ANNOUNCEMENT
The Volvo Awards for Low Back Pain Research 1992

In order to encourage research in low back pain, the Volvo Company of Göteborg, Sweden, also this year has sponsored three prizes of US$10,000 each. Awards will be made competitively on the basis of scientific merit in one or more of the following three areas:
1. Clinical studies
2. Biomechanical studies
3. Studies in other basic science areas

Papers submitted for the contest must contain original material, not previously published or submitted for publication. A multiple authorship is acceptable. The manuscripts, in the English language, should be in the form of a complete report, including original illustrations (please note: matted with names), not exceeding 30 typed pages, double-spaced, and in a form suitable for submission to an original paper (not thesis) in a scientific journal. One original and 5 copies of each paper in full including illustrations—must reach the address given below not later than December 2, 1991. — Accordingly, articles sent by fax will not be accepted.

One of the authors should be prepared, at his own expense, to come to Chicago, Illinois, USA, at the time of the meeting of the International Society for the Study of the Lumbar Spine, May 21-24, 1992, to present the paper and receive the award.

The board of referees will be chaired by the undersigned and will contain members from the fields of clinical medicine, biomechanics and biostatistics.

Please direct all correspondence to:
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 Sahlgrens Hospital
S-413 45 Göteborg, Sweden

BOOKS RECEIVED


BENEFITS OF SPORT AND PHYSICAL ACTIVITY FOR THE DISABLED: IMPLICATIONS FOR THE INDIVIDUAL AND FOR SOCIETY*

Roy J. Shepherd
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ABSTRACT. An increase of physical activity is commonly recommended to those with physical disability, but it is necessary to distinguish competitive sport from illness programmes, remedial gymnastics and active recreation. Potential benefits of enhanced activity are reviewed. Likely psychological gains include an improvement of mood-state, with a reduction of anxiety and depression, an increase of self-esteem and feelings of greater self-efficacy. Sociological gains include new experiences, new friendships, and a countering of stigmatisation. Perceived health is improved, and in a more long-term perspective there is a reduced risk of many chronic diseases. Finally, there is a greater likelihood of employment, with less absenteeism and enhanced productivity. Both the health and the industrial benefits have a potential to yield cost savings that could make an important contribution toward the expense of newly adapted activity programmes. It is concluded that the physically disabled should be encouraged to engage in physical activity, although further large-scale longitudinal studies are needed to determine the optimal type of programme for such individuals.

Key words: terminology of "sport", psychological benefits, social benefits, economic benefits, employment, physical activity.

The purpose of the present review is to examine the potential benefits of sport and physical activity in the context of the physically disabled, and to suggest directions for future research. The reviewer recognises the problem that there are many forms of physical disability, and that much of the available information relates only to paraplegics or the wheelchair disabled.

The most commonly reported reason why an able-bodied person exercises is for psychological benefits in order to "feel better" (61, 66, 68). Particularly among older age groups, there may also be an appreciation of the social benefits of exercise, and a search for personal health or improved body function (68). From a governmental and a commercial perspective there may finally be an anticipation of reduced health care costs and increased productivity.

However, before discussing these possible benefits of sport and physical activity, it is first necessary to comment on differences in our understanding of the word "sport" that lead to difficulties of international communication (13, 64).

ISSUES OF TERMINOLOGY REGARDING SPORT AND PHYSICAL ACTIVITY

When Canadians speak about sport, they generally think in terms of team games like ice hockey and North American football. Sometimes there is personal participation, but more often the reference is to a spectator pursuit—a commercial activity watched in television or within a large stadium. In contrast, European countries have tended to adopt the UNESCO concept of "Sport for All" (49). This embraces all forms of leisure activity, but often excludes required school programmes of team sport. It describes what Canadians would regard as "Fait du physique" or exercise—pursuits such as walking, jogging, cycling, and cross-country skiing, all undertaken for recreation rather than for competitive success. A third option, sometimes exploited by the experimental physicist or psychologist is a closely-timed period of exercise carried out on a laboratory ergometer.

