Australian Homeless World Cup re-engaged participants through facilitating social capital, concluding that sport alone cannot be held responsible but has certainly contributed to these benefits; Magee and Jeanes (2011) conducted a critical evaluation based on a group of young male players from the UK, and Owen and McLuckie (2009) have examined the street football model more generally for its use as a tool to engage homeless and excluded young people through fun, fitness and friendship.

THE HOMELESS WORLD CUP, AMONGST OTHER THINGS, CLEARLY DEMONSTRATES HOW THROUGH RECREATIONAL PHYSICAL ACTIVITY PARTICIPANTS CAN BE GIVEN AUTONOMY, CONFIDENCE, USEFUL SKILLS AND, PERHAPS MOST IMPORTANTLY, HOPE FOR THE FUTURE

In the year ending June 2011, 241,000 people were granted settlement in the UK and 195,000 people were granted British Citizenship (Home Office, 2011). More than half (56%) of people surveyed in the Government's Citizenship Survey believe that the number of immigrants coming to Britain should be reduced a lot whilst a further 21% feel it should be reduced a little (Department for Communities and Local Government, 2011). This accords with the Coalition Government's strategy to reduce net migration with a more targeted approach that aims to fill gaps in the labour market and see the number of immigrants fall to tens of thousands a year. It is expected that there will be fewer non-EU migrants entering the UK in coming years and the focus on employment for their arrival

may result in not all sectors of society welcoming migrants. Migrants will be unlikely to have all of their family with them in the UK and there will be an increased potential for them to feel isolated, either highlighting the resilience of communities or the disconnections between people, groups and institutions (Hickman, Crowley and Mai, 2008). Social cohesion will be more important than ever, and yet may also be more difficult than ever. The complex interaction between sport and identity politics on both a national and local level puts sport and recreation in a position where they are both capable of helping or potentially hindering social cohesion. A systematic review of the evidence for sport and recreation creating social inclusion amongst refugees and asylum seekers was conducted in 2005 but substantial research evidence was found to be lacking, whilst case studies provided a flavour of the benefits but were based on qualitative or observational evidence (Amara et al., 2005).

A study of 388 new East European immigrants and 402 long-term resident East European immigrants in South East England included community participation in their considerations of community cohesion. Whilst the sample was not representative of immigrants in the UK, it was found that amongst this group 60% of immigrants and 70% of long-term residents were involved in a group, club or organisation, and of these, immigrants were more likely to be involved in a sports club (Markova and Black, 2007). If this is true across the UK then not only is sport and recreation a useful tool for social inclusion because it isn't based on faith or belief systems, but it is also useful because of its wide appeal.

Norwegian research with 1,585 fitness centre customers and 1,205 voluntary sports club members found that social integration occurs as a result of the social part of exercising rather than the physicality of the activity itself and that integration occurred more frequently in sports clubs than in commercial fitness centres. In commercial centres, social integration was largely restricted to existing friendships instead of establishing new relationships, with four in ten (81%) sports club members stating that they made friends through their exercising compared to just 14% of fitness centre users (Ulseth, 2004). Factors thought to affect the increased ability for sports clubs to foster social integration included the physical presence of more meeting spaces for members, the role of volunteering, conducting activities in groups and the size of groups. In addition, sports club members placed a greater value on the social dimension of exercising, with 38% stating that the social part is most important and 2% stating the physical part is most important, compared to 1% of fitness centre members prioritising socialising and 64% prioritising the physical element. High levels of sports club membership amongst immigrant communities could therefore be an appealing and effective way of making meaningful connections with others in the local community.

