Brian W. Martin[a,b], Urs Mäder[b], Hanspeter Stamm[c], Charlotte Braun-Fahrländer[d]

[a] Institute of Social and Preventive Medicine, University of Zurich, Switzerland
[b] Swiss Federal Institute of Sport, Magglingen, Switzerland
[c] Lamprecht & Stamm Sozialforschung AG, Zürich
[d] Institute of Social and Preventive Medicine, University of Basel, Switzerland

Physical activity and health – what are the recommendations and where do we find the Swiss population?

Abstract

Since 1999 Switzerland has physical activity recommendations for adults, since 2006 also for school-age children and adolescents. The best available estimates indicate that 32% of adults meet the recommendations for three endurance-type training sessions and another 9% the minimal recommendations of half an hour moderate intensity physical activity on most days of the week. 13% of Swiss adolescents seem to meet the minimal recommendations of one hour on every day of the week, 35% on five days per week. These data rely on standardised, nationally representative surveys providing robust estimates, but they are based on self-report instruments of untested, poor or questionable validity against objective measurements of physical activity. No nationally representative data is available on compliance of children with the recommendations. Physical activity recommendations for all age groups in Switzerland should be reviewed in the light of the WHO recommendations expected for 2010. Established national surveys should be continued to allow the description of trends. In addition, physical activity behaviour of children and other age groups should be assessed using internationally standardised and nationally validated questionnaires and objective measurements. The feasibility of physiological measurements at the population level should be explored.

Zusammenfassung

Seit 1999 hat die Schweiz Empfehlungen für gesundheitswirksame Bewegung für Erwachsene, seit 2006 auch für Kinder und Jugendliche. Die besten verfügbaren Schätzungen zeigen, dass 32% der Erwachsenen die Empfehlungen für drei wöchentliche Ausdauertrainings erfüllen, weitere 9% die Minimalempfehlungen einer halben Stunde Bewegung mit sogenannt mittlerer Intensität an den meisten Tagen der Woche. 13% der Schweizer Jugendlichen scheinen die Minimalempfehlungen einer Stunde Bewegung an jedem Tag der Woche zu erreichen, 35% an fünf Tagen pro Woche. Diese Daten stammen aus standardisierten, national repräsentativen Befragungen mit stabilen Schätzungen, basieren aber auf Instrumenten von ungeprüfter, schlechter oder zweifelhafter Validität bezüglich ihrer Vergleichbarkeit mit objektiven Messmethoden. Es gibt keinerlei national repräsentative Daten zum Erreichen der Bewegungsempfehlungen bei Kindern. Die Schweizer Bewegungsempfehlungen für alle Altersgruppen sollten überprüft werden, sobald die für 2010 zu erwartenden Empfehlungen der WHO vorliegen. Etablierte nationale Surveys sollten weitergeführt werden, um Entwicklungen verfolgen zu können. Zusätzlich sollte das Bewegungsverhalten von Kindern und anderen Altersgruppen mit international standardisierten und für den Schweizer Kontext validierten Befragungsinstrumenten sowie objektiven Messmethoden beschrieben werden. Die Möglichkeiten zur Anwendung physiologischer Untersuchungen auf Bevölkerungsebene sollten abgeklärt werden.

Schweizerische Zeitschrift für «Sportmedizin und Sporttraumatologie» 57 (2), 37–43, 2009

Introduction

The concern with physical inactivity is a relatively new development in public health. The first and internationally very influential public health recommendations of the US American Centers for Disease Control CDC were issued in 1995 (Pate et al, 1995). In the same year, a symposium on "Sports–Physical Activity–Health" was held at the then Swiss Federal Sport School Magglingen and the first estimates for physical activity levels in Switzerland were presented. As no nationally representative data had been published yet, the estimates were based on a review of 12 local studies. The author stated, "it becomes clear that not more than one third of the Swiss population is physically active or does sports in a frequency sufficient for health, i.e. at least twice per week. At least one third of the population is never or practically never physically active" (Hättich, 1995). Since 1995, recommendations for health-enhancing physical activity have been issued also in Switzerland and attempts have been made to measure the levels of activity in different population groups. At the same time the issue is more and more recognised within public health. WHO's Global Strategy on Diet, Physical Activity and Health (WHO, 2004) and the Swiss National Programme Diet and Physical Activity (BAG, 2008) emphasize the importance of physical activity and have population-level monitoring as one of their priorities.

This article gives an overview of the current situation for both recommendations and monitoring of physical activity behaviour and discusses the implications of the international developments for future activities in Switzerland.

