

Fitness and health of children through sport: the context for action

Lyle Micheli,¹ Margo Mountjoy,^{2,3} Lars Engebretsen,^{2,4} Ken Hardman,⁵ Sonja Kahlmeier,⁶ Estelle Lambert,⁷ Arne Ljungqvist,² Victor Matsudo,⁸ Heather McKay,⁹ Carl Johan Sundberg¹⁰

¹Division of Sports Medicine, Harvard Medical School, Children's Hospital Boston, Boston, Massachusetts, USA

²IOC Medical Commission, Lausanne, Switzerland

³Department of Family Medicine, Institute of Sport & Exercise Science, McMaster University, Hamilton, Ontario, Canada

⁴Oslo Sports Trauma Research Center, Norwegian School of Sport Sciences, Oslo, Norway

⁵University of Worcester, Worcester, UK

⁶Physical Activity and Health Unit, Institute of Social and Preventive Medicine, University of Zurich, Zurich, Switzerland

⁷UCT/MRC Research Unit for Exercise Science and Sports Medicine, University of Cape Town, Cape Town, South Africa

⁸Physical Fitness Research Laboratory, Sao Paulo, Brazil

⁹Department of Orthopaedics, Centre for Hip Health and Mobility, University of British Columbia, Vancouver, British Columbia, Canada

¹⁰Molecular Exercise Physiology, Department of Physiology and Pharmacology, Karolinska Institutet, Stockholm, Sweden

Correspondence to

Professor Lyle Micheli, Director, Division of Sports Medicine, Children's Hospital Boston, 319 Longwood Avenue, Boston, MA 02115, USA; michelilyle@aol.com

Accepted 15 June 2011

ABSTRACT

A growing body of scientific evidence indicates that the declining levels of physical activity and fitness in children and youth are associated with adverse impacts on their health, including rising levels of obesity, diabetes, heart disease, metabolic syndrome and increased risk of sports injury. In response, a number of governmental and non-governmental organisations have instituted programmes to promote health in children and youth through sports and physical activity. Many of these programmes have achieved success in increasing participation in sports and other forms of physical activity and, by extension, improving the health of these young people. These programmes have also been used successfully to enhance the lives of the young participants by means other than improving physical health.

INTRODUCTION

It takes a village to raise a child. This African proverb should be at the heart of any collective strategy to improve the physical health of our children through sport. It is a global village that needs to step into action, and its leaders need to lead.

In January 2011, the International Olympic Committee (IOC) assembled an expert group to discuss the role of physical activity and sport on the health and fitness of young people. The group reviewed the evidence base related to fitness and activity levels of children, the consequences of inactivity, the correlates of activity and sedentary behaviour and the efficacy of community- and school-based interventions. After reviewing this evidence base, the group set about addressing the question of what international actors currently exist and how they can better coordinate to promote physical activity to the global youth.

Thus, the entities and organisations that can have the most impact and the proposed means by which they might most effectively provide solutions and action to effect change were identified. These entities and organisations are the IOC, International Sports Federations (IFs), National Olympic Committees (NOCs), the WHO, International Physical Activity Networks, non-governmental organisations (NGOs), governments, the educational system and the healthcare system.

The following is a setting of the context of the ways in which these bodies—our 'global village leaders', if you will—may impact the role of physical activity and sport on the health and fitness of

young people around the world, some of the ways these entities have begun this process and ways in which they might be further expected to do so.

INTERNATIONAL OLYMPIC COMMITTEE

At its annual Congress in October 2010, the IOC outlined the organisation's future priorities. These stated priorities include the promotion of sports participation for public health and the prevention of injuries and disease in athletes.

In July 2010, the WHO and the IOC signed a memorandum of understanding¹ that formed the political background for further projects. Through this, the WHO and the IOC will collaborate to promote healthy lifestyle choices, including physical activity, sports for all, tobacco-free Olympic Games and the prevention of childhood obesity.

The WHO and the IOC will work at both the international and the national level to promote activities and policy choices to help people reduce their risk of non-communicable diseases (NCDs) such as cardiovascular disease, cancers and diabetes. NCDs kill nearly 35 million people each year, including almost 9 million under the age of 60, and are increasing in all regions of the world. If trends continue unabated, deaths will rise to an estimated 41.2 million a year by 2015. Almost 90% of deaths before the age of 60 occur in developing countries and can be largely prevented by reducing the level of exposure to tobacco use, unhealthy diet and physical inactivity. Physical inactivity is ranked as the fourth leading risk factor for all deaths globally, contributing to 3.2 million deaths each year.² Through the memorandum of understanding, the IOC and the WHO plan to act in concert to promote physical activity and thus reduce the risk of NCDs across all age groups.

