

# Physically active lifestyles and well-being

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## Introduction

Few days go past without reference in the mass media to (un)healthy lifestyles in modern society. Diseases of the age that are most often mentioned and have an association with physical inactivity include obesity, diabetes, heart disease, and some cancers. Indeed, obesity seems to be a current health issue most worrying politicians and health professionals, and lack of physical activity is a key element of the energy imbalance that is causing current obesity trends (Bouchard 2000; Bouchard and Blair 1999). However, the beneficial effects of physical activity go far beyond healthy weight management. The 'magic pill' of physical activity is powerful, with effects demonstrated on numerous health outcomes, including positive mental health (Dishman *et al.* 2004). Indeed, physical activity research pioneer, Professor Jeremy Morris, once referred to physical activity as 'today's best buy for public health' (Morris 1994). Nevertheless, it was only in 1988 that one of the present authors (SJHB) was referred to a General Practitioner (GP) at his local primary care health centre who not only smoked (in his consulting room!), but recommended that all one really needed in respect of physical activity was a game of rugby at the weekend! Fortunately, we have come some way since then and now have strong advocacy documents promoting the importance of regular, moderate intensity physical activity on most days of the week (Department of Health 2004; Department of Health and Human Services and Centers for Disease Control and Prevention 1996; Pate *et al.* 1995). In addition, recommendations can be tailored to individual needs, such as those of young people, adults, older adults, or those with certain medical conditions (Department of Health 2004).

In this chapter, we review the evidence that physical activity can contribute to positive well-being as well as prevent or ameliorate disease. We examine the so-called 'feel-good factor'—the psychological benefits that people derive from physical activity. Our current understanding of the mechanisms underlying the beneficial effects of physical activity is presented, challenging some widely held views. A brief

examination of the factors underlying why some people are physically active while others are not is followed by a section on successful interventions at both an individual and a societal level. We conclude that, despite the long history of research in this field, there remain some exciting challenges in establishing how physical activity exerts its enhancing effects on well-being and in using this knowledge to develop interventions that would raise levels of physical activity and well-being in the population at large.

### **Defining key terms**

Typically, physical activity includes movement of the body produced by the skeletal muscles that results in energy expenditure (Caspersen *et al.* 1985). This over-arching category can include any form of movement but, for the purposes of health enhancement, we tend to be more interested in more gross motor movements such as walking, cycling, lifting, or large or prolonged do-it-yourself (DIY) activities.

Physical activity can include others types of movement, such as structured exercise and sport. Exercise involves 'planned, structured and repetitive bodily movement' (Caspersen *et al.* 1985, p. 127), often with the objective of fitness maintenance or improvement. An example would be exercising on a treadmill at a fitness club. Sport, on the other hand, is physical activity that is rule-governed, structured, and competitive and involves gross motor movement characterized by physical strategy, prowess, and chance (Rejeski and Brawley 1988), such as golf or tennis. Not all forms of physical activity are necessarily healthy and this may depend on the nature of the activity, how it is performed, and the characteristics of the individual. However, within the normal bounds of safety and appropriate advice, physical activity can have major health benefits.

### **Behavioural epidemiology framework**

The five-phase behavioural epidemiology framework advocated by Sallis and Owen (1999) is a useful way of viewing various processes in the understanding of physical activity and health. Behavioural epidemiology considers the link between behaviours and health and disease, such as why some people are physically active and others are not. In relation to physical activity, this framework has five main phases.

- 1 *To establish the link between physical activity and health.* This is now well documented for many diverse conditions as well as well-being (Bouchard *et al.* 1994; Dishman *et al.* 2004).
- 2 *To develop methods for the accurate assessment of physical activity.* This remains a problematic area. Large-scale surveillance of population trends inevitably relies on self-report, a method that is fraught with validity and reliability problems. Recent 'objective' methods, such as movement sensors, heart rate monitors, or

pedometers, are useful but do not necessarily give all of the information required, such as intensity or type of activity or the setting in which activity took place. Until we have better measures of the behaviour itself—i.e. physical activity—the field will struggle to progress in many respects.

- 3 *To identify factors that are associated with different levels of physical activity.* Given the evidence supporting the beneficial effects of physical activity on health, it is important to identify factors that might be associated with the adoption and maintenance of the behaviour. This area is referred to as the study of ‘correlates’ or ‘determinants’ of physical activity. The term correlates is now preferred in order to avoid the assumption of causal links. Much of the evidence at this stage is not able to support causality.
- 4 *To evaluate interventions designed to promote physical activity.* Once a variable is identified as a correlate of physical activity (e.g. self-efficacy), then interventions can manipulate this variable to test if it is, in fact, a determinant. The number of intervention studies in physical activity is increasing (Kahn *et al.* 2002).
- 5 *To translate findings from research into practice.* If interventions work, it is appropriate to translate such findings into ecologically valid ‘real-world’ settings.

It is important to realize that the above sequence is not linear. For example, measures of physical activity are developed and refined alongside tests of outcomes, and often community projects are established prior to convincing evidence, but may include a monitoring and evaluation element to test the efficacy of such an intervention before refining future interventions. The whole process then becomes iterative. Drawing on the behavioural epidemiology framework, this chapter will consider the psychological benefits of physical activity (phase 2 of the framework), the correlates of physical activity (phase 3), and interventions designed to enhance physical activity levels (phase 4).

## **The feel-good factor: what psychological benefits do people derive from physical activity?**

The psychological effects associated with physical activity have been the topic of numerous scientific studies, conducted mainly since the early 1970s. The general conclusion from this research is that physical activity can enhance the participants’ sense of well-being. As described in a recent literature review, ‘both survey and experimental research . . . provide support for the well publicized statement that “*exercise makes you feel good*” ’ (Fox 1999; p. 413, italics in the original). However, although the conceptual and methodological sophistication of the studies has increased over the years, not all reviewers have reached a similarly definitive conclusion. Skeptics have argued that, in many cases, statements about the psychological benefits of physical activity seem to ‘anticipate rather than reflect the accumulation of strong evidence’ (Salmon 2001, p. 36).

The controversy has been persisting for many years. Over 2 decades ago, based on a few preliminary studies, Morgan (1981, p. 306) asserted that ‘the “feeling better” sensation that accompanies regular physical activity is so obvious that it is one of the few universally accepted benefits of exercise.’ Yet, at about the same time, Hughes’s (1984, p. 76) assessment was that ‘the enthusiastic support of exercise to improve mental health has a limited empirical basis and lacks a well-tested rationale.’ More recently, a similar contrast is evident in the conclusions reached by different reviewers evaluating the research on the effects of habitual physical activity on depression. Biddle *et al.* (2000, p. 155) stated that ‘overall, the evidence is strong enough for us to conclude that there is support for a *causal* link between physical activity and reduced clinically defined depression. This is the first time such a statement has been made.’ In contrast, Lawlor and Hopker (2001, p.1) found that ‘the effectiveness of exercise in reducing symptoms of depression cannot be determined because of a lack of good quality research on clinical populations with adequate follow up.’ Others, characterizing Lawlor and Hopker’s conclusion as ‘a bit harsh’ (Brosse *et al.* 2002, p. 754), acknowledge that, although, if taken together, the extant studies seem to suggest that regular physical activity can reduce depression, the literature still contains a very small number of high-quality clinical trials and, consequently, the quantity and quality of the evidence could not yet satisfy the most stringent of criteria, such as those established for evaluating the effectiveness of prescription drugs.

