

Injury Prevention and the Promotion of Physical Activity: What is the Nexus?

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The promotion of physical activity is a public health priority for Australia. The new "National Physical Activity Guidelines for Australians" include a statement on additional health benefits of vigorous sporting and fitness activities. However, injury associated with sport and physical activity can lead to significant health care costs and consequent disabilities and reduced mobility may result in inactivity, this increasing the risk of cardiovascular disease and other health problems. Consideration of injury prevention principles when promoting physical activity is therefore crucial. There are several areas of research needed in this new field. These include the importance of good quality population monitoring and the use of other data sources to determine the population-wide consequences and health costs of injury sustained during sport and physical activity. The goal is to have evidence based, educational, regulatory and other preventive strategies that can be systematically evaluated by drawing on well organised, representative population-based injury data.

Introduction

Physical inactivity is a major risk factor for chronic diseases that result in premature death and disability, particularly cardiovascular disease, diabetes and some cancers (Pate, Pratt, Blair et al., 1995; U.S. Department of Health and Human Services, 1996; Bauman & Owen, 1999.). Public health initiatives are concerned with the protection of the health of the total population and, as such, focus on broad community health issues, rather than just the health of individuals. Initiatives to promote participation in regular physical activity are now central to public health strategies for the prevention of non-communicable diseases in Australia and internationally (Commonwealth Department of Human Services and Health, 1994; U.S. Department of Health and Human Services, 1996; Australian Sports Commission, 1997; National Health and Medical Research Council, 1997; Sallis & Owen, 1999). Physical activity promotion requires strong injury prevention principles as part of their foundations.

Increased participation in physical activity, which includes participation in vigorous sports and fitness activities, implies potentially greater exposure to risk of injury (Finch & McGrath, 1997; Ball, 1998a). The benefits of participating in sport and physical activity therefore need to be weighed up against such risks (Ball, 1998b). Actual injury and fear of injury can also be barriers to adopting a more active lifestyle for some adults (Booth, Bauman, Owen & Gore, 1997; Finch, Owen & Price, 2001). Musculoskeletal and other traumatic injury is the major

potential adverse outcome of physical activity. Musculoskeletal injuries include both acute injuries and those that are chronic or overuse; other traumatic injuries include those to other tissues of the body, such as concussion and eye injury. While activity related injury includes other health conditions such as heat stress and sudden cardiac death, these are relatively rare events.

Although injuries during sport and physical activity have been identified as a major public health concern in Australia and are regarded as a major barrier to participation (Commonwealth Department of Human Services and Health, 1994; Finch & McGrath, 1997), few data are currently available to quantify the magnitude of the problem. Most of the Australian sports injury prevention research to date relates to elite/professional athletes or to particular subgroups of competitive participants. However, on a frequency basis, most injuries occur to community sports participants, as they account for the vast majority of all community sport and other physical activity participants. Data relating to elite/professional athletes may not be applicable to community level sport and physical activity because the injury risk factors and injury profiles are different (Finch et al., 1995). Nevertheless, the current knowledge base suggests that most injuries are likely to be preventable. Research is needed to extend current knowledge so that evidence based strategies to prevent sport and physical activity injuries can be developed. Such an evidence base will provide a significant underpinning for the promotion of safer, lifelong participation in sport and physical activity by all Australians.

The aim of this paper is to discuss the importance of reaching Australia's public health goals of preventing sport and physical activity related injuries and their relationship to the Commonwealth Government's National Health Priority Areas (Commonwealth Department of Human Services and Health, 1994; Commonwealth Department of Health and Family Services and Australian Institute of Health and Welfare, 1998). In particular, the relationships between musculoskeletal and other traumatic injury and participation in the context of the new public health agenda to promote physical activity in the whole population are highlighted. The different pathways through which such injuries and their outcomes can lead to short and longer term public health costs are considered. Finally, there is consideration of ways in which injury surveillance should be integrated into public health strategies for monitoring physical activity participation and priorities for research are suggested.

