

Mental Health Benefits of Physical Activity for Young People

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Introduction

There is a commonly held view that participation in physical activity is good for mental health, and this perception has roots in antiquity. The case for mental health benefits across the lifespan is strong. However, this research field is also complex and there is uncertainty regarding some issues.

This chapter will consider the links between involvement in physical activity and various mental health outcomes in young people. Given the diversity of psychological and mental health states and conditions that can be experienced, the chapter will focus on the key themes of self-esteem, depression, anxiety, and health-related quality of life. Other important concepts will be discussed, including enjoyment and social outcomes of physical activity. Cognitive functioning is dealt with elsewhere in this book. We will briefly discuss the psychological outcomes of involvement in acute bouts of physical activity, but the main focus will be on involvement over time, the so-called 'chronic' effects of physical activity, such as participation in an exercise program.

It is important to recognize that this field of research is complex. Figure 1 highlights a number of key issues, including aspects of physical activity itself (e.g., intensity and type), mental health conditions and outcomes, and characteristics of the individual, such as their preferences. Even with such a simplified summary shown, Figure 1 highlights the potential complexity of the field. Interactions are possible between virtually all elements.

Figure 1 about here

Defining mental health

The World Health Organisation states that mental health is more than the absence of mental disorders and is a central component of health. It formally defines mental health as “a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community” (see http://www.who.int/features/factfiles/mental_health/en/). This is a broad definition based on positive and effective functioning – it is not centred on poor mental health or ‘deficit’. That said, defining mental health in this way cannot hide the fact that it can be both positive and negative, and that poor mental health is a highly prevalent and serious issue in modern society (see later). As such, mental health organisations (e.g., ‘Beyondblue’ in Australia), have a focus on depression, anxiety and suicide (see <https://www.beyondblue.org.au/about-us/who-we-are-and-what-we-do>).

For research purposes, mental health has no universal definition, however key issues include those of self-esteem, depression, anxiety, and health-related quality of life. Self-esteem, for example, is considered a key indicator of mental health, including emotional stability and subjective well-being, and is often a strong focus for educational programs for young people. The wider concept of health-related quality of life (HRQoL) includes psychological as well physical and functional health components (Bowling, 1997; Rejeski, Brawley, & Shumaker, 1996). Depression and anxiety states and disorders are common, including day-to-day mood changes that may affect functioning.

A useful conceptual model concerning the effects of physical activity on mental health outcomes in children and adolescents is provided by Lubans et al. (2016). They group mental health outcomes into cognitive function, well-being, and ill-being. Well-being includes global self-esteem, subjective and psychological well-

being, quality of life, and resilience. Ill-being includes internalising disorders (e.g., anxiety and depression), and externalising disorders (e.g., conduct disorder and ADHD).

Epidemiology and prevalence of mental health conditions in young people

Data suggest that the mental health of many young people is less than optimal. The Mental Health Foundation reported that 20% of those aged 16 years and over in the UK in 2014 had symptoms of anxiety or depression, and this trend appears to be increasing. Moreover, rates are higher among females (Mental Health Foundation, 2018). The second National Survey of the Mental Health and Wellbeing of Australian Children and Adolescents, conducted 2013-14, reported that a mental disorder was experienced by 14% of those aged 4-17 years, including major depressive and anxiety disorders (Lawrence et al., 2015). Other Australian data from 2008-09 show as many as 1.2 million mental health-related general practice encounters annually for those in late adolescence and early adulthood (16-24 years), and this number increased by 21% during the 2000s (Australian Institute of Health and Welfare, 2011). The most frequently managed mental health problems concern depression and anxiety.

On a more positive note, a recent large meta-analysis, covering mainly Western countries, has shown that average levels of self-esteem have increased in children from 4 to 11 years of age though remained stable from 11 through to 15 years (Orth, Erol, & Luciano, 2018). There will be many potential threats to self-esteem in young people at the individual level, including societal pressures (e.g., appearance), evaluations (e.g., exam performance), and social interactions (e.g., bullying).

Given these data and trends, it is evident that many young people will encounter mental health problems. Moreover, it is widely accepted that as a society we want children and adolescents to live their lives not just free of mental ill-health, but to experience positive growth, high self-esteem, happiness, resilience, and high levels of psychological well-being and quality of life. For these reasons, cost-effective solutions to achieve positive mental health – including avoidance of ill-health – are widely sought after. Physical activity is proposed as one such solution.

Historical context to the field

Although reference to psychological benefits of physical activity stretch back many centuries, much of this is in respect of adults rather than young people. One of the earliest research overviews on the topic with adults was authored by Emma McCloy Layman (1960), but it was not until two decades later that research syntheses appeared with a focus on young people (Brown, 1982). The overview by Brown drew on evidence from student dissertations, other overviews and commentaries, and a few small-scale studies, the earliest dating only to 1977. A clear focus was on self-concept and children with psychological impairment. One of the first meta-analyses in the field was published in 1986 by Gruber, reporting on physical activity and self-concept in young people. Studies only as far back as 1967 were included (Gruber, 1986).

Two important papers were published on physical activity and mental health in young people as part of the first developments of national physical activity guidelines for young people in the US (Calfas & Taylor, 1994) and UK (Mutrie & Parfitt, 1998). In the latter research review, it was concluded that “some progress” had been made, and that “physical activity is associated with good mental health” (p. 64). But, equally, many questions remained unanswered, including those concerning the

mechanisms, or causes, of this link. Overall, therefore, the field concerning physical activity and mental health in young people has quite a short history.

Review of Literature

As shown in Figure 1, one of the key distinctions to make in considering mental health outcomes is whether the physical activity is taken in single bouts (acute) or over time (chronic). In acute studies, assessments of mental health are usually taken before and after single bouts of exercise with the aim of detecting short-term changes. Chronic studies typically investigate differences or changes over a longer time period, such as before and after involvement in a 12-week program of physical activity, or whether there are differences in mental health between those undertaking regular physical activity and those who are inactive.

Acute affective responses to physical activity

Typically, single session studies will be testing whether physical activity (usually 'exercise') makes you 'feel better'. In practice, this will involve the assessment of changes in 'affect' or 'mood'. 'Affect', sometimes referred to as 'core affect' or 'basic affect', is a generic 'valenced' (good/bad) response. It is considered a basic human response. Russell and Feldman-Barrett (1999) refer to 'core affect' as "the most elementary consciously accessible affective feelings" (p. 806). Mood is a global set of affective (feeling) states we experience on a day-to-day basis and may last hours, days, weeks, or even months. Mood can be conceptualised in terms of distinct mood states, such as vigour and depression. It represents generic feelings rather than a reaction to an event. The latter is an emotion. The origin of mood states is usually more difficult to specify than the origin of emotions. One can be 'feeling

down' for no obvious reason, hence moods tend to be 'diffuse' and relatively low in intensity (Ekkekakis, 2013).

An early review of acute affective outcomes of exercise was conducted by Tuson and Sinyor (1993). They concluded that only 'modest' anxiety effects were evident and "no reliable effects were found for any of the other affective states examined" (p. 100). No conclusions could be drawn about young people. However, at the time, assessments of affective states in acute studies used simple 'before and after' measures, typically using multiple-item questionnaires. This precluded the assessment of feelings during exercise and thus studies lacked the ability to see how affect changed over the course of an exercise bout.