To promote physical activity effectively, the IOC also acknowledges the need to care for possible health problems of active individuals. This involves providing effective care for the injured athlete and developing and promoting injury prevention measures actively.³

In 2010, the first Youth Olympic Games were held in Singapore, emphasising culture, education and sports in 14–18-year-old athletes. During these Games, the athletes were exposed to educational tools developed by the IOC. Since 2005, the IOC has been developing programmes for the prevention of injuries and diseases in high-level and recreational sports, such as the IOC Periodic Health Exam,⁴ and protection of the child athlete

through the consensus meetings on training of the elite athlete⁵ and age determination.⁶

INTERNATIONAL SPORTS FEDERATIONS

Everyone involved in the Olympic Movement must become more aware of the fundamental importance of physical activity and sport for a healthy life style, not least in the growing battle against obesity, and must reach out to parents and schools as part of a strategy to counter the rising inactivity of young people.⁷

According to Recommendation #51 from the Olympic Congress held in 2009 in Copenhagen, from which the above is excerpted, IFs also have the additional responsibility of addressing the issue of physical inactivity.

An unpublished survey of 13 large IFs in 2010 revealed that few have programmes that address the issue of inactivity in youth. Many IFs support and promote junior or youth championships. Other IFs have modified their sport to encourage youth participation.

One IF, FIFA (Fédération Internationale de Football Association), has published two studies on lack of participation in sport. One study conducted in South Africa illustrates the efficacy of the 'Football for Health' programme for delivering health education on communicable diseases and NCDs.⁷

The purpose of a second FIFA study was to analyse the efficacy of a 6-month football training programme in comparison with a standard exercise programme (modified Freiburg Intervention Trial for Obese Children) on health and fitness parameters in overweight children. This study showed that football training was as effective as a standardised fitness training programme for enhancing the following: endurance capacity, cardiocirculatory adaptation, exercise capacity and self-esteem. There were, however, no statistically significant changes noted in body composition or psychometric variables.⁸

Most IFs have a limited role in addressing the issue of inactivity in youth. Given the important role they play in the delivery of sport, IFs should be encouraged to more actively participate in providing solutions to the serious health risks and societal costs of inactivity.

NATIONAL OLYMPIC COMMITTEES

At the 2009 Olympic Congress, IOC President Rogge challenged the members of the Olympic Movement to address the issue of inactivity in children by invoking the name of Pierre de Coubertin, founder of the IOC and the 'father of the modern Olympic Games':

In the late 1800s, de Coubertin worried that youth in his native France were turning away from physical activity. Today, we see the same problem in the growing rate of obesity in youth throughout the world. We are here to make sure that the Olympic Movement will continue to serve athletes, the world's youth and society at large for decades to come.⁹

Canadian Olympic School Program

One NOC that accepted this challenge was the Canadian Olympic Committee. The Canadian Olympic School Program (COSP) was developed by the Committee as an educational tool for grades 2–12. It was designed to support the development of a healthy, active, physically literate nation and to proactively combat the epidemic of physical inactivity.¹⁰

The COSP encourages physical exercise by linking Olympian stories with physical literacy activities based on

Canada's Long-Term Athlete Development Model.¹¹ The curriculum focuses on participation, effort and pride in the pursuit of excellence. In 2010, the programme was implemented by 56 000 educators, reaching over 2 million students. There are three levels in the programme: the bronze level (grades 2 and 3), which addresses physical skills of agility, balance and coordination; the silver level (grades 4 and 5), which provides more complex physical activities in addition to rhythm and creativity; and the gold level (grades 6–12), which introduces games, team events and physical fitness skills.

This section of the curriculum promotes literacy via five Olympian stories presented as written text or online as audio and visual podcasts.

The Personal Best Challenges presented by the Olympians challenge the students to achieve their personal best by applying Olympic Values in everyday life. These values are respect, inclusion, healthy choices, healthy active living and courage.

In summary, the COSP is an example of several ways in which an NOC can address the issue of inactivity in youth.