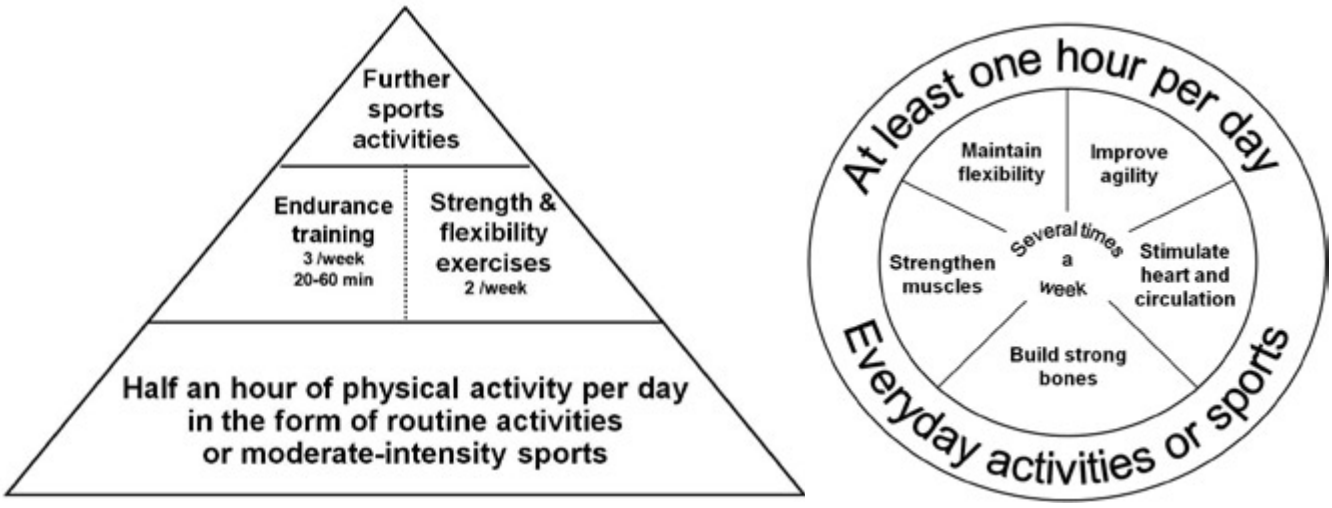

Figure 1: **Current Swiss recommendations for health-enhancing physical activity in adults in form of the physical activity pyramid and for school-aged children and adolescents in form of the physical activity disk.** The recommendations were issued in 1999 and in 2006 respectively by the Federal Offices for Sport and Physical Activity, by Health Promotion Switzerland and by the Network HEPA Switzerland.

Physical activity recommendations in adults

A draft was published in 1998 (Martin and Marti, 1998), but the actual first physical activity recommendations for Switzerland were issued in 1999 by the Federal Offices of Sport and Public Health together with the foundation Health Promotion Switzerland and the Network HEPA Switzerland (figure 1). They were combining the 1995 CDC "30 minutes" recommendations with other earlier ones such as the recommendations on cardio-respiratory and muscular fitness by the American College of Sports Medicine ACSM which had also been re-published in Switzerland (ACSM, 1993). The minimal recommendations of half an hour of moderate intensity activities a day are already promising substantial health effects, they represent the first level of the Swiss Physical Activity Pyramid. Additional benefits can be derived from cardio-respiratory fitness training, strength training and stretching exercises. The top of the pyramid can be reached by further sports activities (Swiss Federal Office of Sport et al., 2006).

In the last few years several countries have introduced physical activity recommendations. Nevertheless, in a recent analysis of 27 national and sub-national policy documents on physical activity promotion from 14 European countries published in English, only 6 polices "contained quantified physical activity goals specifying the intended level of physical activity to be achieved over a specific time period" (Daugbjerg et al, in press). Again the most influential development was the one in the US where a detailed review of the evidence on the effects of physical activity has been carried out (Physical Activity Guidelines Advisory Committee, 2008) and where new recommendations based on this evidence have been issued first by the American College of Sports Medicine (Haskell et al., 2007) and then also by the US Department of Health and Social Services USDHSS (2008). These recommendations maintain the "moderate intensity message", but they also highlight the effects of vigorous intensity activities and the additional benefits of greater amounts of activity. Muscle-strengthening activities involving all major muscle groups are recommended on two or more days per week. Both recommendations include the combination of moderate and vigorous intensity activities, but the USDHHS even drops the "most days of the week" message and focuses in its minimal recommendations almost entirely on the overall weekly amount: "2 hours and 30 minutes a week of moderate-intensity, or 1 hour and 15 minutes a week of vigorous-intensity aerobic physical activity, or an equivalent combination". Both ACSM and USDHSS have also issued recommendations for elderly adults.

The US recommendations are national documents, but they are based on an exceptionally thorough review of the scientific literature and they have implications at the international level. The World Health Organisation WHO is currently in the process of developing its own recommendations which are going to rely on the same body of evidence. Therefore, they are not expected to vary substantially from the US recommendations, but details such as the focus on either the total weekly amount of physical activity or on the regularity of activities may vary. Switzerland does not have a document for elderly adults, but its recommendations for adults are all in all consistent with the current US ones with the exception of the emphasis on the daily regularity of activities. Once the WHO recommendations will be issued – which is currently expected for 2010 – a thorough review of the Swiss document will be indicated. In addition to the development of specific recommendations for elderly people, even a regular review and revision mechanism could be considered such as the on the US administration is currently institutionalising with a five year period.

Physical activity behaviour data in adults

There are many ways in which physical activity can be measured (figure 2). The instruments most frequently used at the population level are questionnaires, because they can be applied in large samples at low costs and because they can capture not only frequency, duration and intensity of activities, but also their context. However, in physical activity as in food intake (Baranowski and Domel, 1994) there have been considerations that human cognitive pro-cesses make it less likely for unstructured and often "unspectacular" activities to be memorised and also to be recalled in an interview situation. This could explain why often objective measures with motion detectors such as pedometers and accelerometers yield higher estimates of moderate intensity physical activity than questionnaires (Mäder, 2006) and why sometimes questionnaire data show a surprisingly high contribution of structured exercise to overall physical activity (Lamprecht et al., 2008b, p. 50–52). With technological progress and falling costs, these accurate motion detectors are now becoming readily available, other objective measurement tools will follow.