The assessment of acute mental health effects of physical activity has been debated (Ekkekakis & Petruzzello, 2000), but one framework used mainly with adults is the 'affect circumplex' (Russell, 1980). This model tends to depict affect in terms of the two dimensions of valence (i.e., pleasant - unpleasant) and arousal (i.e., high - low). This allows affective states to be classified into four quadrants, as shown in Figure 2. Typically, studies use single item measures of the two dimensions, thus multiple assessments can be made before, during and after exercise, allowing for a time-line of affective responses to be plotted. This approach has been used with young people (Benjamin, Rowlands, & Parfitt, 2012), mainly through the assessment of affective valence, but it remains an understudied population using this method.

Figure 2 about here

Exercise intensity is likely to be an important moderator of the relationship between physical activity and affective reactions. In 2003, Ekkekakis proposed a 'Dual-Mode Model' regarding affective responses, intensity, and temporal aspects of

responses (Ekkekakis, 2003). One of his propositions stated that “responses immediately following moderately vigorous exercise are almost uniformly positive, regardless of whether the responses during exercise were positive or negative” (p. 221). This is the so-called ‘rebound’ effect, and Ekkekakis (2003) describes the robustness of this effect as “remarkable” (p. 221). Another proposition states that “affective responses during strenuous exercise unify into a negative trend as the intensity of exercise approaches each individual’s functional limits” (p. 222). The ventilatory threshold (VT) has been suggested as one biological marker for when this shift occurs. VT represents a change from the primary use of aerobic metabolism to a significant contribution of anaerobic metabolism, resulting in the accumulation of blood lactate and hyperventilation.

Reed and Ones (2006) conducted a comprehensive meta-analysis of 158 studies investigating acute aerobic exercise and measures reflecting ‘positive activated affect’ (PAA). This is represented in the circumplex model by high affective valence (feeling ‘good’) and high arousal/activation (see Figure 2). The overall effect size in the meta-analysis was 0.47, showing a ‘moderate’ but clear effect. However, while studies were included from all age groups, no analysis was reported testing for the effects of age, thus we cannot conclude from this meta-analysis if such an effect is evident in young people.

Several studies from Parfitt and colleagues, however, do suggest that this approach is relevant to children and adolescents. In an early study, Sheppard and Parfitt (2008) examined the affective responses of 22 young adolescents to each of three exercise conditions on a cycle ergometer. Having determined individual ventilatory thresholds, two exercise intensities were prescribed. The first was considered ‘low’ intensity and was below the VT, and the second was ‘high’ intensity

and above the VT. For the third condition, the adolescents were able to set a self-selected level of exercise intensity. This was determined by the request to “select an intensity that you would be happy to sustain for 15 minutes and that you would feel happy to do regularly”. Affective valence was assessed using the Feeling Scale (Hardy & Rejeski, 1989) which is a single item scale ranging from -5 (feeling ‘very bad’) through zero, and up to +5 (feeling ‘very good’). Results showed that affect was positive throughout the exercise when at the lower intensity or self-selected. Affect declined in the higher intensity condition. Similar findings have been reported with low active adolescents (Stych & Parfitt, 2011), younger children (Benjamin et al., 2012), and adolescent girls (Hamlyn-Williams, Freeman, & Parfitt, 2014).

In conclusion, acute exercise studies with children and adolescents do seem to support the basic tenets of the Dual Mode model. Moreover, Parfitt and colleagues have shown that affective responses to exercise seem to be more positive when participants are allowed to choose their own exercise intensity.

Chronic effects of physical activity on mental health

It has been more typical to study the effects of chronic (longer term) involvement in physical activity on mental health than it has been to study acute affective reactions to single exercise bouts. Common mental health outcomes studied include self-esteem, depression and anxiety. All three outcomes have been reviewed by Biddle et al. (2018) in an update of a previous review of reviews (Biddle & Asare, 2011) in which evidence linking chronic physical activity to these outcomes was synthesised from published literature reviews.

Self-esteem and physical self-perceptions.

Self-esteem is a term used in daily life, including within general conversations by parents, teachers, and managers at work. It is generally seen as a key indicator of psychological well-being (Fox, 2000). Self-esteem reflects the degree to which individuals appraise and value themselves, and reflects a core sense of self-worth. It is concerned with feelings of 'good' in oneself, however that is perceived. Typically, self-concept describes aspects of the self (e.g., 'I am an exerciser'), whereas self-esteem attaches a value to such descriptors (e.g., 'I feel good about myself because I exercise'). In the research literature, however, the two terms are often used interchangeably.

A commonly used theory of self-esteem involves a hierarchical model proposing that our global view of ourselves ('global self-esteem') – how we feel about ourselves in general – is underpinned by perceptions and feelings of ourselves in specific domains in our lives. These domains include, among others, social, academic and physical domains, and each of these is constructed from perceptions in relevant further subdomains or more focussed contexts (Shavelson, Hubner, & Stanton, 1976). This is illustrated in Figure 3 with example domains and subdomains. Constructs lower down the hierarchy, and likely even further beneath those illustrated in Figure 3, are more open to change and, consequently, those higher up will require more intensive or prolonged experiences to change.

Figure 3 about here

There is an assumption that physical activity is a positive influence on self-esteem. The potential to enhance self-esteem is frequently used as a rationale for promoting participation and is a common justification for the teaching of physical education to children. However, it is possible for relationships between self-esteem and physical activity to be bi-directional. That is, not only might we expect physical

activity to affect self-esteem, but we could hypothesise that those with high or low self-esteem may choose to adopt and maintain behaviours that reflect this. For example, if someone has low perceptions of their physical competence (see Figure 3), why would they risk exposing this in a public exercise context?

One of the first meta-analyses in the field of physical activity concerned self-esteem and was reported by Gruber (1986). It was centred on play and physical education programmes for children. From 27 studies, an overall moderate effect size was reported for physical activity on self-esteem and over 60% of the studies found positive effects. A more recent meta-analysis examining whether exercise interventions improved global self-esteem among children and young people aged 3-20 years (Ekeland, Heian, & Hagen, 2005; Ekeland, Heian, Hagen, Abbott, & Nordheim, 2004), also showed a moderate effect for exercise. The authors concluded that exercise can lead to improvements in self-esteem in young people, at least in the short term and among those considered at-risk. A meta-analysis from 18 randomised controlled trials by Liu et al. (2015) reported an overall small but significant positive effect for physical activity when the intervention was 'physical activity alone'.

In a recent update of the 2011 review of reviews by Biddle and Asare (2011), Biddle et al. (2018) located 10 systematic reviews on physical activity and self-esteem in young people in the eight years up to the end of 2017, suggesting that the field is expanding quite rapidly. The reviews tended to include healthy samples, with ages ranging from pre-school to late adolescence. Physical activity was broadly defined, including leisure-time physical activity, yoga, recreational dance, and muscle strengthening exercise. Overall, the reviews were suggestive of positive

associations between physical activity and self-esteem, with six reviews concluding positive findings and four reporting inconclusive, mixed, or null results.