Despite the conflicting views, the appeal of physical activity as an intervention modality for enhancing psychological well-being is such that the research will surely continue. In an era of rising mental health care costs, physical activity is a potentially viable alternative or adjunct to traditional forms of therapy (i.e. pharmacological and psychotherapy) and is inexpensive and free of serious side-effects. Moreover, physical activity has some added advantages that other interventions cannot claim. First, besides being potentially effective as a therapeutic modality, physical activity also seems to have great potential value as a preventive modality among healthy individuals. Second, besides its psychological effects, physical activity also has substantial beneficial effects on physical health—and these are supported by a much more extensive and robust evidence base! In the following paragraphs, we provide a brief summary of the research on the psychological effects of physical activity, separating them into the effects of physical fitness or habitual participation in physical activity (e.g. for months or years) and those associated with single bouts of activity.

### **Psychological effects of habitual physical activity**

The effects of habitual physical activity on various aspects of well-being have been examined in numerous studies. These include both cross-sectional studies (i.e. examining differences in aspects of well-being between groups differing in

**Table 6.1** Benefits of regular, long-term physical activity for various aspects of well-being, with references to representative literature reviews

<b>Benefit for well-being</b>	<b>Selected references</b>
Reduction in anxiety	Landers and Petruzzello 1994; O'Connor <i>et al.</i> 2000; Petruzzello <i>et al.</i> 1991; Taylor 2000
Reduction in depression	Brosse <i>et al.</i> 2002; Craft and Landers 1998; Mutrie 2000; O'Neal <i>et al.</i> 2000
Improved mood states	Arent <i>et al.</i> 2000; Biddle 2000
Enhanced health-related quality of life in the elderly and various patient populations	Berger 2004; Berger and Motl 2001; Rejeski <i>et al.</i> 1996; Rejeski and Mihalko 2001
Improved physical and general self-worth	Fox 2000a, b; Sonstroem 1997
Improved sleep	Kubitz <i>et al.</i> 1996; Youngstedt 2000; Youngstedt <i>et al.</i> 1997
Reduced reactivity to psychosocial stressors	Dishman and Jackson 2000; Sothmann <i>et al.</i> 1996
Improved cognitive function in all populations, including older adults	Colcombe and Kramer 2003; Etnier <i>et al.</i> 1997

habitual levels of activity or levels of physical fitness) and experimental studies (i.e. examining the effects of weeks or months of participation). With so many studies whose methodological approaches are quite diverse and none of which can be characterized as definitive, this topic has also been the subject of many reviews, including meta-analytic reviews. These reviews have generally concluded that physical activity is associated with reduced anxiety, reduced depression, improved mood states, enhanced health-related quality of life in the elderly and various patient populations, improved physical and general self-worth, improved sleep, reduced reactivity to psychosocial stressors, and improved cognitive function in all populations including older adults (for references, see Table 6.1).

Collectively, these findings suggest that individuals who are physically active, besides lowering their risk of premature death or chronic disease and physical disability, should experience a sense of psychological well-being. The following additional conclusions can also be drawn. First, consistent with common conceptualizations of well-being as a multifaceted construct, the beneficial effects of physical activity are clearly not restricted to one outcome variable but, instead, appear to be broad (Landers and Arent 2001; McAuley and Katula 1998). Second, the beneficial effects of physical activity on the various aspects of well-being appear to extend to both genders and all age groups. Third, these benefits tend to be larger with longer interventions and for those individuals whose mental health is more compromised at baseline. Having said this, it is important to clarify that individuals without compromised mental health also receive significant benefits, albeit of smaller magnitude, given their narrower available margin for improvement. Fourth, the beneficial effects on well-being are not fully accounted for by the beneficial effects of physical activity on objective measures of physical fitness or physical function.

For example, research on health-related quality of life, particularly among older adults, has demonstrated that 'objective' (e.g. the ability to walk certain distances, climb a flight of stairs, or maintain balance) and 'subjective' measures (e.g. self-reports of pain, physical self-efficacy, or satisfaction with physical function) are not necessarily correlated and do not necessarily show the same time-course in response to physical activity interventions. Other studies have consistently shown that there is no association between activity-induced increases in physical fitness and improvements in anxiety and depression. Collectively, these findings suggest that cognitive self-appraisals of activity-related effects, which may or may not be entirely congruent with actual physical gains, constitute an important mechanism by which physical activity influences quality of life and well-being. Fifth, studies that, based on the assumption that the 'active ingredient' in physical activity interventions is the *aerobic* training, used control groups involving non-aerobic activities, such as stretching and toning (strength training), have shown that reductions in anxiety and depression were similar, regardless of the aerobic or non-aerobic nature of the activity. These findings clearly point to alternative explanations, including the possibility that these psychological benefits are influenced by social interactions or the participants' perception that they are actively taking control of their mental and physical health.

Although, as noted earlier, most literature reviews have concluded that habitual physical activity entails substantial benefits for various aspects of well-being, the research picture is complicated, so it is necessary to examine the findings from a critical standpoint. As a case in point, consider the arguably most complete study of the effects of physical activity on depression (Blumenthal *et al.* 1999). In this study, 156 men and women, 50 years of age or older, who had been diagnosed with major depressive disorder, were randomly assigned to one of three 16-week treatment conditions: (1) exercise (3 sessions per week, lasting for 45 minutes each, at 70–85% of heart rate reserve); (2) antidepressant medication (using the popular serotonin reuptake inhibitor sertraline hydrochloride or Zoloft™); or (3) a combination of the exercise and antidepressant treatments. The drop-out rates at the end of the 16-week period were not significantly different between the three groups (26%, 15%, and 20% for groups 1, 2, and 3, respectively). At the end of the treatment period, both clinician-rated and self-reported levels of depression were reduced compared to baseline, with no significant differences between the groups. A similar result was also found for anxiety, self-esteem, life satisfaction, and dysfunctional attitudes. At the 10-month follow-up (6 months after the conclusion of treatment), self-reported depression scores were also not different across the three groups. However, based on DSM-IV criteria and clinician ratings (a Hamilton Rating Scale score higher than 7), the participants in the exercise group had a lower rate of depression (30%) than those in the medication (52%) and combined-treatment groups (55%). Furthermore, of the participants who were in remission after the

initial 16-week treatment period, those who had been assigned to the exercise group were more likely to have partly or fully recovered after 6 months than those in the medication and combined-treatment groups (Babyak *et al.* 2000). The authors discussed these findings stating that exercise helps participants develop 'a sense of personal mastery and positive self-regard', whereas the exclusive reliance on or the inclusion of medication 'may undermine this benefit by prioritising an alternative, less self-confirming attribution for one's improved condition' (Babyak *et al.* 2000, p. 636).