WORLD HEALTH ORGANIZATION

The objective of the WHO is the attainment by all peoples of the highest possible level of health. The link between regular physical activity and good health is well established. Physical inactivity is the fourth leading risk factor for deaths around the world.⁴ Significantly, recent estimates indicate that 31% of adults globally do not reach the minimum levels of physical activity recommended for health benefits.¹² In a 34 cross-national comparison study of schoolchildren aged 13–15 years, only 23.8% of boys and 15.4% of girls met physical activity recommendations.¹³ However, given a supportive environment, increasing levels of physical activity can be reached with the potential of bringing health benefits across age groups, including children and youth.

The WHO is primarily responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring and assessing health trends. In fulfilling this mandate, the 57th World Health Assembly endorsed, in May 2004, Resolution WHA57.17: *Global Strategy on Diet, Physical Activity and Health*, and recommended that member states develop national physical activity action plans and policies to increase physical activity levels in their populations.¹⁴ Additionally, in May 2008, the 61st World Health Assembly endorsed Resolution WHA61.14: *Prevention and Control of Noncommunicable Diseases: Implementation of the Global Strategy and the Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases*.¹⁵ This *Action Plan* urges member states to promote physical activity through the implementation of school-based interventions and the provision of physical environments that support safe active commuting, safe transport and the creation of space for recreational activity.

The limited existence of national recommendations on physical activity for health in low- and middle-income countries, the public health significance of physical activity and the global mandates for the work of the WHO, related to promotion of physical activity and NCD prevention, made evident the need for the development of global recommendations that address the links between the frequency, duration, intensity, type and total amount of physical activity needed for the prevention of NCDs. Therefore, in 2010, the WHO published the *Global Recommendations on Physical Activity for Health*.¹⁶ These can be adopted and adapted by member states in order to set

national physical activity recommendations or can be used by national policy makers as an entry point for the development or update of broader NCD prevention plans.

The *Global Recommendations* addresses three age groups: 5–17 years old, 18–64 years old and 65 years old and above. The following apply to children and youth aged 5–17 years in order to improve their cardiorespiratory and muscular fitness, bone health and cardiovascular and metabolic health biomarkers:

1. They should accumulate at least 60 min of moderate- to vigorous-intensity physical activity daily.
2. Amounts of physical activity greater than 60 min provide additional health benefits.
3. Most of the daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least three times per week.

For children and young people, physical activity includes play, games, sports, transportation, chores, recreation, physical education or planned exercise, in the context of family, school and community activities.

Physical activity patterns are influenced by policies and practices in sectors such as transport, sport, education, environment and urban design, as well as by external forces such as industry and media. All the evidence on changing physical activity habits shows that creating an enabling environment, providing appropriate information and ensuring wide accessibility to active lifestyles are critical to influencing behaviour change, regardless of the setting. Therefore, all sectors and all levels within governments, international partners, civil society, NGOs and the private sector have vital roles to play in shaping healthy environments and contributing to the promotion of physical activity.

INTERNATIONAL PHYSICAL ACTIVITY NETWORKS

As described above, in the last decade, a number of important international policy documents on physical activity and health have been developed, most notably the WHO *Global Strategy on Diet, Physical Activity and Health*¹⁷ and, more recently, the *Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases*.¹³

In addition to several international NGOs, the development and implementation of these frameworks have been supported by global and regional physical activity promotion networks.

Agita Mundo is the global network for physical activity promotion¹⁸ with a strong presence in the Americas as well as global activities, including the World Day for Physical Activity. Global Advocacy for Physical Activity¹⁹ is the global advocacy council of the International Society for Physical Activity and Health and has recently launched the Toronto Charter on Physical Activity.²⁰ There are also four regional physical activity promotion networks: RAFA/PANA (Red de Actividad Física de las Americas/Physical Activity Network of the Americas),²¹ HEPA Europe (European Network for the Promotion of Health-Enhancing Physical Activity),^{22,23} APPAN (Asia Pacific Physical Activity Network)²⁴ and AFPAN (African Physical Activity Network).²⁵ RAFA/PANA²⁰ was launched in 2000 and now has 82 member institutions from 19 (of 31) countries of the region. It is active in exchange of policies, programmes and strategies for physical activity promotion, regional and national training courses and monitoring and in connecting and supporting national networks for physical activity promotion. APPAN²³ was launched in 2006 and has around 200 individual members from 29 (of 49) countries. It is an informal communication network aimed at facilitating communication

around physical activity and health in the region; it is active in teaching courses, systematic compilation of national physical activity levels and policy documents, and it disseminates a bi-weekly e-newsletter. AFPAN²⁴ was formally launched in 2010 and is planning to develop a best practice repository for programmes in the African region in 2011.

