Physical Activity and Mental Health: the role of physical activity in promoting mental wellbeing and preventing mental health problems

An Evidence Briefing

May 2008

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Glossary of selected terms

Association is a conceptual term used to depict the nature of a link between two (or more) factors. It tends to be used in relatively complex circumstances where simple or clear directional 'causality' (e.g. factor 'A' *causes* factor 'B') is difficult to prove. That is, it maintains the possibility of interactivity (e.g. factor 'A' and factor 'B' are inter-related) or that other factors are significant (factors 'C', 'D', etc are associated with 'A' & 'B').

Mental health refers to both mental wellbeing and mental health problems.

Mental wellbeing considered to comprise of three main dimensions – emotional, social and psychological and includes aspects of emotional wellbeing, life satisfaction, optimism and hope, self-esteem, mastery and a sense of control, having a purpose in life, a sense of belonging and personal support; the alternative terms positive mental health or mental health are often used synonymously.

Mental health problems refer to symptoms which meet the criteria for clinical diagnosis of mental illness (such as depression, anxiety and schizophrenia) which interfere with an individual's cognitive, emotional or social abilities.

Mental health improvement refers to any activities that seek to improve the mental health of the population. It is defined here in terms of three key areas: *protect and promote the mental wellbeing* of the general population, including those with mental health problems; *prevention* of mental health problems and mental illness, co-morbidity and suicide; *improving the quality of life* for people with a mental illness diagnosis.

Physical activity refers to "any force exerted by skeletal muscle that results in energy expenditure above resting level…(comprising) the full range of human movement, from competitive sport and exercise to active hobbies, walking and cycling or activities of daily living" *Department of Health* (2004; Appendix 1 – Glossary p.81).

Self is a series of constructs that are organised in a hierarchical system, involving 'self concept' and 'self esteem' or 'self worth'. *Self concept* is a description of self and *'self esteem is a self rating of how well the self is doing'* (Fox, 2000; 90).

Summary

The association[1] between physical activity and mental health is increasingly being seen as significant within Scottish and UK mental health and physical activity policy (e.g. *The Mental Health of Children and Young People: A framework for promotion, prevention and care (Scottish Government 2005*; *Let's Make Scotland More Active: a strategy for physical activity (Scottish Government 2003)*. The past 15 years has also seen the development of a significant amount of academic literature on this potential association. This body of evidence has broadly suggested the existence of an association between physical activity and mental health.

Terms relating to mental health in the literature can be inconsistent and definitions of terms are the subject of much debate. For the purpose of this report the following terms are used:

mental health: an umbrella term to include mental health and mental wellbeing

mental wellbeing: considered to comprise of three main dimensions – emotional, social and psychological. It includes aspects of emotional wellbeing, life satisfaction, optimism and hope, self-esteem, mastery and a sense of control, having a purpose in life, a sense of bellowing and personal support

mental health problems: refers to symptoms which meet the criteria for clinical diagnosis of mental illness (such as depression, anxiety and schizophrenia) which interfere with an individual's cognitive, emotional or social abilities.

The term mental health is used throughout this report where there is research and/or evidence which relates to aspects of <u>both</u> mental wellbeing and mental health problems.

Despite the extent of this evidence base, existing work has however tended: not to utilise emergent mental health terminology; to report evidence in relation to the effect of physical activity on the alleviation of mental health problems rather than

[1]Various terms are used in the literature to indicate some form of relationship between physical activity and mental wellbeing. The term, 'association' is used in this report in an attempt to articulate this complex link and to ensure that a causal relationship is not being inferred. Evidence from various sources would suggest that physical activity plausibly leads to improved mental wellbeing. However in the absence of sufficiently structured research, this cannot be formally confirmed. The plausible possibility that a sufficient level of mental wellbeing may precede and lead to participation in physical activity is therefore also expressed in the literature. 'Association' thus accommodates the possibility of a two-way flow between the concepts.

in terms of improvements in *mental wellbeing*; and not to report explicitly on the potential efficacy of *different types* of physical activity, intensities, frequencies and durations (activity 'dose'[2]) in achieving mental health benefits.

In this context, *NHS Health Scotland* commissioned this evidence briefing of the benefits of physical activity in terms of promoting mental wellbeing and preventing mental health problems with particular emphasis on the efficacy of different physical activity types, intensities, frequencies and durations ('dose response') in achieving these benefits.

Phase one of this work was a scoping exercise that considered the association between participation in physical activity & the *promotion* of mental wellbeing and the *prevention* of mental health problems (see section 2). It used a search strategy that included emergent mental health terminology, particularly in relation to *protective* factors (e.g. environmental quality, self esteem, emotional processing, self management skills & social participation) and *risk* factors (e.g. environmental deprivation, emotional abuse, emotional neglect, stress & social exclusion). It specifically sought to identify what may potentially be optimal 'doses' of physical activity associated with improvements in mental wellbeing. Informed by phase 1, phase 2 involved a more focused review that specifically examined the association between participation in physical activity and improved mental wellbeing and prevention of mental health problems in 'young people' and sought to translate this evidence into knowledge that will be useful to practitioners (see section 3).

Using a relatively broad search strategy**, Phase 1** of the study, a scoping exercise, mapped the volume and nature of review level literature in this area. Searching involved the cross matching of 8 physical activity related terms with the 43 mental health related terms contained within three broad categories: broadly, various mental health related terms (12); *'risk factors'* (13) and *'protective factors'* (18). Inclusion parameters were set: limit by 'systematic review'; 'review article'; 'English'; 'English language'; and, year (1997-2007).

This exercise suggested that the majority of reviews still focus on the traditional themes of *'physical activity'* and *'exercise'* with wider aspects such as *walking 'play', 'active living'*, *'active commuting'* or *'cycling'* being relatively under-represented. In relation to mental wellbeing, the majority of the reviews consider six key concepts: *quality of life, mental health, self esteem, wellbeing, psychological wellbeing and psychosocial health.* The search around wider terms was relatively fruitless, only yielding infrequent citations in for example themes like *locus of control*, *resilience, wellness & social inclusion.* There was some evidence that optimal physical activity intensity, frequency and duration ('dose response') was being considered but this tended to be associated with reviews dealing specifically with older people. A number of concerns over the nature of the research and associated findings were expressed in this literature including:

[2] 'Dose' refers to different types of physical activity, intensities, frequencies and durations.

poor methodology and invalid or poorly reported measurement of physical activity and mental health.

Based on this exercise it was decided by the project steering group that the evidence specifically addressing 'young people' would be explored in more depth as it was:

- relatively more extensive than other target groups;
- more explicitly related to the aim of the planned review to specifically consider mental health *improvement;*
- was compatible with the significance placed on young people by Scottish Government policy.

Consequently, **Phase 2** of the study focussed specifically on the potential nature of the association between physical activity and mental health within young people. The phase 1 database was used to identify relevant review papers within the scope of 'younger people' (variously, the labels used in the database of 'children', 'adolescents', 'girls' & 'boys') and these were complemented with follow up papers from the reference lists of these reviews and other broader 'contextual' pieces of literature. This literature tended to focus on the association between physical activity and the enhancement of varied broadly mental wellbeing concepts (e.g. self esteem, self worth, self concept, body image and mood) or the reduction of specific risk factors for mental health problems (e.g. childhood neglect, social exclusion and stress).

The narrative within the literature was consistently bound by two key limiting features: this is a conceptually complex area that is not particularly conducive to highly structured research; and more sustained empirical work with improved research methodology is required. The main thrust of it suggested that there was a broad association between participation in physical activity and mental health for young people, though the strength of this assertion was varied across the reviews. A range of specific themes were highlighted:

- **self esteem** and **self concept** were most frequently cited and reviews reported significant evidence of the existence of a consistent association between physical activity and heightened physical self esteem or self-concept amongst young people - physical activity potentially acting to promote feelings of self-efficacy, self-determination and personal control. The possibility that physical activity can have negative effects was also noted, mainly in relation to poor activity experiences such as embarrassment, loss of control and failure.

- the broad thrust of the literature around **cognitive functioning** (how individuals take in and process information from the world and act on it) suggested that evidence of this association appeared to be relatively equivocal; however, some studies supported this association particularly at the younger end of the age spectrum;

- the evidence concerning the association between physical activity and enhancing **pro-social** and combating **anti-social behaviour** appeared to be relatively ambiguous; however, there was some evidence that suggested that *appropriately structured* co-operative forms of physical activity (particularly play) in the younger age groups could enhance **pro-social** and combat **anti-social behaviour**;

- whilst physical activity has been theoretically associated with promoting **social inclusion** and mitigating against **social exclusion** (e.g. reducing school truancy, preventing criminal behaviour via 'diversionary' activities or 'rehabilitating' those with criminal records) the supporting empirical evidence in the reviews for these claims remained relatively equivocal;

- a number of studies indicated that physical activity can **prevent** or **reduce mental health problems** (typically, anxiety and depression) and that adolescents who are physically active are less likely to suffer from these mental health problems.

The literature contained few definitive statements or recommendations on optimal physical activity quantity, intensity or type. At present, the most definitive over-arching statement that could be made is that, "a range of exercise modes and intensities, based on the participant's previous exercise experiences, preferences and goals, will therefore need to be considered" (*The Department of Health*, 2004[3]). A number of more detailed themes were detectable in the literature:

- **The optimal quantity (frequency & duration) of physical activity**: there appeared to be a general association between increased quantities of physical activity (a product of both the duration of physical activity 'sessions' and the frequency of the sessions) and enhanced mental health.

  There was little consensus on an optimal frequency of activity. The literature reported on both the traditional norm of delivering three sessions of formal physical activity per week as well as the accumulation of more informal 'active living' forms of activity on 'most days of the week'. Within the context of formally delivered discrete 'sessions' of physical activity,

[3]Department of Health (2004) *At Least Five a Week. Evidence on the impact of physical activity and its relationship to health. A report from the Chief Medical Officer.* London: Department of Health.

significant effect was found in durations ranging from 60 to 180 minutes *per week*. Within the context of a broader 'active living' definition, studies tended to suggest what would appear to be the more demanding need to achieve 60 minutes of *daily* activity in order to optimise potential mental wellbeing gain. However, it was recognised that, compared to physiological benefit, *lesser levels may be sufficient for mental wellbeing gain* – that is, the *quality* of the physical activity experience may be as important as *quantity*.

- **The intensity of physical activity**: evidence in this area was relatively unspecific; the major theme being that *all* levels of physical activity intensity had the *potential* to enhance mental health. There was limited evidence within existing literature that different levels of activity intensity may contribute to different psychological outcomes; for example, high intensity aerobic activity could be associated with lowered anxiety and stress and 'non-aerobic' and moderate activity could be associated with enhanced mood;

- **Length of physical activity intervention:** evidence in this area was again equivocal**,** the only consensus being that longer-term programmes had the potential to be more effective (e.g. a minimum of at least 12 weeks with some form of contact continuing for 6 months or more was suggested);

- **Physical activity type:** despite research work using a variety of activity types, this domain offered relatively few rigorous pointers. Depending on individual preference, there was again a view that *all* types of activity have the *potential* to enhance mental wellbeing with choice being a key issue.

  A small numbers of reviews did however make some tentative evidence based assertions, for example; running, walking, aerobic dance, circuit training could be effective; weight and resistance training was superior to endurance exercise in improving body image & self esteem; physical fitness & aerobics programmes produced superior results to motor skills & sports programmes; rhythmic aerobic activities like walking and gentle jogging were most effective with those who have previously been inactive; co-operative exercise settings produced stronger effects and group recreational sports & activities were also likely to bring social & mood benefits; resistance exercise had a relatively immediate effect of body perception and could promote self-concept, efficacy and perception; sports & vigorous activity could promote mental wellbeing *only for those who already prefer this type of activity*.

There was more concurrence around **generalised theoretical principles of good practice** that defined the broad nature of activity that would result in the promotion of intrinsic motivation and longer-term activity adherence and created a context in which mental wellbeing could be enhanced and mental health problems reduced:

- a **variety** of activity types needs to be offered;
- **choice** needs to be promoted and individually determined & realistic activity goals set;
- emphasis should be placed on **enjoyment**, **immediate pay off** and **positive** experiences;
- activity should be undertaken with **peers, family & friends**;
- there needs to be **ease of access** to **high quality** and **safe** activity opportunities and facilities, preferably based with local communities;
- attempts should be made to develop **core psychological competencies** such as general competence, control, autonomy and self efficacy as well as **physical activity competencies** and **skills**;
- interventions should be delivered by **high quality leaders**, teachers & coaches who have a good awareness of the principles of the delivery of physical activity that is conducive to the promotion of mental health.

These two broad areas (the theory of the nature of the physical activity-mental wellbeing/mental health problem association and the 'delivery' mechanisms) could be combined in a comprehensive framework that suggested that positive outcomes could only occur when strong theory was combined with favourable circumstances and that poorly delivered physical activity opportunities could actually have a detrimental effect on mental health. In this context creating a conducive setting for enhancing mental wellbeing in the delivery of physical activity programmes was seen as crucial in realising what on balance could be considered only a potential or theoretical association.

In summary, it could be concluded that despite a relative paucity of especially robust research evidence (particularly that derived from randomised controlled trials), reviews in this area remained broadly positive. There were many pointers from various sources that an association could exist - it is biologically, socially and logically *plausible* and was supported to some extent by empirical evidence. Furthermore, the optimal nature of physical activity associated with enhanced mental health appeared to be generally congruent with existing guidelines pertaining predominantly to the physical benefits (e.g. reduced risk of coronary heart disease and various cancers) associated with physical activity.

1. Introduction and background to the evidence briefing

Fostering good mental wellbeing and preventing mental health problems are increasingly being seen as a crucial role for public health and health improvement. Scottish Government policy on mental health incorporates both mental health improvement (that is, promotion, prevention and support) and treatment (that is, implementation of mental health legislation and mental health services) and is also reflected in a range of associated areas such as education, enterprise and life long learning, and arts, sports & culture.

Starting with 1998's *Towards a Healthier Scotland*[4], Scottish public health policy over the past 10 years has given mental health improvement high priority. *Our National Health: a plan for action, a plan for change*[5] paved the way for a range of work in this area, including that oriented towards the promotion of mental wellbeing and the prevention of mental health problems. The *National Programme for Improving Mental Health and Well-being: Action plan 2003–2006*[6] re-enforced these developments and this action plan was extended into a second phase (2006-2008). *The Mental Health of Children and Young People: A framework for promotion, prevention and care*[7] translated policy intent to a younger age group and specifically stressed the influence that physical activity can have on mental wellbeing.

Whilst the *physical* benefits of physical activity have long been known and promoted, there is growing evidence that being physically active is strongly associated with mental health and that being *in*active can contribute to poor mental health. The past 15 years has seen the development of a considerable literature in this area (for example, Biddle, Fox & Boutcher, 2000[8]) that broadly suggests that physical activity has the potential to contribute towards: enhancements in mood, self-perception and self esteem; the prevention of the development of mental health problems such as depression; and to alleviation of the symptoms of mental health problems.

[4]Scottish Executive (1998) *Towards a Healthier Scotland* Edinburgh: Scottish Executive.
[5]Scottish Executive (2000) *Our National Health: a plan for action, a plan for change* Edinburgh: Scottish Executive.
[6]Scottish Executive (2003) *National Programme for Improving Mental Health and Well-being: Action plan 2003–2006* Edinburgh: Scottish Executive.
[7]Scottish Executive (2005) *The Mental Health of Children and Young People: A framework for promotion, prevention and care* Edinburgh: Scottish Executive.
[8]Biddle S., Fox K. & Boutcher S. (eds.) *Physical Activity and Psychological Well-Being* Rutledge, London.

This emerging evidence base has subsequently informed various policy documents; for example, 2003's *Improving Health: the Challenge*[9] links good mental health to a "physically active childhood" and *Let's Make Scotland More Active: A strategy for physical activity*[10] recognises the potential for physical activity to "promote positive mental health" amongst children, young people and adults.

Whilst the existing evidence base is relatively well developed and to some extent is consistent, insightful, practically useful and provides a clear policy direction, a number of additional issues informed the initial rationale behind the work reported here. These were:

- a tendency for search strategies to be built upon conventional rather than emergent mental health terminology (for example, reflecting the varied terms associated with 'protective' and 'risk' factors);

- relatedly, a tendency to report evidence in relation to improvements in mental health *problems* or a reduction in the prevalence of symptomology rather than in terms of *improvements* in *mental wellbeing*;

- a lack of specificity in reporting the means by which various aspects of mental wellbeing are formally measured;

- a lack of detail or precision around the potential efficacy of different physical activity intensities, frequencies durations and types ('dose response') in achieving these potential mental wellbeing improvements;

- as such, the need to offer practitioners more specific guidance on the types of physical activity that might be optimally associated with improved mental wellbeing and the prevention of mental health problems.

NHS Health Scotland therefore commissioned this evidence briefing of the benefits of physical activity on promoting mental wellbeing and preventing mental health problems, with particular emphasis on the efficacy of different types, intensities, frequencies and durations of physical activity ('dose response') in achieving these benefits. The specific purpose of the work was to provide practitioners and NHS Health Scotland with an up to date briefing on the evidence for the role of physical activity in mental health improvement; specifically which elements of physical activity are effective in improving mental wellbeing and preventing mental health problems. It was hoped that this in turn

[9]Scottish Executive (2003) *Improving Health in Scotland: The Challenge* Edinburgh: Scottish Executive.
[10]Physical Activity Task Force (2003) *Let's Make Scotland More Active: A strategy for physical activity* Edinburgh: Scottish Executive.

would increase the likelihood of practitioners incorporating physical activity in their repertoire of strategies within mental health improvement.

Specifically, this work sought to:

1. conduct a critical review that both specifically considered the association[11] between physical activity and the promotion of mental wellbeing and the prevention of mental health problems;

2. deploy a search strategy using emergent mental health terminology, particularly in relation to mental wellbeing and to *protective* factors (indicatively, environmental quality, self esteem, emotional processing, self management skills and social participation) and *risk* factors (indicatively, environmental deprivation, emotional abuse, emotional neglect, stress and social exclusion in relation to mental health promotion);

3. specifically consider what might potentially be optimal 'doses'[12] of physical activity associated with improvements in mental wellbeing and pay particular attention to the means by which possible improvements in mental wellbeing are assessed and reported; to translate this evidence into an accessible practitioner briefing paper.

1.1 Aim and objectives

Aim: to collate and review the evidence on the efficacy of physical activity in improving mental wellbeing and preventing mental health problems.

Objectives:

1. To scope the literature on physical activity and mental health and create a related database to identify:

    - the efficacy of physical activity in improving mental wellbeing and/or the components of mental wellbeing;

[11]Various terms are used in the literature to indicate some form of relationship between physical activity and mental wellbeing. The term, 'association' is used in this report in an attempt to articulate this complex link and to ensure that a causal relationship is not being inferred. Evidence from various sources would suggest that physical activity plausibly leads to improved mental wellbeing. However in the absence of sufficiently structured research, this cannot be formally confirmed. The plausible possibility that a sufficient level of mental wellbeing may precede and lead to participation in physical activity is therefore also expressed in the literature. 'Association' thus accommodates the possibility of a two-way flow between the concepts.

[12]'Dose' refers to different types of physical activity, intensities, frequencies and durations.

- the efficacy of physical activity in preventing the development of mental health problems either directly or through impacting on the risk factors and protective factors influencing the development of mental health problems.

2. Using the information gathered from the scoping exercise to establish the breadth of the subsequent evidence briefing.

3. To collate and review the evidence regarding the efficacy of physical activity in improving mental wellbeing and preventing mental health problems (as agreed in 2) with particular reference to duration, type, frequency and intensity of activity.