Alongside the review of reviews itself, an analysis was conducted to assess whether the association between physical activity and self-esteem could be considered causal according to criteria proposed by Hill (1965). Overall, it was concluded that the association was not causal because the criterion of strength of the association was only partially supported, and there was no support for physical activity preceding, rather than following, self-esteem ('temporal sequencing'), or for a dose-response relationship (Biddle et al., 2018). However, there was evidence from experimental designs. Given that experimental evidence is a cornerstone of scientific enquiry, this does suggest that physical activity may have a causal role in enhancing self-esteem in youth. However, when put alongside other criteria concerning causality, the weight of evidence was not supportive of a causal relationship based on evidence from recent systematic reviews.

In slight contrast to the conclusions regarding causality from the review by Biddle et al. (2018), Lubans et al. (2016) came to the conclusion that a causal link is evident between physical activity and self-esteem in young people. However, they used a different perspective and their conclusions were arrived at by reviewing the mechanisms linking physical activity and mental health in youth. Specifically, they identified studies where it was possible to test whether physical activity changed potential mechanisms affecting self-esteem – a different analysis to that undertaken by Biddle et al. (2018). Changes in appearance were associated with changes in self-esteem in five of six studies. Physical self-worth (in two of three studies) and perceived competence (in three of four studies) also showed associations with self-esteem.

The work of Lubans et al. does point to the potential importance of studying changes in aspects of physical self-perceptions rather than just global self-esteem. Moreover, this might highlight a key weakness of this field. Why would we expect global self-esteem to change significantly as a result of greater physical activity? It is more likely that perceptions lower in the hierarchy will be amenable to change (see Figure 3). Of course, such changes may then filter through and affect global self-esteem, but these changes may be slow and difficult to assess, as well as global self-esteem being affected by other, non-physical, experiences.

Interestingly, a meta-analysis by Babic et al. (2014), concerning the association between physical self-concept/self-worth and physical activity, showed clear, but somewhat moderate, associations across cross-sectional, longitudinal, and intervention designs. As shown in Figure 4, general physical self-concept had a small association with physical activity, whereas perceived competence, and perceived fitness both had 'moderate' associations. Perceived appearance had only a small association, and this could be expected given that many other factors beyond physical activity could affect such perceptions. Associations tended to be larger for boys than girls for general physical self-concept and perceived fitness. Study design was not a significant moderator for any of the four outcomes.

Figure 4 about here

One issue to consider is the nature of the physical activity undertaken. Although it is often the case that we emphasise moderate-to-vigorous physical activity (typically meant as 'aerobic activity'), national and international guidelines also recommend that children and adolescents take part in activities that strengthen muscle and bone (for Australia, see:

<http://www.health.gov.au/internet/main/publishing.nsf/content/health-pubhlth-strateg->

[phys-act-guidelines](#)). These activities might involve resistance exercise (e.g., using body weight or external equipment) and movement with substantial weight bearing. Such 'muscle strength exercise' has been considered to be the forgotten part of the guidelines (Strain, Fitzsimons, Kelly, & Mutrie, 2016) even though the evidence for health benefits is clearly emerging (Bennie, Lee, et al., 2018).

A review of the association between muscle strength exercise and health outcomes in young people by Smith et al. (2014) found a moderate association between participation in such exercise and perceptions of sport competence when a meta-analytic synthesis was possible. They also reported positive cross-sectional associations between muscle strength exercise and physical self-perceptions, including appearance and perceived competence, but no analyses by sex were reported. However, of importance is that the only experimental study included in Smith et al's review showed that changes in muscle strength exercise were not related to changes in any of the measures of physical self-perceptions. Moreover, a large school-based randomised controlled trial in Australia did not show any significant changes in self-esteem from involvement in a resistance exercise program (Smith et al., 2018). Domain-specific physical self-perceptions, other than perceived fitness, were not assessed. These experimental findings suggests that the complexity of this field may still be clouding our view of how physical activity is associated with global self-esteem or its domains.

In conclusion, it might be better to have a re-think about the role of physical activity in the promotion of global self-esteem. Obviously, it is desirable to achieve changes in self-esteem, but equally we should not expect large changes at that level of the hierarchy. We should be more optimistic that positive experiences in physical activity, such as improved fitness and competence, will affect the domain of physical

self-worth. This in itself will be positive and maybe should be the goal of physical activity programs. But the relationship between self-esteem and physical activity is complex and this needs greater recognition. More emphasis is needed on the social-emotional contexts in which physical activity is delivered or takes place. It could be argued that we should look more at the conditions in which physical activity can support more positive and stable self-esteem in young people than testing for simple linear associations.

We have argued that global self-esteem is just one part of the wider view of the self. In addition, other conceptualisations, for example, look at what constitutes vulnerable (J. E. Roberts & Monroe, 1994) or contingent self-esteem (Bos, Huijding, Muris, Vogel, & Biesheuvel, 2010). Vulnerable self-esteem means the absence of a stable, inner anchor of self-worth, which makes one overly dependent on external sources of self-worth. These tend to vary according to circumstances and thus make self-esteem temporally unstable and fluctuating. High or low levels of self-esteem will be contingent on the perceived presence or withdrawal of love and appreciation and/or on perceived success or failure. In addition, vulnerable self-esteem is often accompanied by cognitive self-evaluations that include unrealistically high criteria for achievement, and an inability to tolerate even small discrepancies between real and ideal self. Furthermore, feelings of self-worth may rely on a very limited number of sources and/or sources that are difficult to maintain (J. E. Roberts & Monroe, 1994).

It is important to consider the sources of self-esteem, and how and why physical activity might affect these. Self-esteem, in the context of physical activity, is dependent on, or influenced by, psychosocial and interpersonal processes, as well as the experience of success and failure. Other influences include social inclusion and stressful life events. How the young person is guided through failure, loss, and

rejection experiences in the physical activity context is important. The sport domain, for example, with its proliferation of possibilities for both success and failure experiences, is full of potential opportunities for both enhancing and degrading self-esteem. When failure experiences dominate, this will be a challenge for self-esteem in all children, but particularly so for those with few other positive sources of self-esteem.

Depression.

As stated, one of the most frequently encountered mental health problems is depression. Depression can be characterised by the absence of positive affective states, such as enjoyment, as well as persistent low depressive mood. In addition, depression symptoms can be emotional, cognitive, physical and behavioural. However, over many years physical activity has been seen as a viable strategy for preventing or managing depressive episodes. Despite some inaccurate appraisals of the literature concerning adults (see Ekkekakis, 2015; Ekkekakis, Hartman, & Ladwig, 2018, for critiques) or underestimated effects due to publication bias (Schuch et al., 2016), it has been concluded that “compared to non-active interventions, exercise has a large and significant antidepressant effect”, and that the evidence “confirms and strengthens the case that exercise is an evidence-based treatment for depression” (Schuch et al., 2016, p. 49). However, rather less is known about children and adolescents.

Biddle and Asare (2011) concluded from four systematic reviews that “physical activity over no intervention seems to be potentially beneficial for reduced depression, but the evidence base is limited” (p. 888). When updating this evidence, Biddle et al. (2018), located a further 10 systematic reviews.

