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The relationship between physical activity and self-image and problem behaviour among adolescents

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Abstract *Background* Although there are a vast array of studies which have demonstrated the psychological and physical health benefits of regular aerobic exercise for adults, few studies have focussed on children and adolescents. The current study examined associations between the extent of participation in endurance sport, and self-report data on self-image, physical and psychological health and overall lifestyle in a large representative sample of German high-school students. *Method* Almost 1000 German adolescents (aged 14–18 years) were administered a comprehensive series of questionnaires aimed at assessing anxiety-depression, trait addiction, smoking and drinking behaviour, physical ill-health reports, and self-perception of self-image, parental acceptance and educational attainment. *Results* Regular practice of endurance exercise was related to a more favourable self-image. There was a strong association between participation in sports and the type of personality that tends to be resistant to drug and alcohol addiction. Physical exercise was further significantly related to scores for physical and psychological well-being. Adolescents who engaged regularly in physical activity were characterised by lower anxiety-depression scores, and displayed much less social behav-

oural inhibition than their less active counterparts. *Conclusion* It is likely that discussion of recreational or exercise involvement may provide a useful point of entry for facilitating dialogue among adolescents about concerns relating to body image and self-esteem. In terms of psychotherapeutic applications, physical activity has many additional rewards for adolescents. It is probable that by promoting physical fitness, increased physical performance, lessening body mass and promoting a more favourable body shape and structure, exercise will provide more positive social feedback and recognition from peer groups, and this will subsequently lead to improvement in an individual's self-image.

Key words adolescence – physical activity – self-image – physical health – psychological well-being – social problems – anxiety-depression

Introduction

In a comprehensive review of the literature exploring the advantages of regular physical activity [1] it has been asserted that “among a long list of postulated psychological benefits, we note positive shifts of mood state and perceived health, an increased sense of self-sufficiency, greater personal adjustment, enhanced body image, and impaired self-concept. Cognitive and perceptual processing is said to be facilitated, type A behaviour is reduced, stress management skills are improved, and overall psychological performance is bolstered. Exercise has further been recommended as a tool in the therapy of frank psychiatric ailments, including chronic depression and anxiety states”.

Unfortunately, the majority of these studies have tended to focus on adult populations, with a disregard for children and adolescents. There has been little attempt to attest to whether adolescents who exercise more regularly really display superior self-image, educational attainment, enhanced interpersonal relations,

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physical and psychological health when compared to their less active counterparts.

Some studies have demonstrated that participation in school sports programmes can have a positive immediate effect upon self-image during the adolescent years, particularly if the chosen activity is some form of team sport such as American football, soccer, handball or volleyball with a high profile among the peer group [2]. The effects of such adulation and social status may be reinforced by socially-accepted changes in body build – increases in muscularity (particularly in boys) and reductions in surplus body fat (particularly in girls) [3]. Conversely, there may be a substantial negative impact on self-image among the majority of students who (because of an unfavourable body build, or other interests) do not gain a “celebrity” position on the school team [4]. In this connection, perceived self-confidence and self-efficacy have greater influence than actual physical competence [5].

Field [6] examined the exercise habits of adolescents, as well as relationship with peers and parents, depressive tendencies, drug use and educational attainment. Individuals who exercised more reported better relationships with parents (greater quality, increased touching and intimacy), less depression, less frequent use of drugs and higher class average performance grades than the less physical active individuals. It has been suggested that since substance abuse (a major problem among young adolescents) occurs during leisure time, involvement in physical activity may serve as a healthy substitute allowing time-out and serving to enhance sense of accomplishment and self-esteem [7].

In an extensive review [8] of the literature on leisure and adolescence it was reported that over 90% of the 13- to 14-year-olds participate in weekly sport, but this level falls to 67% for males and 49% for females some 6 years later. Competitive sport and group physical pursuits become replaced by regular physical exercise in the form of swimming, jogging, aerobics or walking. Girls have been shown to drop out quickly, especially among competitive sports, presumably because of concern about bodily changes. More recent statistics published by the US Surgeon General [9] suggest that only about one-half of young American people aged 12–21 years participate in vigorous physical activity regularly, and one fourth report no involvement in vigorous activity. Only 19% of high-school students reported being physically active for 20 min or more per day in physical education classes. Moreover, physical activity declines sharply during adolescence.