On the one hand, this study overcame several of the methodological shortcomings of earlier studies, having an adequate sample size, including both men and women, and examining individuals who were depressed at baseline rather than a convenience sample. Furthermore, the study involved reasonably long treatment and follow-up periods, two comparison conditions, and more than one standard measure of the main outcome variable (i.e. both self-reports and clinician ratings of depression). Finally, as Lawlor and Hopker (2001) noted in their review, the Blumenthal *et al.* (1999) study did involve an 'intention to treat' analysis, thus accounting for the possible biasing effects of the less-than-perfect adherence and often substantial drop-out rates commonly associated with exercise and medication interventions.

On the other hand, this study could not address other persistent problems, some of which seem to be unavoidable (Morgan 1997). First, there was a selection bias, since the participants were all volunteers who responded to advertisements for a research study of 'exercise therapy for depression'. It has been shown that the expectation of psychological benefits from physical activity can significantly influence the outcome (Desharnais *et al.* 1993). Babyak *et al.* (2000) also commented on the possible presence of an 'anti-medication' bias among some participants. Perhaps associated with volunteerism, the participants were also highly educated and physically healthy. Furthermore, the possibility of 'spontaneous recovery' cannot be excluded since there was no no-treatment control condition. The reason for this is that there can be no true 'placebo' exercise intervention, leaving only control conditions that are of questionable meaningfulness (e.g. wait list), since they fail to control for expectancy. Moreover, since the exercise was conducted in a group environment, it is possible that the beneficial effects of exercise were partly or fully mediated by the factor of social interaction. Finally, there is no way to fully account for treatment cross-overs that can take place during the follow-up period (e.g. participants opting to switch or discontinue treatments). These limitations, which are clearly not trivial, underscore the fact that even large, costly, and well-designed studies that produce seemingly robust results supporting the beneficial role of physical activity should be viewed cautiously.

In addition to the continued efforts to design methodologically stronger randomized clinical trials, research is also being conducted on several other fronts. One important area of research deals with the delineation of the shape of the

relationship between the 'dose' of physical activity (i.e. frequency, session duration, intensity) and the psychological response. In the case of depression and anxiety, which are the most intensely studied outcomes of habitual physical activity, the current conclusion is that 'there is little evidence for dose-response effects, though this is largely because of a lack of studies rather than a lack of evidence' (Dunn *et al.* 2001, p. S587).

### **Psychological effects of single bouts of physical activity**

Findings that people report 'feeling better' after they participate in a session of physical activity, regardless of how this 'feel-better' effect is operationally defined and largely regardless of the characteristics of the physical activity stimulus and the participants, are remarkably robust. The most common methodological approach in this line of research has been the assessment of psychological states, using multi-item inventories, before and after a bout of physical activity and some control condition, typically a sedentary one (e.g. reading an article or participating in an arts and crafts class). Compared to these control conditions, physical activity has consistently been shown to be associated with reductions in state anxiety and improvements in various mood states, such as decreases in tension and depression and increases in vigour (Landers and Arent 2001; Tuson and Sinyor 1993; Yeung 1996). The publication of studies that follow this basic paradigm (and produce similar, positive results) has continued unabated for over 3 decades, having generated a literature that now contains literally hundreds of reports.

As was the case with research examining the effects of habitual physical activity, studies on the effects of single sessions of activity also have limitations, both conceptual and methodological. One example is the fact that the aforementioned operational definitions of the 'feel-better' effect (i.e. mainly self-reports of state anxiety and mood states) were chosen not because these had been demonstrated to be the only or the strongest changes associated with physical activity but rather due to the fact that these could be assessed by available self-report measures when this research got under way (i.e. in the early 1970s). Consequently, even though the positive changes in these variables have been replicated in numerous studies, it remains unclear if these are the only or the most experientially salient changes that occur in response to physical activity under various conditions.

Another consequence is that very little attention was paid over the years to distinctions between the various constructs that fall under the affective umbrella, such as prototypical emotions, moods, and core affect (Ekkekakis and Petruzzello 2000; Russell 2003), yet these distinctions are clearly important. Emotions, such as state anxiety or pride, and moods, such as irritability or cheerfulness, rely on cognitive appraisals, whereas core affect, such as tension or calmness, could emanate from the body in a direct, cognitively unmediated fashion. These differences imply



that not all facets of the response to a session of physical activity are necessarily subject to the same mechanisms or likely to follow a unified pattern.

Furthermore, as a consequence of using standard self-report measures of state anxiety and mood states that contain a relatively large number of items (typically between 20 and 65 each), change in the outcome variables was assessed from before to various time points after the termination of the activity. Logically, this practice would make sense only if the trajectory of change during the intervening period were linear. However, it has become clear that, in many cases, the changes are nonlinear, particularly as the intensity of the activity increases or the duration progresses (e.g. consisting of a curvilinear decline during the activity, followed by an instantaneous rebound after the end). Thus, a pre-to-post assessment protocol would clearly misrepresent the changes that take place in the interim.

An important consequence of failing to recognize that such dynamic changes might occur has been the inability to identify a consistent pattern of dose-response effects. Despite the fact that, as anyone with any physical activity experience can attest, different intensities and/or durations of physical activity will likely lead a participant to experience a gamut of experientially different responses, possibly including both pleasant and unpleasant ones, 30 years of research have failed to provide reliable evidence for such an effect (Ekkekakis and Petruzzello 1999).

Finally, contrary to the assumption that all or most individuals would respond to physical activity in the same direction (presumably, with changes toward a more pleasant state), it has become apparent that, under certain conditions, it is possible for some participants to respond with changes toward pleasure and others with changes toward displeasure. For example, a study involving cycling for 30 minutes at 60% of the participants' maximal capacity, showed that approximately half reported feeling progressively better and half reported feeling progressively worse (Van Landuyt *et al.* 2000). Nevertheless, given the enormous multitude of interacting influences on affective responses (e.g. physical and social conditions, exercise intensity and duration, and the physiological and psychological traits of the participants), the proportions of individuals who respond positively and negatively under various conditions remain extremely difficult to predict.