From reviews of intervention studies, six of seven meta-analytic effect sizes (ES) varied between -0.41 to -0.61, which shows 'moderate' strength. Reviews of depressed participants seemed to show slightly stronger effects than those from mixed or healthy samples. In the review by Carter et al. (2016) concerning treatment effects from physical activity for adolescents, a meta-analysis of eight trials showed a significant overall moderate difference between intervention and controls for depressive symptom reduction. A similar strength of effect was shown in trials that studied only clinical samples. For trials with a higher methodological rating, the SMD was also similar but was marginally non-significant.

One trial illustrative of the field was reported by Nabkasorn and colleagues (2006). Adolescent females with mild-to-moderate depression were randomised to a group jogging condition for 5 x 50 mins weekly sessions for 8 weeks or a control group. Not only did depression scores decline in comparison to controls, but neurobiological markers also indicated favourable effects. Two issues should be noted. One is the high volume of exercise - the level is greater than standard physical activity guidelines and may prove to be a challenge to many people. Second, the exercise took place in groups and any favourable psychological effect could be due to social effects.

Biddle et al. (2018) also conducted an analysis concerning whether physical activity is causally associated with depression in young people (see Table 1). It was concluded that only a 'partial' case could be made for causality. Compared to adults, where it has been suggested that physical activity is causally associated with clinical depression (Biddle, Mutrie, & Gorely, 2015; Mutrie, 2000), the evidence appears less convincing for young people for both clinical and non-clinical populations. As indicated in Table 1, while the evidence is encouraging from interventions, there is

little evidence showing an appropriate temporal sequencing of physical activity preceding changes in depression. Moreover, reverse causality has not been tested whereby those with higher levels of depression become less active. There was also little to suggest that indicators of exercise dose (e.g., intensity or frequency) affected depression. If studies on chronic involvement in physical activity mirror data from acute studies, one might expect highly variable affective responses to 'heavy' exercise, but largely favourable responses to lighter (light and moderate) exercise. 'Severe' (very high) intensity exercise can be associated with negative affective states (Ekkekakis & Dafermos, 2012; Ekkekakis, Vazou, Bixby, & Georgiadis, 2016). However, these issues are in need of further testing in programs of physical activity involvement over time.

Table 1 about here

The somewhat mixed findings concerning physical activity and depression in young people could be due to several reasons. First, studies show great diversity in the sampling of young people, and have included those apparently 'healthy', those with mild depressive moods, as well as those with clinical levels of depression. In addition, youth with other conditions have also been studied (e.g., ADHD). The identification of the reasons for why physical activity might be beneficial for the reduction of depression in young people remains less well studied. Most commentary on the 'why' question – so called 'mechanisms' – has referred to adults. Psychological mechanisms that have been proposed include the enhancement of self-efficacy, the regulation of affect and mood, and reinforcement of positive behaviours (Craft, 2013). Neurobiological mechanisms have also been proposed, including the monoamine and neurotrophin hypotheses (see Chen, 2013).

Lubans et al's (2016) conceptual model for the effects of physical activity on mental health in youth includes neurobiological, psychosocial, and behavioural mechanisms. These authors also conducted a systematic review of mechanisms by synthesising studies that tested for mediation effects. Rather few studies were available concerning depression. Only one of four studies presented evidence showing a change in a mediator (physical self-concept) and change in depression. No conclusions could be made regarding causality and, clearly, more is needed using this kind of approach.

Anxiety and stress.

Another frequently encountered mental health problem is anxiety. It is also common to hear anecdotal reports of day-to-day 'stress', such as examinations, concerns about money, and family and social conflicts. These point to the need to find accessible and affordable treatments or coping strategies. Physical activity has long been thought to be suitable for stress relief. This could be immediately following an exercise session (acute effects), or a gradual decline in trait levels of anxiety over time as a result of participation in an exercise program (chronic effects). Moreover, reactions to psychosocial stressors can also be attenuated through physical activity (Crews & Landers, 1987; Utschig, Otto, Powers, & Smits, 2013).

Biddle and Asare (2011) concluded from four systematic reviews that "physical activity interventions for young people have been shown to have a small beneficial effect for reduced anxiety. However, the evidence is limited and in need of development" (pp. 888-889). In their updated review, Biddle et al. (2018) located only three new systematic reviews between 2012-2017, suggesting that the field did not progress a great deal over this time period. Overall, results from the updated reviews show anxiety reduction effects from physical activity, with effect sizes ranging from

very small to moderate. The latter was for young people with ADHD. The reviews showed moderate-to-large intervention effects for healthy young people. No evidence was available in the review by Lubans et al. (2016) concerning possible mechanisms for anxiety reducing effects of physical activity in youth.

With scant attention being paid to young people, it is important to note findings and issues gleaned from research with adults. For example, Utschig et al. (2013) conclude that “physical activity is beneficial for most anxiety, most of the time” (p. 112). Research directions that could equally apply to young people include interventions for people with anxiety disorders, the nature of the dose-response relationship, and self-selected versus prescribed exercise intensities (Utschig et al., 2013). Moreover, there is a need to test bi-directional effects between physical activity and anxiety (Burg et al., 2017). Regarding mechanisms for anxiety reduction effects, Gaudlitz et al. (2013) suggest a number of possibilities, including:

- Psychological: exposure to internal bodily sensations; anxiety sensitivity; self-efficacy; self-esteem; changes in accessibility or intensity of ruminations, worries, and anxiety; modification of emotional action tendencies; social contact/engagement.
- Biological: serotonin, opioids, stress hormone system, atrial natriuretic peptide, brain-derived neurotrophic factor (BDNF), genetics.

Despite the importance of anxiety as a mental health construct, the literature regarding physical activity and anxiety reduction in youth seems rather limited in comparison to the other constructs discussed in this chapter.

Health-Related Quality of Life.

Perceived quality of life is considered an over-arching concept of importance to well-being and is similar to concepts such as life satisfaction. At this generic level

it can include perceptions of health, well-being, personal circumstances, happiness, and even where you live (e.g., 'livability'). In most physical activity studies, where quality of life has been assessed, it has usually been as health-related quality of life (HRQoL) (Focht, 2012), including 'subjective well-being'. Rejeski, Brawley and Shumaker (1996) suggest that it is typical for HRQoL to be defined in terms of participants' perceptions of function, such as shown in Table 2.

Table 2 about here

Some have suggested a simple division of HRQoL into functional measures and those assessing quality of life (Muldoon, Barger, Flory, & Manuck, 1998). The assessment of quality of life has become increasingly important because health economists use it to quantify the benefits of different approaches to treatment. The unit of 'quality adjusted life year' (QALY) is used to estimate how much it would cost to improve someone's quality of life or extend that person's life with a new treatment.

Given the emphasis in HRQoL measures on functional status, it is not surprising that when this is included in physical activity studies, it has been in the context of special populations. These have included older adults (Elavsky & McAuley, 2013), those with disability, or with chronic conditions, including cancer and cardiovascular disease (e.g., Vallance, Culos-Reed, Mackenzie, & Courneya, 2013). Focht (2012) concludes that findings "clearly demonstrate that exercise consistently results in ... clinically meaningful improvements in a variety of quality-of-life outcomes ..." (p. 110). However, while some evidence exists in young people (e.g., Page et al., 2009), this is considerably less than for adults and more research is needed (Marker, Steele, & Noser, 2018).