In practical terms, the work thus comprised of two main elements: a broad scoping exercise (see section 2) followed by a more focused review that specifically examined the association between physical activity and improved mental wellbeing and prevention of mental health problems in 'young people' (see section 3).

1.2 The purpose and development of the database

One particular element of the work was the creation of an evidence database within which details of the review papers identified in the scoping exercise could be usefully collated and ultimately accessed in the future by researchers and practitioners. Additionally, it would form the basis of the search for relevant papers for the more focused second phase of the work.

Given the potential breadth of this literature base it was felt that it should be designed in a way that would make interrogation relatively straightforward and searchable in relation to key dimensions of work that might be of interest. From an initial review of identified papers, a range of key variables were identified that formed the basic structure of the database; there were:

- basic bibliographic details: author(s), title, journal, year & abstract (where available);

- physical activity and mental health domains (derived from the search terminology in section 2.1.2), searchable in combinations;

- the setting in which the work was undertaken (community/general, education, health service, workplace, not specified);

- the demographic group to which the work pertained (adolescents; adults, boys, children, those with a disability, girls, men, minority ethnic groups,

older people, those with a physical illness/condition, those with a psychiatric condition, women);

- type of review (narrative, critical, systematic review).

These dimensions were built into a Microsoft Access database, allowing interrogation for pertinent review papers on any combination of the variables; for example, the ability to search for systematic review papers on children, in a community setting, with a particular interest in the association between 'exercise; and self 'esteem'.

1.3 An overview of mental health

Before embarking on the specifics of the review, it is important to be clear about the key concepts involved in it; since the use of terms relating to mental health in the literature can be inconsistent and the definition of terms is the subject of much debate. For the purpose of this paper the following terms and definitions are used:

Mental health is considered an umbrella term which includes two dimensions: mental wellbeing and mental health problems as defined below. *The term mental health is used throughout this report where there is research and/or evidence which relates to aspects of <u>both</u> mental wellbeing and mental health problems.*

- *mental wellbeing* considered to comprise of three main dimensions – emotional, social and psychological and includes aspects of emotional wellbeing, life satisfaction, optimism and hope, self-esteem, mastery and a sense of control, having a purpose in life, a sense of belonging and personal support

  "this includes our ability to cope with life's problems and make the most of life's opportunities, to cope in the face of adversity and to flourish in all our environments; to feel good and function well, both individually and collectively" (Scottish Government 2007; p.2[13])

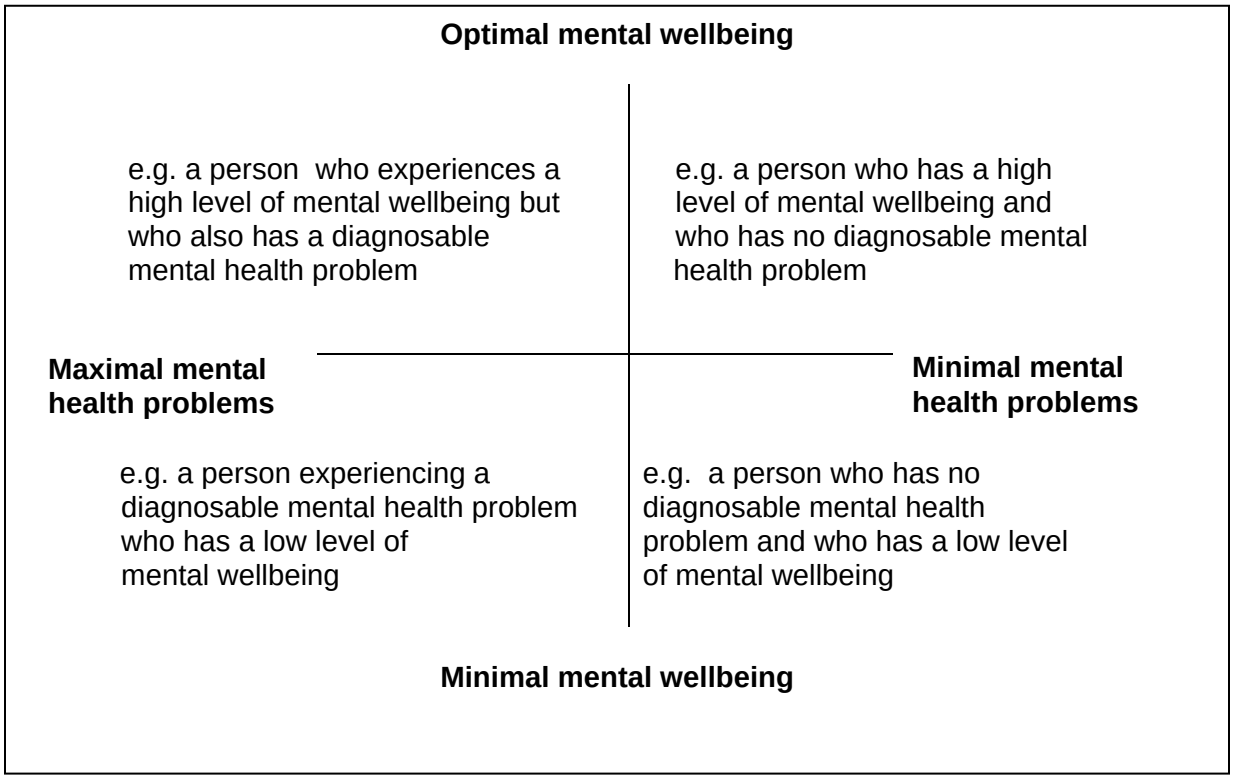
- *mental health problems* refers to symptoms which meet the criteria for clinical diagnosis of mental illness (such as depression, anxiety and schizophrenia) which interfere with an individual's cognitive, emotional or social abilities.

Good mental health is therefore seen as more than the absence of mental illness. The dimensions of mental wellbeing and mental health problems are understood as operating on a model of interacting 'dual continua' shown in

[13]Scottish Government (2007) *Towards* a *Mentally Flourishing Scotland:* Discussion Paper on *mental health improvement* 2008-2011 Scottish Government, Edinburgh.

Figure 1 below. This model demonstrates the possibility of having optimal mental wellbeing, while experiencing diagnosable mental health problems and having minimal mental wellbeing whilst having no diagnosable mental health problems.

Figure 1: Concepts of mental health: a dual continua model [14]



There are a number of factors that are considered to support mental wellbeing and prevent mental health problems (protective factors) and others that increase the risk of mental health problems and decrease mental wellbeing (risk factors). These factors can operate at individual, social and wider societal levels and are shown below in table 1.

[14] Adapted from Tudor K. (1996) *Mental Health Promotion Paradigms and Practice* Routledge, London.

Table 1 : Risk and protective factors [15]

Level	Protective Factors	Risk factors
Individual	positive sense of self good coping skills attachment to family social skills good physical health	low self-esteem low self-efficacy poor coping skills insecure attachment in childhood physical and intellectual disability
Social	positive experience of early attachment supportive caring parents/family good communication skills supportive social relationships sense of social belonging community participation	abuse and violence separation and loss peer rejection social isolation
Structural	safe and secure living environment economic security employment positive educational experience access to support services	neighbourhood violence and crime poverty unemployment/economic insecurity homelessness school failure social or cultural discrimination lack of support services

Mental health improvement refers to any activities that seek to improve the mental health of the population. It is defined in terms of three key areas:

- *protect and promote the mental wellbeing* of the general population, including those with mental health problems; this focuses on the building of competencies, resources and strengths and has a major contribution to make to personal and social development;

- *prevention* of mental health problems, co-morbidity and suicide;

- *improving the quality of life social inclusion, health, equality and recovery* of people who experience mental health problems, including addressing stigma and discrimination, and on promoting equality of opportunity in areas such as employment, housing, education, cultural, sporting and recreational activities.

Mental health improvement involves working to support protective factors and reduce risk factors (MacDonald and O'Hara, 1998[16]) and is considered to work at three levels and each is relevant to variously; the whole population, individuals at risk, vulnerable groups and people with mental health problems:

[15]Barry M. & Jenkins R. (2007) *Implementing Mental Health Promotion* Churchill, London.
[16]MacDonald G. & O'Hara K. (1998) *Ten Elements of Mental Health, Its Promotion and Demotion: Implications for Practice* Society of Health Education and Promotion Specialists, London.

- *strengthening individuals* - by increasing emotional resilience through interventions designed to promote self-esteem, life and coping skills, e.g. communicating, negotiating, relationship and parenting skills;

- *strengthening communities* - by increasing social support, social inclusion and participation, improving community safety, neighbourhood environments, promoting childcare and self-help networks, developing health and social services which support mental health, improving mental health within schools and workplaces e.g. through anti-bullying strategies and mental health strategies;

- *reducing structural barriers to mental wellbeing* - through initiatives to reduce discrimination and inequalities and to promote access to education, meaningful employment, housing, services and support for those who are vulnerable.

Measuring mental wellbeing: Defining and formally assessing mental wellbeing is potentially complex and varied, not least because there is a wide range of tools for measurement focusing on different elements. In turn, this tends to make comparisons across studies difficult (McCullough and Boxer, 1997[17]) and this notion is confirmed in the current review. More constructively, recent work undertaken by *NHS Health Scotland* and the Universities of Edinburgh & Warwick has seen the development of a new comprehensive scale for measuring population mental wellbeing based on established indicators: the Warwick-Edinburgh Mental Well-being Scale (WEMWBS) [Parkinson, 2006[18]].

1.4 The nature of physical activity

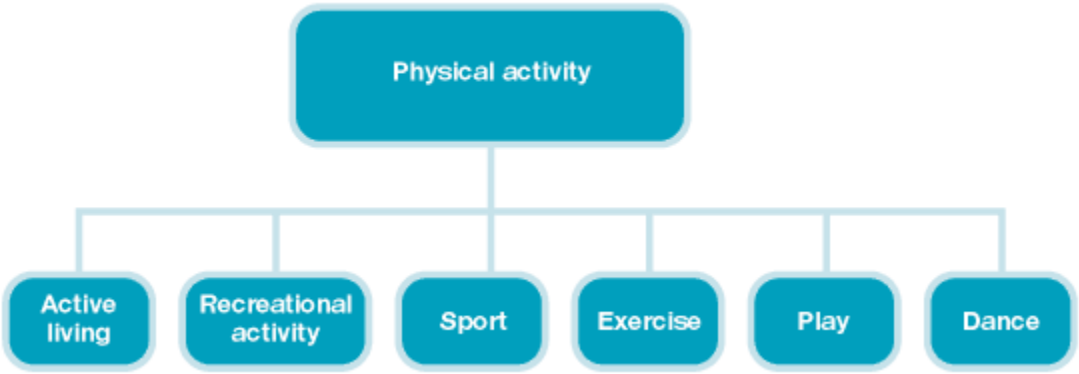
In many ways, the nature of **physical activity** is similarly (though not perhaps quite so) complex. The Department of Health document *At least five a week - evidence on the impact of physical activity and its association to health* (2004) defines it broadly as:

> *"any force exerted by skeletal muscle that results in energy expenditure above resting level…(comprising) the full range of human movement, from competitive sport and exercise to active hobbies, walking and cycling or activities of daily living"* DoH (2004; *p.81 Appendix 1 – Glossary*[19]).

[17]Boxer J. & McCullough G. (1997) *Mental Health Promotion; Policy, Practice and Partnerships* Baillaire/Tindall, London.
[18]Parkinson J. (2006) Establishing national mental health and well-being indicators for Scotland. *Journal of Public Mental Health Vol.* 5 (1); 42–48.
[19]Department of Health (2004) *At Least Five a Week. Evidence on the impact of physical activity and its relationship to health. A report from the Chief Medical Officer.* London: Department of Health.

In more practical terms, a range of types of activity is suggested, including: active living, recreation, sport, exercise, play and dance. These features are outlined below in Figure 2.

Figure 2 : The nature of physical activity



From Let's Make Scotland More Active: A strategy for physical activity, 2003; 12.

These insights ultimately informed the physical activity element of our search strategy.

These various activities have the potential to bring about improvements in muscle strength & stamina, flexibility, power, speed, agility, co-ordination and balance and suggests that physical activity can vary in relation to: intensity (relatively high to relatively low) and quantity (duration and frequency).

In turn, these qualities suggest that physical activity can contribute to a range of wider health gains. Traditionally these features have been couched in physiological terms (for example, heart, respiratory & circulatory health, weight & body composition), though the past 15 years have seen an increasing interest in the potential for physical activity to contribute to gains in mental wellbeing and prevention of mental health problems. This review exists within this expanded context.

1.5 A brief introduction to the core evidence base around physical activity and mental health[20]

There has been a growing recognition that being physically active is associated with improved mental health including improving aspects of mental wellbeing and preventing the development of mental health problems. In addition, the potential for physical activity to alleviate the symptoms of various mental illnesses is noted[21]. The following benefits of physical activity to mental health are indicated in the literature:

- *perception of mental wellbeing*: physical activity (particularly moderate active living type like walking) is linked with improved self perception of mental wellbeing;

- *self esteem*: physical activity is linked to positive effects on self esteem and self perceptions;

- *cognitive function:* there is some evidence that physical activity can promote some aspects of cognitive functioning such as memory, reasoning, problem solving and spatial awareness – this work has particularly emphasised the potential for physical activity to contribute to educational attainment within young people and to maintain good cognitive functioning in older people;

- *sleep:* those who are active tend to fall asleep faster and sleep longer and deeper than those who are inactive – the likelihood of having sleep disorders in lower amongst those who are active;

- *stress & anxiety reduction*: those who are active tend to be able to cope with stress better – this can act at a general long term level (trait anxiety) or immediately (state anxiety)[22].

There is also evidence that physical activity can be effective in alleviating some symptoms in those with clinically defined mental health problems: for example, as an effective treatment for mild, moderate and potentially severe clinical depression; helping people with other mental health problems, such as improving the mental wellbeing of people with a diagnosis of schizophrenia and, supporting recovery from alcohol & drug misuse[23].

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[20]For further details see Physical Activity & Health Alliance Briefing paper No. 10 *Physical Activity and Mental Health* http://www.healthscotland.com/uploads/documents/5566-10.pdf

[21]Department of Health (2004). *At least five a week: Evidence on the impact of physical activity and its relationship to health*. London: Department of Health.

[22]See for example Biddle S. & Mutrie N. (2001) *Psychology of Physical Activity: determinants, well-being and interventions* Routledge, London; Biddle S., Fox K., Boutcher S. (eds.) (2000) *Physical Activity and Psychological Well-Being* Routledge, London.

[23]See for example Physical Activity & Health Alliance Briefing paper No. 10 *Physical Activity and Mental Health* http://www.healthscotland.com/uploads/documents/5566-10.pdf

In relation to understanding the dynamics of this link, various potential explanations have been offered; these could act either in an independent fashion, or what is more likely, in some form of combination. These themes will be developed in more detail in section 3.4.1 but for now they can be broadly characterised as being based upon physiological, psychological and social mechanisms[24].

1.6 The status of the evidence

Despite the relative firmness of many of assertions cited above, the literature is still mindful of many features of the research work that underpins the nature of any conclusions and these provide an important context in understanding the nature and subsequent strength of evidence based claims.

First, it is noted that work in this area is still relatively in its infancy, especially that which is concerned with the promotion of mental wellbeing or prevention of mental health problems. As such, a significant critical mass of material has not accumulated. This in turn suggests that gaps in the evidence base around possible physical activity - mental health links do not necessarily mean that no such association exists; rather the work has not yet been undertaken.

Second, both physical activity and mental health are conceptually complex and diverse and do not lend themselves to clearly structured controlled trial work that would highlight any potentially 'definitive' causal links. Therefore, work has tended to be of an epidemiological nature, using cross sectional survey methods that establish correlational associations between physical activity and mental wellbeing rather than simple 'causality'.

This 'correlational' or 'associative' based evidence exists within the mental health field that stresses the need for a *range* of contextual evidence types to be given consideration alongside 'causality' based evidence derived from randomized controlled trials; for example, practice studies, non-controlled studies and action based research studies, local data and project evaluations, expert and practitioner opinion and client opinion & experience[25].

[24]See for example Faulkner G. & Taylor A. (2005) *Exercise, Health and Mental Health: Emerging Relationships* Routledge, London.

[25]See Health Scotland (2005) *Mental Health Improvement: Evidence and Practice Guide 1: Evidence-based practice evaluation guides* Health Scotland, Edinburgh; pages 8-9.

2. Phase 1: The scoping exercise

On the basis of the foundations described above, the purpose of the scoping exercise was to:

1. Search for reviews in the defined topic area and to select those which met the inclusion criteria;
2. Input the data from the search results into an *Access* database;
3. Map the volume and nature of the literature selected for inclusion in the study in relation to physical activity related terms, mental health related terms, demographic grouping, setting and review type.

2.1 Methods

The method for the scoping exercise involved:

1. Searching for reviews using search terms related to the topics;
2. Determining the criteria for selection and sorting the findings from the search into items for inclusion and exclusion;
3. Inputting the findings into an Access database;
4. Further exclusion of items;
5. Analysing the findings to give a brief overview of content and themes.

2.1.1 Searching for reviews and articles

The search strategy involved interrogation using the OVID suite of databases:

Medline, Journals@Ovid Full Text**,** NHS Scotland**;** Journals@Ovid**;** All EBM Reviews - Cochrane DSR, ACP Journal Club, DARE, CCTR, CMR, HTA, and NHSEED**,** CINAHL - Cumulative Index to Nursing & Allied Health Literature**,** EMBASE**,** ERIC**,** PsycINFO**,** SPORTDiscus**,** Social Sciences Citation Index.

Google Scholar was used as a complementary check to this systematic search. Bibliographic details of all items found were saved and managed using the reference managing software *EndNote Web*.

2.1.2 Search terms

An inclusive search term framework below was developed collaboratively between the research team and *NHS Health Scotland*, drawing upon emergent

terminology frameworks described earlier in both the mental health [for example, Parkinson (2006)[26]] and physical activity fields. Table 2 below lays out the specific terms used in each domain. It should be recognized that the potential scope of terminology in this field is extremely wide (both generally and specifically in relation to young people) and potentially helpful terms may have been initially omitted in the name of practical expediency. However, given the extensive scope of what was searched, there is belief that any supplementary terms would have been picked up in these papers.

Table 2 : Search terms [27]

I. Physical activity	II. Variants of 'mental health'	II. Risk factors	III. Protective factors
1. Physical activity 2. Active living 3. Exercise 4. Play 5. Active commuting 6. Walking 7. Cycling 8. Sport	1. Mental health 2. Well being 3. Psychological well being 4. Mental wellbeing 5. Psychosocial health 6. Wellness 7. Social functioning 8. Emotional health 9. Emotional intelligence 10. Quality of life 11. Life satisfaction 12. Prevention mental health problems	13. Environmental deprivation 14. Emotional abuse 15. Emotional negligence 16. Stress 17. Social exclusion 18. Gender 19. Emotional resilience 20. Role conflict 21. Genetic pre-disposition 22. Childhood neglect 23. Bereavement 24. Carer 25. Unemployment	26. Environmental quality 27. Self esteem 28. Emotional processing 29. Self management 30. Social skills participation 31. Resilience 32. Coping 33. Spirituality 34. Respect 35. Hopefulness 36. Coherence 37. Locus of control 38. Mastery 39. Self efficacy 40. Inter-personal skills 41. Social inclusion 42. Social capital 43. Social trust

Subsequent to this initial search, it was felt important to check for reviews that might report on activity that sought to act preventatively on 'anxiety' and 'depression'. Searching thus involved the cross matching within OVID of the 8 physical activity related terms with each of the 43 mental health related terms contained within three broad categories [variants of mental health (12), risk factors (13), protective factors (18) and the additional two mental health problem

[26]Parkinson J. (2006) Establishing national mental health and well-being indicators for Scotland. *Journal of Public Mental Health Vol.* 5 (1); 42–48.
[27]Additional terms 'anxiety' and 'depression' were searched at a later stage.

related terms]; that is, 360 individual searches. The following OVID inclusion parameters were set:

- limit to ‘systematic review’;
- limit to ‘review article’;
- limit to ‘English language’;
- limit to years 1997-2007.