Football United in New South Wales, Australia is a football-based health promotion intervention seeking to foster social inclusion and cohesion in areas with high refugee settlements. In order to achieve this, newly arrived refugees and settled community members participate. Current monitoring of the project shows that in 2011, 705 young people born in 43 countries and living in 59 suburbs participated in the programme. Football has been chosen specifically because it is enjoyed worldwide, is relatively inexpensive, is intended to be a non-violent, sport played by both genders and is often the sport of choice amongst refugees in Australia, again demonstrating the appeal of sport and recreation to wide audiences. The programme focuses on skill and leadership development, mentoring and creating links with local communities, corporate leaders and organisations. It has three main elements: the football activities themselves at weekends, after school, as holiday camps and gala days; capacity building courses in coaching, mentoring and life skills, leadership,

first aid, project management and volunteering; and fostering involvement with local football clubs. A prospective impact cohort study intends to assess the effect of the programme at an individual, school and community level using qualitative and quantitative measures (Nathan et al., 2010). It is disappointing that the findings of this research are not yet available, but once completed the findings will be enlightening for the role of sport and recreation to influence social cohesion in communities with high proportions of immigrant or refugees.

Outdoor recreational activities should not be overlooked for their ability to influence social inclusion and community cohesion. They offer opportunities for interaction and take place in open spaces and natural environments that can play a valuable role in an individual's sense of attachment to the area in which they live and the local community more generally (Kim and Kaplan, 2004). In support of this, enjoyment of living in the local neighbourhood has been found to be higher in rural areas (80%) than in urban areas (65%) (Department for Communities and Local Government, 2011). From a sample of 437 schoolchildren in Zurich, Seeland, Dübendorfer and Hansmann (2008) studied leisure activities in urban forests and public green spaces to establish their ability to influence social interaction between Swiss and immigrant youths. The research found that these spaces had a positive and significant role for making friends across cultures, providing a base for social inclusion. It has also been suggested that the additional advantage to outdoor recreation is that the spaces in which it occurs are typically more accessible for immigrants and people from ethnic minorities than other leisure facilities (Ravenscroft and Markwell, 2000).

Sport at an elite and international level is also capable of fostering national identity and pride and can create bonds between different groups of people brought together as supporters of teams (Delaney and Keaney, 2005).

International sport offers the tools for building social solidarity: for example, a BBC poll revealed that seven in ten people (71%) say that the performance of Team GB at the Olympics affects their national pride[65] whilst 58% of British people state they take pride in British sporting achievements more generally. Involvement with a sports clubs has also been found to influence national pride, however, with three in ten respondents who strongly agreed that they were proud to be a British citizen having engaged with a sports club, either by taking part, coaching or watching. This is compared to one in four of those who neither agreed nor disagreed and less than one in five of those who strongly disagreed (Wind-Cowie and Gregory, 2011). Support for the home team in international competitions such as the Olympics can cross cultural and political boundaries in a unique way, but differences in allegiance at national or local levels such as between football teams also have the potential to create hostility.

Women are almost twice as likely to be low paid than men, with 26% of female employees paid less than £7.50 an hour compared to 14% of male employees, and even the highest paid women are paid less than their male counterparts. The hourly wage for the 10% most highly paid men is 220% of the median male full-time pay whilst the 10% most highly paid women earn 178% of the median male full time pay (New Policy Institute, 2011). Women are also at high risk of persistent low income (Bradshaw et al., 2004), increasing their chance of long term poverty and social exclusion. Although gender equality is still high up on the agenda for sport and recreation, which historically has been a male domain, as gains have been made the role of sport and recreation for addressing gender issues has come to the fore.

65 Poll of 21,061 people across 21 countries surveyed in 2011, available online at http://www.bbc.co.uk/news/world-16245075, last accessed 17.05.2012.

The health benefits of physical activity have already been noted; these of course apply to men and women, but given that there are gender inequalities in health, specifically targeted activities could have more resonance. For example, 66% of men and 57% of women are overweight or obese (The Health and Social Care Information Centre, 2011) but more women die of respiratory disease than men (British Heart Foundation, 2011). Three quarters of all suicides in the UK in 2010 were male (Ministry of Justice, 2011c) but women are more likely than men to suffer from common mental disorders (The Health and Social Care Information Centre, 2009).