In a systematic review by Marker and colleagues (2018), 33 studies were identified concerning physical activity and HRQoL in young people. They found from cross-sectional observational studies that there was a small, positive association when self-reported by the child. However, when the assessments were completed by the parents, the association was smaller. For intervention studies, there was a small effect using reports by the child. This effect size was greater when parent reports were used. The authors concluded that physical activity was related to better HRQoL in children and adolescents. However, they stated that the “magnitude of these effects did not represent a minimal clinically important difference (MCID) in most studies”. There also appears to be inconsistency of findings based on whether the data were reported by children or parents.

Possible Moderators of Mental Health Effects from Physical Activity

The association between physical activity and mental health in young people may be moderated by various factors, including sex, age, mental health status of the participants, and type of physical activity. In our analysis of causality of the effects of physical activity on self-esteem and depression (Biddle et al., 2018), we found no consistency in evidence across systematic reviews for differential effects for sex and age. While some studies or reviews have shown sex and age differences, these are not consistent.

An important moderator that has been found is that of the mental health status of participants. It has been a problem in the literature for many years that studies often concern essentially healthy participants. While physical activity could affect daily mood, for example, it is less likely to influence depression or anxiety if such mental health conditions are of a ‘normal’ or non-clinical level. In our updated review of reviews (Biddle et al., 2018), we found a great deal of diversity in the reviews

concerning depression. For example, reviews included studies where the young people were mentally 'healthy', had mild depressive moods, had clinically assessed depression at least at a 'moderate' level, as well as some studies addressing youth with ADHD. Such diversity is likely to lead to some inconsistency in findings.

However, for those diagnosed as depressed, results favoured physical activity quite consistently. For self-esteem, the issue may be different as it is possible for physical activity to boost the self-esteem of those with low self-esteem, as well as enhance it to levels higher than 'normal'. Equally, negative physical activity experiences may undermine self-esteem.

Different types of physical activity

It would be naive to expect all types of physical activity to affect mental health in the same way. While results suggest that key indicators of mental health in youth can be positively affected by physical activity, a great deal more needs to be known about how different types of physical activity operate, especially across different contexts. In a systematic review covering all age groups, including adults, White et al. (2017) reported that mental health was weakly and positively associated with participation in leisure-time and work-related physical activity. Household physical activity, as well as school sport and physical education, were not significantly associated with better mental health. This suggests that greater attention needs to be paid to different domains of physical activity.

Moreover, different types and domains of physical activities can have different qualities and different contexts could affect mental health outcomes. Key activity domains include school physical education, competitive sport, exercise programs, incidental/habitual physical activity (including active transport), dance, martial arts, and holistic movement practices (e.g., yoga).

Physical education. Physical education in schools has the primary aim of educating children about movement and their bodies. It will include some elements of competition and largely unavoidable public display of skills and competencies, which may lead to diverse psychological reactions. It will also include elements of compulsion and thus will not always be a 'free choice' behaviour. In a survey of perceptions of their school physical education lessons in the US, respondents reported on their 'worst memories'. Feelings of embarrassment were reported by 34%, lack of enjoyment by 18%, bullying by 17%, and social–physique anxiety by 14% (Ladwig, Vazou, & Ekkekakis, 2018). While 'best memories' included enjoyment of the activities in class (56%; see later) and experiencing feelings of physical competence (37%), 7% expressed their best memory was not having to take PE class any longer or missing the class altogether! It appears that the context of school physical education – experienced by nearly all children and adolescents – leads to diverse psychological responses. Any conclusions, therefore, that physical education 'boosts self-esteem' for example, are too simplistic.

Sport. Competitive sport is a key physical activity opportunity for young people and tends to be highly valued in society. It usually places clear emphasis on competence, skills and comparative abilities, and outcomes can create negative as well as positive feelings. Equally, it can challenge young people to improve and structure their practice, as well as help them learn about persistence and striving. Such diversity of approaches and outcomes based on outcome- versus self-focused are reflected in a great deal of research concerning achievement goals of youth in physical activity (Keegan, 2019; G. C. Roberts & Papaioannou, 2014). This remains an important explanatory framework, alongside other theories such as Self-Determination Theory (Ryan & Deci, 2000b; Standage, Curran, & Rouse, 2019).

Youth sport can also assist in creating strong social bonds (see later) and positive feelings of affiliation and group goal-seeking. However, as shown in seminal research many years ago, inter-group competition can create negative as well as positive environments and responses (Sherif, 1958; Sherif, Harvey, White, Hood, & Sherif, 1961).

Exercise. Exercise programs usually have the aim of improving fitness and health. They can involve solo or group exercising but are often structured and repetitive forms of movement (Caspersen, Powell, & Christenson, 1985). Exercise programs are likely to impact body image and physical self-perceptions in positive ways, but also challenge discipline and adherence (Lunt et al., 2014). It is likely that structured exercise training with a personal trainer will reach those from lower socio-economic groups less (Bennie, Thornton, van Uffelen, Banting, & Biddle, 2016), and personal trainers appear to have only a modest level of interest in training high health-risk groups (Bennie, Thomas, et al., 2018). But the appeal of 'traditional' exercise sessions may not be appealing to many young people, although may develop as young people progress from adolescence to young adulthood and thus adopt more adult-like lifestyles. For younger children, 'exercise' will be part of active play, active transport, and sport.

Incidental physical activity. What might be termed 'incidental physical activity' – sometimes referred to as 'habitual physical activity' – includes physical activity that is undertaken throughout the day in less structured bouts. This might involve stair climbing, and walking and cycling as forms of transport. It is unclear whether the utilitarian purpose of some of these behaviours will affect mental health, particularly in young people, and may in some cases be seen as unpleasant effort or inconvenient, and less comfortable ways to travel. This needs further research.

Dance. Dance comes in a multitude of forms and types of engagement varying from performance-oriented forms such as ballet, to competitive forms, social dances, as well as creative and free movement forms, delivered both within and outside of school education. Dance forms and contexts can vary greatly in terms of their emphases on what is important, ranging from skill learning, mastery, and technical perfection aimed at performance or competition, to fun and social interaction, and to self-expression, self-knowledge and sometimes self-transcendence.

Some performance-oriented dance contexts, particularly the ballet environment, can provide strong pressures on young dancers. This may include absorbing a great deal of critical assessment, competition for performance roles, conforming to certain body shapes, and the pressures of performing itself. This environment has been shown to be associated with lower levels of self-esteem, and higher levels of body dissatisfaction and disordered eating in young female dancers (Bettle, Bettle, Neumärker, & Neumärker, 2001; Ravaldi et al., 2006). On the other hand, committed young dancers often thrive on the discipline that is part of this type of dance environment (Bond & Stinson, 2007; Stinson, Blumenfield, & van Dyke, 1990).