It should be noted that some sub databases within OVID did not allow sorting by review, so in some cases the search yielded in excess of 1,000 items. Here, an additional OVID search term ‘review’ was included alongside the physical activity and mental health terms to successfully limit the number of identified items.

These searches yielded a breadth of potential papers and close scrutiny followed that identified, from the available titles and abstracts, those papers that fell within the specific domains of physical activity *and* improved mental wellbeing and prevention of mental health problems. Any tendency at this point to exclude papers was tempered – the initial motivation was towards inclusion.

Search terms did however naturally throw up anomalies and a quantity of papers were excluded on the basis that they were not concerned with the search terms in the way that this project was interested in; for example, the term ‘exercise’ has various meanings and uses. These numbers were recorded on a reference log showing the initial number of pieces identified by the general search and bracketed figures for those taken forward as potentially relevant after scrutiny. Bibliographic details (authors, title, source and where available abstract) of these papers were then imported to *EndNote Web* and any duplicate items eliminated. At this stage this search yielded **428** potential items.

2.1.3 Managing the findings

Review took place in 3 phases and initially operated on favouring an ‘inclusive’ approach that became more rigorous and critical as the process proceeded:

1. Papers identified in an initial search of OVID databases, meeting the inclusion criteria and entered on a reference log = **428** items to go forward;

2. Using the available bibliographic evidence (titles, search terms and where possible abstracts), initial examination was undertaken by a member of the team (SW). Since the study was aimed at review level, the following criteria were used to include/exclude items from the study at various stages (see table 3):

Table 3 : Inclusion and exclusion criteria

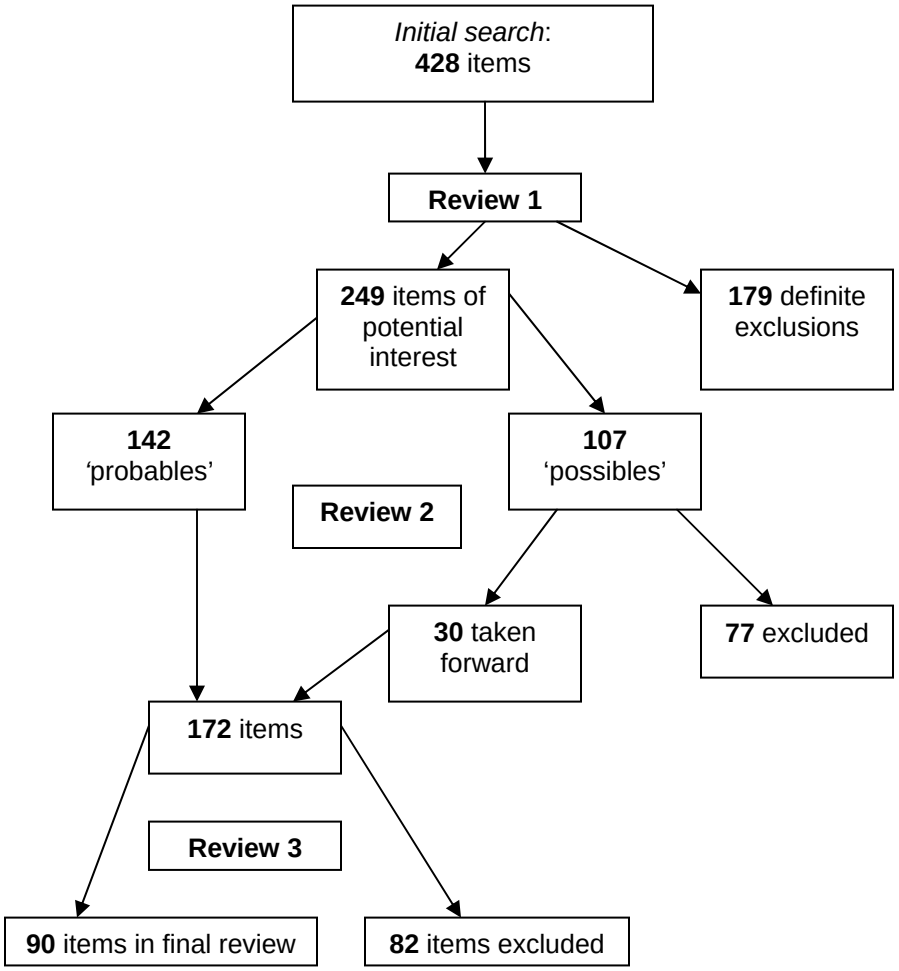
inclusion	exclusion
Review article; Specific and sufficient interest in physical activity and mental health improvement/prevention of mental health problems.	Individual empirical studies; Not specifically relevant to physical activity and mental health improvement/prevention of mental health problems; Explicitly concerned with treatment interventions for mental illness; Duplicate items.

From the initial analysis **179** definite *exclusions* were identified*.* **249** papers were identified as being of potential interest and these items were further allocated to 2 broad categories: 'probables' (**142**); and 'possibles requiring further examination' (**107**). From this base, a second member of the team (JS) reviewed these using the same criteria and bibliographic evidence. Of the **249** papers, the **142** 'probables' were confirmed and of the **107** 'possibles', **77** were excluded on the basis of exclusion criteria, and **30** were identified as being of potential interest and thus went forward for further review. **172** papers were therefore taken forward to the next stage;

3. Prior to data entry to the Access database a final more in-depth appraisal was undertaken by SW. Where necessary, abstracts and full articles of those items where uncertainty still existed (e.g. abstract absent or brief) were retrieved and this offered important insights into the nature of review work not apparent in abstracts with respect to the set inclusion/exclusion criteria. Using this additional information, **82** papers were excluded; the final corpus was therefore reduced to **90** individual items.

The following chart (figure 3 below) indicates numbers at each stage of the process.

Figure 3 : Number of items at each stage of selection process



2.2 A quantitative summary of distribution of themes

Physical activity themes: The majority of work still existed around the traditional themes of *'physical activity'* **(43 citations)** and *'exercise'* **(37 citations)**. *'Sport'* was perhaps surprisingly relatively under-represented **(7 citations)** and wider aspects of physical activity had relatively low expressions: **2 reviews** looked at *walking;* **2 items** at *'play'* and none at *'active living'*, *'active commuting'* or *'cycling'.*

Mental health themes: The majority of work existed around six concepts:

- *'quality of life'* **(18 citations)**
- *'mental health'* **(17 citations)**
- *'self esteem'* **(17 citations)**
- *'well being'* **(14 citations)**
- *'psychological wellbeing'* **(11 citations)**
- *'psychosocial health'* **(7 citations)**

The search around wider terms was relatively fruitless, only yielding 1-2 citations in for example, themes like *'locus of control'*, and *'wellness'* & *'social inclusion'*.

Lifecycle groups: The majority of items existed in relation to those with various *'physical condition/illnesses'* **(25 citations)**. There was strong expression around young people ['*adolescents'* **(14 citations)**; *'children'* **(12 citations)** & 'girls' **(4)**]. These themes were reflected within various contexts: **24** items were within *'health services'* and **6** in *'education'.*

Strength of associations: It was generally difficult to ascertain specific association strengths from abstracts; but in general terms papers were mostly reporting 'moderate' associations **(45 citations)**; **26 items** did not cite an association; **5** reported *'strong'* associations and **2** *'weak'*.

Review types: 43 of the items were of a *narrative* nature; **20** were *critical* reviews and **14** were *systematic reviews*.

These items are included in the access database available from the Evidence for Action team at *NHS Health Scotland*.

2.3 A qualitative analysis of the included items

Beyond this simple quantitative overview of the nature of the identified review papers, an examination of the key themes contained within them was undertaken. This was done generally and in the context of the broad population groups, settings and related categories that were reflected in these reviews:

‘general population’; ‘young people’; ‘older adults’; ‘specific types of physical activity’ ‘specific physical conditions and illnesses’; ‘mental illness, disorders and conditions’ and ‘social exclusion/inclusion’. It should be noted that, given that access at this point was only to review abstracts, this could only be considered as a ‘preliminary’ overview.

2.3.1 Summary of key themes

Overall, the evidence on mental health improvement appears to be limited to traditional terminology in both physical activity and mental health domains, with relatively little representation of wider types of activity; risk and protective factors; or, broader terminology such as social exclusion and deprivation. Those concepts most frequently cited included: self esteem; stress; mood; sleep; cognitive functioning; body image and self-efficacy.

Whilst there was some exploration of the strength of the physical activity – mental health association, this was by no means common to all reviews. Coverage of physical activity ‘dose’ appeared to be relatively limited and most frequently expressed in reviews dealing with older people. The borderline between treatment of mental health problems and promotion of mental wellbeing was also often blurred.

In many reviews mental health improvement was a minor ‘add-on’ to the main theme of improving physical health and alleviation of symptoms & illness. The term ‘quality of life’ was frequently used, and it was difficult to determine what measures or indicators were being used to assess this concept.

2.3.2 General population

This section tended to cover physical activity in generic terms rather than in relation to specific activities. Several reviews included the influence of physical activity on mental health as a part of a wider battery of measures that tended to pay more attention to various aspects of physical health. Some reviews highlighted the possibility of there being a reverse causal association; that is, mental health state as a predictor/influence for involvement in physical activity. The themes in these papers focused on a range of concepts, including the effects of physical activity on mood states, self-esteem, resilience to stress, cognitive function, self determination, body image, sleep, social environment and social exclusion.

2.3.3 Young people

A significant proportion of the identified papers focused on young people (in the context of for example, 'children', 'adolescents' & 'girls'). The main focus was on concepts such as, self esteem, social competence, self-efficacy and body image (especially in girls). There were relatively few considerations of 'dose response' issues. Significant attention was however paid to the mechanisms of effective delivery of activity opportunities that may be conducive to the promotion of mental health. The examination of the role of physical activity as one element in improving mental health for young people with developmental difficulties, cancer, obesity and physical disability was also a recurring theme. A detailed account of age ranges included in these reviews is offered below in section 3.2.

2.3.4 Older people

The mental health focus of papers in this area tended to be around the following areas: mental wellbeing in general; prevention of cognitive impairment; the promotion of psycho-social health; promoting sleep; promoting the emotional health components of quality of life (particularly amongst the frail elderly) and mood. Perhaps given reservations about delivering physical activity to this group, papers in this area were the most likely to refer to 'dose response'. It should be noted that in the abstracts of the 12 papers within the corpus relating to older people, only one[28] explicitly stated their assessment of how older people might be defined chronologically.

2.3.5 Women

The main emphasis of papers exploring physical activity amongst women was on: improved body image, gender and sport, empowerment, gender and disability/self-efficacy, pregnancy and barriers to physical activity.

2.3.6 People with mental health problems

Many of these papers related to physical activity as a treatment intervention for depression and anxiety. There was some consideration of prevention of these conditions, plus controlling stress and the promotion of resilience to stress. Some reviews focused of the strength of this association. One review looked at outdoor recreation in relation to quality of life for people with enduring mental health problems.

[28]Schechtman K.B. & Ory M.G. (2001) The effects of exercise on the quality of life of frail older adults: A pre-planned meta-analysis of the FICSIT trials. *Annals of Behavioral Medicine,* 23**,** 186-197 state that the mean age of their review is 73.4 years.

2.3.7 People with existing physical health conditions and illnesses

Papers concerned with examining the use of physical activity to improve mental wellbeing of those with various chronic physical health conditions and illnesses were strongly represented in the review level literature. This can perhaps be attributed to a publication bias in that systematic reviews are relatively popular in clinical contexts. The items tended to focus on the benefits of physical activity for people with existing conditions such as; coronary heart disease, stroke, diabetes, chronic obstructive pulmonary disease, HIV/AIDS, multiple sclerosis and osteoarthritis. There was limited consideration of specifically improved mental wellbeing, with the emphasis tending to be on quality of life measures and functional health.

A number of reviews consider physical activity for cancer patients, but analysis suggested that again there was more emphasis on physical health benefits and limited evidence of attention being specifically paid to improving mental health. However, fatigue was a key issue that crossed the boundary of physical and mental health.

3. Phase 2: Review of evidence around young people

3.1 Rationale

The choice of young people[29] as a focus of stage 2 of the work was made on the basis of a number of influences. First, the amount of evidence identified within the scoping exercise that specifically addressed young people was relatively more extensive than other target groups.

Second, these reviews tended to be more explicitly related to the project aim of considering the promotion of mental wellbeing and the prevention of mental health problems. Finally, this area was compatible with the significance placed generally on young people within broad Scottish Government policy and *NHS Health Scotland's* Delivery Plan for 2007/08[30] and the associated advantages clearly achievable in addressing physical activity and mental health in this particular lifecycle group.

3.2 Delineation of the term 'young people'

Whilst the use of various terms associated with this particular period of the lifecycle (for example, 'young people', 'children', adolescents') was naturally present in reviews, explicit numerical delineation of these concepts tended not to be undertaken.

Table 4 below outlines the specific operationalisation of these terms in the 18 papers that formed the corpus of this second stage of the work; 11 of the 18 papers included did not specify an age range and of the 8 that did, the predominant tendency was towards the 11-21 years age group. One paper did consider younger children (down to 3 years).

[29]For convenience, the term 'young people' is used from this point forward, though it should be recognised that the reviews themselves deployed a range of terms relating to the age range 3-21.
[30]NHS Health Scotland Delivery Plan 2007/08

Table 4 : Delineation of the term 'Young People'

Reviews with no defined age range	Definition
Bailey (2005)	no specific delineation; 'children and young people' 'children of school age'
Bailey (2006)	no specific delineation; 'children' 'children of school age'
Biddle *et al* (2004)	no specific delineation; 'children and adolescents' 'youth'
Bunker (1998)	no specific delineation; 'girls'; 'childhood' & 'children'
Nowicka & Flodmark (2007)	no specific delineation; 'childhood', 'children' & 'adolescents'
Penedo & Dahn (2005)	no specific delineation; 'adolescents'
Dykens *et al* (1998)	no specific delineation; 'children' & 'adolescents'
Eppright *et al* (1997)	no specific delineation; 'childhood' and 'adolescence'
Allin *et al* (2005)	no specific delineation; 'children'
Hallal *et al* (2006)	no specific delineation; 'adolescence'

Reviews with defined age range	Definition
Lotan *et al* (2005)	'adolescence'; 12-21 years specifically cited
Mutrie & Parfitt (1998)	'young people' focus; search terms cited: 'adolescence', 'youth', 'teenager', & 'children', papers cited studies cited with age range 11-20
Parfitt & Eston (2005)	'children'; specifically 9 -11 years
Twisk (2001)	'children' & 'adolescents'; "in this review roughly defined as the age group between 8 and 18 years"
Fox (2000)	'children' & 'adolescents' US studies grade 1-8 (6-14 years)
Larun *et al* (2007)	'children' & 'young people'; participants between 11 and 19 years
Ekeland *et al* (2007)	'children' & 'young people'; children from 3 years to young people up to 20 years
Calfas & Taylor (1994)	studies that included subjects in the 11-21 year-old age range were included in the review

3.3 Phase 2 methodology

The phase 1 database was used to identify 21 potential review papers within the scope of 'younger people' (incorporating the terms, children, adolescents & girls). Bearing in mind that the scoping exercise only allowed us access to summary details and not the full paper, 7 of these papers were subsequently excluded from the end list on the basis of:

- the substantive part of the paper being written in a foreign language (Ommundsen, 2000; Sothern, 1999);

- the paper being wholly oriented towards the alleviation of mental health problems (Schomer & Drake, 2001; Kane & Larkin, 1997);

- the mental health component being a small poorly defined part of a larger intervention battery (Culos-Reed, 2002; Biddle *et al*, 2004);

- the paper being extremely brief [Editorial (1997) *Journal of Musculoskeletal Medicine* was a 1 page editorial paper].

In the process of scrutinizing these papers, attention was also paid to potential 'follow up' papers within reference lists and it was agreed that if relevant papers fell outwith the 10 years time-frame that was placed on the initial scoping exercise, they would be included. A range of criteria was still applied: the paper was of a review nature; it dealt specifically with the promotion of mental wellbeing and the prevention of mental health problems; it was cited in a number of reviews.

From this, an additional 4 papers were identified which were added to the final review, one of which was more than 10 years old (see appendix 2):

- Calfas K.J. & Taylor W.C. (1994) Effects of physical activity on psychological variables in adolescents *Pediatr Exerc Sci*; Vol.6; 406-23;

- Mutrie N. & Parfitt G. (1998) Physical activity and its link with mental, social and moral health in young people in Biddle S., Sallis & Cavill N. (eds.) *Young & Active?: Young people and health – enhancing physical activity – evidence and implications* HEA, London;

- Twisk JW. (2001) Physical activity guidelines for children and adolescents: a critical review *Sports Med* Vol. 31; 617-27;

- Parfitt G. & Eston R. (2005) The relationship between children's habitual activity level and psychological wellbeing *Acta Paediatrica* Vol. 94 (12); 1791-1797[31].

Also, various additional pieces were used as 'contextual' papers that did not fall strictly within the domain of the search in and around young people but, in the absence of significant levels of specific material with respect to particular issues of interest, nevertheless gave important insights into various contextual matters. These papers reflected an interest in three main areas:

- the nature of existing physical activity guidelines alongside which specific mental wellbeing related guidelines would exist;

[31] It should be noted that this paper is actually reporting on an empirical piece of work but does contain a significant literature review that was of interest in its own right.

- specific attention to research work related to ‘dose response’;
- recent general population reviews published subsequent to the current review.

These additional papers are listed in Appendix 2. Details from the final review papers were independently extracted by two reviewers within the context of a formal review framework that was based on insights from various review methodology guidelines[32]: The domains are listed below in figure 4:

[32]SIGN (2007) *A guideline developer's handbook* Guideline No. 50; EPPI Centre *Guidelines for reporting of Primary Empirical Research Studies in Education;* NHS Centre for Reviews and Dissemination (2001) *Undertaking Systematic Reviews of Research on Effectiveness CRD's Guidance for those Carrying Out or Commissioning Reviews;* Swann C. *et al* (2004) *HDA Evidence Base Process and Quality Standards Manual for Evidence Briefings* Third edition HDA, London.

Figure 4 : Framework for data extraction

I. Introduction & context

- ***General information:*** title, authors, journal, publication details, general notes.
- ***Study aims and rationale:*** broad aims of the study***;*** explanation of why the study was undertaken; funding sources; date study started and completed.
- ***Study research questions:*** general focus/foci; specific research questions; hypotheses; concepts considered.

II. Review methodology

- **Review design/nature:** systematic review/critical review/narrative review.
- **Sampling & 'Sytematicity'**: databases searched; years searched; references followed up; experts consulted; grey literature searched; search terms specified; inclusion criteria described; the breadth of databases accessed.
- **Inclusion:** types of study included in the review [(quasi) experiments/RCTs (and assessment of the quality of); case control studies; cohort studies; before-after study; case studies; observations; expert/consensus opinion; surveys]

III. Results

- Nature of the association: descriptive/narrative; statistical (difference testing/associative); record p-values

Critical analysis

- Does the study address an appropriate and clearly focused question?
- Is there a description of review methodology included?
- Is the search sufficiently rigorous to identify all relevant studies?
- Is the study quality assessed and taken into account (rating)?
- Are there are enough similarities between studies to make combining reasonable?
- Has there been a check for bias (selection, process)?
- Can the results be applied/are generalisable to a UK population/population group?
- Has there been an overall assessment of validity of concluding claims?