The US Physical Activity Guidelines Advisory Committee Report states in the research recommendations of its report: "Surveillance of the total activity energy expenditure of representative samples of the US population needs to be implemented once appropriate assessment tools have been developed and validated. Such tools could include either questionnaires or new objective measurement technology, or a combination of the two" (2008, p. H-4). Only very few countries such as Finland and Canada have long established monitoring systems for physical activity (Craig et al.,

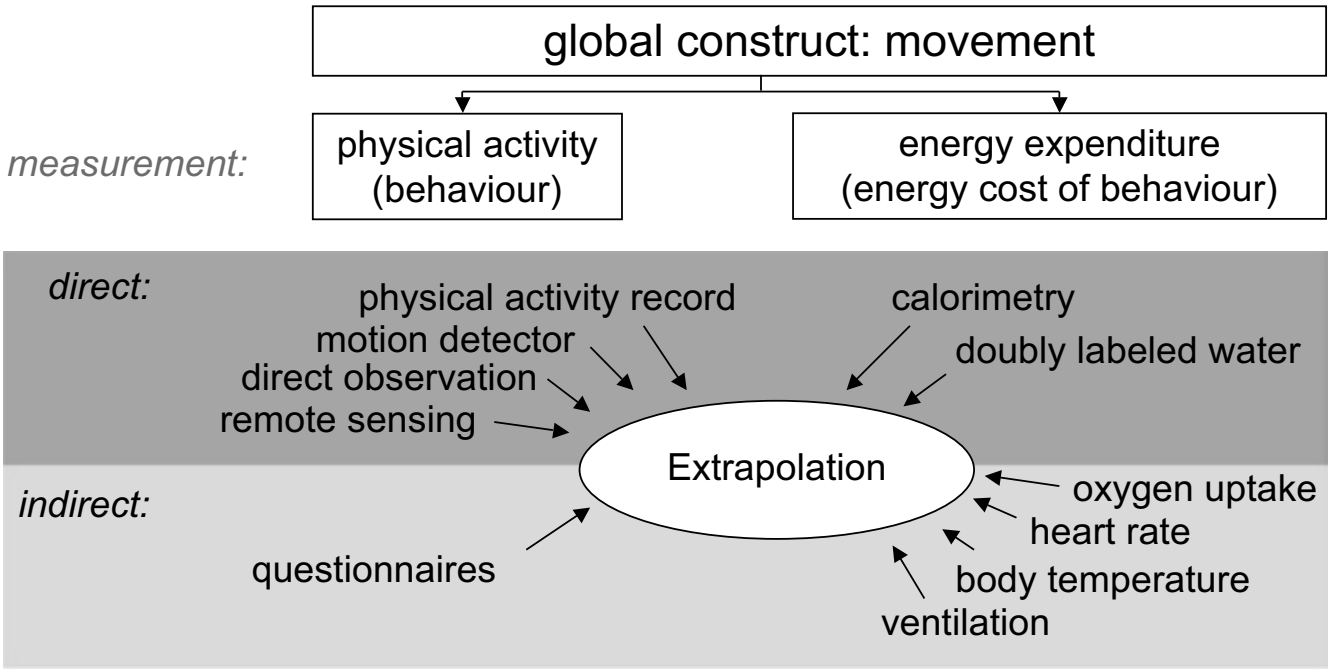

Figure 2: **Conceptual framework for the measurement of movement by Ainsworth and Levy (2004).** For nationally representative samples in Switzerland, only questionnaire data have been published so far.

2004), therefore these recommendations are valid not only for the US, but also for most other parts of the world. WHO global Headquarters has a group of experts working on Physical Activity Global Surveillance with support from the WHO Collaborating Centre for Physical Activity and Health of the CDC in Atlanta; and the European Office of WHO together with the European Union has a project on "Monitoring on improving nutrition and physical activity and prevention obesity" that has measurement of physical activity behaviour as an important pillar.

All these efforts are aiming at developing internationally stan-dardised and comparable monitoring tools with established mea-surement properties. Two standardised short physical activity questionnaires for the use in population surveys have been developed so far, the International Physical Activity Questionnaire IPAQ (www.ipaq.ki.se) and the Global Physical Activity Questionnaire GPAQ (www.who.int/chp/steps/resources). A considerable number of articles have already been published on IPAQ (Bauman et al., 2009), a manuscript on the first multi-country study with GPAQ is under preparation. The criterion validities of both tools seem to be similar and in most countries are close to the ones found in a Swiss study where the correlation was 0.39 for comparing total activities with total accelerometer counts (Mäder, 2006). These measurement properties seem to be typical for short questionnaires and are considerably weaker than those of the more extensive Physical Activity Frequency Questionnaire PAFQ developed in Switzerland (r = 0.79 comparing with heart rate based estimates of energy expenditure; Bernstein, 1998) which – because of its length – has not yet been used for monitoring at the national level. The measurement properties of questionnaires used in Switzerland at the population level are described below.