Much of the analysis to date has focussed on young adults, and although endurance exercise is much more likely to have a positive impact upon long-term health, the impact of such activity upon self-image has received less attention. It seems likely that if the chosen pattern of physical activity has a favourable effect upon self-image, the student will be less likely to become involved in adverse lifestyles (smoking, drinking alcohol and abuse of drugs), but again there has been little experimental ex-

ploration of this issue. Accordingly, we have examined associations between the extent of participation in endurance sport, self-image, physical and psychological health and overall lifestyle in a substantial sample of German high-school students.

We postulated a positive association between engagement in regular physical exercise and health, and from this viewpoint we formulated five sub-hypotheses:

- H1 Young adolescents who engage in regular sporting activities will display a more favourable self-image than their sedentary counterparts;
- H2 Physically active adolescents will exhibit less negative affect, in terms of anxiety and depression, than more sedentary individuals;
- H3 Physical ailments will be less prevalent in the exercising than in the sedentary group, and this will be most apparent on those somatic scales related to physical exhaustion and tiredness (emotionality);
- H4 Individuals who report frequent problems in their social interactions with others are likely to be sedentary;
- H5 Relative to their sedentary peers, adolescents who engage in regular forms of exercise will display lower addiction scores and be less likely to smoke, to consume alcohol or to take illicit drugs.

Subjects and methods

■ Subjects and experimental plan

Data were collected from nine of the ten secondary schools in the Marl area of West Germany, a semi-rural region in the northern, Protestant part of Germany. The geographical region is typical of middle-sized urban communities in the Rhine-Ruhr industrial area. The sample included pupils from both technical schools, three secondary schools, two comprehensive schools, and two of three grammar schools. The directors of the schools were informed about the nature, aims and procedures of the assessment programme, which was conducted in accordance with a protocol reviewed by the institutional committee on human experimentation. In addition to the main survey, written material in the form of letters and survey descriptions was mailed to parents and teachers. Tests were administered between 21.02.2000 and 09.06.2000, and were limited to pupils in the 9th and 10th grades. Four trained university students were involved in conducting the questionnaire sessions. Two hours were allowed for “explanation and delivery of test instruments”, but in practice the time required to complete the questionnaires varied from 30 to 65 min. The response rate represented 63.4% of pupils of that class group in the schools sampled.

Students ranged in age from 14 to 18 years (Table 1), with a mean age (SD) of 15.6 years [0.8]. The total sample of 988 adolescents included an approximately equal proportion of boys and girls (47.2 and 52.8%, respectively). About half of the students were attending either a technical or a grammar school, and the remainder a secondary or comprehensive school. The typical one-way distance from the students’ homes to their respective schools was 3–6 km, travel being by bus, or more frequently by the parents’ car.

The questionnaires, which were written in the German language, explored socio-demographic variables (gender, age, nationality, number of siblings and educational status); family variables (e. g. self-image); mental well-being (problems of introversion and anxiety/depression); physical health (exhaustion, gastric disorders, limb pains, circulatory problems and “colds”) and a personality construct of addiction.

Table 1 Socio-demographic variables

	n	%
Gender		
Male	477	48.3%
Female	511	51.7%
Age		
14–15 years	449	45.4%
16–18	539	54.6%
Educational status		
Secondary school	213	21.5%
Comprehensive	257	26.0%
Technical-grammar	348	35.2%
Grammar	171	17.3%

Assessment of involvement in endurance sport

Involvement in endurance sport was assessed by a simple questionnaire developed by the authors (note that in Europe, the term sport covers all types of physical activity, rather than simply involvement in team sports such as soccer). Students are asked about their degree of regular, continuous involvement in general recreational activities (running, swimming and cycling). Ratings were in step-wise, graduated increments (never, seldom, often, always).

Physical health

Physical health was assessed by the Giessen Subjective Complaints List [10, 11]. This instrument comprises 59 items relating to physical ailments. Each item is rated on a 1–5 Likert scale (never, rarely, sometimes, often and always). The inventory includes items from the areas of general well-being, autonomic complaints, bodily pains, emotionality and common childhood problems. Factor analysis has previously revealed a five-factor solution of “ailments”, with seven items loading on each of the following areas: exhaustion, gastric complaints, pains in the limbs, circulatory problems and symptoms of “colds”. By aggregating scores across all items, a global measure of physical discomfort/distress is derived (alpha coefficient 0.938).