PARTICIPATION PATTERNS OF THE ABLE-BODIED

The great majority of active and able-bodied North Americans are interested in walking, jogging and...
Table I. Principal types of voluntary physical activity adopted by Canadian citizens, with and without functional disability

<table>
<thead>
<tr>
<th>Activity (once in 1981)</th>
<th>Functionally disabled</th>
<th>Able-bodied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>Walking</td>
<td>58%</td>
<td>56%</td>
</tr>
<tr>
<td>Gardening</td>
<td>32</td>
<td>27</td>
</tr>
<tr>
<td>Bicycling</td>
<td>24</td>
<td>27</td>
</tr>
<tr>
<td>Swimming</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Hume exercises</td>
<td>18</td>
<td>23</td>
</tr>
<tr>
<td>Dancing</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Jogging</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Skating</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Nordic skiing</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Tennis</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Bowling</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Team sports</td>
<td>9</td>
<td>13</td>
</tr>
</tbody>
</table>

* The Canada Fitness Survey (11, 12) included 13.7% of individuals who described themselves as functionally disabled, and yet were willing to participate in the Survey. The nature and extent of the disability was not explored in any detail.

swimming (Table II), rather than in ice hockey, North American football, soccer, or training on a laboratory ergometer (11, 55, 64); the main difference relative to Scandinavian populations is the lesser popularity of cross-country skiing (54, 64). Such vigorous recreational activity is the type of physical activity for which health and socio-economic benefits have been claimed (25, 63). The typical preventive recommendation is to spend 20-60 min, 3-5 times per week, at an intensity of effort demanding 60-70% of maximal oxygen intake (2, 3, 5, 63). However, in epidemiological studies where health benefit has been observed, the amount of exercise has been less clearly defined (56, 58). Participants in some work-site programmes have attended less than two sessions per week, and have reached the postulated training intensity for 15 min or less per session (65, 66). Gains of physiological function, if measured, have been correspondingly small, for example a 10-13% average increase of maximal oxygen transport (65). In terms of increased longevity, Paffenbarger et al. (36) suggested that benefits began at an estimated leisure expenditure of 500 kcal (2.1 MJ) per week, and that benefit was maximized with an added expenditure of 2000 kcal (8.4 MJ) per week. Many able-bodied people seemingly gained this protection from normal fast walking and stair-climbing (56), although it is less clearly established that normal wheelchair ambulation is beneficial for either cardiovascular condition or health (37).

"SPORT FOR THE DISABLED"

Adapted physical activity is a sufficiently recent concept that the definition of disabled sport has yet to be finalized (70). In launching the Stoke Mandeville Games, Sir Ludwig Guttmann (34) focussed upon the therapeutic value of competitive sport. There have been occasional research studies where para-athletes have undertaken carefully controlled amounts of exercise on an arm ergometer or a wheelchair ergometer (19, 20, 38). Others have stressed gymnastics, therapeutic sport and physical activity adapted in an educational, technical or structural sense. But the big emphasis in both Europe and North America has been upon competitive activity, with wheelchair basketball, track and slalom events playing a dominant role (70).

"PSYCHOLOGICAL BENEFITS OF PHYSICAL ACTIVITY"

Mechanisms of psychological benefit. "Feeling better" is a frequent self-report following vigorous exercise (61), but the precise psycho-physiological explanation remains unclear. Potential contributing factors include: (i) an elevation of mood-state, with relief of stress, tension, anxiety depression, (ii) an improvement of self-image, (iii) an increase of arousal associated with properceptive stimulation, and (iv) in prolonged, intense exercise, the secretion of catecholamines and beta-endorphins.

Initial status of the disabled. The ability of exercise to elevate mood, to relieve anxiety and to improve self-image depends greatly upon initial status (59), benefit being particularly likely if a person is substantially disturbed. Many categories of disabled patient thus seem well-qualified to benefit from exercise. Difficulties of daily living in a hostile environment and an uncertain future leave the inactive disabled person prone to anxiety and depression (31), with an external " locus of control" (Table II), as shown by a high score on the Rotter scale (30, 70). Likewise, a personal recognition of disability (27, 40, 57) and stigmatization (71) lead to a poor self-concept, with a broadening of the normal gap between the perceived and the desired body image (Table II).