As these and other limitations became apparent, more recent studies have started to investigate the affective changes associated with single sessions of physical activity using a new conceptual and methodological platform. The primary characteristics of this new approach have been: (1) the conceptualization and assessment of affective changes not in terms of distinct states but rather in terms of broad dimensions, such as those comprising the circumplex model of affect, namely pleasure-displeasure and activation (Ekkekakis and Petruzzello 1999, 2002); (2) the repeated assessments of these dimensions both during and after the sessions of activity; and (3) the examination of individual patterns of change. These studies have produced the first

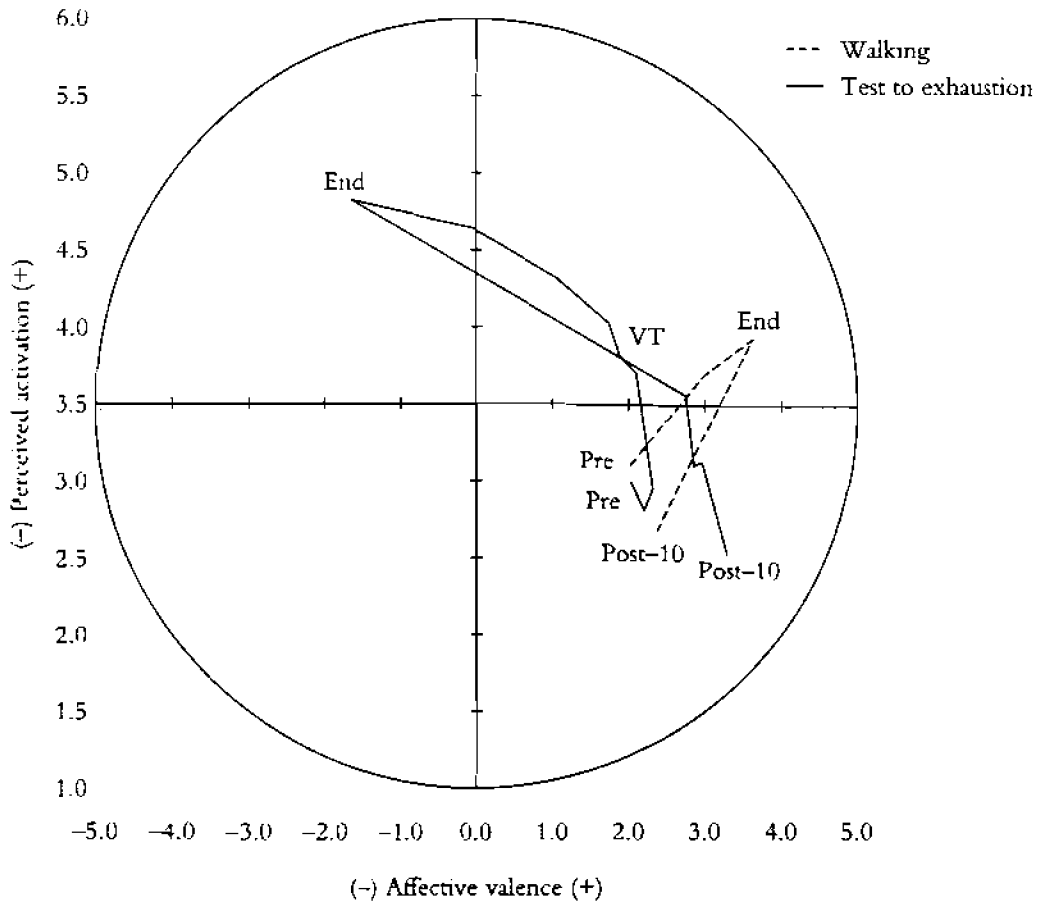
reliable evidence of a specific relationship between the intensity of physical activity and affective responses, showing that the level of intensity corresponding to the transition from aerobic to anaerobic metabolism appears to be the 'turning point' toward displeasure during physical activity (Acevedo *et al.* 2003; Bixby *et al.* 2001; Ekkekakis *et al.* 2004; Hall *et al.* 2002). This is an important physiological landmark, since the metabolic resources that are available to anaerobic metabolism are limited and exceeding the point of transition entails the inability to maintain a physiological steady state (i.e. a continuous rise in heart rate, oxygen uptake, and lactic acid concentration) and a multitude of physiological adjustments as the body approaches fatigue and exhaustion. Below this transition, affective changes tend to be mostly pleasant. However, above this transition, there is a gradual decrease in pleasure and, ultimately, an increase in displeasure. However, once physical activity is stopped, there is a rapid increase in self-rated pleasure, regardless of whether this response represents a *continuation* of a positive trend or a *rebound* from a negative trend during the activity (Bixby *et al.* 2001). Examples of affective responses to two physical activity stimuli of markedly different intensities, one treadmill walk at a self-chosen pace (lasting 15 minutes) and a treadmill test involving gradual increases of the speed and grade until the point of volitional exhaustion (lasting 11.3 minutes), are shown in Fig. 6.1 (see caption for more details).

### **Mechanisms underlying the psychological benefits of physical activity**

An important area of research in exercise psychology focuses on the mechanism(s) by which physical activity benefits well-being. Establishing one or more plausible mechanisms could help to show that the relationship between physical activity and well-being goes beyond statistical association, providing evidence that physical activity can, in fact, *cause* positive changes in well-being. Unfortunately, this research has traditionally been fragmented, reflecting dualistic thinking, with some researchers seeking explanations in *psychological* mechanisms, others seeking explanations in *physiological* mechanisms, and virtually no efforts aimed at integrating the two.

As noted earlier, cognitive appraisals of agency, mastery, control, or self-efficacy have long been theorized to underlie the beneficial effects of physical activity on various aspects of well-being. For example, studies designed to manipulate the known sources of self-efficacy (i.e. prior accomplishments, vicarious experiences, verbal persuasion, and physiological arousal) have shown congruent changes in affective parameters, both in single sessions of activity and in long-term participation (McAuley 1991).