As noted by Donnelly and Coakely (2002), a benefit of sport and recreation is the creation of safe spaces which can create a feeling of affiliation and sense of belonging. Alongside this feeling of inclusion, for girls reaching adolescence safe spaces outside the home are vitally important for exercising control and ownership outside of traditional restrictive domestic settings; this is particularly important in developing countries. The Sport for Peace curriculum was created to address concerns around student violence, fighting, profanity and physical and sexual harassment in six American urban high schools on the East Coast. The curriculum emphasised responsibility, conflict negotiation and care and concern for others through playing and coaching football and included a taught unit on Sport for Peace. Analysis of the programme suggests that the structure and delivery of the sessions fostered shared responsibility for learning, trust, respect and a sense of family, with participants of both genders and all skill levels feeling successful and positive about the experience. Furthermore, Ennis et al. concluded that the programme, *"created a safe place for both high and low-skilled girls and boys in the physical education curriculum... those in which students can affiliate with others and know that their emotions and sense of self will be protected"* (1999, pp.283-284).

In addition, by tackling imbalances in participation levels for certain activities, both male and female gender norms can be broken down to establish healthy attitudes towards gender equality. For example, values such as competitiveness or assertiveness are valued in many sport and recreation activities, providing a suitable arena for women to demonstrate these qualities and society to place a value on women who display them. This was confirmed by Anderson (2008), who qualitatively assessed a representative sample of 68 self-identified heterosexual male university cheerleaders in mixed gender teams who had previously been high school football players and were part of male only teams. Approximately 70% of the male participants reported beforehand having had no idea that women could be so athletic and almost all expressed a new-found appreciation for the leadership skills and coaching abilities they had seen exhibited by women in cheerleading. In addition, qualitative evidence suggested that some of the men with previously misogynistic attitudes had rethought these, seeing the female cheerleaders as more like their sisters than as sex objects.

Acquiring attributes such as confidence and assertiveness during leisure time physical activities can also provide women with a sense of confidence and additional skills to take into the workplace, where they may find their gender to be a barrier to opportunity or progression (Huggins and Randell, 2007). Additionally, sport and recreation itself may provide opportunities for women to develop their leadership skills and realise a sense of achievement. However, the number of women in leadership positions in sport is currently disappointingly low, with women accounting for one in five positions on the boards of national governing bodies and seven out of the 46 funded national governing bodies without any women on their board (WSFF, 2010).

During the 1970s in America a portion of the Education Amendments stated that no American should be excluded from participating in physical activity, causing high school and collegiate athletics to become entrenched in the American way of life. Utilising the subsequent increase in female athletic participation between 1972 and 1978, Stevenson (2010) assessed the impact of increasing athletic participation amongst girls on their later life chances. The research found that a 10% rise in state-level female sports participation was directly responsible for a 1% rise in female college attendance and between a 1% to 2% rise in female labour force participation. Overall, Stevenson concludes that the increased participation in physical activity following the Education Amendment explained about 20% of the increase in women's education and 40% of the rise in employment. Furthermore, after controlling for underlying ability and resources, Stevenson found that women who had participated in athletics had wages that were 8% higher as adults.

The disability charity Scope highlights that disabled people are on the fringes of society, with nearly 40% of people not knowing any disabled people (excluding those who are disabled or have a disabled family member) and only one in five (21%) Britons having ever worked with a disabled colleague[66]. Families with at least one disabled member are more likely to live in relative income poverty than those with no disabled members: in 2009/2010 the figures were 21% and 16% respectively on a Before Housing Costs basis (Department for Work and Pensions, 2011). Disabled people are also far less likely to be employed than non-disabled people, with employment rates of 9% and 78% respectively[67]. As with gender equality, disability equality is also still a priority on the sports agenda; disabled participation in sport and recreation and in volunteering is lower than in comparison to non-disabled people. In 2010 35% of disabled people had participated in sport at least once in the previous four weeks to being surveyed compared to 60% of non-disabled people (Department for Culture, Media and Sport, 2011) and in 2009/2010 26% of non-disabled people volunteered formally at least once a month. For disabled people this fell to 22% (Department for Communities and Local Government, 2011).