Table II. Locus of control (Rotter scale) and discrepancy between perceived and ideal body image (McPherson scale)

<table>
<thead>
<tr>
<th>Group</th>
<th>Locus of control</th>
<th>Body image discrepancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>Able-bodied</td>
<td>9.2</td>
<td>9.5</td>
</tr>
<tr>
<td>Middle-aged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elderly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inactive paraplegic</td>
<td>10.7</td>
<td>12.7</td>
</tr>
<tr>
<td>Less-active paraplegic</td>
<td>21.9</td>
<td>30.2</td>
</tr>
<tr>
<td>Active paraplegic</td>
<td>22.9</td>
<td>34.6</td>
</tr>
<tr>
<td>Active paraplegic</td>
<td></td>
<td>42.0</td>
</tr>
</tbody>
</table>

Response to physical activity. By analogy with groups such as post-coronary patients (42, 43), it seems likely that regular exercise will reduce anxiety and depression (26), improve self-concept, increase acceptance of the disabled (37, 40, 57), and lead to feelings of greater competence (35) and self-efficacy (6). Nevertheless, much depends on the ability of the disabled person to meet the expectations of the programme director (68). If the training regime is perceived as too demanding, if complications such as pressure sores halt training, or if there is a lack of success in competition, an insistence upon sporting involvement may have a negative impact upon body image and mood state.

Cross-sectional observations have shown that wheelchair disabled athletes are more venturesome and tough-minded than their inactive peers (30, 70), and they have a smaller gap between actual and desired body image (Table II). However, longitudinal studies are needed to clarify whether such advantages can be attributed to athletic involvement, or whether a favourable initial psychological profile has encouraged involvement in sports. Further longitudinal studies are needed.

If such studies replicate the psychological gains noted by Geron et al. (66) and Glaser et al. (27), there will still be a need to determine the most effective type of physical activity. Should we recommend competitive sports (where peer recognition is obtained at the risk of defeat), handicapped sports, fitness programmes (where physiological function is augmented), remedial gymnastics (which seek to meet specific medical objectives) or recreational programmes (where the main gains may be psychological detente or social support)? Akebrand (4), for example, claimed substantial improvements of self-concept and self-acceptance as a result of participation in no more than an eight-week recreational bowling programme.

SOCIAL BENEFITS OF SPORT AND PHYSICAL ACTIVITY

Countering stigmatization. Social stigmatization of the disabled (71) can lead to isolation or a ghetto culture. Achievements in competitive sport can counter this tendency by demonstrating the potential of the disabled. The individual who trains to complete a wheelchair marathon event in less than two hours may not gain any great personal advantage of health relative to peers with a more moderate involvement in physical activity, but the marathoner nevertheless makes a major contribution to perceptions of disabled people as a class (69).

Sport and regular physical activity also open up new opportunities for disabled persons, encouraging new friendships and developing social support networks. But it is less clear that such benefits exceed what might be realised through other forms of goal-oriented activity. Furthermore, there is a danger that disabled competition can itself become a form of ghetto. There thus seems much to commend the concept that where possible disabled athletes be "fully integrated" or "normalized", sharing in the life of the "village" for able-bodied athletes, and participating in the same competitions—albeit with some form of handicap if appropriate (53, 72).

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Based on data from the Canada Fitness Survey of 1981 for subjects aged 10-69 years (11, 12)

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<th>Functionally disabled*</th>
<th>Able-bodied Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>58% 56% 61%</td>
<td>57%</td>
</tr>
<tr>
<td>Gardening</td>
<td>29 32 27 30</td>
<td></td>
</tr>
<tr>
<td>Bicycling</td>
<td>24 27 25 25</td>
<td></td>
</tr>
<tr>
<td>Swimming</td>
<td>22 22 22 23</td>
<td></td>
</tr>
<tr>
<td>Hone exercises</td>
<td>22 18 22 24</td>
<td></td>
</tr>
<tr>
<td>Dancing</td>
<td>9 10 8 12</td>
<td></td>
</tr>
<tr>
<td>Jogging</td>
<td>11 7 11 7</td>
<td></td>
</tr>
<tr>
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<td>10 7 10 7</td>
<td></td>
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<tr>
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<td>8 8 8 8</td>
<td></td>
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<tr>
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<td>5 5 4 5</td>
<td></td>
</tr>
<tr>
<td>Bowling</td>
<td>5 7 5 8</td>
<td></td>
</tr>
<tr>
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<td>13 13 13 13</td>
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<tbody>
<tr>
<td></td>
<td>Score Men Women</td>
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</tr>
<tr>
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<td>9.2 9.5 23.8</td>
<td>21.8 26.6</td>
</tr>
<tr>
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<td>–</td>
<td>–</td>
</tr>
<tr>
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<td>10.7 12.7 30.2</td>
<td>–</td>
</tr>
<tr>
<td>Ext. training volunteers</td>
<td>21.9</td>
<td>–</td>
</tr>
<tr>
<td>(paraplegic)</td>
<td>22.9 34.6 45.0</td>
<td>42.0 47.9</td>
</tr>
<tr>
<td>Active paraplegic</td>
<td>–</td>
<td>–</td>
</tr>
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<td>–</td>
</tr>
<tr>
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<td>–</td>
<td>–</td>
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</tbody>
</table>

