

## Physical fitness and health

This section contains research and evidence on complex and wide-ranging issues relating to the impact of physical activity on various aspects of health. It includes:

- Comprehensive reviews of general evidence.
- Consideration of dose-response relationships.
- Reviews of the relationship between physical activity and cardiovascular health and bone density and osteoporosis.
- A review of the evidence of the positive effects of physical conditioning on asthmatic children.
- Reviews of the relationship between sports participation and more general health behaviours.
- The effects of physical activity on the health of older people.

The US Department of Health and Human Services' seminal, comprehensive, review provides an analysis of evidence of the relationship between physical activity and various aspects of health. It illustrates the positive impacts of activity on a number of systems - cardiovascular, musculoskeletal, metabolic, endocrine and immune. The overall conclusion is that those who are regularly active, even on a moderate basis, have lower mortality rates than the least active. It also outlines the positive impacts of physical activity on various aspects of mental health. O'Donovan et al is a consensus statement prepared on behalf of the British Association of Sport and Exercise Sciences, based on an update of research published since 2004. It provides tabular summaries of the nature and strength of the evidence relating to causal relationships between physical activity and reduced risk of a range of chronic diseases. It also contains a series of tables outlining the perception of effort for various physical activities for males and females in different age ranges with varying levels of aerobic fitness. It provides a comprehensive set of recommendations and outlines a range of strategies that may help to initiate and sustain physical activity. Mountjoy et al's expert group consensus statement on behalf of the International Olympic Committee examined the evidence relating to various aspects of health and fitness of young people relating to physical activity and sport and outlines a detailed programme of action for various stakeholders.

Allison's much shorter review outlines a wide range of physical and health benefits associated with even moderate physical activity and it discusses some of the possible mechanism involved. Warburton et al present a narrative review confirming that there is irrefutable evidence of the effectiveness of regular physical activity (and a dose-response relationship) in the primary and secondary prevention of several chronic diseases such as cardiovascular diseases, diabetes, cancer, hypertension, obesity, depression and osteoporosis.

Cooper et al review evidence about the effect of physical activity on people with various disabilities. Although research indicates that physical activity can contribute to the amelioration of the effects of a range of disabilities, the authors note the need to

expand research studies to include people from a range of disability etiologies. They also provide a series of recommendations for the use of physical activity to improve the health and quality of life of people with disabilities.

Farrell and Shields, via a secondary analysis of the English Health Education Monitoring Survey, provide some statistical support for the medical and epidemiological literature. They illustrate that those who claim to participate regularly in sporting activities report significantly higher levels of general health than non-participants, with the average daily duration of participation being positively and significantly related to self-reported health. Van Amelsvoort et al found that workers who reported physical activity at least twice per week also reported significantly less sickness absence compared to those doing less exercise.

Rankinen and Bouchard's review, based on the contributions of 24 experts from 6 countries, concludes that, despite strong evidence for the beneficial effects of regular physical activity across a range of health factors, the precise nature of the dose-response relationship is unclear and requires more research. Twisk supports this conclusion via a review of physical activity guidelines for children and adolescents. Although acknowledging their public health value, the author suggests that guidelines are based on weak, if suggestive, scientific evidence.

The review by the European Heart Network Expert Group on Physical Activity illustrates that a sedentary lifestyle more than doubles the risk of cardiovascular disease. It summarises the evidence that regular, moderate and accumulated activity can lower heart rate, raise insulin sensitivity, lower blood pressure, raise HDL/total blood cholesterol ratio and helps weight control. Rodriguez et al illustrate that physical activity reduced the risk of ischemic stroke among those with increased left ventricular mass. Baggish et al compared the effect of exercise over time among endurance and strength athletes and at the end of 90 days both groups had significant overall increases in heart size, although the type of effects differed between the two groups. This leads the authors to conclude that all exercise prescriptions are not equal and that there is a need to tailor the type of exercise patients do to their specific type of heart disease.

Welk and Blair review research on the combined effect of physical fitness and body composition on obesity and health. They conclude that physical activity reduces and/or reverses the development of insulin-resistance, even among overweight or obese individuals.