Personality: “addiction”

Liability to the development of a drug dependency was assessed using the addiction scale of Gossop and Eysenck [12]. This inventory contains 32 constituent items taken from the EPQ (Eysenck Personality Questionnaire) [13]. It is able to distinguish between normal males and male drug-dependent individuals at the probability level of 0.001. The majority of these same items were also effective in discriminating female addicts from a control group of non-addicts. The score is essentially a conglomerate of introversion, neuroticism and psychotism, and its internal reliability is satisfactory (alpha = 0.76). This measure showed a consistent significant positive association with adolescent’s self-report of drug abuse.

Psychological health (social problems and anxiety-depression)

The German version of the Achenbach Child Behaviour Checklist [14] was used to assess problem social behaviour and anxiety/depression. For this purpose, two of the eight YSR [13] scales were scored on a 3-point scale (“0” not applicable, “1” occasionally and “2” frequently): “social problems” (8 items) “anxiety/depression” (16 items relating to introversion, perfectionism, guilt-proneness, anxiety, emotionality, etc.). Alpha coefficients were 0.69 (social problems) and 0.85 (anxiety-depressive), respectively.

Social and educational attitudes

In addition to the standardised questionnaires (addiction scale of the EPQ; Achenbach’s Child Behaviour Checklist – subscales social problems, and anxiety-depression, Giessen Subjective Complaints List for Children and Adolescents), an attempt was made to extract relevant

data concerning social and school life. Eighteen items were included: school grades in German language, history or politics, mathematics, natural sciences and foreign languages; number of times school was changed, or a school year was repeated; self-image (reported level of self-satisfaction, number of friends, self-rejection and self-importance); family relationships (parental expectations, parental conflict, maternal acceptance, paternal acceptance). This section was constructed in a nationwide survey among German adolescents to monitor more transient changes in the social-educational domain. The psychometric properties of this section of the questionnaire are discussed in detail in Kirkcaldy, Siefen, Surall and Bischoff [15]. The scales had demonstrated satisfactory internal consistency and related in a meaningful way to other psychological constructs.

Self-reported use of drugs

The self-reported level of drug usage (smoking cigarettes, drinking beer [the main alcoholic beverage in this part of Germany] and using cannabis) was assessed by asking “Have you ever tried the following?” Possible responses were “never” 1; “only tried” 2, “yes, occasional usage” 3, and “yes, regular use” 4.

Statistical methods

All univariate and multivariate statistical analyses (linear discriminant analysis and ANOVA) were computed using SPSS 10 (2001). Male and female subjects indicated closely comparable exercise participation (“never” males 10.3%, females 11.2%; “seldom” males 34.2%, females 42.6%; “often” males 31.5% females 29.2%; “frequently” males 23.9%, females 17%, chi-squared (3) = 10.98, $p < 0.05$). In all initial analyses we examined the impact of the main terms gender and exercise separately, and then the interactive term gender x exercise for the first set of variables (personality, parental attitudes and health outcome). There was no evidence of a statistically significant interaction for the first set (Pillai’s trace = 0.049, $F [30, 2136] = 1.19$, $p > 0.05$), nor indeed for the physical ailment profiles (Pillai’s trace = 0.013, $F [15, 2634] = 0.75$, $p > 0.05$). Subsequent covariate analysis controlled for potentially confounding effects of gender and, if anything, the effects attributed to exercise were accentuated in consequence. Hence, we concluded that overall gender did not confound the effects attributed to exercise per se. Thus, for ease of exposition, we decided to focus on between-exercise group differences.

Associations between various levels of participation in endurance sport and the other variables have been tested by a series of discriminant analyses. Where significant differences have been demonstrated, these have been explored *post-hoc*, using the least significant difference method. Linear discriminant analysis was conducted in order to examine all personality and attitudinal variables simultaneously; this method possesses distinct advantages over the classical univariate procedure of profile analysis in the event of non-orthogonality of scales. It minimises the likelihood of making a type 1 error by adjoining multiple measures as a single cluster, thus taking into account interrelationships between dimensions, individual subject variability around the group means on the profile elements and group variability on the individual variables [16].