Monitoring and surveillance tools do not automatically relate to physical activity recommendations. This may be because the measurement instruments were developed before the recommendations existed and therefore did not capture all the respective dimensions of physical activity, it may also be because too little is still understood about the way in which results yielded form different measurement tools relate to each other (Physical Activity Guidelines Advisory Committee, 2008, p. H-4).

In Switzerland, nationally representative data on leisure-time vigorous intensity physical activity was first collected in the Swiss Health Survey 1992 and published in 1997 (Calmonte and Kälin). These data showed that 36% of the Swiss adult population reported less than one episode of vigorous intensity leisure time activities per week. When this proportion increased to 39% in 1997, it was a great cause of concern, but levels have fallen again to 37% in 2002 and 32% in 2007 (figure 3, Lamprecht and Stamm, 2006; Stamm and Lamprecht, 2009).

Nationally representative data on overall physical activity in adults is available since the first Swiss Survey on Health-Enhancing Physical Activity, the HEPA survey 1999 (Martin, 1999). However, the survey had a small sample size of only little more than 1500 and was only carried out in the summer. In addition, the questionnaire used in the survey yielded only categorical data on meeting either the minimal or the endurance training recommendations. The proportion of individuals meeting at least one of these recommendations was 63% and it remained the same when the survey was repeated in 2001 (Martin 2002). As experiences from intervention studies with the same questionnaire had given rise to concern about it possibly being too suggestive by explicitly describing the target behaviour in question, the full sample of the 2001 survey was also given questions about the frequency and average duration of both moderate intensity and vigorous intensity activities separately. When these data were secondarily categorised, the proportion of sufficiently active individuals dropped from 63% to 42% in the same people (Martin 2002). Based on these experiences, the new moderate intensity items from the HEPA 2001 survey were combined with the established leisure time vigorous intensity item, when the Swiss Health Survey introduced more detailed physical activity questions in 2002.

The Swiss Health Survey is now the most important data source on overall physical activity in Swiss adults. It is a multi-thematic survey covering individuals from the age of 15 years on, it runs over the whole year and it has a nationally representative sample of now about 19'000 participants. In the 2007 survey, 32% of adults reported behaviour corresponding to the recommendations for three endurance-type training sessions and another 9% corresponding to the minimal recommendations of half an hour moderate intensity physical activity on at least five days of the week. In comparison to the first estimates in 2002, the proportion of trained individuals had increased by 5%, the proportion of active individuals remained unchanged (figure 3). Detailed analyses showed that sport activities during leisure time remained stable from 1997