Specific MH/PA dimensions

I. Orientation of intervention (promotion/prevention)
II. Context
III. Sub-group(s)
IV. Defined impacts
V. Specific formal measurement
VI. Insights on dose-response/intensity
VII. Insights on 'best practice' implementation

This assessment was cross checked between reviewers and agreements made on allocations. Details were recorded on an *Excel* spreadsheet whose key elements are summarised in Appendix 3.

3.4 Findings

3.4.1 The nature of the association between physical activity and mental health in young people

Evidence was examined from 18 reviews concerned with physical activity and mental health improvement in young people that particularly related to children and adolescents. The majority of the studies were narrative reviews (10) with little or no discussion of the criteria for inclusion of studies. Three reviews were critical in nature and 5 were systematic reviews[33] (see further discussion below in section 3.4.2).

The use of terminology tended to be variable and not specifically aligned to the concepts outlined in section 1.3; for example, mental wellbeing, protective and risk factors and mental health improvement. The terms promoting mental wellbeing and mental health improvement tended not to be used in the identified literature. Rather, terms such as 'psychological wellbeing' and 'positive mental health' were common.

There was a strong focus in the identified literature on the association between physical activity and one or more of the generally mental wellbeing related concepts and protective or specific risk factors; with a greater emphasis on the mental wellbeing and protective factors than risk factors. Those *concepts* that were expressed included:

- self esteem/self worth
- self concept
- body image
- mood
- cognitive functioning and development
- social competence, positive social relationships, moral code
- peer acceptance
- social inclusion & community networks

The *risk factors* were:

- childhood neglect
- social exclusion
- stress.

[33] Three of these systematic reviews involved a form of meta-analysis.

3.4.2 The strength of the association between physical activity and mental health in young people

The reviews included in the study, in broad terms, indicated an association between physical activity and mental health for young people, though the reported strength of the associations is varied. Conclusions fell into two broad categories:

1. the suggestion that there is moderate to strong evidence to support the association, especially in relation to preventing anxiety and depression;

2. the suggestion that there is some evidence to support the association, but it is relatively weak.

Also, the affirmative reviews varied in the extent to which their methodology can be considered technically rigorous. Of the 18 reviews included in this study, 10 were of a ‘narrative’ nature, with little or no critical analysis of the studies that are cited and no description of search strategies or criteria for exclusion of studies lacking rigour. Of the remaining 8, 3 were classed as ‘critical reviews’ (some reporting of background search methodology) and 5 were of a full ‘systematic’ nature, citing a fully transparent methodology. Insufficient definitional details were given in these papers to allow for any judgment on whether they were of a promotional or preventative nature. The broad array is summarised in table 5 below.

Table 5 : An overview of review types

Category of evidence on association	Systematic Review[34]	Critical Review	Narrative review	Total
1.Moderate to strong	Calfas & Taylor, 1994 Hallal, 2006	Mutrie & Parfitt, 1998	Bailey, 2005 Bailey, 2006 Bunker, 1998 Nowicka, 2007 Penedo & Dahn, 2005 Dykens *et al*, 1998 Lotan *et al*, 2005	10
2. Limited	Allin *et al* , 2005 Ekeland *et al*, 2007 Larun *et al*, 2007	Fox, 2000 Twisk, 2001	Eppwright, 1997 Biddle, 2004 Parfitt & Eston, 2005	8
Total	5	3	10	18

So, although there were 10 reviews stating that there is sufficient evidence to support this association, 7 of these were unclear about the rigour of the studies they were citing. Given the volume of secondary references contained within these 18 pieces, making any rigorous assessment of the equivalence of the source material across reviews was difficult and largely beyond the scope of the current study. However, a general appraisal would suggest that beyond a relatively small number of core papers, the reviews in the various domains and across countries tended to draw upon relatively diverse primary material.

Before moving on to more substantive discussion, it should be noted that 12 of the 18 reviews examined made no explicit statement on how the mental health concepts being examined were formally assessed. Of the 6 that did the following tools were cited and these are outlined in table 6 below.

[34]Calfas & Taylor, 1994; Larun *et al*, 2007; Ekeland *et al*, 2007 involved meta analysis.

Table 6 : Formal tools to assess aspects of mental health

	Assessment tool
Self concept	Children's Self Concept Scale (CSCS) Martinek-Zaichkowsky Self Concept Scale for Children Piers-Harris Children's Self-Concept Scale Tennessee Self-Concept Scale (TSCS) Thomas Self-Concept Values Test
Self perception	Children and Youth's Physical Self-perception Profile (CY-PSPP) Self-Perception Profile for Children Self Perception Profile for Adolescents Self-Perception Profile for Learning-Disabled Students
Mental health problems	General Health Questionnaire (GHQ)
Personality	Jackson Personality Inventory (JPI) Minnesota Multiphasic Personality Inventory (MMPI) State-Trait Anxiety Inventory for Children (STAIC)
Mood	Profile of Mood States (POMS)
Self esteem	Rosenberg Self-Esteem Scale Self Esteem Inventory
Self description	Self Description Questionnaires for Adolescents (SDQ I and II)
Miscellaneous	Goodenough's House-Tree-Person Projective Test; Multiple Adjective Check List (MAACL)

Additionally, a range of assessment tools related to depression and anxiety were also cited:

- Beck Depression Inventory (BDI)
- Childhood Depression Inventory (CDI)
- Hospital Anxiety and Depression Scale (HADS)
- Reynold's Adolescent Depression Scale (RADS)

The broader significance of the power of different research designs and associated evidence will be explored later in Section 4: 'Discussion'.

3.4.3 The evidence on specific protective and risk factors for mental health

The following section explores the evidence around the general strength of the association between physical activity and mental health improvement. In the widest sense, the narrative reviews tended to paint a relatively positive picture. For example, Bailey (2005; 80) cites Talbot (2001):

"Physical education helps children develop respect for the body, their own and others; contributes to the integrated development of mind and body…..positively enhances self confidence and self esteem; enhances social and cognitive development and academic achievement."

A blurring tends to occur in the reviews between what might strictly be termed 'prevention' and the alleviation of mental health problems. The term 'reducing' is often used but tends not to be defined; potentially relating to both reducing population prevalence (that might constitute 'prevention') and/or reducing levels of anxiety in those already having a mental health problem (that would tend to suggest that this reflects the alleviation of existing symptoms within individuals). Biddle (2005) described physical activity and sport as providing one medium for enhancing positive feelings about oneself, increasing alertness and reducing depression, tension and anxiety. Bunker (1998) quoted the conclusions of the International Society of Sport Psychology and an examination of the research literature regarding the influence of exercise on depression and anxiety:

- exercise can help reduce anxiety;
- long-term exercise can help reduce neuroticism and anxiety;
- exercise can help reduce various types of stress;
- exercise can have a beneficial emotional effect.

A systematic review by Calfas & Taylor (1994) concluded that there was moderate evidence to support the view that physical activity is psychologically beneficial for young people. They found that for adolescents, physical activity is associated with:

- increased self esteem/self concept/self efficacy (9 out of 10 studies);
- reduced depression (9 out 11 studies);
- reduced anxiety and stress (8 out of 11 studies).

A report from the Council of Europe in 1994 stated that:

"there is strong evidence...on the positive effects of physical activities on self-concept, self-esteem, anxiety, depression, tension and stress, self-confidence, energy, mood, efficiency and well-being." (Svoboda, 1994:15)

In more specific terms, a greater emphasis was placed in the reviews included on aspects of mental wellbeing and protective factors (e.g. self esteem and self concept) rather than the negatively oriented 'risk' factors.

3.4.3.1 Self esteem and self concept

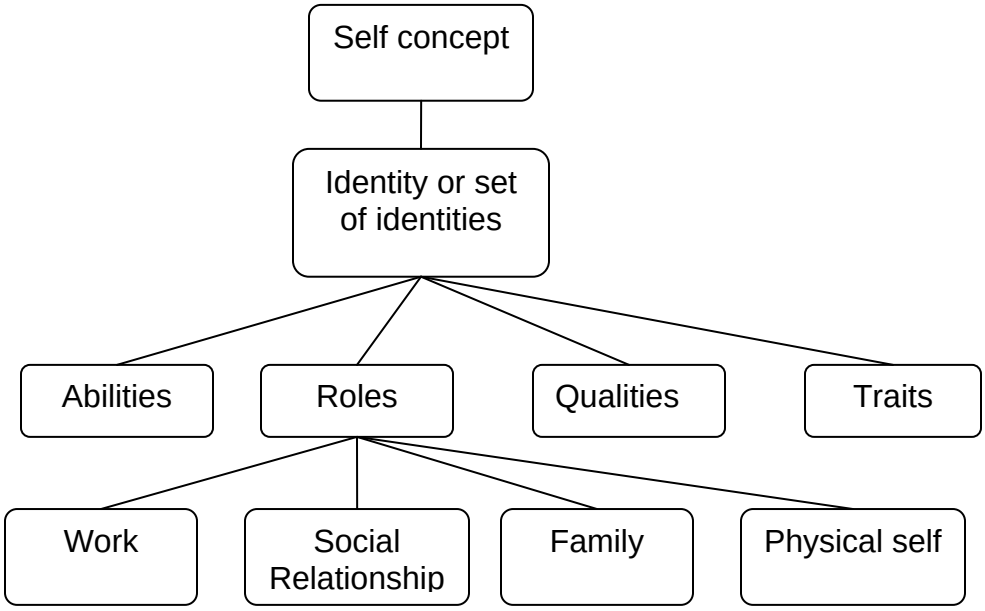
Attention to self esteem and self concept was particularly prominent in the reviews identified. A comprehensive account of these concepts is given by Fox

(2000) who describes self esteem as one of the strongest indicators of *"subjective well being"* and an important element of mental wellbeing (p. 89-93).

The self is described as a series of constructs that are organised in a hierarchical system, involving 'self concept' and 'self esteem' or 'self worth'. Self concept is a description of self, whereas *'self esteem is a self rating of how well the self is doing'* (Fox, 2000; 90). Significantly, the concept is seen to be shaped by the social contexts and cultures in which individual exist. A number of researchers have conceptualised self concept as multi-dimensional and hierarchical (e.g. Fox, 2000; Parfitt & Eston, 2005). Self concept is based on an identity or set of identities that consist of various domains, with a set of sub-domains at the next level (shown below in figure 5).

The physical self consists of 'physical self worth' that in turn relies on perception of a range of physical attributes and competences; for example, body image is an important aspect of the physical self. Self efficacy is another construct of self which impacts on the physical self in terms of perceived confidence to complete a task such as an exercise programme or a sporting skill.

Figure 5 : A hierarchy of self concept and its associated domains



Whilst self esteem is specifically seen as a complex concept [for example, Emler (2001; p.2) concludes, ¨there is not perfect unanimity within the scientific community as to exactly what self-esteem is¨] assessment of it has occurred, based on two broad conceptual bases: self esteem as a holistic, generalised feeling about the self; or the product of a series of more particular dimensions (e.g. intellectual competence, social skills, appearance, physical co-ordination)[35]. Emler notes that measures emanating from the simpler global notion of self esteem tend to be deployed and table 6 (section 3.4.2) provides an overview of tools cited in the papers included in this review.

A number of reviews reported evidence of the existence of a consistent association between physical activity and heightened self esteem, although some conceded that the evidence was not particularly extensive (e.g. Calfas & Taylor, 1994, Eppright *et al*, 1997, Mutrie & Parfitt, 1998, Fox, 2000, Bailey, 2005 & 2006, Biddle, 2005, Ekeland *et al*, 2007, Hallal *et al* , 2006 and Twisk, 2001). The reasons cited for these reservations included: reliance on studies that are cross sectional (that is a single 'one-off' study); small scale; lacking measurement consistency and using poorly validated instruments. For these reasons, few studies have been able to display a *sustained* improvement in self esteem

[35]See Emler N. (2001) *Self-esteem: The costs and causes of low self-worth* Joseph Rowntree Foundation/YPS, London.

associated with physical activity. Some reviews referred only to studies that measure 'global self-esteem' (e.g. Ekeland *et al*, 2007) while others used instruments to measure the different domains and elements of self esteem, such as perceptions of physical competency and social relationships.

In relation to the whole population, Fox (2000) drew the conclusion that there was robust evidence of an association between exercise and *physical self-esteem or self-concept"* (in particular see page 99) and that whilst the evidence for associating global self esteem with physical activity was more equivocal, 44% of the studies reviewed still showed a positive change in self esteem post activity intervention. Fox thus found this evidence for children sufficiently robust to conclude that:

> *"exercise is an effective medium for developing a positive self in children, is particularly effective for those with low self-esteem and has the greatest potential when presented in a style that will encourage mastery and self-development"* (Fox 2000; 108)

The importance of mastery is supported by Calfas & Taylor (1994), who concluded that in the 11-21 age group, mastery and success in physical activity could be meaningful in enhancing self esteem, particularly during adolescence. Similarly, Bailey (2006) highlighted the importance of increased perceived physical competence. Bunker (1998) suggested that participation in sport may lead to improved self concept and self esteem particularly for girls, through providing opportunities for skills enhancement, self challenge and risk taking.

Negative effects: Fox (2000) recognised that physical activity had the potential to have paradoxical effects on self esteem; it can be lowered not raised if experiences raise self criticism without increasing perceived competence or if individuals have negative experiences such as embarrassment or failure. This is supported by Eppright *et al* (1997) who discussed the possible negative impact of participating in sport, highlighting evidence that excessive participation could contribute to harmful effects on self esteem (although what constitutes 'excessive' activity is not normally defined). It was also recognised that young people with low self esteem and high competitive trait anxiety could be more vulnerable to '*competitive stress'* (Eppright *et al,* 1997).

3.4.3.2 Cognitive development and academic performance

There has long been a belief that physical activity can support intellectual development in young people; for example, a classic study was conducted in France as far back as 1952 (the Hervet study). In spite of 'academic' curriculum time being reduced by 25% and replaced by personal and social education (PSE), academic results did not worsen and there were fewer discipline problems, greater attentiveness and less absenteeism (cited in Bailey, 2006). There have been some subsequent studies that have suggested that (i)

increasing levels of physical activity in the school context does not interfere with cognitive development and academic achievement (see Bailey, 2006; 399); and more positively (ii) some broad support for an association between physical activity and cognitive functioning through physical activity.

However, the predominant thrust of the majority of reviews was that the evidence of an association between physical activity and cognitive or academic performance appeared to be relatively equivocal and weak. For example, Mutrie & Parfitt (1998) reviewed a number of studies and concluded that while there was some limited evidence that physical activity improves academic or cognitive performance in young people, there were very few good studies. They suggested the potential for effect may be likely in what is termed broadly as 'younger' age groups.

3.4.3.3 Social competence, positive social associations, moral code and peer acceptance

Social development includes the development of social competence, social relationships, peer acceptance and development of a moral code. The commonly held theoretical view in the literature was that sport and structured physical activity could provide an environment in which general social skills development, moral reasoning skills and a moral code could be rehearsed and practiced (Bunker, 1998). In particular, sport has conventionally been viewed as a mechanism for social development.

The evidence suggested that appropriately structured and presented physical activity could enhance pro-social behaviour and combat anti-social behavior (Bailey, 2006). Bailey (2006) reported that the evidence was particularly strong in the school setting, but did not support the claim that these effects are inherently associated with participation; they were seen as being dependent on the context and quality of interaction between young people and teachers & leaders. In particular, physical activity was, in theory, seen to provide opportunities to: meet and communicate with others; take different social roles; and learn particular social skills such as, leadership, tolerance and respect for others (Bailey, 2005; Eppright *et al*, 1997). The elements of physical activity that were highlighted as potentially contributing to social development were:

- success in sport leads to recognition from teachers, parents and peers (Bunker, 1998);
- participation in competitive sport brings greater social status and more favourable personal qualities (Eppright *et al*, 1997);
- a sense of fair play and 'sportspersonship' (Bailey, 2006);
- taking personal responsibility (Bailey, 2006).

There was almost universal agreement that the evidence shows that play in younger children can enhance the development of social skills through co-operation (Mutrie & Parfitt, 1998; Nowicka, 2007). A systematic review of the use of play with children experiencing neglect found that play therapy increased inter-active peer play, reduced behaviour problems, increased co-operation and interaction and less aggressive play with peers (Allin *et al*, 2005). At a theoretical level, quality adult leadership was also seen as important in providing structures and role models that supported personal growth and enabled the delivery of appropriate feedback.

Appropriate moral development was seen by some as a product of good teaching and coaching environments and several authors have provided guidance on good practice (Mutrie & Parfitt, 1998; Bunker, 1998; Bailey, 2006). School is seen as a particularly favourable environment in which social development can occur for a number of reasons: having access to all children; fewer external pressures to emphasise outcome and competition and the ability to integrate social education across the curriculum (Bailey, 2006). The link between participating in physical activity and improved attitudes towards school has been explored in a number of studies, notably in attendance figures. In this respect however, the evidence was relatively weak, based largely on small scale studies or anecdotal evidence. Gender differences were also apparent, as girls can potentially become progressively disillusioned and disengaged with physical education that may increase disaffection and truancy (Bailey 2005).

In summary, the broad consensus with regard to this association between social development and physical activity, particularly when considered in relation to 'high quality' evidence, was still largely equivocal (Mutrie & Parfitt, 1998).

3.4.3.4 Social inclusion

Recent policy (articulated for example in *Sport*scotland's Sport *21 2003-2007 – the national strategy for sport*[36]) suggests that participation in sport can variously contribute to neighbourhood renewal, promote social capital & social inclusion and counter anti-social behaviour. Bailey (2005) reported that the literature suggests participation in physical activity has the theoretical potential to contribute to the following dimensions of social inclusion (table 7):

[36] *Sport*scotland (2003) Sport *21 2003-2007 – the national strategy for sport sport*scotland, Edinburgh.

Table 7 : Contribution of physical activity to dimensions of social inclusion

Dimension of social inclusion	Description	Contribution of participating in physical activity
Spatial	relates to proximity and the closing of social and economic distances	participating in activities that are valuable in allowing integration of social and economically separate groups
Relational	is defined in terms of a sense of belonging and acceptance	offering a sense of belonging to a team, club or programme
Functional	relates to educational enhancement	providing opportunities for development of valued capabilities and competencies
Power	assumes an increase in the locus of control	increasing community capital by extending social networks, community cohesion and civic pride

So, the theoretical suggestion being made by Bailey is that physical activity has the potential to bring people from varied background together around a common interest, thus providing individual development as well as a broader sense of collective belonging (Bailey, 2005; 76-77).

The debate on the role of physical activity in relation to crime reduction was couched in relation to two main domains: prevention of crime (diversion) and rehabilitation of offenders (Bailey, 2005). Rehabilitation programmes which utilize physical activity tend to use demanding physical activity programmes that rely on achievement of intermediate individual outcomes of improved self esteem, self efficacy, locus of control and social & personal skills as well as the broader possibility of social inclusion as suggested above.

Establishing a causal association between physical activity programmes and such crime reduction in both preventative and rehabilitative domains was however seen as problematic (Bailey, 2005). Of efforts to rehabilitate, a Home Office review of programmes concluded:

> *"There is a shortage of reliable information regarding which aspects of sport, adventure and leisure pursuit programmes are most effective and for how long. It is not clear which interventions are most appropriate for different groups of young people"* (Utting, 1996; 56)[37].

A similar situation prevailed for diversionary activities. The same Home Office review commented on the lack of empirical research on the effect of diversionary

[37]Utting D. (1996) *Reducing criminality among young people: a sample of relevant programmes in the United Kingdom* Home Office Research and Statistics Directorate, London.

programmes on criminality. There was no evidence to support the hypothesised role of outdoor adventure programmes as a successful intervention for 'delinquency' (Mutrie & Parfitt, 1998). However there was some evidence of improved social attitudes, behaviour and crime reduction in this rehabilitative group (Bailey, 2005).