There are also dance contexts for children that encourage free movement, self-exploration, and self-expression. Koff (2000) has argued that this type of creative involvement in dance should be the basis of dance education in schools. Research is still limited in terms of what these types of dance engagement can do for young people's mental health. But it has been suggested, for example, that free movement forms of dance could help young people, girls in particular, to experience and appreciate their bodies from the inside out and as a way of improving physical

self-esteem (Johansson, 2015). This could act as an antidote to society's objectification of the female body as outlined in Fredrickson and Roberts' (1997) objectification theory. This posits that girls and women are typically acculturated to internalise an observer's perspective on their physical selves, which can lead to shame, anxiety, eating disorders, and low physical self-esteem, rather than a lived and empowered appreciation of one's physicality.

Martial arts. Traditional martial arts (e.g., judo, karate, taekwondo) can provide structure, predictability, and discipline, in addition to grading systems that reward personal mastery and commitment. A review by Vertonghen and Theeboom (2010) indicated that research on martial arts in youth has shown positive psychosocial benefits, with a number of studies finding beneficial effects for anxiety, self-reliance, cognitive and affective self-regulation, self-acceptance, and personal growth, and decreases in hostility and aggression. However, they also noted some inconsistency in findings and some studies showed associations with increases in hostility and anti-social behaviour. Martial arts have been found to be relatively popular choices for intervention programs targeted at socially vulnerable or 'at risk' youth (Theeboom, De Knop, & Wylleman, 2008).

Holistic movement practices. Holistic movement practices (HMPs) are physical practices embedded in philosophies of holistic well-being. The most well-known of these in western society are the imported oriental practices of yoga, t'ai chi and qigong. These include a range of internally-focused skills, including meditation, breathing, mindful attention, self-acceptance, body awareness, mental & emotional awareness, and sometimes imagery (Park et al., 2018; Wayne & Kaptchuk, 2008). Research on psychological effects of holistic movement practices on children and

adolescents is still very limited but these practices have potential for training and improving internal processes related to self-knowledge and self-regulation.

A systematic review of psychosocial and other outcomes of yoga in schools was reported by Ferreira-Vorkapic and colleagues (2015). Results were supportive of the benefits of yoga in some studies, but overall there was uncertainty in findings. A number of problems with the literature were identified and these might have contributed to this uncertainty. These included inadequate sample sizes, variability in the type of yoga being taught, and failure to measure intervening variables such as mindfulness and body awareness.

In a recent systematic review, Riskowski and Almeheyawi (2017) concluded that there was insufficient evidence to evaluate the effect of t'ai chi and qigong interventions on psychological well-being and behaviour of children and adolescents. The authors noted that there was a large variety in type, dose and duration of the interventions, as well as in the outcome measures studied. Although the slowness and required levels of concentration of t'ai chi/qigong may act as a deterrent to some young people (Riskowski & Almeheyawi, 2017), t'ai chi and qigong's ingredients of slow movements, concentration, mindful awareness, imagery, intention, and body awareness offer potential avenues for relaxation, stress management, and self-regulation when taught with age appropriate adaptations.

Overall, given their inclusion of internally focused self-regulation skills, the holistic movement practices discussed, and others, may offer particular benefits to young people in whom these skills are impaired.

In conclusion, more research is required concerning the effect of different types and contexts of physical activity for mental health in young people. The belief

that all physical activities will automatically be positive for mental health, or operate in similar ways, is unlikely to be true. A more nuanced approach is required that recognizes the complexity of this field.

Emerging and Other Perspectives

In this chapter, we have focused on evidence linking the key mental outcomes of self-esteem, anxiety, and depression with physical activity in young people.

However, there are other important concepts and perspectives requiring attention.

These include:

- enjoyment as a significant antecedent and outcome of physical activity
- combining affective and reflective perspectives on physical activity motivation and psychological outcomes
- social benefits of physical activity.

Discussion on enjoyment is included because enjoyment can act as both a mental health-related outcome as well as an antecedent of physical activity choices and motivation. It is often a misunderstood concept in exercise science and requires some clarification. Similarly, affect can play an important role as both an outcome and antecedent of physical activity.

Enjoyment as a psychological outcome

Enjoyment is a rather elusive or 'slippery' concept in physical activity research. It is not easy to define or measure, and it can act as an antecedent as well as a consequence of physical activity. Indeed, it is likely to act in a cyclical fashion, with people choosing activities they expect to enjoy and, if they then 'enjoy' the participation and experience, will come back for more. Equally, other important motives will need to operate to adhere to a program of exercise that is not inherently

enjoyable. For example, In a recent study (Ladwig et al., 2018), an online questionnaire was completed by over 1000 American adults in which they were asked to rate their retrospective enjoyment of school physical education, as well other perceptions, including attitudes and intentions for physical activity. In responses concerning their 'best memories', 56% referred to enjoyment of the PE class activities.

The notion of enjoyment being linked to participation might be considered common sense. In Australia, for example, it is recognised in national physical activity guidelines (see <http://www.health.gov.au/internet/main/publishing.nsf/content/health-pubhlth-strateg-phys-act-guidelines#apa512>). The Australian brochure summarising guidelines for adolescents suggests to “choose activities you enjoy doing, and you will be more likely to continue doing them”. But such statements are not as dominant as those concerning the physical health benefits of physical activity. In the 2018 updated guidelines from the US, a key summary paper in JAMA, with 115,736 online 'views' in the 30 days prior to November 22nd, 2018, has just one mention of the word 'enjoy(ment)', yet uses the word 'health' more than 60 times (Piercy et al., 2018). In the new 'Sport Plan' for Australia (see <https://www.sportaus.gov.au/home>), which includes wider aspects of physical activity, the word 'enjoy(ment)' is mentioned once in 70 pages, and only in the context of swimming.

It was over three decades ago when Dishman et al. (1985) stated that “Knowledge of and belief in the health benefits of physical activity may motivate initial involvement, but feelings of enjoyment and well-being seem to be stronger motives for continued participation” (p. 162). This is likely to be even more important for young people as health consequences of physical activity will not be a highly salient for them.

There are several ways to view enjoyment, including the concept of 'flow', intrinsic motivation, and affective states (Biddle et al., 2015). Csikzentmihalyi (1975) described activities that people invested a great deal of time and energy in as 'autotelic' (meaning 'self-goal' or 'self-purpose'). When asking people in a range of activities (e.g., rock climbers, composers, dancers) why they enjoyed their chosen activity, 'intrinsic' factors were clearly evident. For example, 'enjoyment of the experience and use of skills' was strongly endorsed as a reason for involvement. Csikzentmihalyi concluded that motivation seemed highest when the difficulty of the task (challenge) was matched by the personal abilities and skills of the individual. This matching led to a state of 'flow', or supreme enjoyment and engagement in the task. A mismatch can lead to either boredom (low challenge relative to skills) or anxiety (high challenge relative to skills). This is shown in Figure 5.

Figure 5 about here

The concept of flow is one way to view physical activity enjoyment and suggests that greater emphasis is required on the matching of the challenges of the activity with capabilities. Of course, while gains in fitness will require increasing the challenge of exercise, large mismatches in this regard will likely lead to anxiety or negative affect, and possible dropout.