Results

Participation in endurance sports

One section of the questionnaire focussed on whether the subject engaged in endurance sports and, if so, to what extent. Overall, 10.7% ($n = 106$) of the students reported “never” undertaking endurance/aerobic sporting activities, 38.6% ($n = 381$) reported “seldom”, about one-third 30.3% ($n = 299$) “often” and the final 20.2% ($n = 202$) “frequently”.

For subsequent analyses, the figures vary depending on the number of respondents to a particular groups of questions.

■ Personality, parental attitudes, physical and psychological health

A between-group linear discriminant analysis was next applied to the reported levels of participation in endurance sport (Table 2). The first canonical variate [1–3] was statistically significant (eigenvalue = 0.905, chi-squared [30] = 72.12, $R_c = 0.242$, $p < 0.001$), as was the second variate (eigenvalue = 0.961, chi-squared [18] = 28.65, $p < 0.06$, $R_c = 0.155$). Overall, the profiles differed between groups (Pillai's trace = 0.074, [15, 2163] = 3.652, $p < 0.001$).

For those F-tests which were statistically significant, we have presented the figures for the highest scoring group in bold, and the lowest scoring group is shown in italics (e.g. overall physical symptoms were reported most frequently among the group of adolescents who reported “never” being involved in endurance sports) (Table 3). On all scales associated with personality and self-perceptions, individuals with differing degrees of

involvement in endurance/aerobic sports revealed quite distinct differences (Table 3). For example, although no difference in reported physical ailments was observed between the two sets of extreme groups (“never” vs. “seldom” exercising, or “often” vs. “regularly” exercising), differences were observed when comparing the “low” and “high” activity groups, with the less active individuals reporting significantly more physical complaints.

■ Physical ailments

The next stage of the analysis examined associations between participation in endurance sport and subclasses of physical ailments (Tables 4 and 5). The between-groups physical ailment profiles were compared using multivariate statistical analysis. The groups differed significantly in their respective profiles of reported physical illnesses (Pillai's trace = 0.056, $F [15, 2646] = 3.37$, $p < 0.001^{***}$).

Table 2 Relationships between participation in endurance sport, self-image and problem behaviour. Significance of relationships is tested by discriminant analysis (see text)

Group category	1 (n = 80)		2 (n = 286)		3 (n = 218)		4 (n = 143)		F (3,723)
	Never		Seldom		Often		Frequently		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Attitudes									
Self-image	5.10	2.92	5.07	2.81	5.76	2.82	6.25	2.84	6.68***
Paternal acceptance	5.30	2.96	5.29	2.89	5.85	2.99	5.55	2.74	1.72
Mathematical competency	5.06	2.99	5.53	2.76	5.59	2.69	6.06	2.92	2.31
Educational threat	5.90	3.12	5.36	2.91	5.52	2.83	5.45	2.76	0.75
Maternal rejection	5.28	3.11	5.64	2.76	5.36	2.91	5.62	2.83	0.63
Linguistic competency	4.94	3.06	5.37	2.87	5.91	2.77	5.53	2.94	2.67*
Personality									
Addiction	12.36	4.83	11.02	4.51	9.69	4.57	9.62	5.04	5.40***
Physical well-being									
Physical illness	121.34	27.13	120.86	25.94	113.58	25.36	112.53	27.67	5.09**
Psychological well-being									
Anxiety-depression	23.09	5.31	23.09	5.78	22.30	5.26	21.05	4.56	2.95*
Social problems	10.25	2.57	9.70	1.99	9.59	2.08	9.43	1.75	9.29***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 3 A post-hoc comparison of scores on the various personality scales between specific groups, classified in terms of their participation in endurance sport (Least Significant Difference Method)

	Never/seldom 1–2	Never/often 1–3	Never/frequently 1–4	Seldom/often 2–3	Seldom/frequently 2–4	Often/frequently 3–4
Addiction	0.05*	0.001***	0.001***	0.01**	0.01**	n. s.
Self-image	n. s.	n. s.	0.01**	0.01**	0.001***	n. s.
Ailments	n. s.	0.05*	0.05*	0.01**	0.01**	n. s.
Anxiety-depression	n. s.	n. s.	0.001***	n. s.	0.001***	0.05*
Social problems	0.05*	0.05*	0.001***	0.05*	n. s.	n. s.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 4 Physical ailments and participation in endurance sport. Significance of relationships is tested by discriminant analysis (see text)