According to another psychological mechanistic hypothesis, physical activity can enhance well-being by providing a distraction or a 'time-out' from daily hassles and worries. This explanation was based on a finding that exercise, meditation, and quiet rest for equal periods of time were all accompanied by similar reductions in



**Fig. 6.1** Affective responses to two bouts of physical activity, plotted in circumplex space, where the horizontal dimension represents affective valence, ranging from displeasure (left) to pleasure (right) and the vertical dimension represents perceived activation, ranging from low (bottom) to high (top). Both dimensions are assessed by self-ratings. 'Pre' indicates the beginning of each activity, 'End' indicates its end, and 'Post-10' indicates a time point 10 minutes after the end. A 15 minute treadmill walk at a self-chosen pace on the treadmill results in an activated pleasant state during and immediately after its completion, whereas a 10 minute seated recovery period leads to a low-activation pleasant state. A treadmill test, lasting on average 11.3 minutes, during which the speed and grade are gradually increased until the point of volitional exhaustion, leads to an activated unpleasant state, whereas a subsequent cool-down and 10 minute seated recovery period bring about a return to a low-activation pleasant state. Notice that the ventilatory threshold (indicated by VT), a marker of the transition from aerobic to anaerobic metabolism, appears to be the turning point toward displeasure during the treadmill test (see text for additional information). (Plotted with data from Ekkekakis *et al.* (2000) and Hall *et al.* (2002).)

state anxiety (Bahrke and Morgan 1978). Given that these three tasks had no similarities other than giving participants the opportunity for a break, researchers assumed that this common ingredient was the key to reducing state anxiety. However, if the assessment of the affective outcomes is extended beyond the single variable of state anxiety, it becomes clear that physical activity leads to affective responses that differ substantially from those associated with sedentary tasks, with physical activity leading, at least initially, to a high-activation pleasant state (e.g. energy, excitement) and sedentary or relaxing activities leading to a low-activation pleasant state (e.g. calmness,

serenity). Given this qualitative difference, the explanation that physical activity leads to an enhanced affective state simply because it provides a distraction from worries becomes unlikely.

A third psychological explanation is that, given the fact that in most studies physical activity takes place in groups, physical activity can enhance the sense of well-being by providing an opportunity for social interactions. Although this explanation remains possible, it cannot be considered the only explanation, primarily because of studies that have shown positive affective responses to physical activity even if the activity takes place in social isolation and in the relatively dull environment of a laboratory. Furthermore, studies have shown that the presence of others does not necessarily have a positive influence on affect, as individuals concerned about their appearance may respond with increased anxiety when exercising in a social setting (Focht and Hausenblas 2003).

Of the physiological explanations, perhaps the most intuitively appealing proposes that the positive effects of physical activity on well-being are consequences of its well-established effects on physical fitness, including cardiorespiratory endurance, strength, and flexibility. Specifically, it is assumed that a physically active individual will 'feel better' because he or she is able to do more things more efficiently, avoid health problems (such as obesity or chronic debilitating diseases), and, importantly, maintain these abilities into old age. This hypothesis seems particularly relevant to how physical activity benefits health-related quality of life. However, as noted earlier, several studies have failed to provide evidence of an association between objectively quantified physical gains, such as improvements in endurance or strength, and changes in well-being. Therefore, what remains as a viable explanation at this point is that the beneficial effects of physical activity on well-being might be mediated by the perceived, rather than the objective, physical and physiological changes associated with physical activity participation.

The studies that have focused on brain mechanisms have usually taken one of two approaches. In one, physical activity is viewed as an appetitive stimulus (akin to tasty food or addictive drugs) and, consequently, what is being sought is the mechanism by which it is experienced as pleasant or rewarding. Studies that have followed this approach have considered primarily brain areas known to be involved in pleasure and reward, focusing particularly on the mesolimbic dopaminergic pathway projecting from the ventral tegmental area of the midbrain to the nucleus accumbens. In the second approach, physical activity is viewed as an intervention modality capable of correcting imbalances in brain neurotransmission commonly associated with anxiety and depression, in a manner analogous to that of centrally acting drugs. For example, modern antidepressant medications (serotonin-specific reuptake inhibitors or SSRIs) work mainly by blocking the reuptake pumps that collect serotonin from the synaptic cleft back into the releasing neuron, thus leaving more serotonin available to attach to receptors on the receiving neuron. Using

techniques such as microdialysis, which allows the collection of extracellular fluid from specific locations in the brain of free-living animals, studies have shown that exercise appears to have an effect similar to that of the SSRIs, raising the levels of serotonin (Meeusen and De Meirleir 1995; Meeusen *et al.* 2001).

But perhaps the most widely known mechanism for the 'feel-better' effects of physical activity is the 'endorphin hypothesis', popularized through numerous press reports over the years. The popularity of this hypothesis can be attributed to the coincident timing of several events. First, the isolation of endogenous opioids was quickly followed by the discovery that the level of these opioid substances is raised following vigorous exercise. Then, this happened to coincide with the developing exercise craze during the second half of the 1970s and anecdotal reports of what became known as the 'runner's high' phenomenon. Eager journalists (and some overzealous scientists) hastily made the connection that the natural opioids must be responsible for the 'high'. From a research standpoint, this connection has proven infinitely more difficult to make and the literature has by no means yielded an unequivocal answer (Hoffmann 1997). What seems clear is that peripherally circulating opioids (beta-endorphin from the pituitary and beta-enkephalin from the chromaffin cells of the adrenal medulla) have limited, if any, central effects and do not reflect the dynamics of brain opioid neurotransmission. On the other hand, brain opioids, which can be experimentally manipulated by blocker agents such as naloxone and naltrexone, may have a role in exercise-associated affective responses. Even if their role is not to directly induce pleasure, central opioids have been shown to have an attenuating effect on cardiovascular and respiratory responses to exercise. Through that, they can potentially suppress symptoms associated with perceived exertion (e.g. heart rate, blood pressure, ventilation), which is, in turn, closely linked to affect at strenuous levels of exercise intensity. Furthermore, descending opioidergic neurons, originating primarily in the periaqueductal grey and activated by high levels of stress, can regulate the flow of bodily sensory cues that ascend the spinal cord and enter the brain.

Finally, a recently proposed hypothesis is aimed at explaining the changing affective responses to increasing levels of physical activity intensity (Ekkekakis 2003). According to this hypothesis, affective responses to physical activity are shaped by evolution and are the product of the continuous interaction of social-cognitive factors (such as physical self-efficacy) and interoceptive factors (such as respiratory and muscular cues). The relative influence of these two factors on affect is hypothesized to change systematically as a function of the intensity of the activity, with the former being dominant at low and mid-range intensities and the latter gaining dominance at high and near-maximal intensities. This hypothesis also has some implications for interventions aimed at controlling some unpleasant responses to physical activity, particularly among beginner exercisers. According to the hypothesis, cognitive techniques, such as attentional dissociation, cognitive reframing, or boosting

self-efficacy, can only be expected to be effective when the intensity of the activity presents an appreciable but not yet overwhelming challenge but not when it reaches high or near-maximal levels.

### **Expanding the focus: the psychosomatic benefits**

Although the vast majority of research on the health benefits of physical activity has been conducted along either *physiological* or *psychological* lines, some studies have taken a more interdisciplinary approach by examining health and well-being from a psychosomatic perspective. The influence of psychosocial factors in the pathogenesis of the two leading causes of death in Western societies, namely, coronary heart disease (Krantz and McCeney 2002; Rozanski *et al.* 1999) and cancer (Kiecolt-Glaser and Glaser 1999), is fairly well established. It is also well established that the two psychoneuroendocrine systems, namely, the sympathetic-adrenomedullary (SAM) axis and the hypothalamic-pituitary-adrenocortical (HPA) axis, are the main mediators in the relationship between psychosocial stress and pathogenesis (Chrousos 1998; Chrousos and Gold 1998; Tsigos and Chrousos 2002).