HEPA Europe^{21,22} was set up in 2005 in close collaboration with WHO Regional Office for Europe. It counts 112 member institutions from 30 (of 53) countries in the European WHO region. As most other regional networks, it holds annual meetings. HEPA Europe is organised around several topical work groups, including one on sport and physical activity promotion in children and youth.²² The work group has analysed selected national approaches to promote physical activity in children,²⁶ and it is currently involved in developing a blueprint for what makes a physical activity project 'youth friendly', including the views of youth.

International physical activity networks can play a crucial role in promoting the health and fitness of children in several ways. First of all, they provide exchange platforms as well as access to key experts on research, implementation and evaluation; for example, more than one third of IOC's expert members of the committee on fitness and health of children through sport participate in one of the mentioned networks. Networks can gather and analyse practice-led evidence on existing approaches to promote health and fitness in children to identify good practice, develop guidance and foster monitoring and evaluation. Through the networks, recommendations can be distributed efficiently to the expert communities and local implementers. In addition, the networks can contribute to more effective dissemination, particularly through translation of key documents into national languages, as has been the case for the Toronto Charter¹⁹ of which translations are under way in over 20 languages already, as well as for another international advocacy publication on physical activity and health,²⁷ which is now available in 11 languages. Other ways to support dissemination could include presentations at the annual meetings of the networks, contributions to e-alerts and newsletters and dissemination of evidence-based programmes and interventions regionally, nationally or locally. While these networks have become instrumental platforms for exchange and expertise, their scope and reach are constrained by limited funding as they depend largely on voluntary contributions.

NON-GOVERNMENTAL ORGANISATIONS

Many NGOs have been involved, directly or indirectly, in health promotion through sport and physical activity. These NGOs may act locally or be part of global networks, and the mechanisms by which these NGOs may achieve their aims include the following: fund raising or financial support, mentoring or capacity development, education and awareness and changing of social norms.²⁸ It may be argued that the work of these organisations may impact directly on a number of the United Nations' Millennium Development Goals, including the provision of a universal primary education, which would be inclusive of physical education, physical activity and health promotion.

Levermore²⁹ describes these organisations as either operational or advocacy-based NGOs and further categorises them functionally as 'plus sport', 'sport plus' or 'sport first'. Mainstream development NGOs that use sport as a vehicle to strengthen or broaden their reach are an example of the plus-sport model. This includes, for example, the NCD alliance, which actively disseminates the Toronto Charter for Physical Activity as part of its global advocacy agenda for the

prevention of NCDs (<http://www.ncdalliance.org> and <http://www.globalpa.org.uk/>).

Other sport-plus models, such as networks of NGOs involved in Sports for All and Sports for Development, have identified health as a key outcome objective.²⁸ The 'highest attainable standard of health' and the right to 'participate in sport, physical activity or play' are both considered fundamental human rights according to international bodies such as the WHO and Unesco.^{30 31}

TAFISA (The Association For International Sport for All) currently has more than 200 member organisations, from 130 different countries, including both governmental and non-governmental constituencies. TAFISA works closely with international partners with shared objectives to promote participation in physical activity in the spheres of health, culture, education and recreation and to provide a platform for sharing experiences (<http://www.tafisa.net>).

The International Platform for Sport and Development, represented by more than 1350 individuals, from more than 250 organisations, has highlighted the substantial benefits of partnering with NGOs to achieve shared goals (<http://www.sportanddev.org>). This platform also exists to share knowledge and best practice, building collaboration and partnerships among all stakeholders in Sports for Development.

The sport-first NGO models exist primarily to promote participation in sport. In Africa, sport-plus and sport-first NGOs have begun to play a major role in the fight against HIV/AIDS, tuberculosis and malaria, in promoting human rights, gender equality and religious tolerance, along with the prevention of NCDs and obesity.³²

There are a number of NGO-led programmes and networks that are exemplars in promoting health in children through sports and physical activity. Right to Play is one such international organisation, whose mission is 'to improve the lives of children in some of the most disadvantaged areas of the world by using the power of sport and play for development, health and peace'. One key outcome is that children who have participated in the Right to Play *Live Safe Play Safe* programme have a greater knowledge of HIV/AIDS and a reduction in stigma surrounding the disease.³³