The national physical activity guidelines for Australia include vigorous sporting and fitness activities

The promotion of physical activity has been identified as a key Australian public health aspiration in several recent Australian statements of public health policy and strategy: the National Health Priority Areas (Commonwealth Department of Human Services and Health, 1994); NHMRC's Acting on Australia's Weight: a strategic plan for the prevention of overweight and obesity (National Health and Medical Research Council, 1997); Active Australia - a national participation framework (Australian Sports Commission, 1997).

The new National Physical Activity Guidelines for Australians (Commonwealth Department of Health and Aged Care, 1999) have four major elements as shown in Table 1. These guidelines provide a concise rationale for the importance of generally being more active and describe various ways to increase moderate-intensity activity. There is a particular focus on brisk walking, cycling and social

1. Think of movement as an opportunity, not an inconvenience.
2. Be Active every day in as many ways as you can.
3. Put together at least 30 minutes of moderate-intensity activity on most, preferably all, days.
4. If you can, also enjoy some regular, vigorous exercise for extra health benefits.

Table 1: Core elements of the 1999 National physical activity guidelines for Australians (Source: Commonwealth Department of Health and Aged Care, 1999).

and family based activities (relating particularly to Guideline 3). Guideline 4 refers specifically to vigorous sporting and fitness activities. In this context, vigorous activity is defined to be exercise at a heart rate of 70-85% of maximum heart rate. There is specific advice on seeking medical advice prior to starting vigorous activity for higher risk groups and older adults and general advice on warm-up and cool-down. However, musculoskeletal and other traumatic injury risk and its avoidance is not addressed explicitly in these guidelines.

Recent state based health promotion campaigns to promote physical activity under the "Active Australia" banner have focussed on moderate-intensity activity, particularly walking (Commonwealth Department of Health and Family Services, 1998). Given the general focus on "activating the sedentary" (Owen & Bauman, 1992), it seems probable that physical activity campaigns and public health programs will continue to focus much more on Guidelines 1, 2 and 3 (the moderate-intensity and incidental activity elements) than they will on Guideline 4 (vigorous activity for extra health and fitness). Nevertheless, vigorous activity, sport participation and fitness activities are integral to Australia's public health strategy to promote physical activity. This being so, a strong public health focus on injury, both as a barrier to health related physical activity and as a potential consequence of participation, requires serious attention.

Such a focus will be particularly important for young adults, amongst whom vigorous forms of activity are more prevalent (Bauman, Owen, Rushforth, 1990). The NHMRC's document Acting on Australia's weight (National Health and Medical Research Council, 1997, p122, Table 6.2) reports that among adults aged under 25 years, 22% participate in jogging, 24% in aerobics and 20% in cycling. These vigorous activities decline significantly with age, with 1%, 3% and 4% of those aged over 55 years reporting taking part in these same activities, respectively. The proportion of people taking part in walking is at about 40% of all age groups (National Health and Medical Research Council, 1997). With lifelong participation in physical activity as a public health goal, the high rates of participation by young adults in activities that can be associated with a moderate to high risk of musculoskeletal injury point clearly to the importance of developing and adopting evidence based prevention strategies.

Participation in sport and physical activity can also help to prevent certain injuries, particularly in older persons. A meta analysis has concluded that exercise programs for elderly adults can reduce the risk of falls (Province, Hadley & Hornbrook, 1995). Furthermore, high compliance to an exercise program can

lead to a reduced frequency of falls (Lord, Ward & Williams, 1995). Another study which randomised people aged 70+ years to three groups (Tai Chi, balance training, education) found a significant reduction in falls rate in the Tai Chi group (Wolf, Barnhart & Kutner, 1996). Additional, or varied physical activity, can also have a role in preventing injuries in younger people. Examples are cross-training programs to prevent overuse injuries, conditioning programs, preseason training and specific get fit programs (Finch & McGrath, 1997; Saxon et al., 1999).