The claims that physical activity programmes in schools have the potential to reduce disaffection and truancy was underpinned by very limited evidence. A key issue was the acknowledgement that not all pupils enjoy physical education and sport, notably the disengagement of girls in this aspect of the curriculum (Bailey, 2005). This is discussed in more depth below in section 3.4.3.6 in relation to gender issues.

In addition to the potential for enhancing social inclusion, there is evidence that sport and physical education in schools has the capacity to contribute to social exclusion, in that from the onset, certain socially excluded groups were less likely to participate in physical activity (Bailey, 2005 & 2006). Similarly, gender differences in participation in sports meant that girls were less likely to participate. Similar patterns of restricted access and participation were shown for Black and minority ethnic groups and disabled young people (Bailey, 2005).

3.4.3.5 Vulnerable populations

Fox (2000) indicated that participation in physical activity is most effective at raising self esteem in young people with initially low levels of self-esteem, particularly if mastery and self-development were features of the style of delivery. A systematic review (Gruber, 1986 cited in Calfas & Taylor, 1994) concluded that young people with a wide range of particular needs (e.g. emotionally disturbed, various degrees of learning disability and economically disadvantaged young people) can experience enhanced self-esteem and self concept through participating in physical activity. In addition, numerous studies have indicated strong support for the beneficial role of exercise in reducing maladaptive behaviours, such as self stimulation, aggression and self-injury, in young people and adults with developmental disabilities (Dykens *et al*, 1998).

A review of exercise and sports in young people with developmental disabilities found associations with improved self esteem, although research in this area is often hampered by difficulties in measuring this concept in the target group (Dykens *et al*, 1998). Standardised measures have been developed and used in particular with 104 young athletes from the USA who competed in the 1993 'Special Olympics World Winter Games', where strong evidence was found of improved self esteem in comparison with 'non-Olympians'. Enhanced social competence and peer relationships, sub-domains of self concept, were also linked with participation in the Special Olympics. Evidence of an association with duration was apparent in Dyken's review, which cited a study demonstrating that,

“length of time in the programme emerged as the strongest predictor of increased social competence” (Dykens *et al*, 1998; p.763).

3.4.3.6 Gender issues

The literature described gender issues in various respects. It was clear that boys were more likely to participate in vigorous activity and sport than girls (Mutrie & Parfitt, 1998). Bunker (1998) described how participation in sport was affected by gender in that involvement for girls was influenced by the attitudes of parents and other role models, whereas for boys, the influences tended to more likely come from peer role models and social pressure. Whilst both boys and girls could benefit from improved levels of mental wellbeing from participation in physical activity, there were differences in the levels of participation, the type of activity, their motivation for being involved and the way in which they experienced physical activity (Mutrie & Parfitt, 1998). More specifically, gender differences existed within the literature in the following respects:

- girls tended to focus more on achieving goals rather than winning, and working together rather than acting competitively (Bunker 1998);

- girls tended to prefer individual sports such as swimming, athletics and riding, which is significant for the way many physical education curricula in school place a heavy emphasis on competitive team sports (Bailey, 2005);

- girls tended to rely on adults and their own self-comparisons, while boys appeared to rely more on competitive outcomes, their ability to learn new skills and their own ego-centric judgments of physical competence (Bunker 1998);

- boys tended to be more likely than girls to say that doing sport made them feel happy and winning at sport made them feel good about themselves (Mutrie & Parfitt, 1998).

- participating in sport and exercise seemed to have a more salient role in describing good mental wellbeing for boys than for girls; however, in the absence of appropriate leadership and structure in the delivery of interventions with boys, the literature suggested that there was greater risk of developing anti-social behaviour (see Mutrie & Parfitt, 1998).

3.4.4 The evidence on the prevention of mental health problems

The emphasis in the literature on physical activity and the prevention of mental health problems clustered around the following concepts:

- anxiety

- depression
- stress
- neuroticism
- maladaptive behaviour.

There were a number of studies that indicated that participation in physical activity can prevent or reduce mental health problems such as anxiety and depression and that adolescents who are physically active were less likely to suffer from common mental health problems such as depression, anxiety and emotional distress (Biddle, 2004; Bunker, 1998; Hallal *et al*, 2006; Mutrie & Parfitt, 1998). Sport and vigorous activity were inversely related to psychological symptoms, independent of gender, social class and health status (Mutrie & Parfitt, 1998).

Conversely, Biddle (2004) stated that the evidence and the associations were far from clear and that there was less evidence for younger people than for adults in this respect. A Cochrane study (Larun *et al*, 2007), which reviewed the evidence in the general population of young people, concluded activity might have a constructive effect in reducing levels of depression, anxiety, hyperactive behaviour and conduct problems in young people. The study did however comment on the paucity of rigorous research, finding the majority of the studies to be of low methodological quality and "*highly heterogeneous with regard to population, intervention and measurement instruments"* (Larun *et al*, 2007; p.6). The majority of the studies tended to access university and college students, and the authors highlighted the necessity for more research with under 16's.

Calfas & Taylor (1994) found the most consistent effect for physical activity was for enhancement of self-esteem and self concept and reduction of anxiety and stress variables. This was supported by Bunker (1998), Parfitt & Eston (2005) and Hallal *et al* (2006). However, Hallal *et al* (2006) also cited a trial involving fourth grade low income Hispanic students exposed to a 6-week aerobic exercise programme and found they were less likely to experience depression and had better self-esteem than controls. Exercise did not however reduce anxiety (Crews, 1998 cited in Hallal *et al*, 2006). Lotan *et al* (2005) suggested that adolescents who engaged in regular physical activity were characterised by lower anxiety/depression scores than their inactive counterparts. Penedo & Dahn (2005) cited a study by Motl (2004) with a sample of over 4,500 adolescents, where naturally occurring increases in leisure time physical activity were associated with fewer depressive symptoms.

The possible mechanisms underlying these associations are complex and may involve a combination of the range of biochemical, psychological and social factors discussed in section 3.6.1.

3.4.5 Negative effects of physical activity on mental health & wellbeing

The majority of the reviews focused on the constructive impact of physical activity on mental health in young people and Ekeland *et al* (2007), for example, openly concluded that exercise has "no known negative effects". Some reviews, however, highlighted potentially harmful consequences to mental health from involvement in physical activity:

- reductions in levels of self esteem;
- eating disorders (anorexia nervosa and bulimia nervosa);
- stress;
- anti-social or immoral behaviour.

As already highlighted, Fox (2000) recognised that self esteem can be lowered not raised if experiences of physical activity raise awareness and self criticism without increasing perceived competence or if people have negative experiences such as embarrassment and failure. This was supported by Eppright *et al* (1997) specifically in relation to sport.

Pressure and stress on athletes has also been linked to eating disorders, but this tended to be exclusive to elite athletes rather than the general population of young people. Mutrie & Parfitt (1998) reported on a study that found that 20% of elite female athletes in Norway were at risk of eating disorders and nearly 80% of these met the criteria for anorexia nervosa, bulimia nervosa or anorexia athletica. Another study cited by Mutrie & Parfitt found lean female athletes had a higher drive for 'thinness scores'. Hallal *et al* (2006) also drew links between exaggerated physical activity in adolescent girls and eating disorders, but did not specify if these were elite athletes or part of the general population. However, Eppright *et al* (1997) commented that the research in this area has been conducted from the perspective of sports medicine. They report that eating disorders and steroid use have been associated with pressure and stress on athletes, and eating disorders have been found primarily in females involved in competitive athletics such as gymnastics, swimming, dance and distance running. These disorders were lower in the 9-18 age range and higher in college-aged women. The occurrence of eating disorders seemed to increase as the level of competition increased.

Potential burn out, high levels of stress and anxiety leading to withdrawal from the activity was reported in the literature. It is suggested that this could result when young athletes participated in physical activity to the exclusion of other aspects of their lives (Bunker, 1998). This was considered more likely if young people were subject to too much pressure, either from others or themselves, and has the potential to happen when:

- young people felt that the demands are too great and they lose the joy of participation that was their initial motivation;
- there was constant or intense competition and too much adult pressure;
- there were high training demands (time and intensity) and competitive pressure;
- young people felt that they had lost personal control in making decisions about participation or training;
- young people placed undue pressures on themselves and became perfectionist or overly concerned about pleasing others (Gould, 1993 cited in Bunker, 1998).

There was some evidence of participation in some sports, particularly male sports such as rugby, being linked with low moral reasoning and the acceptance of anti-social behaviour (Mutrie & Parfitt, 1998). The negative impact on mental wellbeing suggested the significance of the effective delivery of physical activity opportunities (as is discussed below in detail in section 3.6.2).

3.5 Optimal physical activity for mental health promotion

The literature contained few definitive statements or recommendations on optimal physical activity quantity, intensity or type. This is often attributed to the fundamental complexity of both 'mental health' and 'physical activity' and more importantly, the complex relationship between them (e.g. Ekeland *et al*, 2007). The Department of Health review *At Least Five a Week. Evidence on the impact of physical activity and its relationship to health* (2004; 6) noted,

> *"no generic mechanisms have been established to explain the positive effects of activity on psychological improvement. The effects in individuals are likely to be more variable than those found with physiological or biomedical change and may depend on the individual's subjective experiences of the activity and the setting in which it takes place".*

More specifically, research on this association was seen as being relatively still in its infancy, particularly in relation to understanding the associations between particular types of physical activity and various dimensions of mental health. For example, studies tended not to explicitly attend to, report or control for various graded types of physical activity.

As such, this review is in broad agreement with a related whole population review recently undertaken by Fox & Mutrie (2007; 10) when they stated that our knowledge in this area is, 'still at too early a stage' and conclude,

> *"the limited numbers of studies and the range of aspects of physical activity measured, different measures used and the variety of outcome variables*

prevents the formulation of any firm conclusions about graded or threshold effects".

At present, the most definitive over-arching statement that can be made is that, "a range of exercise modes and intensities, based on the participant's previous exercise experiences, preferences and goals, will therefore need to be considered" (The Department of Health, 2004). However, a number of more partial themes were detectable in the literature identified in this review that could progress existing generalised insights. These are summarised below in relation to activity quantity, intensity, frequency and type.

3.5.1 The optimal quantity (frequency & duration) of physical activity

There appeared to be a general association between increased quantities of physical activity (a product of both the duration of each physical activity 'session' and the frequency of the sessions) and enhanced mental wellbeing (Calfas & Taylor, 1994; Parfitt & Eston, 2005; Fox & Mutrie, 2007); in relation to the general population, accrued physical activity above sedentariness appeared to confer benefit (Fox & Mutrie, 2007). In young people, Parfitt & Eston (2005) found that those who accumulated over an average of 12,000 steps per day had more positive mental health status than those who accumulated less (that is, less than 9,200 steps per day). It should be noted though that only a limited number of studies have confirmed this general trend (Fox & Mutrie, 2007).

There was little consensus on optimal frequency of activity; Fox (2000; 111), concludes, "there is insufficient variance in the studies to assess the impact of frequency". Fox (2000) also noted that the conventional view has tended to work within outmoded physical activity guidelines and to associate activity with formal physical education and sport. An accepted, though not necessarily valid, norm of three sessions per week has therefore tended to be used and at times accepted. On the basis of updated guidance, a norm for frequency would clearly move to being active on 'most days of the week'.

Within the context of what appear to be formally delivered physical activity opportunities (that is, discrete 'sessions' of activity typically of 30-45 minutes duration offered 3 times per week), significant effect was found in durations ranging from 60 to 180 minutes *per week* (Fox, 2000, Calfas & Taylor, 1994); in their systematic review, Calfas & Taylor (1994) for example noted, **"***the average duration that found significant effects was 106 minutes per week (60-125 minutes)"*.

In contrast, others opted to work within a context that avoided associating physical activity with formally delivered opportunities and favoured a broader 'active living' definition (Hallal *et al* 2006; Twisk, 2001). These studies tended to suggest what would appear to be the more demanding need to achieve 60

minutes of *daily* activity in order to optimise potential mental health gain. Importantly, however, it is recognised that, compared to physiological benefit, for some individuals *lesser levels may be sufficient for mental wellbeing gain* – that is, the *quality* of the physical activity experience may be as important as *quantity* (for example, see Hallal *et al* 2006; 9).

This notion was supported by Calfas & Taylor (1994) who suggested that the **'**quantity' association may not be a straightforwardly linear one, citing a study that showed that positive mood was equally improved in a group of runners working at a 'moderate' quantity (*7 miles per week for 5 months*) as those at more advance levels (*56 miles per week > 5 years*). This position was complemented by insights from Brown *et al* (2004) on a whole population study on the association between 'health related quality of life' (HRQOL) and activity, where participation in either moderate 'active living' type activity or more vigorous activity and participation in very short (20 minutes) or extended (90 minutes) periods of activity was associated with poorer HRQOL, suggesting the possible existence of a physical activity – mental health relationship, with optimal benefit in moderate quantities of activity and reduced effects with short and longer durations.

In summary, the reviews suggested that the optimal quantity of activity associated with mental health was generally in line with the existing physiologically oriented guideline of accumulating *at least* 60 minutes of physical activity per day (Parfitt & Eston, 2005; Fox & Mutrie, 2007; Fox*,* 2000). Significantly, relatively lower quantities of high quality physical activity experiences *may* be sufficient for mental wellbeing gain.

3.5.2 The intensity of physical activity

This area was relatively more equivocal; in relation to young people, Twisk (2001; 623) concluded, *¨there is, hardly any evidence for a certain dose response relationship or a particular threshold value from which guidelines can be obtained¨.*

There was a grouping of reviews that suggested that activity intensity, whether termed variously, 'gentle', 'moderate', 'vigorous', 'chronic' and 'acute' or in relation to types (termed, walking, running, aerobics, resistance training, weight lifting, low intensity exercise or psychosocial interventions), has no generalized bearing on end benefit (Larun *et al*, 2007*;* Schomer & Drake, 2001; Fox*,* 2000; Fox & Mutrie, 2007; Twisk, 2001; Dunn, Triveldi & O'Neal, 2001). *All* had the potential to generally enhance mental health and particularly to improve self esteem and reduce symptoms of anxiety, depression & stress.

In contrast, Calfas & Taylor (1994), Fox (2000) and Leppämäki S. (2006) did report the possibility of a difference in effect in relation to activity intensity*.*

Calfas & Taylor and Fox pointed to isolated studies that suggested that anxiety and stress was lower for those involved in high intensity aerobic activity compared to that for moderate intensity, flexibility type activity. Fox (2000; 115) thus concludes that optimal activity intensity would be at least "moderately demanding". However, in relation to mood within the general population, Leppämäki (2006; 28) proposed a contrasting situation, stressing the potential for 'non-aerobic' and moderate activity and identifies studies that show high initial intensity activity may even inhibit formation of new exercise habits and harm mood. He/she concludes, "cardiovascular fitness does not seem to be necessary for mood improvement".

3.5.3 Length of physical activity intervention

There was more agreement on the fact that longer-term programmes have the potential to be more effective, though Fox (2000; 111) notes that, "longer well-controlled studies have not assessed global self esteem and the time required for lasting change is still not known". Nevertheless, a minimum of at least 12 weeks with some form of contact continuing for 6 months or more was suggested (Fox, 2000; Calfas & Taylor, 1994). A useful adjunct to this issue was offered by Dunn *et al* (2005) in their study of the use of exercise in the reduction and remission of mild to moderate depression in a general population. They concluded that the fundamental variable in dose is '*general weekly energy expenditure*' (that is, a function of *both* intensity and frequency).

3.5.4 Physical activity type

A significant foundation for this area was the recognition of there potentially being both variety in opportunity (diverse types of physical activity) and individual preference. For example, Bailey (2005; 85) observed,

> *"it is important to acknowledge that sporting activities are not a homogenous, standardised product or experience….different individuals' experiences of the same activity will be subject to wide variations, as will the effects"*

As such, despite research work being undertaken using a variety of activity types (Fox, 2000), this domain offered little specific guidance. At one level, there was again a belief that *all* types of activity have the *potential* to enhance mental wellbeing and that much will depend on individual preference (see further discussion below).

A relatively small number of reviews (Fox, 2000; Larun *et al*, 2007, DoH, 2004) went on to make specific assertions in this area, offering a number of tentative (and not necessarily consistent) pointers related to young people:

- running, walking, aerobic dance, circuit training show indications that they can be effective;

- activities such as swimming, flexibility training, martial arts and expressive dance have generally failed to indicate significant change;

- weight and resistance is superior to endurance exercise in improving body image and self esteem;

- physical fitness and aerobics programmes produce superior results to motor skills and sports programmes;

- rhythmic aerobic forms of activity (walking, gentle jogging, cycling, swimming or dancing) appear to be most appropriate and effective in those who have previously been inactive;

- co-operative more democratic exercise settings produce particularly stronger effects;

- group recreational sports and activities are also likely to bring social and mood benefits;

- resistance exercise may have a relatively immediate effect of body perception and can therefore promote self-concept, efficacy and perception;

- sports and vigorous activity can promote mental wellbeing only *for those who already prefer this type of activity*.

3.6 Theoretical 'delivery' insights

Where there was greater concurrence was around more generalised principles that define the broad nature of activity that would tend to result in the fostering of intrinsic motivation and longer term activity adherence, thus greater probability of effect. The perceived mechanisms that are at play in the association between physical activity and mental health (as introduced above) is also a related area of significance. It should be noted that (apart from Biddle *et al*, 2005) this evidence tended to be of a theoretical nature rather than being based on empirical investigation.

3.6.1 Perceived mechanisms linking physical activity and mental health

The notion of there being a range of possible explanatory mechanisms that explain the nature of the association between physical activity and mental health was introduced in outline earlier. In more detail, these are:

- *biochemical & physiological:* improved mental health is linked to increased core body temperature; increases in endorphins; changes in the serotonergic systems and effects on neurotransmitters;

- *improvements in fitness and weight loss*: improved mental wellbeing is associated with the feeling that the body is fitter or more 'toned';

- *'mastery':* effects are linked to increases in self worth and personal control that come with the mastering of new physical activity tasks;

- *'distraction':* positive outcomes are associated with the tendency for physical activity to take us away from stressful parts of our lives;

- *social interaction and sense of belonging:* mental wellbeing benefits can arise from the collective experience of being active as a group[38];

- *social and cultural value:* physical activity is largely seen as socially and culturally 'virtuous' and therefore has the potential in itself to increase self-esteem[39].