Unlike pharmacological and psychotherapeutic interventions, physical activity appears to offer the unique advantage of being able to produce beneficial changes in both the psychosocial variables (by reducing depression and anxiety and increasing perceived control) and the neuroendocrine variables (by producing a more adaptive pattern of hormonal responses to stressors). Therefore, two lines of research have emerged, one focusing on physical activity-induced changes in neuroendocrine and cardiovascular responses to psychosocial stressors (Sothmann *et al.* 1996) and one focusing on physical activity-induced changes in the relationship between psychosocial stress and immune function (Hong 2000; LaPerriere *et al.* 1994; Perna *et al.* 1997). The starting point for both of these lines of research is the numerous findings in the last 15 years that physical activity offers significant protection from mortality associated with cardiovascular disease and various types of cancer. The question is whether part of this beneficial effect is due to physical activity-induced changes in how stress impacts the pathogenesis and progression of these diseases.

Conceptually, based on studies focusing on neuroendocrine responses to exercise stimuli among trained and untrained individuals, physical activity and fitness should be associated with an adaptive overall pattern of responses to stressors. Such a pattern would consist of an attenuated elevation of catecholamine levels (the end-products of the SAM axis) and a rapid return to baseline, reduced basal levels and stress-induced responses of cortisol (the end-product of the HPA axis), and an enhanced production of endogenous opioid peptides. These changes, if they manifested themselves in response to daily psychosocial stressors, could help physically active and fit individuals buffer the harmful effects of stress (Jonsson 2000;

LaPerriere *et al.* 1994; Perna *et al.* 1997). Yet, research has once again shown that the complexity of these relationships is far greater than one might have expected. For example, cortisol does not always have an immunosuppressive effect (McEwen *et al.* 1997). Opioids do not always have an immunoenhancing effect (Ris Dahl *et al.* 1998). And physical training does not necessarily lead to an attenuated cortisol (Chennaoui *et al.* 2002; Droste *et al.* 2003) or catecholamine (Peronnet and Szabo 1993) response to psychosocial stressors. Nevertheless, the hypothesis that part of the effectiveness of physical activity for reducing mortality from cardiovascular disease and cancer is due to its effects on stress mechanisms remains viable and certainly warrants additional research. A prominent example is a series of studies showing that physical activity reduces anxiety and depression, improves quality of life, and enhances immunocompetence in individuals suffering from HIV (LaPerriere *et al.* 1990; Rojas *et al.* 2003; Stringer *et al.* 1998).

## **Physical activity: why we do or don't**

A fundamental question concerning many health behaviours—and physical activity is no different—is why people do or do not participate. If physical activity is so ‘good for you’, yet a clear majority of the adult population fail to meet current guidelines of healthy physical activity,<sup>1</sup> it is important to understand the key correlates of an active lifestyle.

### **Key determinants/correlates**

Researchers interested in factors associated with physical activity have typically categorized such ‘correlates’ or ‘determinants’ into personal or demographic, psychological, social, and environmental factors (Sallis *et al.* 2000; Trost *et al.* 2002).

#### **Personal/demographic correlates**

There are consistent positive trends for leisure-time physical activity in adults to be associated with male gender and higher levels of education and socio-economic status, but negatively associated with non-White ethnicity and age (Trost *et al.* 2002), with similar trends in youth. Such gender differences are highly reproducible and one of the most consistent findings in the literature. Promoting physical activity in girls seems a particular challenge, although trials with adults suggest that more women than men show interest in taking part (Mutrie *et al.* 2002).

#### **Psychological correlates**

Psychological correlates of physical activity have been studied quite extensively. There are two main types of studies: those using descriptive approaches whereby

<sup>1</sup> Typically, guidelines for adults are to participate in 30 minutes of moderate intensity physical activity on most (5) days of the week, that is 150 min/week (Department of Health 2004; Pate *et al.* 1995).

psychological variables are assessed alongside physical activity and those that use a theoretical model. The latter enable us to build knowledge and understanding of how and why people might be motivated or not ('amotivated') to adopt and/or maintain a physically active lifestyle. Descriptive studies can be helpful in developing more explanatory research designs.

One intuitively obvious motive is enjoyment. Those who are active tend to report higher levels of enjoyment than those who participate less. However, this may mask a number of issues. First, enjoyment can cover many things. Some may report enjoyment because of the social aspects of participating, others for reasons of positive well-being. In addition, research suggests that people exercise less for intrinsic fun, but more for the satisfaction in meeting valued goals, such as weight control, feeling better, or social connectedness (Chatzisarantis *et al.* 2003).

The development of exercise psychology as a thriving research field has led to the proliferation of theories borrowed from other areas of psychology (Biddle and Mutrie 2001). In particular, theories tested in social and health psychology have been utilized. To help make sense of the different approaches, it is useful to view theories as falling into four categories. There are theories focused on: (1) beliefs and attitudes; (2) perceptions of competence; (3), perceptions of control; and (4) decision-making processes. Although these divisions are not always clear-cut, they may help readers better organize the field (Biddle and Nigg 2000).

Belief/attitude theories test the links between beliefs, attitudes, intentions, and physical activity, such as the theory of planned behaviour. Evidence shows that intentions are predicted best by attitudes and perceived behavioural control, and rather less so by subjective (social) norms (Hagger *et al.* 2002). However, research tends to show that intentions are far from perfect predictors of behaviour, and one could argue that greater emphasis is needed on how to translate intentions into behaviour. Competence-based theories focus on perceptions of competence and confidence as a prime driver of behaviour, such as in self-efficacy approaches (Bandura 1997; McAuley and Blissmer 2000). Early attempts in exercise psychology favoured theories of perceived control, such as locus of control (Rotter 1966). These yielded small effects or were inadequately tested so researchers searched for other control-related constructs (Biddle 1999; Biddle and Mutrie 2001). One that has been popular is the self-determination theory advocated by Deci, Ryan, and colleagues (Deci and Flaste 1995; Deci and Ryan 1985; Ryan and Deci 2000*a, b*; Williams *et al.* 2000) and applied to physical activity by others (Chatzisarantis *et al.* 2003). Research shows that motivation for physical activity is likely to be more robust if it involves greater choice and self-determination rather than external control. In addition, such an approach is likely to lead to feelings of higher well-being.