A series of research findings illustrate the positive relationships between physical activity and bone mineral density (BMD) in a variety of sub-populations. In longitudinal studies using various sample sizes, Kemper et al and Puntilla et al illustrate that regular (weight bearing) physical activity is significantly related to BMD at the lumbar spine and femoral neck. In relation to total body and lumbar spine BMD, van Langendonck et al illustrate that the type of sports participation is a significant factor, with high impact sports (ground forces higher than four time body weight) most effective and remaining beneficial for the skeletal health of males aged 40. Ryan et al report on the effects of 6 months whole body resistive training in both young and older men and women. They report that the programme increased muscle mass and improved BMD in the femoral region for all and suggest that if BMD is

increased at skeletal maturity reductions might be achieved in fracture risk in later years. Supporting this conclusion, Neville et al demonstrate the importance of sports involving high peak strain for determining peak bone status, especially in young men and possibly for young women (who are less likely to take part in such sports). Greendale et al, in a study of 42-52 year old women, explore four domains of physical activity (sport, home, work, active living). They illustrate that both sport and weight bearing work in the home were the best, and equal, predictors of greater BMD at lumbar spine and femoral neck sites. The work of Cheng et al raises the one negative note in this literature, finding that high levels of physical activity (running 20 or more miles per week) were associated with osteoarthritis (knee and hip joints) among men less than 50 years of age (although no relationship was suggested among women or older men). In a 20 year longitudinal study of women Barnekow-Bergkvist et al found that membership of a sports club and site-specific physical performance in adolescence plus change in body weight were significantly associated with adult BMD. The study also suggests that the activities should be maintained through adulthood to maintain the increase in BMD. In a study of females taking part in different types of sports, Egan et al found that all sports participation has a positive effect on BMD, but that the effects are site-specific and depend on the loading characteristics of each sport Iwamoto et al provide a review of research evidence relating to the contribution which sport and exercise can make across the life span to the prevention of female osteoporosis. They argue for age-related strategies and activities for preventing osteoporotic fractures.

A number of papers address the more general issue of the relationship between sports participation and health behaviours in young people. Kemper reviews six longitudinal studies of the relationship between the health and fitness of teenagers and sports participation and illustrates that physically active boys and girls have significantly higher VO<sub>2</sub> max values than their inactive counterparts, although the conclusion is that higher levels of VO<sub>2</sub> cause activity max rather than vice versa. In a three year longitudinal study Ara et al found that early pubertal males who played extra-curricular sport for at least three hours per week increased their total fat mass to a lower extent than non PA-matched control group and during the pre-pubertal years physically active children maintain their physical; fitness and their body composition while the less active children worsen. Miller et al (2000) use data from a large-scale survey of school pupils to illustrate that athletic participation has both positive and negative implications for adolescent health and recommend ways to use sport for health promotion. Miller et al (1999), use cultural resource theory to suggest that athletic participation enables girls to resist traditional gender definitions and have lower rates of sexual experience and higher contraception use. For boys, sport seems to reinforce gendered behaviour. Hellansjo et al's Norwegian survey data indicate that participation in the regulated environment of a sports club may delay the onset of alcohol consumption. Pastor et al use survey data on 15-18 year olds to conclude that the higher the levels of sports participation, the higher the perceived fitness and consequently enhanced perceived health, with lower levels of smoking and alcohol use also enhancing health perceptions. However, the relationships are only weak to moderate. Wichstrom and Wichstrom's longitudinal study found that those initially involved in team sports had increased growth in alcohol intoxication and those in endurance sports had reduced growth. Both team and endurance sports were related to reduced growth in tobacco use. Increase in use of alcohol by team sport participants concurs with the social influence explanation. As does the reduced growth in

endurance sports which are held at weekends (precluding the Friday and Saturday night drinking). Davies and Foxall, the first UK investigation of links between sport and alcohol consumption among high school students, found that males may be socialised at a relatively young age into a masculine culture in which alcohol is accepted as a normal accompaniment to sporting activity and this may affect their expectations of both current and future behaviour (despite having more negative attitudes to alcohol).