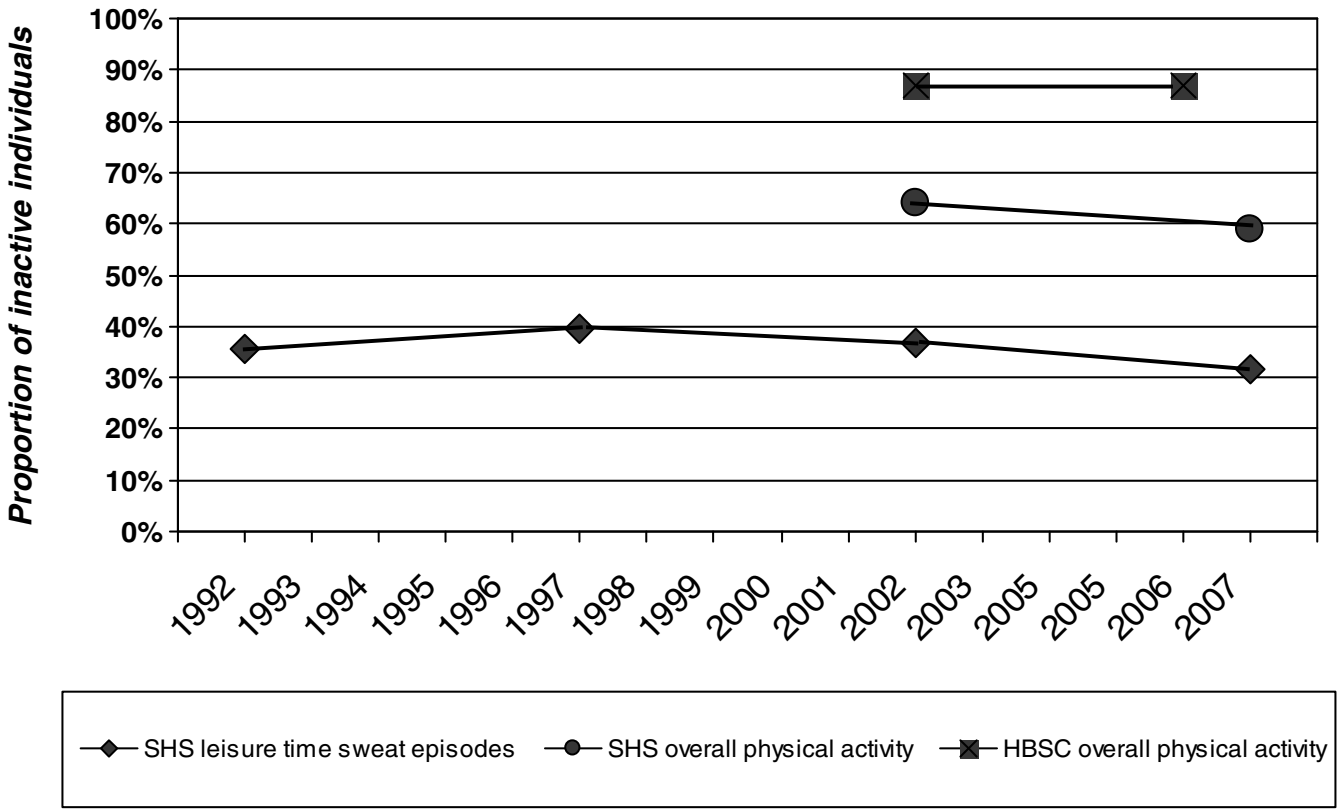

Figure 3: **Best available population estimates for overall physical inactivity in Switzerland.** The Swiss Health Survey (SHS) has measured leisure time physical activity in adults since 1992. The proportion with less than one vigorous intensity leisure time episode per week rose until 1997, but dropped again since. From 2002 on, data were available also on moderate intensity activities. The proportion of adults meeting neither the minimal nor the endurance recommendations dropped 5% and was 59% in 2007. According to the Health Behaviour in School-Aged Children Survey (HBSC), 87% of adolescents in 2006 did not meet the minimal recommendations of one hour of physical activity every day, a level which was not different from 2002.

to 2002 and increased in the following 5 years, particularly in women, while walking and cycling for daily transport seemed to have decreased between 1997 and 2002 and risen again since (Lamprecht and Stamm, 2006; Stamm and Lamprecht, 2009).

These findings are consistent with the data of the two most important surveys covering sports and transport behaviour respectively, the Swiss Sport Survey 2008 (Lamprecht et al, 2008) and the Swiss Travel Census (Sauter, 2008). The Observatory Sport and Physical Activity Switzerland (www.sportobs.ch) presents the available data for Switzerland and a recent report gives a complete overview of the existing data sources, including also national surveys with only limited information on physical activity and important sub-national studies (Stamm et al 2008).

Validity of questionnaires used in national samples of Swiss adults

So far, only limited attempts have been made to assess the measurement properties of questionnaires for which results in Swiss adults have been published. The validity of the vigorous intensity leisure time item introduced in the Swiss Health Survey 1992 was examined, but it showed no significant correlation with vigorous intensity or total activity accelerometer counts (Mäder 2006). In the same study, the physical activity items used since the 2001 HEPA survey were examined using an identical validation design, but results were not published because of methodological differences in the test-retest-reliability reported in the same article. In the 35 study subjects, a Spearman rank order correlation coefficient of 0.26 was found between energy expenditure measured from the questionnaire and accelerometer counts, but it did not reach the level of statistical significance. The categorical items not used anymore since the 2001 survey were examined as well and significant differences were found for the accelerometer counts between individuals classified as active or inactive by the questionnaire. All questionnaires showed moderate to good test-retest reliability (Mäder, 2006). To our knowledge, no other results on the validity of questionnaires used in Swiss adult population based physical activity surveys against objective measurements have been published.

Switzerland has a number of robust population-representative standardised surveys on overall physically activity and aspects of it in adults. Some of the items have shown consistent correlations with health (Calmonte and Kälin, 1997; Lamprecht and Stamm, 2006). However, none of the surveys uses questionnaires of demonstrated validity against objective measurements or objective measurements themselves. The interval between repeated measurements is five years or more for most of the surveys.

The situation in children and adolescents

Nobody doubts the importance of regular physical activity for the health of children and adolescents. But assessing physical activity has additional challenges in children, and the measurement of the early precursors of chronic diseases and of the complex developmental processes influenced through physical activity is very demanding. Therefore more research questions are still unanswered in the quantification of the association between health and physical activity in children and it took longer for the first recommendations for health-enhancing activity in children and adolescents to emerge. In Switzerland this was the case in 2006 (Martin et al, 2006). The recommendations in form of the Physical Activity Disk state that adolescents should be active for a total of at least an hour a day, children at the beginning of school age

considerably more. All activities of at least 10 min duration can be added up. As optimal development requires a full variety of exercise and sports, within or in addition to the daily "minimal hour" activities should be carried out several times a week for at least 10 minutes that increase bone strength, stimulate the cardio-vascular system, increase muscle strength, maintain flexibility, and improve agility. Activities and pastimes that involve no physical activity should not last longer than about two hours without interruption (figure 1, Swiss Federal Office of Sport et al., 2006). Though these recommendations are not very precise concerning the minimal amounts, they are in line with recommendations from other countries. So the USDHSS recommendations (2008) state that children and adolescents should do one hour or more of physical activity every day, most of it being moderate or vigorous intensity activities. As part of their daily physical activity, they should do vigorous intensity activity on at least 3 days and muscle-strengthening and bone-strengthening activity also on at least 3 days per week.

In addition to all the challenges in the measurement of physical activity already mentioned, children have a higher proportion of unstructured activities than adults, and particularly in younger children questionnaires can be only used in very simple forms or through proxies. Objective measurements have been shown to provide meaningful associations with health variables (Anderson et al., 2006), and some of them have already been used in Swiss studies (Narring et al., 1999; Michaud et al., 2002; Kriemler et al., 2008; Bringolf-Isler et al., in press).