The health consequences of sport and physical activity injury

With physical activity now so firmly on the public health agenda, it is timely to consider the broader determinants and consequences of more Australians being physically active. The Commonwealth Government has identified six National Health Priority Areas (cardiovascular disease, cancer, injury prevention and control, mental health, diabetes, asthma). An important prevention strategy for cardiovascular disease is to “increase participation in regular physical activity” (Commonwealth Department of Human Services and Health, 1994; Australian Sports Commission, 1997; National Health and Medical Research Council, 1997). Crucial to this is the identification of barriers towards physical activity and implementation of strategies to overcome them. The injury prevention and control strategy recognises sport and physical activity injuries as a significant public health problem and as a major barrier to participation. It also recognises that

<p>Prevention or limitation of participation by:</p> <ul style="list-style-type: none"> • leading to time lost from sport/physical activity • leading to non-participation • limiting athletic participation/performance (in terms of frequency, duration, etc) • limiting performance (achievements), whether or not there is also time lost to sports/physical activity • being potentially career threatening to elite athletes and others who can no longer perform their work <p>Affecting the health of participants by:</p> <ul style="list-style-type: none"> • causing permanent physical, psychological or emotional damage and disability • creating significant treatment needs (e.g. surgery, ongoing management, etc) • creating significant rehabilitation needs • resulting in fear of future injury • resulting in non-participation and subsequent implications for future health status <p>Significant financial costs through:</p> <ul style="list-style-type: none"> • resulting in health system expenditures <ul style="list-style-type: none"> - health insurance costs - costs of insurance against injury • being associated with other financial costs to the individual (e.g. protective equipment such as braces) • being associated with significant costs to industry (both sporting and employment) • being associated with loss of potential income for individuals and sporting clubs/organisations • being associated with time away from school/work/home duties

Table 2: *The potential adverse outcomes of sport and physical activity injuries.*

such injuries can interfere with the enjoyment of sport and physical activity thereby limiting the potential benefits of physical exertion (Commonwealth Department of Human Services and Health, 1994). Table 2 summarises the adverse impacts that sports injuries can have on participation in further physical activity, performance in such activity and health costs.

There are six major pathways through which sport and physical activity non-participation, participation and associated injuries can have both short and long term impacts on health (see Figure 1). These pathways highlight the inter-