The data for scores on the Rotter scale for able-bodied subjects and for various categories of wheelchair disabled are based on data from Goldberg & Shepherd (29) and Shepherd (68).

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Exercise benefits for the disabled 55

Basis of dependency. On occasion, dependency may date from a catastrophic worsening of clinical condition, such as the onset of total blindness, or from an acute social problem such as a loss of spousal support. But more frequently, the aging process leads to a progressive loss of aerobic power, muscle strength or flexibility, to the point that the minimum requirements of work, leisure, or daily life can no longer be undertaken unabated (68). For example, the loss of maximal oxygen intake is about 5 ml/kg-min for every decade of working life, possibly accelerating after retirement, and an able-bodied person needs a figure of about 12-14 ml/kg-min to allow independent living. Thus, by the age of 80-85 years, oxygen transport is no longer sufficient to sustain independence. The endurance athlete begins adult life with a substantial (>10 ml/kg-min) advantage of oxygen transport, and although the rate of loss of function is not greatly different (again 4-5 ml/kg-min per decade of adult life), it takes perhaps 20 years longer before oxygen transport is insufficient to sustain independence.

Needs of the disabled. The energy cost of moving a wheelchair over a smooth and level surface is relatively low (37). On the other hand, the disabled individual must propel both body mass and a wheelchair up kerbs and across unfavourable surfaces such as curbing; so that the threshold of power output for independent living may well be higher than in the able-bodied. An inactive wheelchair user may thus be close to the oxygen transport dependency threshold even as a young adult, and will quickly be incapacitated by the normal aging process. In contrast, a wheelchair athlete who begins adult life with a maximal oxygen intake of 45-50 ml/kg-min will have an adequate reserve for employment over the normal working span, and will enjoy continued independence through many years of retirement. Part of the advantage of the wheelchair athlete is a matter of competitive selection, but nevertheless a few months of endurance training can carry in to the individual a lead at least half-way towards the values of oxygen transport observed in the able-bodied (19; Fig. 1).

ECONOMIC BENEFITS OF PHYSICAL ACTIVITY

Limitations of economic analysis. An improvement of health and fitness has a personal value that is difficult to quantify, but the costs of providing such benefits are not negligible. The economic Theology of the disabled can be considerable, and the benefits of physical activity may be a significant factor in the overall model of benefits. The total savings from the economic benefits of physical activity could be considerable. The economic Theology of the disabled can be considerable, and the benefits of physical activity may be a significant factor in the overall model of benefits. The total savings from the economic benefits of physical activity could be considerable. The economic Theology of the disabled can be considerable, and the benefits of physical activity may be a significant factor in the overall model of benefits. The total savings from the economic benefits of physical activity could be considerable.
Exercise benefits for the disabled

Health benefits of physical activity

Benefits in the able-bodied. In the able-bodied, regular endurance activity leads to an immediate improvement of perceived health, and in a more long-term perspective it reduces the incidence of ischemic heart disease (56), hypertension (74), obesity (10), diabetes (39), osteoporosis (14), immune disorders (44) and neoplasms (67, 69). However, the long-term impact of competitive "sport" under these conditions is more equivocal.

Perceived health of the disabled. Perceived health lies on a continuum that extends from good health to frank illness. The location of the individual on this continuum depends upon mood-state (36). In the active disabled, the profile of mood-states is relatively normal (70). But there can be substantial depression among the inactive disabled as in the able-bodied (26), leading to a poor perceived health. If involvement in sport or exercise elevates mood, then there may thus be an increase of perceived health (28), with a corresponding reduction in the demand for medical services and social support.