WHO is currently involved in two international surveys that also include items on physical activity, the Global School-Based Student Health Survey GSHS (www.who.int/chp/gshs/en) and the Health Behaviour in School-Aged Children Survey HBSC (www.hbsc.org). Switzerland has participated in the latter since 1985. In 2006, 15% of boys and 11% of girls from 11 to 15 years reported being active for at least an hour on every day of the week. These proportion had not significantly changed since 2002 (Delgrande et al., 2009) and they put Switzerland on the 41st and last position in the international report for the 11 year olds, on the 40th for the 13 year old and on the 31st for the 15 year olds (Currie et al., 2008). For reaching one hour on at least five days of the week, the proportions of the Swiss boys are about 40% and for the girls about 30% (Delgrande et al, 2009).

A number of other national surveys have also described aspects of physical activity behaviour in Swiss children and adolescents. So the Sport Survey 2008 has collected detailed information on sport activities not only in people of 15 years and more of age, but also in 10 to 15 year olds. In addition, it presents estimates of overall physical activity by adding up questionnaire information from different domains (Lamprecht et al., 2008b). The Swiss Household panel has some information on physical activity and sports in all his participants from 14 years on, in the 2007 wave it included also some sport questions in an additional sample of 5 to 13 year olds (Zimmermann-Sloutskis et al., 2009). The Swiss Multicenter Adolescent Surveys on Health SMASH 1993 and 2002 had questions on vigorous intensity activities and sports in 16 to 20 year olds (Narring et al., 2004). Very detailed data on transport behaviour including walking and cycling exists down to the age of 6 years in the National Travel Census 1994, 2000 and 2005 (Sauter, 2008).

However, apart from the Swiss Household Panel and the National Travel Census, no nationally representative data exists on children below the age of 10 years and the Health Behaviour in School-Aged Children Survey HBSC is the only study to have used a internationally standardised questionnaire which has been validated in a US sample. The respective study showed a correlation of 0.40 with accelerometer data. It seems questionable whether the results would be comparable in a Swiss context. Only 13% of Swiss 11 to 15 year olds in the HBSC 2006 reported meeting the one hour recommendations on every day of the week, only 35% on five days. According to the National Travel Census 2005, Swiss 10 to 14 year olds spent about 80 minutes on a weekday on transport and 55% of their transport stages were by foot, 16% by bicycle (BFS and ARE, 2007). The – also by international comparison – very low proportions in the HBSC and the discrepancy with the Travel Census data could be explained if transport-related physical activity – which is probably less important in the average US context – were less captured by the HBSC questionnaire.

Given the difficulties in measuring physical activity in children, a possibility would be also to monitor physiological outcomes related to physical activity such as fitness and performance. Though such initiatives exist at the local level, nationally they are implemented only for the segment of young male adults in recruitment for the Swiss Army (Wyss et al., 2009).

Recommendations for health-enhancing physical activity in school-aged children and adolescents exist for Switzerland, but their quantitative interpretation for specific age groups remains a challenge. Once better methodology is available, even age- and instrument-specific nomograms might become an option. The international development in this field, including the WHO recommendations expected for 2010, should be followed carefully. Data on the proportion of adolescents meeting the one hour minimal recommendations exist from the Health Behaviour in School-Aged Children Survey HBSC which is carried out every four years. Other surveys provide information on specific aspects of physical activity in adolescents, only data on sport and transport behaviour exist for children below the age of ten at the national level. Only the HBSC uses an item which has been validated against objective measurements, its measurement properties should be verified for the Swiss context. Objective measures such as motion detectors are not currently being used at the national level and no monitoring system exists comparable to the one for allergies (Grize et al, 2006) or tobacco consumption (www.tabak-monitoring.ch).

Conclusions

Switzerland has recommendations for health-enhancing physical activity in adults as well as in school-aged children and adolescents that are consistent with the scientific evidence. This has to be verified once the WHO recommendations expected for 2010 will be issued. The development of recommendations for other population groups such as elderly persons and pre-school children should be considered as well.

Switzerland has representative standardised surveys providing robust population estimates for adults and for adolescents meeting current recommendations. In both these age groups and in school-age children estimates exist for specific aspects of physical activity. Even if the questionnaire instruments providing these estimates do not satisfy all quality criteria, it is essential for the description of trends that the measurement of the main indicators is continued. However, it is also necessary to assess the situation in younger children, to quantify the extent to which the changes shown in self-report measurements are influenced by changes in social desirability, to achieve inter-cultural and international comparability, and to arrive at more accurate economic estimates. For these purposes, it will be necessary to develop questionnaires with established measurement properties in all age groups, to apply them in appropriate time intervals in combination with objective measurements, and to explore the feasibility of physiological measurements at the population level. All these elements should then be integrated in a national monitoring system for all age groups.

Physical activity is on its way to becoming an integral part of the prevention of non-communicable diseases. In order to arrive there, the standards for measuring it at the population level have to be raised. Switzerland is well positioned to make progress at the national level and to contribute to the international development as well.