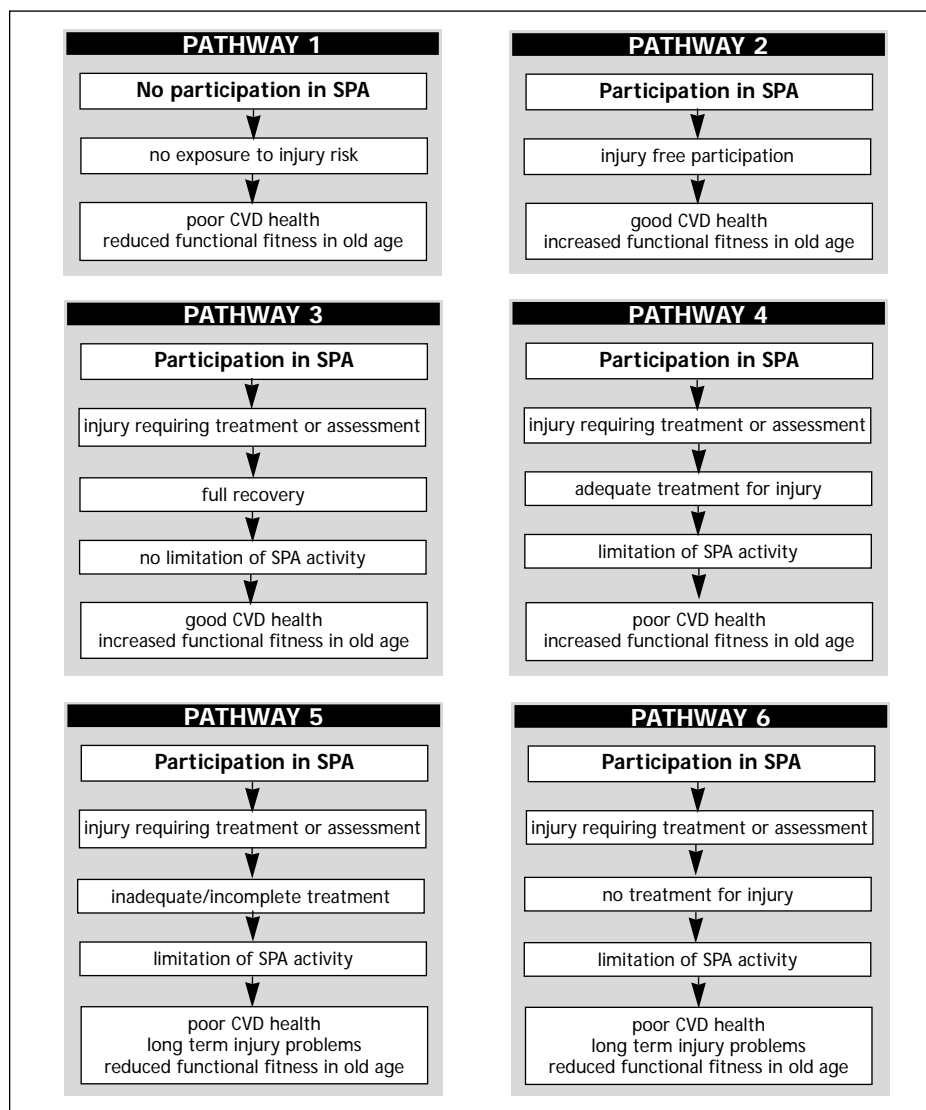


Figure 1: Conceptual pathways linking participation in sport and physical activity (SPA), injury, physical inactivity and subsequent poor health outcomes and cardiovascular disease (CVD) health.

relationships between physical activity factors that can influence long term risk of chronic diseases and injury related factors which can have long term consequences in impairing people's capacities to remain physically active.

In Pathway 1, no participation in sport or physical activity is accompanied by no exposure to injury risk. However, non-participation in physical activity leads to poor long term health outcomes and reduced functional fitness in old age. Functional fitness is important for the elderly in being able to perform such activities as getting up out of a chair or getting dressed. Thus, this pathway has potential long term public health costs. Conversely, if injury free participation in sport or physical activity is enjoyed over a lifespan (Pathway 2), this will be associated with both short and long term public health benefits and increased functional fitness in old age.

Participation in sport or physical activity can sometimes lead to injury severe enough to warrant medical treatment and/or assessment. However, if the injured person has full recovery and no modification, reduction or cessation of participation in activity, they can still achieve good health outcomes and increased functional fitness in old age (Pathway 3). In this case, there may be both short term direct and indirect health costs. However, with resumption of physical activity, long term public health can still be achieved. If such activity is not able to be resumed, even after adequate treatment (Pathway 4), there is a risk of poor long term health outcomes and reduced functional fitness in old age. In this case there are likely to be both short and long term direct and indirect health costs, as well as a potential negative effect on long term public health.

If injured participants do not receive adequate or complete treatment/management/recovery of their injuries before return to sport or physical activity, some modification, reduction or cessation of participation in sport or physical activity is likely. Pathway 5 is therefore associated with both short and long term direct and indirect costs and potential adverse long term public health outcomes. Finally, Pathway 6 shows that sport or physical activity injury that is not treated can also lead to modification, reduction or cessation of participation in sport or physical activity. Whilst this is not associated with short term direct health costs, this pathway is associated with possible long term direct and short and long term indirect costs. The increased long-term risk of chronic disease, long term injury problems (e.g. osteoarthritis) and reduced functional fitness in old age contributes to significantly increased costs to the health system.