Group category	1 (n = 99)		2 (n = 344)		3 (n = 268)		4 (n = 178)		F (3,885)
	Never		Seldom		Often		Frequently		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Exhaustion	27.18	8.16	25.74	7.16	24.09	6.69	23.49	7.49	8.27***
Gastric complaints	14.01	4.17	14.51	4.12	13.78	3.93	13.27	4.56	3.80**
Pains in limbs	12.67	3.89	12.74	3.94	12.39	3.89	12.53	4.17	0.41
Circulatory problems	11.39	3.83	10.72	3.96	9.75	3.60	10.00	3.74	6.33***
Cold symptoms	18.36	4.83	18.88	5.00	17.59	4.59	17.23	4.56	6.56***

* p < 0.05; ** p < 0.01; *** p < 0.001

Table 5 A post-hoc comparison of scores for various ailments between specific groups, classified in terms of their participation in endurance sport (Least Significant Difference Method)

	Never/seldom 1–2	Never/often 1–3	Never/frequently 1–4	Seldom/often 2–3	Seldom/frequently 2–4	Often/frequently 3–4
Exhaustion	n. s.	0.001***	0.001***	0.01**	0.001***	n. s.
Gastric complaints	n. s.	n. s.	n. s.	0.05*	0.001***	n. s.
Pains in limbs	n. s.	n. s.	n. s.	n. s.	n. s.	n. s.
Circulatory problems	n. s.	0.001***	0.01**	0.01**	0.05*	n. s.
Cold symptoms	n. s.	n. s.	0.06	0.001***	n. s.	n. s.

* p < 0.05; ** p < 0.01; *** p < 0.001

Smoking, drinking and drug usage

The final stage of statistical analysis focussed on self-reports of drug and alcohol consumption (Table 6); we selected categories of usage which are common among German adolescents. Overall, the groups differed significantly in drug and alcohol usage (eigenvalue = 0.961, F [9, 2373] = 4.35, p < 0.001***). Adolescents who were regularly involved in endurance sport also reported a significantly lower usage of cigarettes. There was no main effect associating “sport” and drinking beer. Conversely, cannabis use was significantly more frequent among those adolescents who “never” engaged in endurance sports.

Conclusions

The present study shows substantial associations between the regular practice of endurance sport and attitudes, personality, scores for physical and psychological well-being and the adoption of a healthy lifestyle. Nevertheless, causality should not be inferred from a cross-sectional survey of this type. It could be that a poor self-

image or impaired physical or psychological health is a cause of physical inactivity rather than the converse, or it could be that a favourable home environment gives parental encouragement of physical activity, together with a good self-image, physical and psychological health and avoidance of drug usage. Proof of a causal relationship will require further research using either a sophisticated path analysis, or a trial where a proportion of the students in randomly selected classes is persuaded to adopt an increased level of endurance sport.

As regards the mechanisms, it may be that the social aspects of physical activity among adolescents are important determinants of mental and psychological health. Vikjalmsson and Thorlindsson [17] found evidence that those adolescents who were affiliated to a sport's club displayed lower anxiety and depression scores compared to those pursuing individual sports. They concluded that the social adhesive properties of group (sport) participation may have been the key ingredients contributing to psychological well-being, rather than physical activity *per se*.

The association between sport participation and self-image is substantial and highly significant statistically. In the school context, involvement in endurance activi-

Table 6 Relationships between participation in endurance sport, drinking and drug usage. Statistical analysis is as in Tables 2 and 3

	Never 1 M	Seldom 2 M	Often 3 M	Regular 4 M	F 3,977	1/2	1/3	1/4	2/3	2/4	3/4
Smoke	2.95	2.95	2.88	2.56	5.37***	n. s.	n. s.	0.01	n. s.	0.001	0.01
Beer	3.03	2.95	2.95	2.90	0.91	n. s.	n. s.	n. s.	n. s.	n. s.	n. s.
Cannabis	2.02	1.64	1.59	1.58	6.58***	0.001	0.001	0.001	n. s.	n. s.	n. s.