3.6.2 'Delivery' principles

In a theoretical context, various 'delivery' principles tended to highlight the significance of the setting in which activity occurs or is offered. Many of the reviews speculated over the relative contribution of activity in itself against the broader social activity environment that might be significant in promoting mental wellbeing (e.g. Mutrie & Parfitt, 1998; Penedo & Dahn, 2005). Whilst this may be of academic interest, it could be argued that, in practical terms, the distinction is irrelevant. To achieve enhanced mental wellbeing via physical activity *both* the theoretical link between the concepts *and* conducive environmental

[38]For a useful summary of this ground see Fox (2000; 95-96).
[39]Department of Health (2004) *At Least Five a Week. Evidence on the impact of physical activity and its relationship to health. A report from the Chief Medical Officer.* London: Department of Health.

circumstances are required. A range of principles were highlighted in this respect:

- variety is important, the ability to experience a range of types of activity and include a balanced 'intertwined programme': three primary components of endurance, flexibility and strength training; and, individual and group activity (Eppright *et al*, 1997; Lotan *et al*, 2005; Bunker, 1998);

- there needs to be ease of access to high quality and safe activity opportunities and facilities, preferably based with local communities (Lotan *et al*, 2005; Dykens *et al*, 1998);

- associated choice and individually determined realistic goals via Individualized Educational Plans (IEPs) are significant (Schomer & Drake, 2001; Eppright *et al*, 1997; Dykens *et al*, 1998; Biddle *et al,* 2005);

- emphasis should be placed on enjoyment and immediate pay off, rather than stressing longer term health gains (Eppright *et al*, 1997; Twisk, 2001);

- the orientation of physical activity provision should be towards positive experiences, decreased pressure and success based on a sense of accomplishment, rather than simply winning (Eppright *et al*, 1997; Bailey, 2006);

- activity should be based on a 'peer model', fostering participation in activities young people enjoy with family & friends (Lotan *et al*, 2005);

- physical activity should also attempt to develop core psychological competencies such as general competence, control, autonomy and self efficacy (Bailey, 2006);

- physical activity should also attempt to develop physical activity competencies & skills which in turn are associated with increase in self esteem, confidence, peer acceptance (Bailey, 2005; Fox, 2000);

- interventions should be conscious of theories and strategies for dealing with 'relapse' or young people opting out of activity; including, decisional balance, stage based models of change (Schomer & Drake, 2001);

- physical activity interventions should be delivered via high quality teaching & coaching and (local) leadership (Bailey, 2005; Bunker, 1998) and Fox (2000) suggests that this particular principle may be particularly critical to the promotion of self esteem and social and moral development;

- at a general planning level, there is a need for physical activity opportunities to be based on a ‘whole system/multi-sector approach’, including education, health, local authority, community sectors (Biddle *et al*, 2004).

4. Discussion

This section brings together the various themes that have informed this report: methodological review issues, substantive evidence matters and implications these have for practice.

Hopes that literature would exist in the emergent grounds that define physical activity and mental health were not supported. The literature tended to reflect relatively traditional terminology such as physical activity, exercise, self esteem and psychological wellbeing. As such, it could be the case that evidence is particularly strong in certain areas simply because a significant amount of work has been undertaken and that measurement is relatively straightforward; for example, 'self esteem' is well represented as this is relatively easy to measure and validated tools are readily available. This could also be the case in relation to any consideration of the settings in which physical activity is being delivered. In the review of young people, the evidence tended to reflect school based work with little reflection of community based interventions that in theory could have more potential in generally achieving success and specifically greater social inclusion. Finally, evidence tended to exist within already well represented life cycle groups; that is, a significant amount of work in relation to young people and older people. Gender issues were relatively well represented in the context of work around women & girls, and some reference was made to developmental disability. In the very specific context set within this work (review literature in and around physical activity *and* improved mental wellbeing and prevention of mental health problems), the other equality strands of ethnicity and race, sexual orientation and religion were almost completely absent, though given that barriers to physical activity can be particularly prominent and significant to these groups, at a general level, the 'principles of delivery' outlined above (see section 3.6.2) are clearly of particular relevance.

The global assertion in numerous policy documents that physical activity can improve mental wellbeing in young people is on the whole supported by this review. However, some concerns over the nature of the research in this field and associated findings were expressed in the literature, including:

- various concerns over the rigour of the assessment of both physical activity and mental wellbeing (being both potentially invalid and lacking long term consistency across studies for the purposes of comparability);

- concerns over the methodological rigour of the research; for example, the duration for follow up, the self-selected thus questionable representativeness of study participants and the inability for studies to

manipulate or even describe the nature of physical activity and mental health variables;

- weakness in design, particularly the lack of prospective studies that offer the potential to examine the ordering of variables brings into question the direction of causality in the association between physical activity and mental wellbeing; that is, people with initial high levels of wellbeing may be more likely to be physically active;

- the complexity of circumstances make it difficult to establish clear-cut links between physical activity and mental health; for example the extraneous variable of the 'social context' in which physical activity is delivered is often cited as being potentially important;

- the complexity of the relationship between mental wellbeing and mental health problems and physical activity; recognizing that different types of activity may have particular effects on different or even quite divergent aspects of mental health; for example, mood and self concept are clearly very different concepts and in theory could be amenable to quite different types of activity – mood for example to relatively unchallenging gentle activity, whilst self concepts would be dependent on more complex vigorous activity.

These latter points highlighted the fact that assessing evidence in this intricate area of study was considered relatively challenging. Table 5 (page 39): An Overview of Review Types suggested two dynamics: that the more stringent (systematic) reviews tended to draw more cautious conclusions on the strength of the association between physical activity and mental health; similarly, the less stringent narrative reviews tended to conclude that this association is relatively stronger.

- whilst being relatively more guarded in their conclusions, the systematic and critical reviews included in our review remained cautiously affirmative and certainly did not dismiss the physical activity-mental health association out of hand;

- whilst being relatively less rigorous and accepting the concerns that flow from this (for example, in relation to selection bias and the possibility of self serving analysis), the narrative reviews contained a preponderance of studies that do suggest some form of association between various types of activity and aspects of mental health;

- being of a non-systematic nature, such reviews can result in selection bias (that is papers are included simply on the basis of their availability and significant papers may be missed); however, narrative reviews did offer the benefit of allowing the inclusion of a wide range of valuable evidence

that can often be excluded from more stringent systematic review processes;

- finally, there were many indications from various sources that an association *can* exist; the association is biologically, socially and more broadly, logically *plausible* and is supported to some extent by empirical evidence.

Another dimension of this discussion is how guidelines on optimal levels of physical activity related specifically to mental health might interface with existing generic guidelines that are concerned with a range of other potential goals (e.g. physiological health, physical fitness and performance). These generalised global guidelines for the quantity, intensity and types of physical activity that should be undertaken by young people tend to stress the following features:

- in relation to **quantity**, a total of *at least* 60 minutes (and potentially up to several hours) of *at least* moderate intensity physical activity accumulated each day. This accumulation can be made up of episodes of varying duration; short informal bursts physical activity (10-15 minutes), as well as longer bouts such as when taking part in sports (20-60 minutes);

- in relation to **intensity**, this activity should be at least at a moderate level; on at least two occasions per week, they should include those activities that are vigorous enough to produce high physical stresses on the bones so as to improve bone health, muscle strength and flexibility;

- in relation to **type** of activity, the emphasis is on accumulated varied types, depending on age and individual needs appropriate activity that build on young people's natural activity patterns that will include, for example, general active living, active commuting, play and sport [40].

Whilst bearing in mind that it is often easy for emergent research findings to 'fit' with existing expectations and knowledge, in many ways, the insights from this mental health specific review were generally congruent with this evidence framework. In terms of quantity, the broad principle of achieving at least 60 minutes of activity per day would appear to apply to both physiological and psychological outcomes. There was also broad agreement that young people should experience a variety of types of activity and the need for young people in particular to generally experience periods of vigorous and weight bearing activity

[40]Drawn from Physical Activity Task Force (2003) *Let's Make Scotland More Active A strategy for physical activity*; Department of Health, Physical Activity, Health Improvement and Prevention (2004) *At least five a week: Evidence on the impact of physical activity and its relationship to health;* Twisk J. Physical activity guidelines for children and adolescents. A critical review. *Sports Medicine* 2001; 31: 617-627; National Association for Sport and Physical Education (2003) *Children need greater amounts of physical activity in 2004* AAHPED; Pate R., Trost S. & Williams C. Critique of existing guidelines for physical activity in young people in Biddle S., Sallis J. & Cavill N. (eds.) *Young and Active?*].

would appear to be compatible with the potential for such activity to contribute specifically to improvements in self esteem and body image.

One further way of complementing this partial picture is to see it as *one* theoretical element of a much broader evidence system. Fox & Mutrie (2007) point out that research in this area tends to assess 'before and after' outcome measures and not consider the 'interim processes' that occur *between* these points. Whilst this may be true for individual studies (that tend not to simultaneously consider process *and* outcomes), sections 3.6.1. & 3.6.2 above have confirmed that a significant volume of literature exists that informs our understanding of the potential mechanisms that can explain an association between physical activity and mental health and the optimal or necessary conditions for delivery of physical activity interventions that might maximise the potential of mental health being enhanced.

This perspective is in line with recent advancements in thinking about the nature of evidence, in particular, in considering how pure or theoretical evidence might be implemented in a practical or relatively complex practice context (see for example Pawson & Tilley, 1997[41]). This work tends to suggest that it is insufficient to simply assess and use 'theoretical' evidence (i.e. is or isn't there an association between physical activity and mental health?), but rather to accommodate a range of progressive evidence related components, for example:

- ***What*** is the theoretical association? (that is, the traditional approach to judging the strength of evidence) *Is there an association between physical activity and mental health; if so, how strong is it*?,

- ***Why*** might there be an association; that is, having an understanding of the explanatory mechanisms of the association? *How should we understand the mechanisms that might link physical activity and improved mental health?*

- ***How*** do we deliver appropriate interventions that might exploit the theoretical and potential associations that exist? *What are the optimal structures, cultures and specific physical activity delivery mechanism that might realize theoretical potential between activity and mental health?*

These ideas have been most successfully developed by Pawson and Tilley[42], whose broader evidence system is made up of 3 parts: *theory, change mechanisms and outcomes.* In the case of physical activity and mental health, the following position is offered in table 8 below:

[41]Pawson R. & Tilley N. (1997) *Realistic Evaluation* Sage, London.
[42]See Pawson R. & Tilley N. (1997) *Realistic Evaluation* Sage (pages 162-164).

Table 8 : A system of evidence

THEORY CONTEXT (Assessment of the strength and nature of the core physical activity/mental health (PA/MH) 'associative' evidence)	**CHANGE MECHANISMS**	**OUTCOMES**
The association would appear broadly plausible and should be seen a sufficient basis of further action **[*see section 3.4.2*]** The potential mechanisms of association are understood **[*see section 3.6.1*]**	**Socio-cultural context:** e.g. cultural orientation to different types of physical activity **Structural & organisational context:** e.g. conducive PA environments **Specific delivery mechanisms:** e.g. supportive leadership/ teaching/coaching; long term, on-going & progressive programmes **[*see section 3.6.2*]**	**Negative outcomes:** weak PA/MH theory + poor PA change mechanism **or** weak PA/MH theory + appropriate change mechanism; **or** strong PA/MH theory + poor change mechanism = either ineffective outcomes or MH&WB harm ***Positive outcomes:*** ***Strong (enough) PA/MH theory + appropriate PA change mechanisms = PA leading to improvements in MH&WB***

The key feature of the table is recognition that successful outcomes (even if definitive theory were to exist) will not occur in the absence of conducive change mechanisms and positive outcomes occur when strong theory is combined with favourable circumstances (i.e. the bottom right hand corner of the table). Indeed, poorly delivered physical activity opportunities could actually have a detrimental effect on mental health. As such, one significant finding from this review must be that physical activity has the potential to have a negative effect on mental health in young people if guidelines for good practice are not observed and the quality of the teaching or leadership is poor and lacking understanding of the key issues around competition and co-operation, choice and moral development.

More positively, the discussion above on 'mechanisms of association' and 'conducive settings factors' (sections 3.6.1 & 3.6.2) becomes crucial in realising

the potential theoretical associations between physical activity and mental wellbeing; 5 possible strands that might explain any association are identified in table 9 below.

Successfully realising these conducive ‘change mechanisms’ is arguably the most significant requirement of this model and is associated with a range of areas, most importantly, the creation of conducive physical activity settings and the development of a workforce skilled in the delivery of physical activity opportunities that are conducive to the promotion of mental health (i.e. within the context of ‘delivery’ principles).

Table 9 : The relationship between 'mechanisms of association' and 'conducive settings factors'

Associative theory strands	Explanatory mechanisms [see section 3.6.1]	+	Change mechanisms [see section 3.6.2]	=	Potential positive outcomes
Strand 1	Mental health effect is associated with: (i) biochemical & physiological changes and (i) improvements in fitness and weight loss	+	The importance of variety and a range of types of activity (endurance, flexibility & strength training)	=	Increases in levels of physical activity The promotion of mental health The prevention of mental health problems **[see section 3.4.2]**
Strand 2	Mental health effect is associated with increases in self worth and personal control that come with the mastering of new physical activity tasks	+	The importance of choice and realistic goals The need to develop psychological competencies The need to develop PA competencies The significance of high quality leadership	=	
Strand 3	Mental health effect is associated with *'distraction'* - to take us away from stressful parts of our lives	+	The need to place emphasis on positive experiences, enjoyment and immediate pay offs	=	
Strand 4	Mental health effect is associated with social interaction and sense of belonging that physical activity brings	+	The need to base activity on fostering participation with family & friends	=	

Strand 5	Mental health effect is associated with social and cultural virtue		The need for easy access to high quality and safe activity opportunities and facilities within localities	=	

5. Conclusions

The two stages of this review have highlighted that research in and around physical activity and mental health are rich and varied and to some extent it has produced a relatively constructive evidence base. The weight of evidence in the various types of reviews considered here broadly supports the hypothesis that physical activity has the potential to improve mental wellbeing and prevent mental health problems in young people if it is based on expressed preferences and is delivered in a conducive environment by leaders and teachers.

This diversity within the research literature can also be seen as problematic. Work is being undertaken in a huge number of apparently disparate areas; for example, in relation to lifestyle groups, groups with specific diseases and conditions, with interests in different specific aspects of physical activity and mental health and in a variety of settings. There appears to be little co-ordination between these research domains and this is detrimental to achieving long-term consistency and comparability of measures in relation to both physical activity and mental health.

The need for more investigation into the association between physical activity and mental health is another consistent theme in the literature and it could perhaps be argued that the momentum created in this area in the 1990's has not been maintained or extended thereafter. Clearly, more work is required, particularly that of a more sophisticated nature; for example, more prospective cohort studies, attempts to achieve more rigour and consistency in measuring physical activity and mental health and designs that precisely manipulate variables which in turn would provide insights into optimal types of physical activity for mental health promotion and prevention. Furthermore, in addition to any narrow focus on the core physical activity-mental health association, more rounded attention also needs to be paid to the nature of the broader environmental setting (e.g. the socio-cultural, structural & organisational contexts and specific delivery mechanisms outlined above) in which the association is potentially manifested. In this sense, the fostering of physical activity 'settings' that are conducive to the enhancement of mental wellbeing is important.

This quantitative work will only provide one perspective on the association and the review literature perhaps surprisingly does not contain a significant amount of rigorous qualitative research into the association between physical activity and mental health. Again, additional work in these areas would be welcome.

Finally, the review suggests that research work has tended to focus on traditional domains (such as exercise and self esteem) and has identified a relative paucity (at least at review level) in research work exploring significant emergent areas in both the physical activity and mental health domains; for example, ‘active living’ type activity and mental health protective and risk factors. Recent policy developments within the physical activity field (‘the active living agenda’) suggest value in working in these areas, particularly for those who are relatively inactive. The same pertains to mental health, highlighting the need to work more in a promotional or preventative mode. Understanding the potential associations between these particular types of activity and these mental health concepts is therefore significant and as such, more empirical work in these areas would be welcome.

Appendix 1: Phase 1 references

1. ADAMS, T. B. (2005) Association between physical activity and mental disorders among adults in the United States. (Review). *American Journal of Health Promotion,* 19**,** 389.

2. ALLIN, H., WATHEN, C.N. & MACMILLAN, H. (2005) Treatment of child neglect: A systematic review. *Canadian Journal of Psychiatry,* 50**,** 497-504.

3. ARENT, S. M., LANDERS, D.M. & ETNIER J.L. (2000) The effects of exercise on mood in older adults: A meta-analytic review. *Journal of Aging and Physical Activity,* 8**,** 407-430.

4. ARENT, S. M. L., D.M. ROGERS, T.J. (2001) Mental health and physical activity. The effects of physical activity on selected mental health variables: determining causation. *Sportwissenschaft,* 31**,** 239-254.

5. BAILEY, R. (2005) Evaluating the Relationship between Physical Education, Sport and Social Inclusion. *Educational Review,* 57**,** 71-90.

6. BAILEY, R. (2006) Physical education and sport in schools: a review of benefits and outcomes. *Journal of School Health* 76**,** 397-401.

7. BARBOUR K.A. BLUMENTHAL J.A. (2005) Exercise training and depression in older adults. Source: *Neurobiology of Aging*. 26(SUPPL.)(pp S119-S12)

8. BAUMAN, A. E. (2004) Updating the evidence that physical activity is good for health: an epidemiological review 2000-2003. *Journal of Science & Medicine in Sport,* 7**,** 6-19.

9. BERGER, B. G. (2004) Subjective well-being in obese individuals: the multiple roles of exercise. *Quest,* 56**,** 50-76.

10. BIDDLE, S. J. H., BOUTCHER S.H. & FOX K.R. (2000) *Physical activity and psychological well-being*.

11. BIDDLE, S. J. H., CHATZISARANTIS, N.L.D., HAGGER, M.S., SMITH, B., & WANG, J.C.K. (2003) A meta-analysis of perceived locus of causality in exercise, sport, and physical education contexts. *Journal of sport & exercise psychology,* 25**,** 284-306.

12. BIDDLE, S. J. H., GORELY, T. & STENSEL, D.J. (2004) Health-enhancing physical activity and sedentary behaviour in children and

adolescents. *Journal of Sports Sciences,* 22**,** 679-701 (147 ref).

13. BIDDLE, S. J. H., WHITEHEAD, S.H., O'DONOVAN, T.M. & NEVILL, M.E. (2005) Correlates of Participation in Physical Activity for Adolescent Girls: A Systematic Review of Recent Literature. *Journal of Physical Activity & Health* 2**,** 423-434.

14. BIDDLE, S. J. H. M., N. (2001) *Psychology of physical activity: determinants, well-being, and interventions*.

15. BRADY, F. (1998) The Role of Physical Activities throughout the Lifespan: Implications for Counselors and Teachers. *Journal of Humanistic Education and Development,* 36**,** 234-47.

16. BREHM, B. A., & IANNOTTA, J.G. (1998) Women and physical activity: active lifestyles enhance health and well-being. *Journal of Health Education,* 29**,** 89-92.

17. BROSSE A.L. SHEETS E.S. LETT H.S. BLUMENTHAL J.A. (2002) Exercise and the treatment of clinical depression in adults: Recent findings and future directions *Sports Medicine*. 32(12)(pp 741-760)

18. BUNKER, L. K. (1998) Psycho-Physiological Contributions of Physical Activity and Sports for Girls. *President's Council on Physical Fitness and Sports Research Digest,* 3.

19. BURBACH, F. R. (1997) The efficacy of physical activity interventions within mental health services: Anxiety and depressive disorders. *Journal of Mental Health,* 6**,** 543-566.

20. CALLAGHAN, P. (2004) Exercise: a neglected intervention in mental health care? *Journal of Psychiatric and Mental Health Nursing,* 11**,** 476-83 (43 ref).

21. CAMPBELL, K. L., COURNEYA, K.S., KLASSEN, T.P., MACKEY, J.R., MCNEELY, M.L. & ROWE, B.H. (2006) Effects of exercise on breast cancer patients and survivors: a systematic review and meta-analysis. *Canadian Medical Association Journal,* 175**,** 34-41.

22. CENTRE FOR REVIEWS & DISSEMINATION (2007) Exercise as an adjunct treatment for schizophrenia: a review of the literature Database of Abstracts of Reviews of Effects. Issue 4; Reviewed Source Abstract and Commentary for: Faulkner G, Biddle S. Exercise as an adjunct treatment for schizophrenia: a review of the literature. Journal of Mental Health. 1999; 8(5):441-457.

23. CENTRE FOR REVIEWS & DISSEMINATION (2007) Exercise interventions for mental health: a quantitative and qualitative review Database of Abstracts of Reviews of Effects. Issue 4; Reviewed Source Abstract and Commentary for: Stathopoulou G, Powers M B, Berry A C, Smits J A, Otto M W. Exercise interventions for mental health: a quantitative and qualitative review. Clinical Psychology: Science and Practice. 2006;13(2):179-193.