Intrinsic motivation is a commonly studied aspect of physical activity psychology. High intrinsic motivation includes feelings of enjoyment as well as high effort, competence, and autonomy (self-determination), and low levels of pressure and anxiety (Deci & Ryan, 1985). Intrinsic motivation, enjoyment and flow are clearly interrelated. However, 'pure' intrinsic enjoyment is likely to be rare in some forms of physical activity, whereas we might be motivated more by what are called states of 'identified' motivation, such as being physically active for the satisfaction of achieving

goals or mastering tasks, rather than just 'fun'. For example, in a meta-analysis, the association was assessed between 'affective judgement' and physical activity in young people (Nasuti & Rhodes, 2013). Affective judgement was defined as the "overall pleasure/displeasure, enjoyment, and feeling states expected from enacting an activity or from reflection on past activity" (p. 358). The effect size was small (0.2) but significant. It may not be appropriate to assume a simple relationship between physical activity and enjoyment given that 'intrinsic' states can vary in quality (Ryan & Deci, 2000a).

Returning to the circumplex model of affect discussed earlier in this chapter, it is logical to expect positive feeling states, accompanied by high activation ('positive activated affect' – PAA (Reed & Ones, 2006)), to be associated with enjoyment during physical activity. Similarly, the positive engagement sub-scale of the Exercise-Induced Feeling Inventory (Gauvin & Rejeski, 1993) is closely associated with enjoyment. However, while enjoyment is a key to motivation, its nature and measurement is still in need of development and refinement. The only specific scale purporting to assess physical activity enjoyment is Kendzierski and DeCarlo's (1991) 18-item Physical Activity Enjoyment Scale (PACES), and this may be overlong for some studies wishing to assess many other constructs. Moreover, the scale contains multiple constructs that may produce differential responses to varied forms of physical activity. Items reflect the diverse feelings of enjoyment, boredom, pleasure, challenge, accomplishment, frustration, gratification, exhilaration, and others.

In summary, enjoyment is a key mental health-related outcome of physical activity, but can also act as an antecedent of decisions regarding physical activity involvement. It is a poorly understood concept and requires more work to clarify exactly what it is and how it can be assessed.

Affective states and appraisals as motivation

Similar to enjoyment, affective reactions and mental health outcomes of physical activity can also act as reinforcement for participation and motivation for adherence. However, this approach is rarely considered in the light of the mental health literature for young people. Moreover, the literature on motivation for physical activity in general tends to adopt a cognitive approach that assumes people are rational decision makers in such matters. Other perspectives, such as dual-process models, provide additional insight (Brand & Ekkekakis, 2018). Essentially, humans will operate two psychological processes that can lead to a behaviour. The 'type-2' process involves the typical social-cognitive approach in exercise psychology whereby people think through and plan their actions – that is, it involves 'reflective' evaluations and processes. An example would be where people schedule an exercise session, and plan the time, type, and location (referred to as 'action plans'). Hence, this is seen as a 'slow' route. 'Type-1' processes, on the other hand, involve more 'automatic' and 'gut response' reactions. This might involve a spontaneous decision to walk home from work when the weather is nice (referred to as 'action impulse'). Little conscious thought or planning is involved, hence it is a 'fast' processing route. This perspective underpins the 'Affective-Reflective Theory' (ART) of physical inactivity proposed by Brand and Ekkekakis (2018). The ART claims to differ from other approaches by, among other things, focusing on the role of affect and automaticity. Brand and Ekkekakis state "individuals tend to seek pleasurable experiences and avoid displeasure" and,

"hedonistic theories differ significantly from most theories presently used in the study of exercise motivation, which are based on a cognitive core and assert that, once enough information is available ... individuals will inevitably make the

rational decision to change their behavior and will be motivated to do so more or less regardless of any hardship they have to endure in the process” (p. 50-51).

The ART provides an additional approach to conventional views by combining affective and reflective constructs in the advancement of knowledge concerning physical activity motivation. The role of affect is important in this but extends the notion of affect simply being a response to an event, such as exercise, as described earlier in the chapter. Moreover, it may be highly relevant to young people because of their propensity for more spontaneous forms of physical activity (e.g., active play). These are important ways to be active, although more research is required on the mental health outcomes of such forms of physical activity, as suggested earlier.

Social benefits of participation

The focus of research on physical activity and mental health in young people has tended to adopt a strongly psychological orientation. Outcomes described in this chapter (e.g., depression, self-esteem) are obviously ‘psychological’. However, as Carless and Douglas (2010) argue, research should not only investigate the effects of physical activity, but also explore the meaning of physical activity in the context of people’s lives, including those with mental ill-health. To do this, a broader perspective is required where the social context of physical activity is accounted for, and social outcomes are also studied.

It is frequently claimed that physical activity can bring about positive social benefits for the individual, as well as society. Moreover, important developmental tasks include developing healthy interpersonal skills, a coherent sense of identity, and the ability to function as a socially and morally responsible member of society.

In a review of psychological and social benefits of sport participation for young people, Eime et al. (2013) identified a number of ‘social’ outcomes. These included

relationships with coaches and friends, respect for teachers and neighbours, social functioning, social interactions, social self-concept, social well-being, sportsmanship, and teamwork. Initiatives and research concerning 'positive youth development' and 'sport for development' are examples where participation in physical activity – in this case mainly sport – is structured and delivered with explicit social outcomes in mind. Coalter (2005) states that participation in sport has claimed psychosocial and sociological benefits, including for the latter increased community identity, social coherence, and integration. Whether non-sport physical activity can have similar effects for young people remains to be seen, but future research should avoid narrowly focusing only on psychological outcomes and consider broader outcomes of perceived well-being and social benefits at the individual and community level.

Recommendations for Research and Professional Practice

In this final section, we provide recommendations for research concerning physical activity and mental health in young people as well for professional practice. The latter include the settings of education, health, community, and family.

Recommendations for Research

Figure 1 shows the complexity of this field. An important part of this overall picture is the nature of the mental health outcome itself. In the current chapter, we have focused – quite narrowly some might argue – on self-esteem, anxiety, depression, and HRQoL. But there are many psychological outcomes that could be considered, including externalizing disorders (e.g., ADHD, anger), feelings of energy and fatigue, and sleep. In addition, applications to wider contexts are recommended. These might include the role of physical activity in specific conditions, such as schizophrenia, addictions, behavioural difficulties, pain, and mood disorders.

Equally, research needs to continue to address how physical activity operates in different populations. These might include those with physical disabilities, learning difficulties, presenting with pre-existing mental health problems, from different socio-economic backgrounds, and with different physical activity histories. One avenue to pursue is to see if types or characteristics of activities can be matched to mental health conditions for effective mental health promotion.

Different types of physical activity also require greater research attention. Mental health may be associated with a number of activity types or domains in different ways. For example, the context, interactions, and settings for sport and active transport are quite different, thus mental health relationships may not show similar patterns. A priority for future research is to study the mental health effects of different forms of transport for young people, such as comparisons between active and passive forms of transport. It is also worth studying the effects of holistic movement practices, such as yoga, tai chi, that emphasise internal self-regulation skills, on young people's mental health.