Note: post-hoc between group comparisons (“LSD”) are presented on the right-hand side of the table; *p < 0.05, **p < 0.01, ***p < 0.001

ties rarely leads to the adulation that a leader of a soccer or handball team might receive from members of the opposite sex. If physical activity is indeed playing a positive causal role, it may act by increasing feelings of mastery and self-efficacy [18]. Previous investigators have noted a positive effect of curricular physical education upon academic performance [19]. The link with linguistic competency that was observed in the present study could also indicate an underlying “high-achiever” personality. In the adult world, some companies seek out people who are involved in endurance sport because they tend to be employees with an outstanding performance on the job [20]. Alternatively, being verbally more competent may reflect superior social and communication skills which may be beneficial in social sporting activities.

There is also a strong link between participation in endurance sport and the type of personality that is resistant to addictions. Surveys of the adult population have found a relatively weak impact of physical activity upon smoking habits, more obvious for those involved in endurance than in “social” sports such as tennis [21]. Some people indicate that involvement in distance running is helpful in stopping smoking, but the low percentage of smokers among this population also reflects many individuals who stopped smoking *before* they began running [22]. Several studies suggest that individuals with heavy involvement in physical activity were less likely to take up smoking than the sedentary members of this population [23, 24, 25].

Hays [26] referred to Glasser’s [27] research distinguishing between positive and negative addiction. She suggested that in contrast to negative, self-debilitating addictions such as substance abuse, the positive addiction to regular exercise such as swimming or running may serve as a replacement or distraction from smoking or alcohol abuse, strengthening an individual’s self-efficacy and enhancing their life satisfaction.

Finally, there are strong relationships between endurance activity and reported scores for physical and psychological well-being. The most significant physical complaint of sedentary individuals is exhaustion, and this could be either a consequence of a poor level of fitness (so that they have difficulty in keeping up with their fitter peers), or it could be the cause of the inactivity. Given that the analysis is based upon self-reports, a final possibility is that the more anxious members of the group engaged in symptom-reporting to a greater extent than did their more active peers [26, 28]. In regard to symptoms of the common cold, there has been much interest recently concerning possible effects of endurance exercise upon immune function [28]. The current consensus is that moderate participation in endurance exercise enhances the immune response, but that beyond an individually determined critical threshold, en-

durance activity can have a deleterious effect. The threshold for an adverse effect is generally quite high, and is unlikely to be reached except by high performance athletes, so that a favourable effect of endurance activity upon the prevalence of cold symptoms is to be anticipated in ordinary school students.

Limitation of physical activity is a common manifestation of depression; in this association, the psychological disturbance may well be the primary manifestation, and the limitation of physical activity the consequence. Furthermore, one of the limitations of our measure of physical health is that it does not ascertain the presence of an actual chronic physical illness which may conceivably have restricted opportunities for exercising (estimates suggest that 5–10% of children would fall into this category). If such is the case, however, the associations we reported will be attenuated (an underestimate of the association between exercise-health).

The magnitude of effect sizes reveals that it was problems of self-perception and social adjustment (socially avoidant temperament) and to a lesser extent the trend to anxiety-depression and exhaustion which most distinguished adolescents who were physically inactive from those who were (more or less) regularly in physical exercise.

As might be expected, parental attitudes and educational achievement did not appear to be associated with proclivity towards physical activity.

The present data support the potential therapeutic benefits of physical activity for children and adolescents. In addition to enhanced physical health, Hayes [27] has proposed that engagement in physical pursuits or discussion of recreational or exercise involvement may serve as a useful point of entry for facilitating discussion among adolescents about issues relating to body image and self-esteem. In terms of psychotherapeutic applications, physical activity has many further advantages, particularly among children and adolescents. It is likely that by enhancing physical fitness, increased physical performance, decreasing body mass and promoting a more favourable body shape and structure, exercise will provide more positive social feedback/recognition from peer groups, and this in turn will improve an individual’s self-image. The increased opportunity for social interaction and group participation allows a challenging of socially avoidant behavioural propensities and the development of positive expectations. Regular involvement in physical exercise reduces the risk of fatigue by augmenting physiological functions such as maximal oxygen transport and maximal muscle force that would otherwise limit performance; a reduction of fatigue over a normal day may in turn induce a positive change in mood state. Finally, physical activity serves to distract from depressive thoughts and self-debilitating cognitions.

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