The costs and consequences of sport and physical activity injuries

Despite recognition of the public health importance of physical activity, there has been only limited evidence gathered in Australia on the broader health and economic benefits and costs of a physically active lifestyle, in general. The Australian Sports Commission has estimated the potential economic benefits of every additional 10% of the Australian population undertaking appropriate physical activity estimated to be a 5% reduction in the risk of heart disease and a potential saving of \$103.75 million, based on 1985 data, (Australian Sports Commission, 1997). Furthermore, a net benefit of \$6.5 million/day in reduced costs associated with heart disease, low back pain, absenteeism and lowered workplace productivity has been argued to be achievable, if an additional 40% of Australians undertook regular, moderate and effective exercise (Australian Sports Commission, 1997).

Information about the economic costs of sport and physical activity injuries in Australia is also scarce. The only published estimate of the economic costs of sport and physical activity injuries for Australia comes from Egger's 1990 study (Egger, 1991). This study estimated that sports injuries result in direct and indirect costs totalling \$1 billion annually and that 1 million sports injuries occur each year, extrapolating to a sports injury occurring in 1/17 Australians annually. A limitation of these figures is that they were based on crude cost category estimates only and did not involve explicit economic modeling. More recently, the annual cost of sports related eye injuries, alone, in Australia has been estimated to be approximately \$28 million (Fong, 1994). Sports injuries were also found to rank as the second highest cause, after transportation, of lifetime injury costs in Victoria, accounting for an estimated \$556 million, or 21% of all injury costs (Watson & Ozanne-Smith, 1998).

A recent epidemiological study in the Latrobe Valley (Finch, Cassell & Stathakis, 1999) found that injuries during sport and physical activity occur in 5% of participants over a 2 week period. Such injuries have a significant public health impact with 27% of injured participants requiring treatment, 35% experiencing some effect on their quality of life and 36% having their further participation in sport and physical activity affected. Whilst this has enabled some identification of priority target areas and injury impacts, these preliminary estimates are limited because of the relatively small sample size and the potential non-applicability of the results to other Australian communities. Thus there are still a number of areas in which sports safety knowledge and action in Australia is deficient.

The Pilot Survey of the Fitness of Australians found that 85% of respondents agreed/strongly agreed that they would be healthier if they exercised more (Department of the Arts, Sport, Environment and Territories [DASET] et al., 1992; Booth, Bauman, Owen & Gore, 1997). Conversely, a large proportion (46%), agreed/strongly agreed that they would probably be sore or uncomfortable if they exercised more frequently. Taken together, these findings indicate a general awareness of the benefits of sport and physical activity but also show that the injury risks associated with sport and physical activity are a barrier towards increased sport and physical activity participation. Indeed, 11% of respondents gave injury as their major reason for not exercising more (Booth, Bauman, Owen & Gore, 1997). This percentage increased with age, ranging from 6% of 18-29 year olds to 24% of all 70-78 year olds. More recently, 22% of Victorians gave injury/illness as their major reason for non-participation in sport and physical activity (Australian Bureau of Statistics, 1996). This barrier ranked as the third most frequently reported after *no time/too busy* (32%) and *not interested* (30%).

Available information about injury as a barrier to participation in physical activity and/or sport and recreational activities is limited however, because:

1. it often groups "injury and illness" or "injury and disability" into the one category, (i.e. the effect of injuries alone cannot be determined);
2. it generally refers to injuries of all causes, and not just to those incurred during sport and physical activity;
3. it provides very little information to guide injury prevention efforts;
4. there is no ongoing collection of specific sport and physical activity injury data in national data collections; and
5. there is currently no available valid and reliable tool for collecting information

about previous sport and physical activity injuries and the associated exposure to risks at the community level.

Until these inadequacies are addressed, comprehensive and detailed estimates of the impact of sport and physical activity injury in Australia will not be available.