24. CENTRE FOR REVIEWS & DISSEMINATION (2007) Physical activity dose-response effects on outcomes of depression and anxiety Database of Abstracts of Reviews of Effects. Issue 4; Reviewed Source Abstract and Commentary: Dunn A L, Trivedi M H, O'Neal H A. Physical activity dose-response effects on outcomes of depression and anxiety. Medicine and Science in Sports and Exercise. 2001; 33(Supplement 6):S587-S597.

25. CENTRE FOR REVIEWS & DISSEMINATION Institution NHS Centre for Reviews and Dissemination (2007) Effects of rehabilitation exercise programmes on anxiety and depression in coronary patients: a meta-analysis Database of Abstracts of Reviews of Effects. Issue 4; Reviewed Source Abstract and Commentary for: Kugler J, Seelbach H, Kruskemper G M. Effects of rehabilitation exercise programmes on anxiety and depression in coronary patients: a meta-analysis. British Journal of Clinical Psychology. 1994; 33(3):401-10.

26. CENTRE FOR REVIEWS & DISSEMINATION (2007) The effectiveness of exercise as an intervention in the management of depression: systematic review and meta-regression analysis of randomised controlled trials Database of Abstracts of Reviews of Effects. Issue 4; Reviewed Source Abstract and Commentary for: Lawlor D A, Hopker S W. The effectiveness of exercise as an intervention in the management of depression: systematic review and meta-regression analysis of randomised controlled trials. BMJ. 2001; 322: 63-767.

27. CHAVANNES, N., VOLLENBERG, J.J.H., VAN SCHAYCK, C.P. & WOUTERS, E.F.M. (2002) Effects of physical activity in mild to moderate COPD: a systematic review. *British Journal of General Practice,* 52**,** 574-8.

28. CHODZKO-ZAJKO, W. J. (1998) Physical Activity and Aging: Implications for Health and Quality of Life in Older Persons. *President's Council on Physical Fitness and Sports Research Digest,* Series 3.

29. CRONIN, D. L., & SPIRDUSO, W.W. (2001) Exercise dose-response effects on quality of life and independent living in older adults. *Medicine & Science in Sports & Exercise,* 33**,** S598-S608.

30. CULOS-REED, S. N. (2002) Physical activity and cancer in youth: A review of physical activity's protective and rehabilitative functions. *Pediatric Exercise Science,* 14**,** 248-258.

31. DEVOS-COMBY, L., CRONAN, T. & ROESCH, S.C. (2006) Do exercise and self-management interventions benefit patients with osteoarthritis of the knee? A metaanalytic review. *Journal of Rheumatology,* 33**,** 744-756.

32. DONAGHY, M. E. (2007) Exercise can seriously improve your mental health: Fact of fiction? *Advances in Physiotherapy,* 9**,** 76-88.

33. DONAGHY, M. E., & MUTRIE, N. (1999) Is exercise beneficial in the treatment and rehabilitation of the problem drinker? A critical review. *Physical Therapy Reviews,* 4**,** 153-66 (76 ref).

34. DRAKE, B., & SCHOMER, H.H. (2001) Physical activity and mental health. *International SportMed Journal,* 2.

35. DYKENS, E. M., ROSNER, B.A. & BUTTERBAUGH, G. (1998) Exercise and sports in children and adolescents with developmental disabilities: Positive physical and psychosocial effects. *United States Child and Adolescent Psychiatric Clinics of North America,* 7**,** 757-771.

36. EDMONDS, M; McGUIRE, H; PRICE, J. (2007) Exercise therapy for chronic fatigue syndrome Cochrane Database of Systematic Reviews; 4 Cochrane Database of Systematic Reviews

37. EKELAND, E. (2005) Can exercise improve self esteem in children and young people? A systematic review of randomised controlled trials. *British Journal of Sports Medicine,* 39**,** 792-798.

38. EPPRIGHT, T. D., SANFACON, J.A., BECK, N.C. & BRADLEY, J.S. (1997) Sport psychiatry in childhood and adolescence: An overview. *United States Child Psychiatry and Human Development,* 28**,** 71-88.

39. FAULKNER, G., & TAYLOR, A. (2005) *Exercise, Health and Mental Health: Emerging Relationships*, Routledge, London.

40. FOX, K. R. (1999) The influence of physical activity on mental well-being. *Public Health Nutrition,* 2**,** 411-418.

41. FOX, K. R. (2000a) Physical activity and mental health promotion: the natural partnership. *International Journal of Mental Health Promotion.,* 2**,** 4-12 (38 ref).

42. FOX, K. R. (2000b) Self-esteem, self-perceptions and exercise. *International Journal of Sport Psychology,* 31**,** 228-240.

43. FRANCES, K. (2006) Outdoor recreation as an occupation to improve quality of life for people with enduring mental health problems. *British Journal of Occupational Therapy,* 69**,** 182-186.

44. GLAZIER, R., NIXON, S., O'BRIEN, S., & KELLY TYNANA, A.M. (2004) Effectiveness of Aerobic Exercise in Adults Living with HIV/AIDS: Systematic Review. *Medicine & Science in Sports & Exercise,* 36**,** 1659-1666.

45. HALLAL, P. C. E. A. (2006) Adolescent physical activity and health: A systematic review. *Sports Medicine,* 36**,** 1019-1030.

46. HARDMAN, A. E., & MORRIS, J.N. (1997) Walking to health. *Sports Medicine,* 23**,** 306-332.

47. HOFFMAN, K., & DATTILO, J. (2004) Therapeutic use of sports. *American Journal of Recreation Therapy.,* 3**,** 27-35 (28 ref).

48. HUTZLER, Y. (1997) Relationship of physical activity and psychological well-being in persons with disabilities: current theories and empirical evidence. *In, Lidor, R. (ed.), Bar-Eli, M.*

49. IBORRA MOLTO, C., *ET AL* (2000) Quality of life and exercise in renal disease. *EDTNA-ERCA Journal,* 26**,** 38-40.

50. JOHNSTON, M. V., & MIKLOS, C.S. (2002) Activity-related quality of life in rehabilitation and traumatic brain injury. *Archives of Physical Medicine and Rehabilitation,* 83**,** S26-S38.

51. KANE, M., & LARKIN, D. (1997) Physical Activity and Sport in the Lives of Girls. Physical & Mental Health Dimensions from an Interdisciplinary Approach. IN THE, P. S., COUNCIL, ON, PHYSICAL, FITNESS, AND, SPORTS, REPORT (Ed.

52. KNOLS, R., *ET AL* (2005) Physical exercise in cancer patients during and after medical treatment: A systematic review of randomized and controlled clinical trials. *Journal of Clinical Oncology,* 23**,** 3830-3842.

53. KRAMER, A. F., & ERICKSON, K.I. (2007) Effects of physical activity on cognition, well-being, and brain: Human interventions. *Alzheimer's and Dementia,* 3**,** S45-S51.

54. KURAMOTO, A. M. (2006) Therapeutic benefits of Tai Chi exercise: Research review. *Wisconsin Medical Journal,* 105**,** 42-46.

55. LARUN, L; NORDHEIM, LV; EKELAND, E; HAGEN, KB; HEIAN, F. (2007) Exercise in prevention and treatment of anxiety and depression among children and young people Cochrane Database of Systematic Reviews; 4, Cochrane Database of Systematic Reviews

56. LAUTENSCHLAGER, N. T., ALMEIDA, O.P., FLICKER, L. & JANCA, A. (2004) Can physical activity improve the mental health of older adults? *Annals of General Hospital Psychiatry,* 3.

57. LAWLOR D.A. HOPKER S.W. (2001) The effectiveness of exercise as an intervention in the management of depression: Systematic review and meta-regression analysis of randomised controlled trials British Medical Journal. 322(7289)(pp 763-767), 2001.

58. LEONARD, W. M. (1998) Physical activity and psychological well-being among high school seniors. *Journal of Sport Behavior,* 21**,** 196-205.

59. LOTAN, M., MERRICK, J. & CARMELI, E. (2005) Physical activity in adolescence. A review with clinical suggestions. *International Journal of Adolescent Medicine and Health.,* 17**,** 13-21.

60. MARTINSEN, E.W. O'CONNOR, P.J. RAGLIN, J.S. (2000) Physical activity, anxiety and anxiety disorders International Journal of Sport Psychology 31(2); 136-155.

61. MEEK, C., POLLOCK, A., POTTER, J. & LANGHORNE, P. (2003) A systematic review of exercise trials post stroke. *Clinical Rehabilitation,* 17**,** 6-13.

62. MORGAN, W. P. (1997) *Physical activity and mental health*, Taylor & Francis Washington, c1997, xv, 286 p. United States.

63. NETZ, Y. E. A. (2005) Physical activity and psychological well-being in advanced age: A meta-analysis of intervention studies. *Psychology and Aging,* 20**,** 272-284.

64. NORLANDER, T., & SANDLUND, E.S. (2000) The effects of tai chi chuan relaxation and exercise on stress responses and well-being: an overview of research. *International Journal of Stress Management,* 7**,** 139-149.

65. NOWICKA, P., & FLODMARK, C.E. (2007) Physical activity-key issues in treatment of childhood obesity. *Acta Paediatrica Supplement,* 96**,** 39-45.

66. O'BRIEN, K., NIXON, S., TYNAN, A.M., & GLAZIER, R.H. (2004) Effectiveness of aerobic exercise in adults living with HIV/AIDS: systematic review. *Medicine & Science in Sports & Exercise,* 36**,** 1659-66.

67. OMMUNDSEN, Y. (2000) Can sports and physical activity promote young peoples' psychosocial health? *Tidsskrift for Den Norske Laegeforening,* 120**,** 3573-7.

68. PENEDO, F. J., & DAHN, J.R. (2005) Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry,* 18**,** 189-193.

69. PHILLIPS WT. KIERNAN M. & KING AC. (2003) Physical activity as a nonpharmacological treatment for depression: a review Complementary Health Practice Review. 2003 Apr; 8(2): 139-52.

70. POUDEVIGNE, M. S., & O'CONNOR, P.J. (2006) A review of physical activity patterns in pregnant women and their relationship to psychological health. *Sports Medicine,* 36**,** 19-38.

71. REJESKI, W. J., & MIHALKO, S.L. (2001) Physical activity and quality of life in older adults. *Journals of Gerontology. Series A: Biological Sciences and Medical Sciences.***,** 23-35 (69 ref).

72. SAXENA, S. E. A. (2005) Mental health benefits of physical activity. *Journal of Mental Health,* 14**,** 445-451.

73. SCHECHTMAN, K. B., & ORY, M.G. (2001) The effects of exercise on the quality of life of frail older adults: A preplanned meta-analysis of the FICSIT trials. *Annals of Behavioral Medicine,* 23**,** 186-197.

74. SCHMITZ, K. H., *ET AL* (2005) Controlled physical activity trials in cancer survivors: A systematic review and meta-analysis. *Cancer Epidemiology Biomarkers and Prevention,* 14**,** 1588-1595.

75. SCHWARTZ, A. L. (2004) Physical Activity after a Cancer Diagnosis: Psychosocial Outcomes. *Cancer Investigation,* 22**,** 82-92.

76. SCULLY, D., KREMER, J., MEADE, M.M., GRAHAM, R. & DUDGEON, K. (1998) Physical exercise and psychological wellbeing: a critical review. *British Journal of Sports Medicine.,* 32**,** 111-20 (127 ref).

77. SHARKEY, B. J. (2002) *Activity and mental health*.

78. SHEPHARD, R. J. (1999) Do work-site exercise and health programs work? *Physician and Sportsmedicine,* 27**,** 48-72.

79. SIEGEL, D. (2006) The Effects of Physical Activity on the Health and Well-Being of Youths. *The Journal of Physical Education, Recreation & Dance,* 77**,** 11.

80. SOTHERN, M. S. E. A. (1999) The health benefits of physical activity in children and adolescents: Implications for chronic disease prevention *Palaestra,* 18.

81. SPIRDUSO, W. W., & CRONIN, D.L. (2001) Exercise dose-response effects on quality of life and independent living in older adults. *Medicine & Science in Sports & Exercise,* 33**,** S598-608; discussion S609-10.

82. STATHOPOULOU, G. E. A. (2006) Exercise interventions for mental health: A quantitative and qualitative review. *Science and Practice,* 13**,** 179-193.

83. STEVINSON, C., LAWLOR, D.A., & FOX, K.R. (2004) Exercise interventions for cancer patients: Systematic review of controlled trials. *Cancer Causes and Control,* 15**,** 1035-1056.

84. STREINER, D.L.(2003) Physical activity and depression in older adults Clinical Journal of Sport Medicine 13(4), 274

85. SUTHERLAND, G., & ANDERSEN, M.B. (2001) Exercise and multiple sclerosis: Physiological, psychological, and quality of life issues. *Journal of Sports Medicine and Physical Fitness,* 41**,** 421-432.

86. TAYLOR, A. H. E. A. (2004) Physical activity and older adults: a review of health benefits and the effectiveness of interventions. *Journal of Sports Sciences,* 22**,** 703-25 (184 ref).

87. TAYLOR, R. S. & BROWN, A., EBRAHIM, S., JOLLIFFE, J., NOORANI, H., REES, K., SKIDMORE, B., STONE, J.A., THOMPSON, D.R. & OLDRIDGE, N. (2004) Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials.[see comment]. *American Journal of Medicine,* 116**,** 682-92.

88. THOMPSON, L. V. (2001) Physical activity and exercise: identification of benefits. *Orthopaedic Physical Therapy Clinics of North America.,* 10**,** 193-211 (56 ref).

89. EDITORIAL (1997) Clinical update in musculoskeletal medicine. Vigorous physical activity is linked to emotional health in adolescents: is there a cause-and-effect relationship? *Journal of Musculoskeletal Medicine,* 14**,** 60.

90. VISOVSKY, C. D., C. (2005) Exercise and cancer recovery. *Online Journal of Issues in Nursing,* 10.

Appendix 2: Additional papers added to the final review during phase 2

1. CALFAS K.J. & TAYLOR W.C. (1994) Effects of physical activity on psychological variables in adolescents *Pediatr Exerc Sci*; Vol.6; 406-23.

2. MUTRIE N. & PARFITT G. (1998) Physical activity and its link with mental, social and moral health in young people in Biddle S., Sallis & Cavill N. (eds.) *Young & Active?: Young people and health – enhancing physical activity – evidence and implications* HEA, London;

3. PARFITT G. & ESTON R. (2005) The relationship between children's habitual activity level and psychological wellbeing *Acta Paediatrica* Vol. 94 (12); 1791-1797

4. TWISK JW. (2001) Physical activity guidelines for children and adolescents: a critical review *Sports Med* Vol. 31; 617-27.

Appendix 3: Phase 2 core references

Details/*design*	Aims	Conclusions	Orientation of intervention/*measure*	Relationship strength/ *Dose response*	Principles of delivery
(1) Bailey R. (2005). Evaluating the relationship between physical education, sport and social inclusion *Educational Review* : 57(1):71-90 *Narrative review*	To review the evidence related to the outcomes of the participation of children and young people in curricular physical education and sport	Weak to at best moderate associations; "To date, evidence in this regard is limited"	Promotion of concepts (social inclusion, self esteem) & prevention of broader social features (crime and social dysfunction) *Formal measures not specified*	Moderate to strong *Formal measures not specified; "It is important to acknowledge that sporting activities are not a homogenous, standardised product or experience; Different individuals' experiences of the same activity will be subject to wide variations, as will the effects."; "any effects will be determined by frequency and intensity of participation and the degree of adherence over time of the participants"*	Various principles outlined: access; agency/involvement; develop physical competency (linked to self esteem, confidence, peer acceptance); high quality teaching & coaching; (local) leadership
(2) Bailey R. (2006). Physical education and sport in schools: a review of benefits and outcomes *Journal of School Health* 76(8):397-401 *Narrative review*	To explore some of the scientific evidence that has been gathered on the contributions and benefits of PES for both children and for educational systems	The scientific evidence does not support the claim that these effects will occur automatically. There is no reason to believe that simply supporting participation in PES will necessarily bring about positive changes to children or to their communities; the research literature is equivocal	Affective, social, and cognitive development; social skills and social behaviours (social skills and values, moral reasoning, fair play and sports-personship, and personal responsibility), self-esteem and pro-school attitudes, academic and cognitive development *Formal measures not specified*	Moderate to strong *Not specified*	The actions and interactions of teachers and coaches largely determine whether or not children and young people experience these positive aspects of PES; Contexts that emphasize positive PES experiences, characterized by enjoyment, diversity, and the engagement of all, and that are managed by committed and trained teachers and coaches, and supportive and informed parents, are fundamental

Details/*design*	Aims	Conclusions	Orientation of intervention/*measure*	Relationship strength/ *Dose response*	Principles of delivery
(3) Biddle, S. J. H., Whitehaed, S.H., O'Donovan T.M. & Nevill, M.E. (2005). Correlates of participation in physical activity for adolescent girls: A systematic review of recent literature. *Journal of Physical Activity & Health* , 2, 423-434. *Narrative review*	A review of health related physical activity in children and adolescents using a behavioural epidemiology framework	*Of PA-psychosocial outcomes relationship*: PA can enhance psychological well-being; can promote self esteem; those active are less likely to suffer from mental health problems. "Despite claims, the evidence is not always clear"; studies cross sectional, small scale & lack measurement consistency. Psychosocial climate and social interactions may be more crucial than PA itself. The relationship between PA and cognitive or academic performance shows no relationship	Promotion of positive psychosocial factors; prevention anxiety & depression *Formal measures not specified*	Limited *Not specified*	Various elements cited: a 'whole system/multi-sector approach' (education, health, local authority, community); skilled staff supportive environments range of PA opportunities; positive role models in media
(4) Bunker, L.K. (1998). Psycho-physiological contributions of physical activity and sports for girls *President's Council on Physical Fitness and Sports Research Digest*;3(1) *Narrative review*	To summarize some of the contributions of physical activity and sports for girls	*Self-Concept*: Involvement in Sport & PA directly affects the development of a child's self-concept and perception of self-esteem and competence. *Emotional Wellbeing*: Participation in sport & PA has a positive effect on emotional well-being. *Social Competence:* Sport & exercise can provide a venue to resolve conflicts, act fairly, plan proactively, and to develop a moral code of behaviour.	Promotion of self concept, emotional wellbeing, participation and social competence; reduction of neuroticism and anxiety, decrease mild to moderate depression, reduction of various types of stress *Formal measures not specified*	Moderate to strong *Not specified*	Children should participate in regular PA & sport experiences, especially in quality, adult supervised activities and daily PE in schools. Opportunities should be provided which include both health-related fitness activities and skill building to enhance physical competence and life-long participation. A wide range of activities should be available, both individual and group experiences and cooperative vs. competitive ones. Equal and safe opportunities should be provided for both boys and girls to participate in a full range of physical fitness and sport activities.