All studies involving physical activity struggle with measurement. In the present context, this will involve assessment of the exposure (physical activity) and outcome (mental health), both of which provide challenges. While physical activity measurement has advanced a great deal in recent years through the employment of new technology, there are still many unresolved issues. The use of movement-detection wearable technology devices (e.g., pedometers, accelerometers) is often referred to as using 'objective' assessment. However, there are many 'subjective' decisions used in the application of, say, accelerometers. Hence, it is recommended to refer to 'device-based assessment' rather than 'objective assessment'.

Conversely, using self-report measures to assess physical activity is not necessarily

'subjective'. A self-report scale can distinguish between types of physical activities very well ('did you go swimming today?") and, in such cases, the assessment is not 'subjective'. It is recommended to refer to such measures as 'self-reported physical activity'. Of course, deriving accurate values from some self-report measures is difficult, and associations with mental health may be underestimated due to large variability in the data. Equally, accelerometers will not report all activities very well (e.g., cycling) or not be able to distinguish between different types of activity.

As we have suggested in the reviews concerning self-esteem and depression, there is a case to be made for the assessment of whether physical activity is causally associated with mental health. The updated review of reviews by Biddle et al. (2018), used the criteria proposed by Sir Austin Bradford Hill (Hill, 1965), and these are well known in epidemiological research. The key point to note is that many different factors are taken into account, including strength of association, dose-response, and experimental evidence. This 'triangulation' is important for arriving at decisions in research (Munafò & Davey Smith, 2018), and it is recommended that further analyses of this type are undertaken. Moreover, any conclusions reached using these criteria should be updated periodically. Other methods for testing causation are also possible, such as Mendelian randomization (Richmond et al., 2014).

Finally, it is clear from the evidence reviewed that the field is still dominated by quantitative studies. Given the nature of mental health, and the different contexts and experiences of physical activity, it is surprising that there are still rather few qualitative studies in this area. In addition, more mixed-methods studies are recommended where outcomes can be assessed in quantitative terms, but participant views and stories can be gathered through qualitative methods to help enrich and contextualize our understanding of such effects. But let us not fall into the

trap of stating that quantitative studies are unable to 'explain' findings and that qualitative studies are 'in-depth' and thus able to provide the 'why' for mental health change. Both methods can operate in-depth or be superficial, and both offer explanations for the study findings in their own way. It will depend on how they were conducted.

Recommendations for Professional Practice

As the evidence accumulates supporting the role of physical activity in the development of positive mental health in youth, and given the national trends showing considerable prevalence of mental ill-being in young people, it is important to promote physical activity – for mental health as well as other positive outcomes – in different settings. Physical activity environments need to be able to support healthy psychological development. This will require pleasant and attractive environments that encourage physical activity, and provide plenty of opportunities for active rather than passive alternatives. Moreover, it is vital to have physically and emotionally safe, non-abusive, well-guided psychosocial environments provided by responsible adults in sport and other physical activity settings.

Perhaps the most obvious setting to consider is the education system. With nearly all children and adolescents attending school, this provides a highly suitable context for not only promoting physical activity, but also for exploring the role of active lifestyles in mental health. For example, schools can continue to offer high quality physical education for all, as well offer extra-curricular opportunities to be active (e.g., dance, sport, active video games, and holistic physical activities that can foster stress management and emotion regulation skills). In addition, a whole-school approach should be encouraged whereby active living is supported in all aspects of school life, including active travel to and from school, inclusive sport and physical

activity opportunities, and active classrooms designed for movement-based subject learning (Hinckson et al., 2015; Routen et al., 2017). Active living initiatives in schools should also have mental health outcomes as goals, and plan activities to boost self-esteem and HRQoL as standard practice.

Physical activity for positive mental health should also be promoted for young people in health and health care settings. Routine encounters with health care professionals should include assessment and advice about active lifestyles and mental well-being. Training of health professionals will be required.

Community facilitation of active living needs greater priority. A key area for this is to promote active forms of transport to and from school, and provide excellent local public transport systems, thus allowing a mix of passive and active forms of transport in favour of car-dependent travel. In addition, provision of 'green space', such as parks and play areas, is essential. Such environmental supports are usually provided at the 'community' level. Therefore, it is important that physical activity experts are involved in early discussions regarding urban planning.

Finally, the family should be considered as an important setting for the promotion of physical activity for mental health of young people. Linking to issues raised in this section, parents need to be supportive of active opportunities at school, in health care, and in the local community. Where possible, driving children to school should be avoided, and active safe alternatives provided. Within the home, play spaces and equipment should be provided and supported, and young people encouraged to regulate (usually meaning 'reduce') their sitting time, such as at computer games.

Conclusions

This chapter has defined mental health and provided a historical context to contemporary research on physical activity and mental health in young people. We have highlighted that the prevalence of mental ill-being in youth is high. Evidence has been summarized on the key mental health outcomes of self-esteem, anxiety, depression, and HRQoL, and on balance, evidence is supportive of the role of physical activity in mental health promotion. However, many unresolved issues remain, including the role of different types of physical activities and preferences, the different contexts for physical activity, and possible moderators. We have suggested that additional issues should be considered; these include enjoyment, affective and reflective approaches in considering exercise motivation, and the social benefits of activity. Finally, we summarized key recommendations for research and professional practice.

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Table 1. Appraisal of evidence, drawn from a review of systematic reviews (2012-2017) for whether the association between physical activity and depression in young people can be considered causal (Biddle et al., 2018).

Criterion proposed by Hill (1965)	Research question	Assessment	
		Is there evidence for causality?	Comments
Strength of association	How strong is the association between physical activity and depression in young people?	Partial	Interventions show moderate effect sizes (ES). Observational studies show small to very small negative associations.
Temporal sequencing	Does physical inactivity precede the development of depression in young people?	No	Longitudinal studies do not support temporal sequencing, with null to small associations or effects. Reverse causality not tested but plausible.
Dose-response relationship	Do higher levels of physical activity show lower levels of depression in young people?	No	Largely null effects for intensity, frequency and duration as moderators.
Experimental evidence	Is there evidence using experimental methods in young people for changes in depression resulting from changes in physical activity?	Yes	Evidence from experimental intervention trials show moderate effect sizes.

Table 2. Dimensions of health-related quality of life (Rejeski et al., 1996)

Indexes of HRQoL	Include
Global	General life satisfaction; self-esteem
Physical function	Perceptions of function; physical self-perceptions; health-related perceptions
Physical symptoms	Fatigue; energy; sleep
Emotional function	Depression; anxiety; mood; affect
Social function	Social dependency; family/work roles
Cognitive function	Memory; attention; problem-solving

Figure captions

Figure 1. Illustration of key issues showing the complexity of the field of physical activity and mental health in young people

Figure 2. A circumplex model of psychological valence and perceived activation

Figure 3. A multidimensional and hierarchical model of self-esteem, with example domains of physical and social self-worth

Figure 4. Associations from a meta-analysis by Babic et al. (2014) for physical activity with sub-domains of physical self-worth.

Figure 5. Illustration of the concept of 'flow' where high levels of enjoyment are thought to result from a matching of skills and challenge

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