Address for correspondence:

Brian Martin, Institute of Social and Preventive Medicine, University of Zurich, Hirschengraben 84, 8001 Zürich (E-mail: brian.martin@physicalactivityandhealth.ch)

References

ACSM (1993): The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness in healthy adults. Position stand of the American College of Sports Medicine. Schweiz Z Sportmed Sporttraumatol 41: 127–137.

Ainsworth BE, Levy SS (2004): Assessment of Health-Enhancing Physical Activity. In Oja P, Borms J (eds). Health Enhancing Physical Activity. Meyer & Meyer Sport (UK) Ltd, Oxford.

Andersen LB, Harro M, Sardinha LB, Froberg K, Ekelund U, Brage S, Anderssen SA (2006): Physical activity and clustered cardiovascular risk in children: a cross-sectional study (The European Youth Heart Study). Lancet 368(9532): 299–304.

BAG (2008): Nationales Programm Ernährung und Bewegung 2008–2012 (NPEB 2008-2012). Bundesamt für Gesundheit, Bern.

Baranowski T, Domel SB (1994): A cognitive model of children's reporting of food intake. Am J Clin Nutr 59(1 Suppl): 212S–217S.

Bauman A, Bull F, Chey T, Craig CL, Ainsworth BE, Sallis JF, Bowles HR, Hagstromer M, Sjostrom M, Pratt M; The IPS Group (2009): The International Prevalence Study on Physical Activity: results from 20 countries. Int J Behav Nutr Phys Act 6 (1): 21.

Bernstein M, Sloutskis D, Kumanyika S, Sparti A, Schutz Y, Morabia A (1998): Data-based approach for developing a physical activity frequency questionnaire. Am J Epidemiol 147: 147–154.

BFS, ARE (2007): Mobilität in der Schweiz, Ergebnisse des Mikrozensus 2005 zum Verkehrsverhalten. Bundesamt für Statistik und Bundesamt für Raumentwicklung, Neuchâtel and Bern: 54.

Bringolf-Isler B, Grize L, Mäder U, Ruch N, Sennhauser FH, Braun-Fahrländer C (in press): Assessment of intensity, prevalence and duration of everyday ativities in Swiss school children: a cross-sectional analysis of accelerometer and diary data. Int J Behavioral Nutrition Phys Act.

Calmonte R, Kälin W (1997): Körperliche Aktivität und Gesundheit in der Schweizer Bevölkerung. Eine Sekundäranalyse der Daten aus der Schweizerischen Gesundheitsbefragung 1992. Institut für Sozial- und Präventivmedizin, Bern.

Craig CL, Russel SJ, Cameron C, Bauman A (2004): Twenty-year trends in physical activity among Canadian adults. Can J Public Health 95: 59–63

Currie C, Gabhainn SN, Godeau E, Roberts C, Smith R, Currie D, Picket W, Richter M, Morgan A, Barnekow V (eds, 2008): Inequalities in Young People's Health. Health Beahviour in School-Aged Children International Report from The 2005/2006 Survey. WHO Regional Office for Europe, Copenhagen.

Daugbjerg S B, Kahlmeier S, Racioppi F, Martin-Diener E, Martin B, Oja P, Bull F (in press): Promotion of physical activity in the European region: Content analysis of 27 national policy documents. J Phys Act Health.

Grize L, Gassner M, Wüthrich B, Bringolf-Isler B, Takken-Sahli K, Sennhauser FH, Stricker T, Eigenmann PA, Braun-Fahrländer C (2006): Swiss Surveillance Programme on Childhood Allergy and Respiratory symptoms with respect to Air Pollution (SCARPOL) team. Trends in prevalence of asthma, allergic rhinitis and atopic dermatitis in 5–7-year old Swiss children from 1992 to 2001. Allergy 61 (5): 556–62.

Haskell W L, Lee I-M, Pate R R, Powell K E, Blair S N, Franklin B A, Macera C A, Heath G W, Thompson P D, Bauman A (2007): Physical activity and public health. Updated recommendations for adults from the American College of Sports Medicine and the American Heart Association. Circulation 116: 1081–1093.

Hättich A (1995): Bewegung und Sport. Bestandesaufnahme 1994 der epidemiologischen Erhebungen zu Bewegung und Sport in der Schweizer Bevölkerung. Schriftenreihe der Eidgenössischen Sportschule Magglingen, Magglingen.

Jordan M, Annaheim B (2009): Habitudes alimentaires et activité physique chez les élèves de 11 à 15 ans en Suisse. Situation en 2006 et évolution récente. Résultats de l'Enquête internationale Health Behaviour in School-aged Children (HBSC) (Rapport de recherche No 45). Institut suisse de prévention de l'alcoolisme et autres toxicomanies (ISPA), Lausanne.

Kriemler S, Zahner L, Puder JJ, Braun-Fahrländer C, Schindler C, Farpour-Lambert NJ, Kränzlin M, Rizzoli R (2008): Weight-bearing bones are more sensitive to physical exercise in boys than in girls during pre- and early puberty: a cross-sectional study. Osteoporos Int 19(12): 1749–58.

Lamprecht M, Fischer A, Stamm HP (2008a): Sport Schweiz 2008: Das Sportverhalten der Schweizer Bevölkerung. Bundesamt für Sport, Magglingen.