Chronic disease in the disabled. Groups such as amputees, the spinal-injured and the blind show an above-average incidence of chronic diseases (70). There are various reasons for this: pre-existing attitudes or diseases, a poor self-image that encourages acceptance of an adverse lifestyle (Kosky & Shepherd, unpublished), and a reduction of physical activity subsequent to the onset of disability.

Physical activity and ischemic heart disease in the disabled. There have not been any formal studies demonstrating that involvement of the disabled in endurance sport reduces the incidence of ischemic heart disease. But cross-sectional evidence shows that the active disabled have fewer cardiac risk factors: the percentage of body fat is less (17), HDL cholesterol is greater (46), and cigarette smoking is less (70). With regard to smoking, there remains a need to replace smoking awareness on the able-bodied population with evidence-based prevention (39), suggesting that abstinence is associated with endurance activities, but not with "social" types of sport.

Hypertension and physical activity. If there has been an amputation for pre-existing arteriosclerotic disease, the blood pressure is likely to be high. However, in paraplegia, and especially in tetraplegia, the resting blood pressure is low, and it is further reduced by vigorous exercise because of the normal sympathetic outflow, a reduced secretion of catecholamines, and a poor venous return (38). There have not been any studies of blood-pressure changes in amputees, but by analogy with hypertensive patients in general, regular endurance activity seems likely to induce a small but therapeutically useful reduction in systemic blood pressure. Improved venous return could theoretically raise the exercise capacity in paraplegia, but in practice no changes have been seen (38).

Obesity and physical activity. Regular physical activity plays an important role in the control of obesity (10). Fat is mobilised during a moderate work-out, and there is a sustained stimulation of metabolism after exercise has ceased (9). Vigorous exercise also induces a short-term increase of blood sugar and thus a diminution of appetite. The improvements in self-image associated with sport participation may reduce the need to seek consolation from over-eating.

The importance of energy expenditure to the control of obesity is readily brought out by cross-sectional studies comparing wheelchair athletes and those using battery-driven wheelchairs (70). Obesity increases the weight that weakened muscles must lift during transfer from a wheelchair, and it is also a risk factor for ischemic heart disease, hypertension and type II diabetes. Diabetes and physical activity. Maturity-onset diabetes contributes to such disabilities as adult blindness, peripheral vascular disease, and limb amputations (68). As in the able-bodied, involvement in endurance activities presumably reduces the need for such individuals for insulin (36), but this view still needs experimental proof.

Osteoporosis and physical activity. Osteoporosis has been described as a lack of weight-bearing activity (14). Locomotor disability thus predisposes to a weakening of bone structures, with an increased risk of fractures. The stimulus to mineralisation is weight-bearing and local. Lower arm exercise (14). Arm exercise is thus unlikely to correct bone deterioration in paralysed limbs. The sole possibility would seem to be the presence of electrical stimulation, allowing the paralysed limbs to contrast against an opposing force (28).

Immunological function and physical disability. Vigorous endurance training can have a favourable impact on immune function (44), but if a programme is pursued to the point of over-training, immune function is inhibited (78). This has implications for acute infections, auto-immune diseases such as rheumatoid arthritis, and neoplasia. Occasional participants in wheelchair marathons may reach a level of physical activity where immune function is challenged, particularly if their functional muscle mass is small. The possibility that more moderate activity may have a favourable impact upon immune function in rheumatoid arthritis (23) merits closer examination.

Cancer and physical disability. The overall risk of cancer does not differ greatly between sedentary and active people (67), but because endurance exercise stimulates gastro-intestinal motility, there appears to be a lower incidence of colonic tumours in active individuals (67). It seems likely that long-distance wheelchair competitors would share in this benefit.

Functional benefits from physical activity

Current functional prospects. Most people would like to work throughout their normal career span, to enjoy their leisure time, and to continue living independently until close to their death. However, up to 50% of disabled adults are currently unemployed (21, 22, 40), and many become dependent with aging. Likewise, sedentary individuals who are presently able-bodied face, on average, a terminal period of 8-10 years of partial disability, plus a final year of almost total dependency (68).

