

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

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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 fitness 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 stigmatization. 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 suitably adapted physical 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 benefit—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 "l'activité 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 physiologist 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

\* Based in part on an invited opening lecture given to a Research Conference of the Swedish Sports Organization for the Disabled and the Swedish Sports Research Council at Bosön, January 1990, in the presence of Her Majesty Queen Silvia of Sweden.

Table I. *Principal types of voluntary physical activity adopted by Canadian citizens, with and without functional disability*

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

Activity (once in 1981)	Functionally disabled <sup>a</sup>			Able-bodied Total
	Total	Men	Women	
Walking	58%	56%	61%	57%
Gardening	29	32	27	30
Bicycling	24	27	22	38
Swimming	22	22	22	36
Home exercises	22	18	25	28
Dancing	9	8	10	13
Jogging	9	11	7	31
Skating	8	10	7	21
Nordic skiing	8	8	7	18
Tennis	7	8	5	15
Bowling	6	5	7	8
Individ. sports	9	13	6	-
Team sports	8	13	4	-

<sup>a</sup> 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 I), 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 exercise is the type of physical activity for which health and socio-economic benefits have been claimed (2, 5, 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. (56) suggested that benefit 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 paraplegic subjects have undertaken carefully calibrated 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 and depression, (ii) an improvement of self-image, (iii) an increase of arousal associated with proprioceptive stimulation, and (iv) in prolonged, intense exercise, the secretion of catecholamines and beta-endorphins.

*Initial status of disabled.* The ability of exercise to elevate mood, to relieve anxiety and to improve self-image depends greatly upon initial status (50); benefit is 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 (51), 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 nor-



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

Data for scores on the Rotter scale for able-bodied subjects and for various categories of wheelchair disabled. Based on data of Goldberg & Shephard (29) and Shephard (68)

Group	Locus of control Score		Body image discrepancy	
	Men	Women	Men	Women
Able-bodied	9.2	9.5	23.8	-
Middle-aged	-	-		
Elderly			21.8	26.6
Ex. training volunteers				
(paraplegic)	10.7	12.7	-	-
Active paraplegic	21.9	-	30.2	-
			27.9	-
Less active paraplegic	22.9	-	34.6	45.0
			42.0	47.9
Inactive paraplegic	-	-	-	

mal gap between the perceived and the desired body image (Table II).

*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 (27, 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 sports 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. (26) 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)? Ankebrand (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).

*Choice of activity.* If attempting to exploit potential social gains, sports such as wheelchair basketball or recreational bowling intuitively have greater value than individual endurance activities such as a wheelchair marathon race or training on a laboratory ergometer. However, there is a need for empirical data to substantiate such intuitive wisdom.

*Factors influencing socialization.* Specific factors have been suggested as influencing the socialization of the disabled into sport and their socialization by



sport (71). However, there remains scope to apply the theoretical model of reasoned action to explore attitudes, beliefs, social norms and barriers that restrict the translation of an exercise intention into overt behaviour in various types of disability (29).

### 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" upon 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, there may thus be an increase of perceived health (26), with a corresponding reduction in the demand for medical services and social support.

*Chronic disease in the disabled.* Groups such as amputees, the spinally-injured and the blind show an above-average incidence of chronic diseases (70).

There are various reasons for this—pre-existing attitudes or disease, a poor self-image that encourages acceptance of an adverse lifestyle (Kofsky & Shephard, 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 likely (70). With regard to smoking, there remains a need to replicate observations on the able-bodied population (59), suggesting that abstinence is associated with endurance activities, but not with "social" types of sport.

*Hypertension and physical disability.* If there has been an amputation for pre-existing atherosclerotic disease, the blood pressure is likely to be high. However, in paraplegia, and especially in tetraplegia, the resting blood pressure is low, and it falls further with vigorous exercise because of interruption 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 blood pressure in paraplegia, but in practice no changes have been seen (38).

*Obesity and physical disability.* Regular physical activity plays an important role in the control of obesity (10). Fat is mobilised during a moderate work bout, 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 of 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 comparisons between 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 diabetes.

*Diabetes and physical disability.* 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 of such individuals for insulin (38), but this view still needs experimental proof.