Finally, decision-making theories have recently been favoured, and the transtheoretical model (TTM) of behaviour change has grown in popularity (Marshall and Biddle 2001). The TTM was developed as a comprehensive model of behaviour



change and was initially applied to smoking cessation (Prochaska and DiClemente 1982). It incorporates cognitive, behavioural, and temporal aspects of changing behaviour. The TTM applied to physical activity consists of the stages of change, the processes of change, decisional balance (weighing up the pros and cons of change), and self-efficacy. The stage of change is the time dimension along which behaviour change occurs. The stages are:

- ◆ precontemplation: no intention to start physical activity on a regular basis;
- ◆ contemplation: intending to start physical activity on a regular basis, usually within the next 6 months;
- ◆ preparation: immediate intention (within the next 30 days) and commitment to change (sometimes along with small behavioural changes, such as obtaining membership at a fitness club);
- ◆ action: engaging in regular physical activity but for less than 6 months;
- ◆ maintenance: engaging in regular physical activity for some time (more than 6 months).

The processes of change are the strategies used to progress along the stages of change. The processes are divided into cognitive (thinking) and behavioural strategies. For example, people might seek information on physical activity and mood enhancement (cognitive strategy) or post a note on the refrigerator door to remind them to walk that day (behavioural strategy). We found that both types of strategies tend to be used throughout the change cycle (Marshall and Biddle 2001), probably due to individual preferences.

### Social and environmental correlates

Social support appears to be associated with physical activity in adults and youth. Trost *et al.*'s (2002) review suggested that social support from friends/peers and family/spouse was particularly important. In addition, the influence of one's GP (family physician) plays a role, particularly for adults, as may the teacher or trainer in group exercise sessions. The 'motivational climate' created by such a leader may be vital in determining whether people return for future sessions (Ntoumanis and Biddle 1999). Evidence suggests that the most positive climate will be when the exercise leader encourages cooperation and rewards effort over comparative performance.

The influence of school settings and local media may also help or hinder activity. For example, physical activity may be more likely in a school that encourages staff and pupils to be active and has a 'healthy school' policy and positive adult role models, although many of these likely influences lack robust supporting data. In addition, it is not clear to what extent the social setting influences positive mood during or after exercise.

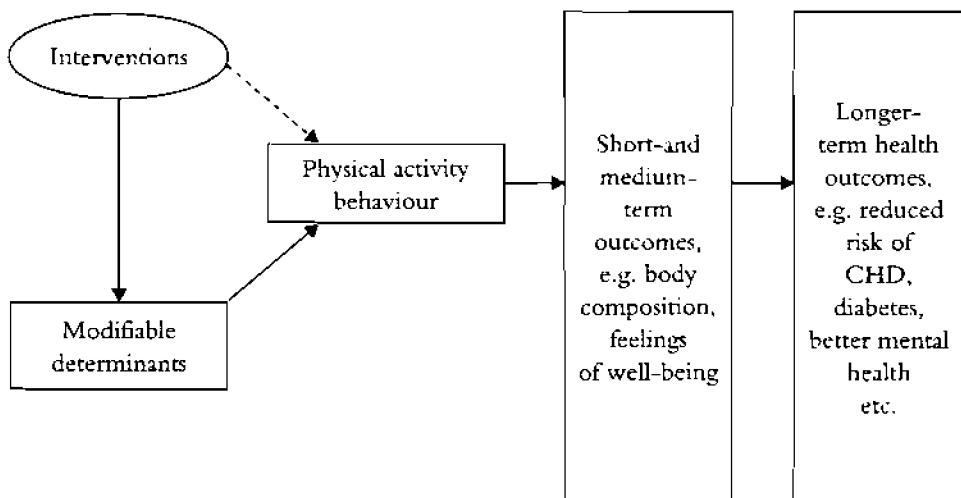
Environmental correlates of physical activity have only been studied quite recently. Trost *et al.*'s (2002) review showed that 11 new environmental variables

had been studied since a review of correlates published in 1999. There was weak or mixed support for an association of most variables with physical activity. A recent review of environmental correlates of walking in adults (Owen *et al.* 2004) found 18 studies. From these, it was concluded that walking was associated with aesthetic attributes; convenience of facilities, such as trails; accessibility of destinations, such as shops; and perceptions of traffic and busy roads. However, the authors concluded that the current evidence is 'promising, although at this stage limited' (p. 75). It is likely that facilities, including open spaces and parks, are only part of a solution to increase physical activity levels. Other factors include previous experiences of physical activity and current level of fitness.

## Interventions: what works?

The behavioural epidemiological framework suggests that interventions should follow from the identification of correlates or determinants. One reason is that effective interventions are the result of manipulating and changing the antecedent of behaviour as a precursor to actual behaviour change. This is illustrated in Fig. 6.2. Interventions, however, can occur at several levels, including the individual, group, and community. Interventions at societal or national level can also be identified, such as governmental policy initiatives (Bull *et al.* 2004).

Individual-level interventions typically involve advice-giving, such as by your family doctor (GP), or through counselling for behaviour change. These strategies might be based on the TTM with the aim to 'tailor' strategies and advice to fit the individual's stage of decision-making. For example, it would seem unnecessary to give much educational information about the benefits of physical activity to those looking to move from the action to the maintenance stage, whereas such a strategy



**Fig. 6.2** A conceptual framework showing links between an intervention, determinants/correlates, and physical activity behaviours and outcomes. CHD = Coronary heart disease. (Adapted from Kahn *et al.* 2002.)

is likely to be key to moving a pre-contemplator to contemplation. Sometimes it is possible to deliver such types of intervention in small groups.

A popular intervention setting is that of primary health care (PHC). Given the importance attached to advice from health care professionals, and GPs in particular, as well as the regularity with which many visit their PHC facility, it seems an appropriate setting in which to test the effectiveness of individually oriented counselling approaches.

There are lessons to be learned from studies in primary care that have focused on improving health behaviour in general and not just physical activity. For example, Steptoe *et al.* (1999) reported on a large-scale trial of the use of behaviourally oriented counselling for primary care patients at increased risk of coronary heart disease. The intervention group received counselling from the practice nurse who had been trained in an approach based on the TTM. At both 4 and 12 months, the intervention group, in comparison to the control group, had a favourable reduction in cigarette smoking, reduction in fat intake, and increased physical activity. This study demonstrated that physical activity, and other health behaviours, can be influenced by a counselling approach in the primary care setting. Beneficial changes in physical activity have also been noted in a similar trial in New Zealand (Elley *et al.* 2003). Physical activity of older adults in Finland has also been shown to be strongly associated with opportunistic advice given by health care professionals (Hirvensalo *et al.* 2003).

Project PACE (physician-based assessment and counselling for exercise), in the USA, has also used the TTM to design short interventions delivered by GPs (Patrick *et al.* 1994). The intervention consisted of brief (3–5 minutes) counselling with each patient where pros and cons, self-efficacy, and likely processes (strategies) might be assessed and discussed. The counselling focused on the benefits and barriers to increasing activity, self-efficacy, and gaining social support for increasing activity. The strategies differed depending on the stage of exercise behaviour of each patient; thus the intervention was stage-matched. Physicians themselves find the PACE tools acceptable (Long *et al.* 1996) and a randomized controlled trial showed that the PACE interventions did increase physical activity, particularly walking (Calfas *et al.* 1996).