Pyle et al's survey data on high school students illustrate that, for males and females, competitive sports participation was associated with a lower frequency of mental ill-health, eating and dietary problems and total risks (although there was a higher frequency of sports-related injuries). Page et al report a cross-sectional analysis that found that male and female students reporting participation in sports teams were less likely to smoke and use illegal drugs, with females significantly less likely to have had a sexually transmitted disease and to have become pregnant. Williams and Streat provide a review of evidence relating to the relationship between physical activity and treatment for substance abuse. They suggest that in order to maximise the impact of exercise in such treatment there is a need to consider individual differences in exercise self-efficacy, motivation and exercise readiness and to adopt the transtheoretical model of behaviour change (pre-contemplation, contemplation, preparation, action and maintenance). Via secondary analysis of a longitudinal survey Nelson and Gordon-Larsen conclude that participation in range of physical-activity related behaviour, especially those characterised by high parental sport/exercise involvement, was associated with favourable adolescent health and social risk profiles. Taliferrio et al used longitudinal survey data to illustrate that although white students had consistent associations between sports participation and multiple positive health behaviours, this was less so for non-white male and female students. It is possible that minority adolescents' exposure to less favourable social and environmental influences may offset the protective effects of sports participation. Until more research is undertaken coaches should attempt to prevent negative behaviours occurring. Beets et al compare a number of health-related fitness variables between high school students taking part in physical education only and those who take part in school sponsored sport. They conclude that, on some measures such as cardiovascular fitness, those taking part in sport had better measures and they suggest that the current PE environment does not provide activities of sufficient intensity and duration for cardiovascular fitness (although it does promote weight management, strength development and flexibility). Leek et al conclude that although participation in youth sports contributes to overall physical activity in their study less than one fourth of participants obtained the recommended 60 minutes of MPVA during sports practices, with girls less active than boys.

Bar-or reviews evidence on the adult health benefits of physical activity in childhood and adolescence and concludes that there is no robust evidence of long-term benefits, although there is some for short-term benefits.

Welsh et al provide a systematic review of the research on the effects of physical conditioning on asthmatic children. Their overall conclusion is that the large majority of studies demonstrate significant increases in aerobic fitness post-training or the achievement of normal levels of aerobic fitness.

A series of studies address the effects of physical activity on the health of older people. Simonsick et al's self-assessed longitudinal data illustrate that more rigorous physical activity and a moderately active lifestyle confer some benefits to physically capable older adults, primarily in reducing the risk of functional decline and mortality. Dionne et al's review, addressing issues of exercise prescription, concludes that improving cardiovascular fitness has a greater impact on a range of health outcomes than simply increasing energy expenditure. Hunter et al's review concludes that the evidence of the benefits of resistance training in older adults is overwhelming, increasing power, reducing the difficulties of performing daily tasks, enhancing daily energy expenditure and body composition and promoting participation in spontaneous physical activity. Cottreau et al's survey and interview data conclude that lifetime leisure physical activity was strongly related to decreased risk of ovarian cancer. In a longitudinal study Dallal et al found that among mid fifties females invasive and in situ breast cancer were inversely associated with long term strenuous activity and conclude that there is a protective role for such activity.

The McCartney et al systematic review of research on the relationship between large scale sports events and health and the socioeconomic determinants of health concludes that the evidence comprises a relatively small number of poor quality studies. The evidence does not refute expectations of a positive or negative legacy, but indicates that very little is known about the impacts of previous events. They conclude that it is unclear how the costs can be justified in terms of host population benefits.

*Professor Fred Coalter, Department of Sports Studies, University of Stirling.  
January 2012*

### **Added to the Value of Sport Monitor in January 2012:**

Davies, F., and Foxall, R., (2011) Involvement in sport and intention to consume alcohol: an exploratory study of UK adolescents, *Journal of Applied Social Psychology*, 49(9), 2284-2311

Leek, D., Carlson, J., Cain, K., Henrichon, S., Rosenberg, D., Patrick, K. and Sallis, J. (2011) Physical activity during youth sports practices, *Archives of Pediatrics and Adolescent Medicine*, 165(4), 294-299

Mountjoy, M., Andersen, L., Armstrong, N., Biddle, S., Boreham, C., Bedenbeck, H-P., Ekelund, U., Engebretsen, L., Hardman, K., Hills, A., Kahlmeier, S., Kriemler, S., Lambert, E., Ljungqvist, A., Matsudo, V., McKay, H., Micheli, L., Pate, Riddoch, C., Schamasch, P., Sundberg, C., Tomkinson, G., van Sluijs, E., van Mechelen, W. (2011) International Olympic Committee consensus statement on the health and fitness of young people through physical activity and sport, *British Journal of Sports Medicine*, 45, 839-848