Another example of a successful NGO-led project that has used sport and physical activity as a vehicle for promoting health is the Grassroots Soccer initiative, whose mission is 'to use the power of soccer to educate, inspire and mobilise communities to stop the spread of HIV'. Primarily implemented in sub-Saharan Africa, the Grassroots Soccer programme uses social learning theory and educates youth concerning HIV prevention and life skills through a sports-skills-based curriculum⁵ along with greater knowledge and more positive attitudes towards HIV in Zimbabwean schoolchildren and educators.²⁵

One difficulty is the lack of a central coordinating body responsible for ensuring that there is effective communication between networks and organisations, to prevent duplication, to support and promote interagency cooperation and to most effectively leverage the platform of sport and physical activity for health. There also remains the problem of inadequate monitoring and evaluation of programmes or interventions offered through NGOs. The importance of monitoring and evaluation cannot be overemphasised, in conjunction with the development of capacity to conduct such evaluation. There is also a need to generate 'practice-based evidence', as many interventions and programmes for promoting physical activity in children from well-resourced settings and developed countries may not translate to lower- and middle-income countries or more

disadvantaged settings. Additionally, measuring reach and impact provides some indication as to the dissemination and effectiveness of such programmes in promoting health through physical activity and sport and provides a tool for use in lobbying government and NGOs for support (<http://www.re-aim.org/>). Monitoring and evaluation should be planned from the outset and should be pragmatic to ensure sustainability.

GOVERNMENT POLICIES

A review of the best actions taken by governments in Europe, North and South America, Africa and Asia (including Arabic countries) has shown that there are countries with reasonably solid policies and with well-established purposes and targets, countries with fragile policies and countries without even an intention to specifically promote physical activity and sports among children and adolescents.

Matsudo *et al* particularly described a quite successful intervention developed in São Paulo, Brasil.³⁴ The Agita Galera is part of the Agita São Paulo programme organised by the state secretariat of health and education and by a research centre, with the help of over 350 partner organisations. It deals with 6000 schools and about 6 million students. The approach of this initiative is based upon the 'Mobile Management of the Ecological Model'.³⁵ Its impact includes a higher level of knowledge about the Centers for Disease Control and Prevention/American College of Sports Medicine recommendations and increased physical activity among students.³⁶ Based upon this review, the authors concluded that government actions included:

1. helping to diagnose the physical activity and sports participation level in each country;
2. supporting a surveillance system for monitoring the evolution;
3. strongly supporting building partnerships;
4. promoting a 'Building Health Policy', in which physical activity should be taken as an important tool to prevent and promote health and treat diseases;
5. building appropriate areas for sports practice;
6. providing incentive for development and implementation of an 'Active-School Curriculum';
7. promoting active transport to school;
8. promoting physical activity and sports inside and outside school.

There appears to be a gap between developing, implementing and demonstrating the effectiveness of novel physical activity interventions and the wide-scale uptake and/or dissemination of *effective* interventions.³⁷ Thus, there appears to be a crucial 'next step' that demands a better understanding of factors that support immediate, sustained and broader implementation of school-based models, that is currently overlooked and understudied.

THE EDUCATIONAL SYSTEM

The school is a key avenue to access all children and youth regardless of race, ethnicity or socioeconomic status and therefore serves as an effective vehicle to promote healthy lifestyles. Comprehensive whole-school approaches to child health represent a feasible and effective strategy to address childhood physical inactivity, obesity and other health issues.³⁶⁻⁴¹ These models typically target multiple health issues based on local needs; incorporate a variety of strategies across settings (physical education, classroom, playground); emphasise partnerships between school, family and community; and advocate for political and financial support from decision makers.

Comprehensive whole-school approaches also targeted single health issues such as physical activity, and this approach has been called an **active school model**. Factors deemed key to success of school-based models are categorised as *upstream factors* (political will, sustained funding, shared common vision, shared decision making, policy development, comprehensive evaluation) and *downstream factors* (teacher training, resources and support, multiple components, adaptability and compatibility of the school-based model).