Two major reviews of interventions aimed at PHC or related settings are now available. Riddoch *et al.* (1998) located 25 papers from the UK. They concluded that 'the majority of studies report some form of improvement in either physical activity or related measures. However, the size of the effect is generally small, and there is no real consistency across studies' (p. 25).

Although not restricted to primary health care, Simons-Morton *et al.* (1998), in their review of interventions in health care settings, concluded that 'interventions in health care settings can increase physical activity for both primary and secondary prevention. Long-term effects are more likely with continuing intervention and

multiple intervention components such as supervised exercise, provision of equipment, and behavioral approaches' (p. 413).

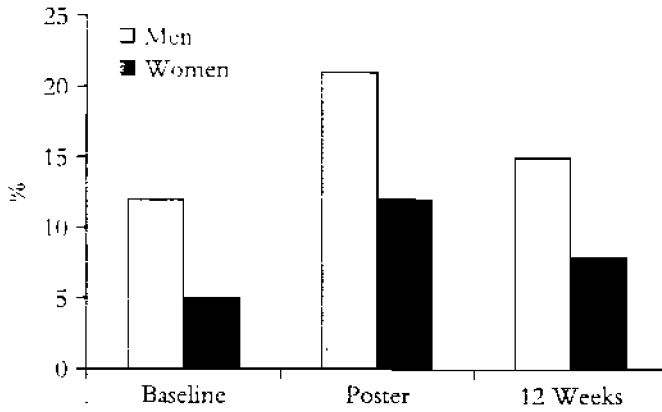
Kahn *et al.* (2002) also reviewed what they called 'individually adapted' programmes. The interventions were often delivered by people through outlets such as phone or mail. Reviewing 18 such studies, they concluded that there was strong evidence for effectiveness and good applicability across diverse settings and populations. They located some evidence for economic effectiveness but warned that successful interventions of this type require careful planning, well-trained staff, and adequate resources.

Perhaps somewhat surprisingly given their profile in the media, personal trainers have been poorly studied as a motivational tool. This may be due to their probably small influence at the level of public health. Few can afford such intense interventions and they remain a marginal strategy for population health gains.

### **Social–environmental interventions**

Ecological models of health suggest that behaviour is determined by multiple influences, including individual, social, and environmental factors (Sallis and Owen 2002). To date, most interventions target the individual or social (e.g. community walking groups) level. However, more recently, interest has grown in the potential of effective interventions at the level of the environment (Owen *et al.* 2000). Sallis *et al.* (1998) suggest that environmental interventions might include those aimed at both the natural and constructed environment. The former might include providing additional indoor facilities for physical activity in places where the weather may preclude or inhibit participation outside, or the lighting of walking or ski paths in the winter. Constructed environment factors might include interventions aimed at the transport infrastructure, suburban environments for walking, the workplace, or specialized facilities.

One of the most successful environmental interventions is the placing of signs in public places to encourage stair climbing (Kahn *et al.* 2002). One example is the study by Blamey *et al.* (1995) in which they aimed to discover if Scottish commuters would respond to motivational signs encouraging them to 'Stay healthy, save time, use the stairs'. The signs were placed in a Glasgow city centre underground station where stairs (30 steps) and escalators were adjacent. Eight observation weeks were split into four stages: a 1-week baseline; a 3-week period when the sign was present; a 2-week period immediately after the sign was removed; and two 1-week follow-ups, during the fourth and twelfth weeks after the intervention. Observers recorded the number of adults using the escalators and stairs and categorized them by gender. Those carrying luggage or with pushchairs were excluded. A comparison was made between the baseline week stair use and each of the seven subsequent observation weeks.



**Fig. 6.3** Stair climbing before (baseline), during (poster), and after (12 weeks) a poster intervention encouraging stair use in favour of escalator use (data from Blamey *et al.* 1995).

Stair use during the 1-week baseline period was around 8%. This increased to the order of 15–17% during the 3 weeks that the sign was present (Fig. 6.3). Stair use significantly increased after the signs were in place and continued to increase during the three intervention weeks. A sudden decrease in stair use occurred once the sign was removed. At the 12-week follow-up, stair use remained significantly higher than at baseline. There is, however, an obvious downward trend suggesting a possible eventual return to baseline levels. The results do show, however, that a motivational sign positively influenced stair use, and similar studies have shown supportive findings (Kerr *et al.* 2001).

## Future directions for research

Great progress has been made in the past few years in the field of exercise psychology. However, inevitably there remain a number of significant research issues that require attention. These include the following.

- 1 Larger and better designed trials are required to investigate the effects of physical activity on various indices of psychological well-being.
- 2 There must be continued efforts to improve on the methodologies adopted for such trials, including controlling for expectancy effects and other likely influencing factors.
- 3 Further efforts are required to delineate likely mechanisms of the ‘feel good effect’ of physical activity and integrating psychological with somatic-based mechanisms.
- 4 More evidence is required on the effects of physical activity on the psychological well-being of children and adolescents.
- 5 More needs to be known about whether there is a dose–response relationship between physical activity and psychological well-being. For example, the relationship between intensity of exercise and psychological effects needs further

- exploration, and other characteristics of exercise, such as type, frequency, and duration, are also understudied.
- 6 Research needs to advance understanding of how physical activity-induced changes can enhance our ability to combat harmful effects of psychosocial stress.
  - 7 Research must continue to study the diverse individual differences reported in psychological responses to exercise.
  - 8 Aspects of well-being, such as health-related quality of life, happiness, and optimism, have been understudied by exercise psychologists.
  - 9 Exercise psychology has been dominated by research concerning correlates of participation and needs to devote more energies to the study of interventions concerning participation.
  - 10 Less is known about environmental correlates of physical activity and how they might interact with other potentially influencing factors, such as socio-economic status or physical fitness.
  - 11 Interventions need wider evaluation, such as in respect to cost-effectiveness.

## Summary and conclusions

Physical activity is a significant health behaviour requiring serious research and public policy attention. Lack of physical activity has major public health consequences with huge personal, societal, and economic costs (McGinnis 1992). However, another focus is to show that physical activity has many health benefits—in other words, it is health-*enhancing* as well as disease-preventing. In a book on well-being it is important to recognize this. As a result, in this chapter, we have outlined the important psychological consequences of physical activity, what factors might be associated with physical activity participation, and how physical activity levels can be changed. Emphasis needs to continue to be placed on the importance of physically active lifestyles for the health and well-being of society.

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# The Science of Well-Being

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