Conclusions

Public health strategies to promote sport and physical activity assume that the benefits of participation outweigh any potential negative impacts or injury risks (U.S. Department of Health and Human Services, 1996; Finch & McGrath, 1997; Ball, 1998a,b; Sallis & Owen, 1999). Increasing sport and physical activity therefore necessitates health and fitness professionals, as well as individuals, making a choice about the type, intensity and amount of appropriate exercise. Crucial to this decision is an understanding of sport and physical activity injury risks, as well as the benefits. Recognition of potential injury risk forms the basis of advice given to long sedentary people against suddenly engaging in vigorous activities. There has not, as yet, been a more general analysis of the costs and benefits of participation and non-participation in sport and physical activity in Australia that provides evidence to guide policy makers and individuals confronted with choices between types and levels of participation in sporting activities.

A critical review of the relationship between exercise, training and injuries concluded that *“better knowledge of the effect of the parameters of training and other factors on the risks of exercise related injuries is necessary to make more judicious choices about how to best achieve the benefits of exercise and to prevent injuries”* (Jones et al., 1994). Furthermore, the key parameters of aerobic exercise for health/fitness (i.e., intensity, duration and frequency) all directly influence the risk of injury in proportion to their effect on the total amount of exercise performed (Jones et al., 1994). The relevance of this conclusion is that promotion of vigorous exercise needs to be accompanied by explicit, evidence based strategies to promote safe participation. This limits the provision of guidelines to previously sedentary and insufficiently active individuals for choosing activities to maximise their health benefits, whilst minimising injury risk.

It should be a priority to bring together public health policy, strategy and research on physical activity with the newly developing body of epidemiological research on sport and physical activity injury. Implementation of public health policies to promote sport and physical activity requires health and fitness professionals, and individuals to make choices about the type, intensity and amount of activity they will promote or undertake. Currently, physical activity choices must largely be made in the absence of information on possible consequences.

Answers to the following key research questions will help to build the necessary evidence base:

1. *What is the magnitude of the sport and physical activity injury problem in Australia?* The picture is currently fragmented and the currently available sports injury data very probably underestimates the size of the problem.
2. *What are the economic costs and other adverse impacts of sport and physical activity injuries to the Australian community?* Only crude estimates are currently available and these are hampered by limitations of available data sources.

3. *To what extent do sports injuries prevent or limit participation in sport and physical activity?* Only limited data are currently available but over one third of all injured participants are likely to experience an adverse injury outcome, irrespective of whether or not they also require treatment.
4. *Which particular sporting and physical activities are associated with the greatest health benefits and least health costs?* Walking is a major focus of public health strategy and current campaigns, but there is the potential to identify other safe forms of activity that can also usefully be promoted to different population subgroups.
5. *How can data about sports injury history be validly and reliably collected in population surveys?* Practical and cost effective methods are not currently available and need to be developed to further progress knowledge towards answering questions 1-4 above.

Vigorous fitness activities and sport participation are an important part of the overall health related physical activity equation, particularly for younger people. As Australians are encouraged to be more physically active, there is the need to acknowledge that all forms of physical activity can be associated with risk of injury. The closer integration of injury prevention efforts with newly emerging population wide strategies to promote physical activity will greatly assist in addressing an important area of public health significance.

A better understanding of the prevalence, trends and determinants of sport and physical activity injuries will make a significant contribution not only to the prevention of injuries themselves, but also to preventive strategies for cardiovascular disease, diabetes and other health problems. Lifelong participation in physical activity is the public health aim and major impediments to this participation will contribute to poorer overall health outcomes. The goal is to have systematically gathered representative population data on both sport and physical activity participation and related injuries, along with health system derived data on costs and consequences. Such information will greatly facilitate the development of appropriate, evidence based strategies for the prevention of sport and physical activity injuries and their consequences. It will also support the systematic evaluation of educational, regulatory and other injury prevention strategies. This knowledge base will also benefit health practitioners, health and fitness professionals and policy makers. Ultimately this will benefit individuals by ensuring that they are better informed about their choices of safe sport and physical activity.

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Injury Prevention and the Promotion of Physical Activity: What is the Nexus?

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