Details/*design*	Aims/*context*	Conclusions	Orientation of intervention/*measure*	Relationship strength/ *Dose response*	Principles of delivery
(5) Nowicka P. & Flodmark, C.E. (2007). Physical activity-key issues in treatment of childhood obesity *Acta Paediatrica Supplement* ; 96 (454):39-45 *Narrative review*	The aim of this paper is to give a short review of what we know about physical activity in paediatric obesity treatment	Regular physical activity is associated with well being and seems to promote self-esteem in children and adolescents	Promotion of well-being & self esteem *Formal measures not specified*	Moderate to strong *Not specified*	10 recommendations: Reduce sedentary activities; Encourage spontaneous play; Discover daily activities; Discuss physical education class; Increase variety of activities; Encourage hobbies; Be flexible and patient; Promote sports; Involve family and friends; Set realistic goals.
(6) Penedo F. J. & Dahn, J.R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity *Current Opinion in Psychiatry* 8(2):189-193 *Narrative review*	This review highlights the very recent work (i.e. published within the last 12 months) evaluating the physical and mental-health benefits of exercise and physical activity.	Multiple studies indicate that physical activity improves mood and reduces symptoms of depression and anxiety; physical activity may prevent the onset of depression	Promotion of self-esteem reduction of depression *Formal measures not specified*	Moderate to strong *A limitation involves the highly variable exercise and physical-activity components in the studies reviewed. It remains a challenge to determine what is the right dosage of treatment to see actual gains associated with physical activity interventions.*	Not specified

Details/*design*	Aims/*context*	Conclusions	Orientation of intervention/*measure*	Relationship strength/ *Dose response*	Principles of delivery
(7) Dykens E. M., Rosner, B.A. & Butterbaugh, G. (1998). Exercise and sports in children and adolescents with developmental disabilities: Positive physical and psychosocial effects *United States Child and Adolescent Psychiatric Clinics of North America* ;7(4):757-77117 *Narrative review*	Examines sports & exercise and the effects that 'athletics' have on children & adolescents with disabilities (congenital or acquired physical, sensory, or motor functioning, academic learning, and mental health or psychiatric functioning).	Exercise regimens and formal sports programmes are associated with improved physical fitness, reduced maladaptive behaviours, and a host of positive psychological effects in children with developmental disabilities.	Promotion of self esteem, social competence, friendship & peers *Formal measures not specified*	Moderate to strong *Not specified*	Need for community based, inclusive recreational opportunities; delivered via Individualized Educational Plans (IEPs)
(8) Lotan M., Merrick, J. & Carmeli, E. (2005). Physical activity in adolescence. A review with clinical suggestions *International Journal of Adolescent Medicine and Health.* 17(1):13-21 *Narrative review*	Reviews the current literature and findings relating to PA with better health and an emphasis on adolescence.	Despite methodological faults, a substantial positive connection was established between physical exercise and promotion of physical, psychological, educational and mental status in adolescence.	General promotion of broadly psychological and emotional health *Formal measures not specified*	Moderate to strong *Not specified*	Strong recommendation: enhanced initiation of community based, easily accessed physical exercise programmes. Specifically: use peer influence (directing adolescents into participating in activities they enjoy with friends can enhance their regular participation); promote physically active habits; a balanced 'intertwined' programme (the three primary components of endurance, flexibility and strength training).

Details/*design*	Aims/*context*	Conclusions	Orientation of intervention/*measure*	Relationship strength/ *Dose response*	Principles of delivery
(9) Mutrie N. & Parfitt G. (1998). Physical activity and its link with mental, social and moral health in young people In *Biddle S., Sallis & Cavill N. (eds.) Young & Active?: Young people and health – enhancing physical activity – evidence and implications* HEA, London. *Narrative review*	Not specified	Prevention and treatment of mental health problems: caution is required in drawing conclusions….analysis suggests there are moderate effects…(but) only five studies were included...and were hampered by high attrition rates but showing promising results. The promotion of good mental health: studies show a consistent positive relationship between PA & mental well-being; including self esteem; it is likely that effects are greatest for those with initially unfavourable scores / data is correlational - there are few experimental studies; varied outcome measures; cross sectional studies. Cognitive development: cautious conclusions should be made; there appears to be some evidence to support the notion that PA improves academic or cognitive performance, but there are few good studies. Social and moral development: there is equivocal evidence about the relationship between involvement in sport and anti-social behaviour. There is no experimental evidence to support PA as an effective treatment for delinquency.	Prevention and treatment of mental health problems (stress, anxiety, depression, psychiatric disorders) The promotion of good mental health (well being, mood, self esteem) Cognitive development (cognitive performance, academic performance). Social and moral development (pro-social behaviour and anti-social values) *Measures* *Prevention and treatment of mental health problems (Profile of Mood States; Beck Depression Inventory); The promotion of good mental health (General Health Questionnaire; Beck Depression Inventory; Children's Self Concept Scale); Cognitive development (not stated)* *Social and moral development (Self Esteem Inventory; Jackson Personality Inventory; Minnesota Multiphasic Personality Inventory)*	Moderate to strong *Not specified*	It is not clear whether exercise itself or the exercise environment is responsible for the psychological benefits noted and various mechanism have been hypothesised.

Details/*design*	Aims/*context*	Conclusions	Orientation of intervention/*measure*	Relationship strength/ *Dose response*	Principles of delivery
(10) Eppright T. D., Sanfacon, J.A., Beck, N.C. & Bradley, J.S. (1997). Sport psychiatry in childhood and adolescence: An overview *United States Child Psychiatry and Human Development* 28(2):71-88 *Narrative review*	This review explores the importance and relevance of sport during childhood and adolescence utilising traditional stage theories of development.	In general, athletic participation is beneficial for youth both physically and mentally; but for some youths there are significant costs (made to feel incompetent, pressure to participate, eating disorders, steroid use).	Promotion of mental well being *Formal measures not specified*	Limited *Not specified*	Sport should be seen as enjoyable and positive experiences; we need to decrease the sense of pressure by altering the definition of success from winning to feeling a sense of accomplishment through individually determined goals, emphasising fun, and allowing individuals to explore all types of athletics
(11) Parfitt G. & Eston R. (2005). The relationship between children's habitual activity level and psychological well-being *Acta Paediatrica* 94 (12): 1791-1797 *Narrative review as base for empirical study*	To explore the relationship between habitual physical activity and psychological well-being in children.	Habitual physical activity has a strong association with global self-esteem, depression & anxiety. However, using partial correlations, the significant relationships were removed for anxiety and depression, but remained for self-esteem. Physical activity has the greatest benefit for individuals with initial low self-esteem and high depression or anxiety. It is feasible that positive results could be accounted for by factors that were not assessed, such as social interaction, psychological climate and the physical environment.	Promotion of well being; reduction of anxiety and depression *Measures State-Trait Anxiety Inventory for Children (STAIC), the Childhood Depression Inventory (CDI) , and the Children and Youth's Physical Self-perception Profile (CY-PSPP)*	Limited *Step count is associated with more positive psychological well-being and in line with recommended young peoples' guidelines. The results of the analyses of variance indicate that those children who accumulated over an average of 12 000 steps per day had more positive psychological profiles (significantly lower depression and anxiety and higher self-esteem) than those who accumulated less than 9200 steps per day.*	Not specified

Details/*design*	Aims/*context*	Conclusions	Orientation of intervention/*measure*	Relationship strength/ *Dose response*	Principles of delivery
(12) Twisk J.W. (2001). Physical activity guidelines for children and adolescents fibrosis patients: a critical review. *Sports Med* 31: 617-27 *Critical review*	The purpose of this review is to give a critical review of the confusion in the field and to provide a critical interpretation of the scientific rationale behind the proposed guidelines	There is only marginal evidence that physical activity is beneficial for health during childhood and adolescence, and that an improvement of physical activity during childhood and adolescence will last forever. If there are some indications that physical activity is beneficial for health, there is hardly any indication that these health benefits have some sort of threshold value. In other words the proposed guidelines are highly speculative. Based on the present scientific evidence, the proposed guidelines are as valid as stating that every increase in physical activity can have some beneficial health effects for children and adolescents. The advantage of such a simple guideline is that this goal is much easier to achieve than the 30 or 60 minutes of moderate intensity physical activity each day	Promotion of self esteem; mood-enhancing effect; social and moral development; stress reduction *Formal measures not specified*	Lack of clear evidence *Moderate levels of intensity and duration of physical activity have been shown to have a stress reducing effect, but an additional increase of either the duration or the intensity will not have further beneficial effects. Furthermore, physical activity with intensity and duration beyond the moderate level was not related to reduced stress levels. There is hardly any evidence for a certain dose response relationship or a particular threshold value from which guidelines can be obtained.*	It is questionable whether guidelines for children and adolescents should be based on possible health benefits later in life. This is a long term benefit, which will probably not have a great influence on the behaviour of children and adolescents.

Details/*design*	Aims/*context*	Conclusions	Orientation of intervention/*measure*	Relationship strength/ *Dose response*	Principles of delivery
(13) Fox K. (2000) The Effect of Exercise on Self Perceptions and Self Esteem in Biddle S., Fox K. & Boutcher S. (eds.) *Physical Activity and Psychological Well-Being* Rutledge, London. *Critical review*	Not specified	Exercise can be used as a medium to promote self worth and other important self-perceptions such as body image. In some situations, this improvement is accompanied by improved self-esteem. Physical self worth carries mental well-being properties in its own right and should be considered a valuable endpoint for exercise programmes. Effects are likely to be greater for those with low self-esteem but these individuals may be difficult to attract into programmes**.** All of the above statements apply only to those who volunteer for studies and remain in the exercise. That is, exercise can enhance well-being for those for whom exercise works. It must also be kept in mind that school based programmes have potential to lower self-esteem, as youngster are not in the same position as adults to drop out if experiences are negative.	Promotion of self perception and self esteem *Measures Tennessee Self-Concept Scale (TSCS); Martinek-Zaichkowsky Self Concept Scale for Children; Self Description Questionnaire for Adolescents; Self Perception Profile for Adolescents*	Limited ***Activity type:*** *The effect of a wide range of PA have been investigated (running, walking, aerobic dance, circuit training). All indicated that they can be effective. Others (swimming, flexibility training, martial arts & expressive dance) have failed to indicate significant change. There is indication that weight & resistance is superior to endurance exercise in improving body image & self esteem. Physical fitness & aerobics programmes produce superior results to motor skills & sport. Co-operative settings produce stronger effects.* ***Frequency, intensity & duration:*** *There is insufficient variance in the studies to assess the impact of frequency. Intensity is rarely reported. In those studies that do, both low & high intensity exercise were effective in stimulating psychological improvement. Studies report that sessions of 60 minutes+ are more likely to produce positive change.* ***Programme duration:*** *Higher likelihood of self-esteem change in longer programmes. Longer well-controlled studies have not assessed global self esteem and the time required for lasting change is still not know.*	There is greatest support for the effectiveness of cardiovascular exercise and weight training. Not enough is known about the effectiveness of specific exercise characteristics but it seems wise to focus on exercise that is moderately demanding, with sessions lasting in the region of 60m. Programmes should last at least 12 weeks with contact continuing for 6+. Limited evidence presented here suggests that global changes in self-esteem and identity are more likely given longer intervention. Conditions which affect the attractiveness of the exercise programme, such as the qualities of the leader or the exercise setting, may be critical to self-esteem.

Details/*design*	Aims/*context*	Conclusions	Orientation of intervention/*measure*	Relationship strength/ *Dose response*	Principles of delivery
(14) Allin H., Wathen, C.N. & MacMillan, H. (2005). Treatment of child neglect: A systematic review *Canadian Journal of Psychiatry* ;50(8):497-504 *Systematic Review*	To systematically evaluate the available evidence regarding the effectiveness of child neglect treatment programs, including those focused on victims of childhood neglect and (or) their caregivers.	Rigorous studies of treatments for neglected children and their families are lacking. Well-designed and well-conducted evaluations are urgently required to identify effective treatments, which should then be made available to children and their caregivers.	Promotion of self concept & self-esteem and quality of parent and peer relationships *Measures* *Children's self-concept scale*	Limited *Not specified*	A few specific programs of play therapy may be beneficial for children exposed to child neglect.
(15) Larun, L, Nordheim, LV, Ekeland, E, Hagen, KB, Heian, F. (2007). Exercise in prevention and treatment of anxiety and depression among children and young people *Cochrane Database of Systematic Reviews*. 4. *Systematic Review*	To assess the effects of exercise interventions in reducing or preventing anxiety or depression in children and young people up to 20 years of age. If so, what are the characteristics of the most effective interventions?	Whilst there appears to be a small effect in favour of exercise in reducing depression and anxiety scores in the general population of children and adolescents, the small number of studies included and the clinical diversity of participants, interventions and methods of measurement limit the ability to draw conclusions. The effect of exercise for children in treatment for anxiety and depression is unknown as the evidence base is scarce.	Prevention and treatment of anxiety and depression. *Measures* *State-Trait Anxiety Inventory for Children (STAIC), State-Trait Anxiety Inventory for Adults (STAI); Hospital Anxiety and Depression Inventory (HADS); Profile of Mood States (POMS).Depression: Beck Depression Inventory (BDI); Hospital Anxiety and Depression Scale (HADS); Reynold's Adolescent Depression Scale (RADS), Profile of Mood States (POMS), The Multiple Adjective Check List (MAACL), and Children's Depression Inventory (CDI).*	Limited *The intervention included different aerobic exercise such as walking, running, aerobics (12 studies) or weight lifting (4 studies). It makes little difference whether the exercise is of high or low intensity. When vigorous exercise was compared to low intensity exercise or psychosocial interventions no difference in anxiety and depression scores was found.*	Not specified

Details/*design*	Aims/*context*	Conclusions	Orientation of intervention/*measure*	Relationship strength/ *Dose response*	Principles of delivery
(16) Ekeland E, Heian F, Hagen KB, *et al*. (2007). Exercise to improve self esteem in children and young people. *Cochrane Database Syst Rev,* Issue 1.CD003683. *Systematic Review*	To determine if exercise interventions can improve self-esteem among children and young people	The results indicate that exercise has positive short-term effects on self-esteem in children and young people. Since there are no known negative effects of exercise and many positive effects on physical health, exercise may be an important measure in improving children's self-esteem. These conclusions are based on several small low-quality trials	Promotion of self esteem *Measures* *Thomas Self-Concept Values Test; Piers-Harris Children's Self-Concept Scale; Self-Perception Profile for Learning-Disabled Students; Self Description Questionnaires (SDQ I and II); Rosenberg Self-Esteem Scale; Self-Perception Profile for Children; Tennessee Self-Concept Scale; Self-Esteem Inventory Form A; Self Description Questionnaires (SDQs); Goodenough's House-Tree-Person Projective Test; the Martinek-Zaichkowsky Self-Concept Scale*	Limited *For exercise as part of a comprehensive intervention the size of the effect is moderate. For exercise alone the effect is about the same, but the results are heterogeneous.*	Not specified
(17) Calfas KJ, Taylor WC. (1994) Effects of physical activity on psychological variables in adolescents. *Pediatr Exerc Sci* 6: 406-23 *Systematic Review*	To identify the most consistent relationships among psychological variables and physical activity in youth	Despite the methodological flaws of the research, the overall trend suggests physical activity can be psychologically beneficial for adolescents. The studies report moderate evidence that physical activity is psychologically beneficial for youth. The most consistent effect was for self esteem/self concept and anxiety/stress variables.	Reductions in depressive symptoms and anxiety; improvement in self esteem and self concept *Formal measures not specified*	Moderate to strong *Difficult to make specific recommendations. There are few studies, and the quality of the data are poor in some studies. Little is known about amount of activity most likely to produce psychological benefits. Few studies experimentally controlled for intensity or dose of activity. Regarding duration and frequency, one study found that moderate levels of running (7 miles per week for 5 months) were associated with positive mood to the same extent as more advanced levels of running (56 miles per week > 5 years). The average duration that found significant effects was 106 minutes per week (60-125 minutes) The average duration of intervention in studies with significant effects = 12.8 weeks (1-20 weeks!)*	Future research should consider the role of the social/psychological context in which activity occurs.

Details/*design*	Aims/*context*	Conclusions	Orientation of intervention/*measure*	Relationship strength/ *Dose response*	Principles of delivery
(18) Hallal P. C. *et al* (2006). Adolescent physical activity and health: A systematic review *Sports Medicine* ;36(12):1019-1030 Systematic review	Aimed at reviewing the short- and long-term benefits of PA during adolescence for physical and mental health, based on a conceptual framework of the benefits of adolescent PA.	Adolescent PA provides short-term benefits; the strongest evidence refers to bone and mental health; Adolescent PA seems to improve self esteem, provides short-term benefits in mental health	Promotion of self esteem *Formal measures not specified*	Moderate to strong *School-age youth should participate daily in 60 minutes or more of moderate to vigorous physical activity that is developmentally appropriate enjoyable and involves a variety of activities*	Not specified

Appendix 4: Phase 2 contextual references

5. BROWN, D.W., BROWN D.R., HEALTH G.W., BALLUZI A., GILES W.H., FORD E.S., and MOKDAD A. H. (2004) Associations between Physical Activity Dose and Health-Related Quality of Life. *Med. Sci. Sports Exerc.,* Vol. 36 (5); 890-896.

6. DEPARTMENT OF HEALTH (2004) *At Least Five a Week. Evidence on the impact of physical activity and its relationship to health. A report from the Chief Medical Officer.* London: Department of Health.

7. DUNN, A.L., TRIVEDI M.H. & O'NEAL H.A. (2001) Physical activity dose-response effects on outcomes of depression and anxiety *Medicine & Science in Sports & Exercise* Vol.33(6); S587-S597

8. DUNN A., TRIVEDI M.H., KAMPERT J., CLARK C. & CHAMBLISS H. (2005) Exercise treatment for depression Efficacy and dose response. *American Journal of Preventive Medicine* Vol. 28(1); 1-8.

9. FOX K. & MUTRIE N. (2007) Physical activity and the prevention of mental illness, dysfunction and deterioration BASES.

10. GRUBER J.J (1986) Physical activity and self esteem development in children: a meta-analysis in Stull G.A. & Eckert H.M. (eds.) *Effects of Physical Activity on Children* Human Kinetics, Champaign, IL.

11. ISSP (2004) *Position Stand Position Statements Physical Activity and Psychological Benefits*

12. LAGERBERG D. (2005) Physical activity and mental health in schoolchildren: A complicated relationship *Acta Paediatrica*, Vol. 94 (12); 1699 – 1701

13. LEPPAMAKI S. (2006) *The Effect of Exercise and Light on Mood* Publications of the National Public Health Institute KTL A8/2006 National Public Health Institute (NPHI), Helsinki.

14. MOTL R., BIRBAUM A., KUBIK M., *et al*. (2004) Naturally occurring changes in physical activity are inversely related to depressive symptoms during early adolescence *Psychosom Med* Vol. 66(3); 336–342.

15. MUTRIE N. & PARFITT G. (1998) Physical activity and its link with mental, social and moral health in young people in Biddle S., Sallis & Cavill N. (eds.) *Young & Active?: Young people and health – enhancing physical activity – evidence and implications* HEA, London.

16. NASPE. (2004) *Physical Activity for Children: A Statement of Guidelines for Children Ages 5-12* Reston, Va: NASPE.

17. PARFITT G. & ESTON R. (2005) The relationship between children's habitual activity level and psychological wellbeing *Acta Paediatrica* Vol. 94 (12); 1791-1797.

18. PATE R. (1995) Physical activity and health: dose-response issues. *Res.Q. Exerc. Sport* Vol. 66; 313–317.

19. ROWLAND T.W. (2007) Promoting Physical Activity for Children's Health: Rationale and Strategies *Sports Medicine* Vol. 37 (11); 929-936.

20. SCHOMER H.H. & DRAKE B. (2001) Physical activity and mental health International SportMed Journal; Vol. 2 (3).

21. SCOTTISH EXECUTIVE *(2003) Let's Make Scotland More Active: A strategy for physical activity* Scottish Executive, Edinburgh.

22. STRONG W.B., MALINA R.M., BLIMKE C.J.R., DISHMAN R.K., GUTIN B. (2005) Evidence based physical activity for school-aged youth *Journal of Pediatrics* Vol. 146; 732-737.

23. SVOBODA B. (1994) *Sport and Physical Activity as a Socialisation Environment: scientific review* Council of Europe**,** Strasbourg.

24. TALBOT M. (2001) The case for physical education, in: G. Doll-Tepper & D. Scoretz (Eds.) *World Summit on Physical Education* (Berlin, ICSSPE).