Economic benefits of physical activity

Limitations of economic analysis. An improvement of health and fitness has a personal value that is difficult to quantify.
to express in dollar terms. Nevertheless, both government and industry are increasingly concerned about the economic consequences of lack of fitness, in the able-bodied and the disabled alike (65, 66). Sports and fitness programs are desirable as attractive investments because of their potential to contain the costs of medical care and to enhance productivity.

Medical care costs. Rising expenditures. In many western industrialized countries, expenditures on medical care consume 8–10% of the gross national product, and in the U.S. a figure of 12% has been estimated (65, 66). Moreover, medical expenditures are rising faster than the general consumer price index, while the proportion of high-cost citizens (mainly the elderly) and the severely disabled is also increasing, so that the medium-term prospects are for further sharp increases in medical expenditures, independent of any costly new forms of treatment.

Impact of exercise programs in the able-bodied. The immediate effect of introducing a work-site fitness program for the able-bodied is a substantial containment of medical insurance claims (65, 66). The response time is sufficiently short that it is an unlikely intermediate process has been either prevented or reversed; presumably, there has been an improvement of perceived health among program adherents, with a resultant reduction in their demand for medical services. Evaluations of the participants' lifestyles also show reductions in cigarette and alcohol consumption, reductions of body mass and other favourable changes likely to decrease the costs of future disease. However, such potential benefits are long-term in nature, and it becomes challenging both to assess direct experimental proof and also to decide upon an appropriate discount rate to apply to anticipated savings.

The extent of any economic benefit is critically dependent upon the costs of pre-exercise medical clearance, and the extent of any exercise-induced injuries. In low intensity work-site programs, such costs are minimal (65, 66), but if a more vigorous program of aerobic and anaerobic exercise, including some form of climbing exercise, the benefits of this intervention are more challenging, both the examination and the treatment of subsequent injuries can become a substantial charge upon anticipated savings.

Impact of exercise programs in the disabled. The potential to decrease medical expenditures is large in a disabled population. Effort is focused upon people who tend to be frequent users of the medical care system. The effect of the inactive disabled are initially depressed (26), and their perceived health is poor, giving considerable scope for an improvement of perceptions and thus a reduction in demand for medical services. Lifestyle may also be poor (70), giving opportunity for a risk-taking behaviour that threatens future health.

On the other hand, if there is to be some involvement in health more than a very light activity, the need for medical clearance will be greater than in the able-bodied. Exercise program costs may be higher because of the need for specialized equipment and personnel. In theory, problems such as pressure sores and osteoporosis could increase calls for medical attention, although to date, the complaints associated with competition for the disabled have been of a very minor nature—gastrointestinal infections, respiratory infections and sunburn being among the commonest diagnoses (41).

Finally, many of the sports popular among the disabled have only a small endurance component, and are thus unlikely to influence the course of chronic conditions such as coronary vascular disease. Curtis et al. (18) found that 72% of spinal-cord-injured patients reported participating at least once per week in such activities as basketball, tennis, swimming and weight lifting, 28% participating at a competitive level. No significant correlation existed with the likelihood of rehospitalization, but there was a suggestion that the athletes had fewer medical complications and required less medical care. Plainly, there is a need for an empirical longitudinal study of costs and benefits in various categories of disabled individuals who are pursuing exercise programs appropriate to their clinical condition.

Industrial productivity and exercise

Findings in the able-bodied. Industrial fitness programs can improve corporate image, increase the quality and the quantity of production, reduce absenteeism and turnover, and enhance the likelihood of industrial accidents (65, 66). Moreover, the reported benefits far outweigh the costs of introducing a work-site program.

Knowledge that a corporation not only hires the disabled, but also organizes suitably adapted sports programs is likely to enhance public perception of the disabled in part because of fears of unemployment, productivity, absenteeism and accident experience are often better for the disabled than for able-bodied individuals. Nevertheless, there remains a potential to enhance productivity by exercise and sports programs. Although gain of employment is only a part of the larger concept of social productivity (77), a return to normal employment is one of the major goals of the disabled (22, 31, 41). Curtis et al. (18) found a non-significant trend for wheelchair athletes to have a higher functional score than non-athletes, achieving more hours of weekly involvement in their employment or education. However, there is again a need for longitudinal investigations, with careful classification of the physical demands of available employment.