Given the known benefits of physical activity for children's health globally, it seems important that schools incorporate daily physical activity and/or physical education opportunities for all students as a key tenet of school culture. The implementation of effective school-based models into the real-world setting is a complex process that demands a multi-partner investment over a long period of time. Ecological approaches that integrate interaction across all levels of government, schools, the community, individuals and the settings in which they spend their time may be key to successful and sustained implementation.^{35 38–43}

THE HEALTHCARE SYSTEM

The healthcare setting can play an important role for promotion of physical activity, fitness and health in adults.^{45–47} The few healthcare-based studies to date that have addressed children and adolescents have dealt with exercise groups, counselling and computer-based behaviour change programmes.⁴⁵ The scientific evidence is insufficient to draw any conclusions about how these methods affect physical activity among children and adolescents. That said, physical activity is regarded as a cornerstone in the treatment of common child and adolescent diseases such as overweight/obesity, diabetes and asthma.^{48 49}

There is a need to know more about which physical activity promotion methods are best for children and adolescents in general and individual patients taking into consideration, for example, disease state, socioeconomic conditions, culture, ethnicity, gender and age. Further, it is important to understand if a certain category of healthcare professionals or a team-based approach is best suited to enhance compliance.

Recommendations for action

1. Education and training on all the aspects of physical activity on prescription for healthcare professionals;
2. Increased collaboration between healthcare, especially general practice, and the community, school and sports actors;
3. Improved follow-up routines and systems, not least through integrated electronic health record systems;
4. A revision of the healthcare financing system to include reimbursement for individual and individualised lifestyle counselling and follow-up.

CONCLUSION

Physical activity is a powerful tool to improve and protect the health of youth. There are multifarious interventions that can help promote physical activity in young people. Entities such as the ones above can play a significant role in initiating these programmes. If we assume, as is so often said, that our young people are the planet's greatest natural resource, then it is incumbent on these entities to pursue the goal of improving and protecting the health of children and youth through physical activity. The international policy framework exists to guide action, and now it is upon organisations and governments to

ensure that physical activity receives adequate attention and resources to meet the great challenges identified.

Acknowledgements The authors acknowledge the contribution of Tim Armstrong from the WHO to this paper.

Competing interests None.

Provenance and peer review Commissioned; internally peer reviewed.

REFERENCES

1. World Health Organization. WHO and IOC Memorandum of Understanding 2010. <http://www.who.int> (accessed 31 Jul 2011).
2. World Health Organization. Global Health Risks: Mortality and burden of disease attributable to selected major risks. http://www.who.int/healthinfo/global_burden_disease/GlobHealthRisks_report_full.pdf on page 11 (accessed 31 Jul 2011).
3. **Bahr R**, van Mechelen W, Kannus P. Prevention of sports injuries. In: Kjaer M, Krogsgaard M, Magnusson P, Engebretsen L, Roos H, Takala T, Woo S, eds. *Textbook of sports medicine: basic science and clinical aspects of sports injury and physical activity*. Oxford: Blackwell Science 2002:299–314.