*Osteoporosis and physical disability.* Osteoporosis has been linked to 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 mineral deposition seems some combination of weight-bearing and local muscular activity (14). Arm exercise is thus unlikely to correct bone deterioration in paralysed legs. The sole possibility would seem some form of electrical stimulation, allowing the paralysed limbs to contract against an opposing force (28).



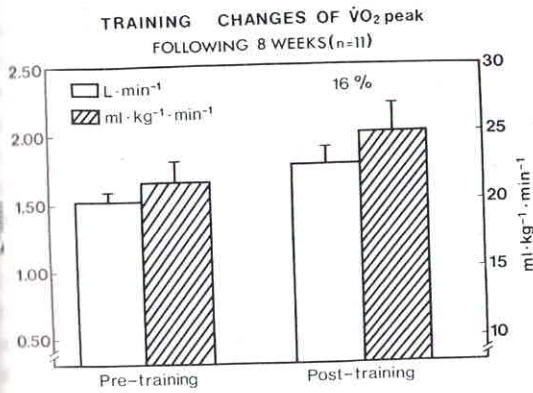


Fig. 1. The impact of training upon maximal oxygen transport of inactive wheelchair users; eight weeks of endurance training carries the inactive group about half way towards the standards observed in wheelchair athletes. (Based on data of Davis and Shephard, in press, 1990.)

*Immune function and physical disability.* Vigorous endurance training can have a favourable impact upon 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 carcinoma 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 a 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, 80), 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).

*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 unaided (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 carpeting, 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 inactive individuals at least half-way towards the values of oxygen transport observed in the athletes (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 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 thus seen 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 democracies, 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 programmes in the able-bodied.* The immediate effect of introducing a work-site fitness programme for the able-bodied is a substantial containment of medical insurance claims (65, 66). The response time is sufficiently short that it is unlikely pathological processes have been either prevented or reversed; presumably, there has been an improvement of perceived health among programme 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 amass 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 programmes, such costs are minimal (65, 66), but if a more vigorous programme of competitive sports is contemplated, both the initial examination and the treatment of subsequent injuries can become a substantial charge upon anticipated savings.

*Impact of exercise programmes in the disabled.* The potential to decrease medical expenditures is large in a disabled population. Effort is focussed upon people who tend to be frequent users of the medical care system. Many 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 to correct the risk-taking behaviour that threatens future health.

On the other hand, if there is to be involvement in more than very light activity, the needs for medical clearance will be greater than in the able-bodied. Exercise programme costs may also be higher because of a 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 competitions for the disabled have been of a very minor nature—gastrointestinal infections, respiratory infections and sunburn being among the common 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 spinally-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 was found between sports participation and the likelihood of rehospitalization, but there was a suggestion that the athletes had fewer medical complications and required less medical care than the non-athletes. Plainly, there is a need for an empirical longitudinal study of costs and benefits in various categories of disabled individual who are pursuing exercise programmes appropriate to their clinical condition.

#### *Industrial productivity and exercise*

*Findings in the able-bodied.* Industrial fitness programmes can improve corporate image, increasing the quality and the quantity of production, reducing absenteeism and turnover, and lessening the likelihood 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 organises suitably adapted sports programmes is likely to enhance public perceptions of a company.

Perhaps 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). 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.* Psycho-social 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 (32) 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 Vash (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, 73, 76, 77), characteristic personal goals (16), and economic need (7, 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). McAdam & Natvig (48) found a positive relationship between stair-climbing ability and the ability to earn a living, while El Ghatit & Hanson (24) commented on the importance of car ownership to employment for the disabled.

*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, poor management or union regulations. Finally, many companies are reluctant to hire the disabled. In Canada, only 0.7% of those recruited to major companies are disabled, compared with quota requirements of 3% in the United Kingdom, 3–10% in France, 15% in Italy and 2–24% in Germany (15).

Absenteeism and turnover may decrease if an exercise programme improves mood state or increases work satisfaction (65, 66). There has been only one empirical study in the disabled (52). Spinally traumatized sports participants had 2% less absenteeism and a 22% greater average monthly wage than the inactive group.

## CONCLUSIONS

By analogy with the able-bodied, we may infer that the involvement of the disabled in physical activity and sports programmes 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. Present data suggest we should encourage involvement of the disabled in exercise and sport programmes, but further research is needed to determine the optimum type of programme to realise the postulated benefits.

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