In the same way that physical activity can create meaningful interactions between different people from different backgrounds, it can bring disabled and non-disabled people together, increase confidence and provide a new level of understanding and cooperation in society. For example, wheelchair basketball can be played by disabled and non-disabled people together at an equal level. The 2009 Sport England satisfaction survey for wheelchair basketball found that 17% of the players they surveyed were not disabled (English Federation of Disability Sport, 2009). The 2011 survey doesn't report on this but does show that the social aspects of the game are important to participants with an average score of 8.7 out of 10, and that satisfaction with the social aspects is high at an average score of 8.4 out of 10, making it the second highest scoring element for satisfaction (Sport England, 2011). At a theoretical level it has also been highlighted that disabled people who wish to effect positive change may utilise sport as a means of gaining notoriety in order to direct attention to the issues they wish to address (International Disability in Sport Working Group, 2007). Although many community inclusion projects exist, little research has been conducted in this area, with Thomas and Smith surmising that, *"there exists very little systematically collected and published data on disability sports development"* (2009, p.60). Analysis of data on the role of wider leisure activities (not just sport and recreation) for a group of young people with cerebral palsy led Aitchison (2003) to conclude that for many young disabled people the role of leisure

66 Scope website, *Disabled People Invisible in Britain Today*, http://www.scope.org.uk/news/comres-poll, last accessed 16.05.2012.

67 Office for Disability Issues website, *Disability Facts and Figures*, http://odi.dwp.gov.uk/disability-statistics-and-research/disability-facts-and-figures.php#7, last accessed 16.05.2012.

time activities in tackling social exclusion exists largely as a political concept rather than as a daily reality. Clearly there is an enormous research void around the relationship between sport and recreation and tackling disability exclusion. Theory suggests that there is a positive relationship and this has been evidenced for others marginalised from society by race or gender, for example. It would stand to reason that similar benefits could be found for tackling disability exclusion; conclusive research into this topic would be warmly welcomed.

Whilst not addressed in this chapter, it is also worth noting that social exclusion can include exclusion from participating in sport and recreational activities and furthermore physical activities can exclude others and create further divides in society. Numerous international conventions recognise the right of access to and participation in sport and recreation as it is generally agreed that this is essential for the development of physical, intellectual and moral powers, and thus the personality more fully. In particular, the International Covenant on Economic, Social and Cultural Rights 1966 states in Article 12 that State Parties (of which the UK is one) recognise the *"right of everyone to the enjoyment of the highest attainable standard of physical and mental health."* Ensuring that leisure time physical activity options are made available to all will aid the full development of individuals within society, which in turn will contribute to a better, more developed and more cohesive society.

CONCLUSION

It is widely recognised in society that sport and recreation can be used as a tool for peace and social cohesion, yet social cohesion and its associated concepts are difficult to evidence in a robust manner. Much of the work in this area is theoretical: for example, there are thought to be six broad benefits that sport and recreational activities have for those who are socially excluded, unintentionally or otherwise. Where research is empirical, it's usually difficult to fully understand causality and the relationships evidenced, although research is suggestive of a range of mechanisms through which sport and recreation can have a positive impact on enhancing social cohesion, increasing social capital and reducing social exclusion. What is easier to demonstrate (as shown in the other chapters of this review) is that sport and recreation positively contribute to many of the factors that build social cohesion, such as better physical and mental health, high educational attainment, reducing crime and antisocial behaviour, creating better employment opportunities and earning potential, and ensuring a fit and healthy workforce.

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