4. **Ljungqvist A**, Jenoure PJ, Engebretsen L, et al. The International Olympic Committee (IOC) consensus statement on periodic health evaluation of elite athletes, March 2009. *Clin J Sport Med* 2009;**19**:347–65.
5. **Mountjoy M**, Armstrong N, Bizzini L, et al. IOC consensus statement: 'training the elite child athlete'. *Br J Sports Med* 2008;**42**:163–4.
6. XIII Olympic Congress. Recommendations: Olympic Congress 2009. Copenhagen, 2009.
7. **Fuller CW**, Junge A, DeCelles J, et al. 'Football for Health'—a football-based health-promotion programme for children in South Africa: a parallel cohort study. *Br J Sports Med* 2010;**44**:546–54.
8. **Faude O**, Kerper O, Mulhaupt M, et al. Football to tackle overweight in children. *Scand J Med Sci Sports* 2010;**20**(Suppl 1):103–10.
9. **Rogge J**. Opening address: Olympic Congress 2009. Copenhagen, 2009.
10. **Dupre J**. Capturing the Olympic legacy in your classroom. Canadian Olympic School Program 2010–2011 Curriculum. Toronto, ON: OPHEA, 2010.
11. **Balyi I**, Cardinal C, Higgs C, et al. Long Term Athlete Development—Canadian Sport for Life. Robertson S, Hamilton A, eds. Canadian Sport Centres, 2010.
12. World Health Organization. Global status report on noncommunicable diseases 2010. Description of the global burden of NCDs, their risk factors and determinants. Geneva: WHO, 2011.
13. **Guthold R**, Cowan MJ, Autenrieth CS, et al. Physical activity and sedentary behavior among schoolchildren: a 34-country comparison. *J Pediatr* 2010;**157**:43–9.e1.
14. World Health Organization. Resolution WHA57.17. Global strategy on diet, physical activity and health. *Proceedings of Fifty-Seventh World Health Assembly*; 17–22 May 2004, Geneva, Switzerland.
15. World Health Organization. 2008–2013 Action plan for the global strategy for the prevention and control of noncommunicable diseases. Geneva: WHO, 2008.
16. World Health Organization. Global recommendations on physical activity for health. Geneva: WHO, 2010.
17. World Health Organization. WHO global strategy on diet, physical activity and health. Geneva: WHO, 2004. <http://www.who.int/dietphysicalactivity/en/> (accessed 8 Aug 2009).
18. Agita Mundo Network. São Caetano do Sul, Brazil. http://www.agitamundo.org/site_en.htm (accessed Jan 2011).
19. GAPA. Global Advocacy for Physical Activity, Advocacy Council of ISPAH <http://www.globalpa.org.uk> (accessed Jan 2011).
20. Global Advocacy Council for Physical Activity, International Society for Physical Activity and Health. The Toronto Charter for Physical Activity: a global call to action. *JPAH* 2010;**7**(Suppl 3):S370–3 <http://www.globalpa.org.uk> (accessed Jan 2011).
21. RAFA/PANA. Red de actividad física de las Americas—Physical Activity Network of the Americas Raza–Pana. <http://www.rafa pana.org/index.php?lang=en> (accessed Jan 2011).
22. **Martin BW**, Kahlmeier S, Racioppi F, et al. Evidence-based physical activity promotion—HEPA Europe, the European Network for the Promotion of Health-Enhancing Physical Activity. *J Public Health* 2006;**2**:53–7. <http://www.springerlink.com/content/a88v532830273444/> (accessed 31 Jul 2011).
23. World Health Organization. HEPA Europe (European Network for the Promotion of Health-Enhancing Physical Activity). Copenhagen: WHO Regional Office for Europe. <http://www.euro.who.int/hepa> (accessed 31 Jul 2011).
24. Asia Pacific Physical Activity Network. Sydney, Centre for Physical Activity and Health (CPAH), University of Sydney, Australia. <http://www.ap-pan.org> (accessed 31 Jul 2011).
25. AFPAN. African Physical Activity Network. <http://www.essm.uct.ac.za/afpan> (accessed Jan 2011).
26. **Kelly P**, Cavill N, Foster C. An analysis of national approaches to promoting physical activity and sports in children and adolescents. British Heart Foundation Health Promotion Research Group, University of Oxford for HEPA Europe.