Lamprecht M, Fischer A, Stamm HP (2008b): Sport Schweiz 2008: Kinder- und Jugendbericht. Bundesamt für Sport, Magglingen.

Lamprecht M, Stamm HP (2006). Bewegung, Sport, Gesundheit. Fakten und Trends aus den Schweizerischen Gesundheitsbefragungen 1992, 1997, 2002. StatSanté, Resultate zu den Gesundheitsstatistiken in der Schweiz, 1/2006. Bundesamt für Statistik, Neuchâtel.

Mäder U, Martin BW, Schutz Y, Martin B (2006): Validity of four short physical activity questionnaires in middle-aged persons. Med Sci Sports Exerc 38: 1255–1266

Martin B, Mäder U, Calmonte R (1999): Einstellung, Wissen und Verhalten der Schweizer Bevölkerung bezüglich körperlicher Aktivität: Resultate aus dem Bewegungssurvey 1999. Schweiz Z Sportmed Sporttraumatol 47 (4): 165–169.

Martin B, Wyss T, Mengisen W, Roost HP, Spieldenner J, Schlegel F, Rudin D, Somaini B, Kriemler S, Mahler P, Cassis I, Farpour-Lambert N, Marti B (2006): Gesundheitswirksame Bewegung – auf dem Weg zu Empfehlungen für Kinder und Jugendliche. Kommentar zu den Empfehlungen des Bundesamts für Sport BASPO, des Bundesamts für Gesundheit BAG, Gesundheitsförderung Schweiz und des Netzwerks Gesundheit und Bewegung Schweiz aus dem Jahr 2006. BAG-Bulletin 18: 326–331.

Martin BW (2006): Physical activity related attitudes, knowledge and behaviour in the Swiss population: comparison of the HEPA Surveys 2001 and 1999. Schweiz Z Sportmed Sporttraumatol 50 (4): 164–168.

Martin BW, Marti B (1998): Bewegung und Sport: eine unterschätzte Gesundheitsressource. Ther Umsch 55 (4): 221–228.

Michaud PA, Cauderay M, Narring F, Schutz Y (2002): Assessment of physical activity with a pedometer and its relationship with VO2max among adolescents in Switzerland. Soz Präventivmed 47(2): 107–15.

Narring F, Cauderay M, Cavadini C, Michaud PA (1999): Physical fitness and sport activity of children and adolescents: methodological aspects of a regional survey. Soz Präventivmed 44 (2): 44–54.

Narring F., Tschumper A., Inderwildi Bonivento L, Jeannin A, Addor V, Bütikofer A, Suris JC, Diserens C, Alsaker F, Michaud PA (2004): Gesundheit und Lebensstil 16- bis 20-Jähriger in der Schweiz (2002): Swiss multicenter adolescent survey on health 2002. Raisons des santé, 95b. Institut universitaire de medicine sociale et preventive, Lausanne.

Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C et al (1995): Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. JAMA 273: 402–407.

Physical Activity Guidelines Advisory Committee (2008): Physical Activity Guidelines Advisory Committee Report, 2008. U.S. Department of Health and Human Services, Washington DC (available at www.health.gov/paguidelines).

Prochaska JJ, Sallis JF, Long B (2001): A physical activity screening measure for use with adolescents in primary care. Arch Pediatr Adolesc Med 155 (5): 554–9.

Sauter D (2008): Mobilität von Kindern und Jugendlichen. Fakten und Trends aus den Mikrozensen zum Verkehrsverhalten 1994, 2000 und 2005. Bundesamt für Strassen, Bern.

Stamm HP, Lamprecht M (2009): Das Bewegungsverhalten der Schweizer Bevölkerung. Zwischenbericht zur Aktualisierung des

Indikators “Sport- und Bewegungsverhalten” des Sportobservatoriums. Lamprecht und Stamm Sozialforschung und Beratung AG, Zürich.
Stamm HP, Studer M, Lamprecht M (2008): Analyse von Monitoring-Projekten in den Themenbereichen Ernährung und Bewegung in der Schweiz. Analyse im Auftrag des Bundesamtes für Gesundheit BAG. Lamprecht und Stamm Sozialforschung und Beratung AG, Zürich.
Swiss Federal Office of Sport, Swiss Federal Office of Public Health, Health Promotion Switzerland, Network HEPA Switzerland (2006): Health-Enhancing Physical Activity. A Base Document. Swiss Federal Office of Sport, Magglingen.
USDHHS (2008): 2008 Physical Activity Guidelines for Americans. Be Active, Healthy, and Happy! US Department of Health and Human Services, Washington DC (available at www.health.gov/paguidelines).
WHO (2004): Global strategy on diet, physical activity and health. World Health Organisation, Geneva.
Wyss T, Beuchat C, Zehr S, Schori B, Mäder U (2009): Physical performance in young men at Swiss Army recruitment 1982 to 2005. Schweiz Z Sportmed Sporttraumatol 57 (2): 75–77.
Zimmermann-Sloutskis D, Zimmermann E, Wanner A, Mäder U, Martin BW (2009): Sport activity in children aged 5 to 13 years in the Swiss Household Panel 2007 – levels and relationship with parents’ behaviour. Schweiz Z Sportmed Sporttraumatol 57 (2): 69–71.