Factors influencing employment. Psychosocial and demographic factors such as a poor mood-state, lack of self-confidence, over-protection, an older age, and a low level of education are often more important determinants of employment than physiological variables, particularly in the early phases of disability (21, 22, 24, 33, 60). Gordon (22) commented that the hours of physical inactivity or passive watching of television correlated with depression scores on the Minnesota Multiphasic personality inventory, while Kemp and Vaux (45) reported that the more productive individuals showed effective social and intellectual functioning, with a high level of self-esteem.

Coping, life-satisfaction, and involvement in paid employment all seem associated with an internal locus of control (62, 75, 77), characteristic personal goals (16), and economic need (8, 79). Better et al. (8) found that there was a lower percentage of successful rehabilitation (55 versus 71%) where social security payments were available, although unfortunately the subjects used in this comparison were not matched for the severity of their disability.

Despite the importance of psycho-social factors, the proportion of the disabled who remain unemployed may decline as personal fitness is brought to a level where the individual can cope with both the barriers of transportation and the physical demands of completing a day's work. The likelihood of employment is influenced by the completeness of the lesion (25) and current function as assessed by the Barthel index (1, 22, 47). More effective competitive sports in a work-site program can give a positive relative advantage between state-climbing ability and the ability to earn a living, while El Ghalit & Hanson (24) commented on the importance of car ownership to employment for the disabled.

Physical activity and work satisfaction. Fitness programs can increase work satisfaction, but this is not invariably the case. Workers may not always appreciate their responsibility for compensating gains of productivity; moreover, production may be limited by extraneous factors such as a shortage of materials, poor management, or union regulations. Finally, potentiality to return to work may be reduced in Canada, only 67% of those recruited to major components of the United Kingdom, 3–10% in Abroad, a work-site program may increase the turnover may decrease if an exercise work-satisfaction study was done on (65, 66). There has been only one study exploring the relationship between sports participation and group.

Conclusions

By analogy with the able-bodied, we may infer that sports programs offers a number of potential benefits to the individual, the employer and the state. However, further large-scale longitudinal studies are urgently required to support such inferences. Presumably, differences in exercise and sport programs, but type of program may not be in line with the postulated benefits.

References

to express in dollar terms. Nevertheless, both government and industry are increasingly concerned about the economic consequences of lack of fitness, in the able-bodied and the disabled alike (65, 66). Sports and fitness programmes are also seen as attractive investments because of their potential to contain the costs of medical care and to enhance productivity.

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**Industrial productivity and exercise.**

**Findings in the able-bodied.** Industrial fitness programmes can improve corporate image, increase the productivity of the quantity and the quality of production, reduce absenteeism and turnover, and decrease the illness and hospitalization (66) of industrial accidents (65, 66). Moreover, the reported benefits far outweigh the costs of introducing a work-site programme.

**Implications for the disabled.** Knowledge that a corporation not only hires the disabled, but also organizes suitable adapted sports programmes is likely to enhance public perception of the disabled in part because of fears of unemployment, productivity, absenteeism and accident experience are often better for the disabled than for able-bodied individuals. Nevertheless, there remains a potential to enhance productivity by exercise and sports programmes. Although gainful employment is only a part of the larger concept of social productivity (77), a return to normal employment is one of the major goals of the disabled (22, 31). Curtiss et al. (18) found a non-significant trend for wheelchair athletes to have a higher functional score than non-athletes, achieving more hours of weekly involvement in their employment or education. However, there is again a need for longitudinal investigations, with careful classification of the physical demands of available employment.

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**Physical activity and work satisfaction.** Fitness programmes can increase work satisfaction, but this is not invariably the case. Workers may not always appreciate their responsibility for compensating gains of productivity; moreover, production may be limited by extraneous factors such as a shortage of materials, many companies are reluctant to hire the disabled. In Canada, only 67% of those recruited to major corporations compared with quota requirements, in France, 15% in Italy and 2-24% in Germany (15). Exercise programme turnover may decrease if an exercise satisfaction is undermined state or increases empirical study in the disabled (52). Spinally traumatized a 22% greater average income than those who monthly wage than the inactive individuals.

**Conclusions.** By analogy with the able-bodied, we may infer that and sports programmes offers a number of potential benefits to the individual, the employer and the state. Urgently required to support such inferences. Press disabled in exercise and sports programmes, but type of programme seems to realize and postulated benefits.

**References.**

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