- Copenhagen: WHO Regional Office for Europe, 2010. http://www.euro.who.int/_data/assets/pdf_file/0009/119295/HEPA_children_analysis_report.pdf (accessed Jan 2011).
27. **Cavill N**, Kahlmeier S, Racioppi F, eds. Physical activity and health in Europe: evidence for action. Copenhagen: WHO Regional Office for Europe, 2006. <http://www.euro.who.int/en/what-we-do/health-topics/disease/prevention/physical-activity/publications/2006/physical-activity-and-health-in-europe-evidence-for-action> (accessed 31 Jul 2011).
 28. **Sport and Health**. Preventing disease and promoting health. http://www.righttoplay.com/International/news-and-media/Documents/Policy%20Reports%20docs/Harnessing%20the%20Power%20-%20FULL/Chapter2_SportandHealth.pdf (accessed 21 Mar 2011).
 29. **Levermore R**. Sport in international development: time to treat it seriously? *Brown J World Aff* 2008;**14**:55–66.
 30. United Nations. International Covenant on Economic, Social and Cultural Rights (16 December 1966) A/ResS/2200 (A) XXI, Entered into Force 3 January 1976, at Article 12 (1).
 31. UNESCO. International Charter of Physical Education and Sport, adopted by the General Conference on 21 November 1978. <http://www.unesco.org/education/> (accessed 31 Jul 2011).
 32. Literature reviews on sport for development and peace, University of Toronto, Faculty of Physical Education and Health, commissioned by Sport for Development and Peace International Working Group (SDP IWG) Secretariat Toronto, Ontario, Canada, 18 October 2007. <http://www.righttoplay.com/International/news-and-media/Documents/Policy%20Reports%20docs/Literature%20Reviews%20SDP.pdf> (accessed 21 Mar 2011).
 33. Right to Play. Results—our report on progress: 10 years of play 2000–2010. http://www.righttoplay.com/International/news-and-media/Documents/Results_2010.pdf (accessed 21 Mar 2011).
 34. **Matsudo VK**, Matsudo SM, Araujo TL, *et al*. Time trends in physical activity in the state of São Paulo, Brazil: 2002–2008. *Med Sci Sports Exerc* 2010;**42**:2231–6.
 35. **Matsudo SMM**, Matsudo VKR, Andrade DR, *et al*. Physical activity promotion: experiences and evaluation of the Agita São Paulo Program using the Ecological Mobile Model. *J Phys Activ Health* 2004;**1**:81–97.
 36. **Andrade DR**, Ceschini FL, Araujo Jr JF, *et al*. Physical activity (PA) level of adolescents from schools with and without an intervention of promotion program. In: *International Congress on Physical Activity and Public Health*. 2006:143.
 37. **van Sluijs EM**, McMinn AM, Griffin SJ. Effectiveness of interventions to promote physical activity in children and adolescents: systematic review of controlled trials. *BMJ* 2007;**335**:703.
 38. **Naylor PJ**, McKay HA. Prevention in the first place: schools a setting for action on physical inactivity. *Br J Sports Med* 2009;**43**:10–13.
 39. **Kreimler S**, Zahner L, Schindler C, *et al*. Effect of school based physical activity programme (KISS) on fitness and adiposity in primary schoolchildren: cluster randomised controlled trial. *BMJ* 2010;**340**:c785.
 40. **Gibson CA**, Smith BK, Dubose KD, *et al*. Physical activity across the curriculum: year one process evaluation results. *Int J Behav Nutr Phys Act* 2008;**5**:36.
 41. **de Meij JS**, Chinapaw MJ, van Stralen MM, *et al*. Effectiveness of JUMP-in, a Dutch primary school-based community intervention aimed at the promotion of physical activity. *Br J Sports Med* 2010; Published Online First: 25 November 2010 doi:10.1136/bjism.2010.075531
 42. **Inman DD**, van Bakergem KM, Larosa AC, *et al*. Evidence-based health promotion programs for schools and communities. *Am J Prev Med* 2011;**40**:207–19.
 43. **Stokols D**. Establishing and maintaining healthy environments. Toward a social ecology of health promotion. *Am Psychol* 1992;**47**:6–22.
 44. **Durlak JA**, DuPre EP. Implementation matters: a review of research on the influence of implementation on program outcomes and the factors affecting implementation. *Am J Community Psychol* 2008;**41**:327–50.
 45. Swedish Council on Technology Assessment in Health Care (SBU). Methods of promoting physical activity—a systematic literature survey (English summary). Stockholm: Swedish Council on Technology Assessment in Health Care, 2007. http://www.sbu.se/upload/Publikationer/Content1/1/Fysisk_sam_ENG.pdf (accessed 31 Jul 2011).
 46. **Börjesson M**, Hellénus M-L, Jansson E, *et al*, eds. Physical activity in the prevention and treatment of disease. Professional Associations for Physical Activity (YFA, Sweden). Swedish National Institute of Public Health, 2010:1–633. <http://www.fyss.se> (accessed 31 Jul 2011).
 47. **Hellénus ML**, Sundberg CJ. Physical activity as medicine: time to translate evidence into clinical practice. *Br J Sports Med* 2011;**45**:158.
 48. **Kahle EB**, Zipf WB, Lamb DR, *et al*. Association between mild, routine exercise and improved insulin dynamics and glucose control in obese adolescents. *Int J Sports Med* 1996;**17**:1–6.
 49. **Williams CL**, Hayman LL, Daniels SR, *et al*. Cardiovascular health in childhood: a statement for health professionals from the Committee on Atherosclerosis, Hypertension, and Obesity in the Young (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. *Circulation* 2002;**106**:143–60.



Fitness and health of children through sport: the context for action

Lyle Micheli, Margo Mountjoy, Lars Engebretsen, et al.

Br J Sports Med 2011 45: 931-936

doi: 10.1136/bjsports-2011-090237

Updated information and services can be found at:

<http://bjsm.bmj.com/content/45/11/931.full.html>

These include:

References

This article cites 21 articles, 8 of which can be accessed free at:

<http://bjsm.bmj.com/content/45/11/931.full.html#ref-list-1>

Email alerting service

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

To request permissions go to:

<http://group.bmj.com/group/rights-licensing/permissions>

To order reprints go to:

<http://journals.bmj.com/cgi/reprintform>

To subscribe to BMJ go to:

<http://group.bmj.com/subscribe/>