

Booth

Research Quarterly for Exercise and Sport
©2000 by the American Alliance for Health,
Physical Education, Recreation and Dance
Vol. 71, No. 2, pp. 114-120

Assessment of Physical Activity: An International Perspective

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Keywords: exercise, questionnaires, measurement

To achieve international consensus on any aspect of public health research or practice is not a simple task. The time and effort required to achieve consensus on physical activity assessment should be well justified before the process of consensus building is commenced. Several questions should be considered in determining the justification for consensus development.

First, are physical inactivity and its health consequences international issues? Are they relevant to a large number of countries and to a large proportion of the world's population? If these questions can be answered in the affirmative, the next question is: What are the potential benefits to public health research and practice? Will the presence of an internationally-agreed measure of physical activity make any real difference to our knowledge, our capacity to influence physical activity participation or the health outcomes associated with physical activity? If these questions can also be answered in the affirmative, the final question is: What are the issues or challenges which must be resolved in order to achieve consensus and can resolution reasonably be achieved?

This paper addresses each of these questions and argues that the health consequences of physical inactivity are problems of truly international proportions, that the benefits to research (and therefore our capacity to intervene effectively) are great and that none of the challenges to reaching international consensus on physical

activity assessment are insurmountable. Although there are many different direct and indirect methods of assessing physical activity participation, the only feasible method of measurement for use in large scale population surveys in developed and developing countries is self-report. All of the comments in this paper are predicated on that basis.

Shared Problems...

Globalization is one of the buzz words of the 1990s and there is no doubt that it will retain a prominent place in our vocabularies for a long time to come. Globalization has been made possible by the introduction of dramatic efficiencies in communication and transport (of people and goods) over the last one or two decades and has been realized as a rapid increase in cross-national activity: in commerce, politics, education, recreation, health and many other areas. One of the effects of globalization has been to increase international understanding of the challenges to good health faced in different countries.

The World Bank's landmark report *The Global Burden of Disease* (Murray & Lopez, 1996) has identified many contemporary and emerging health problems and has made clear that many of these problems are, to a greater or lesser extent, shared among both developing and developed economies. Although there is a long history of international support and cooperation to overcome health problems, never before has our understanding of the global prevalence and distribution of disease and disease risk factors been as great as it is today. The international distribution of infectious diseases has probably received the greatest attention, but a significant amount

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is now also known about the chronic, non-communicable "lifestyle diseases" the key behavioral risk factors for which are: the use of tobacco, alcohol and other substances; poor food habits; and inadequate physical activity.

Murray and Lopez (1997) summarized some of the findings reported in the *Global Burden of Disease* and reported that non-communicable diseases accounted for 50% of all deaths in developing economies and 85% of all deaths in developed economies. Overall, ischemic heart disease and cerebrovascular disease were, respectively, the first and second leading causes of death throughout the world. Physical inactivity is an established risk factor for cardiovascular disease (Blair, Kohl, Gordon, & Paffenbarger, 1992), colon and possibly other cancers (Lee, 1995), osteoporosis (Vuori, 1995), non-insulin dependent diabetes, overweight, and hypertension (Bouchard & Depres, 1995), and anxiety and depression (Biddle, 1995).

It is clear that the diseases and conditions causally associated with inadequate physical activity are prevalent in both developed and developing economies. It is also clear that physical inactivity substantially increases risk for many of the most common causes of mortality and morbidity as well as having very significant economic and personal consequences. Such a significant threat to the health of so many people from so many countries demands a coordinated, cooperative international research response.

...Shared Solutions.

It might be argued that adequate international collaboration on research into physical activity already takes place. Research results are available in international scientific journals; most large scientific conferences are multi-national events; many international consensus meetings and workshops can be identified; and some cross-national collaborative research does take place. Despite these many positive examples, effective cooperation remains keenly hampered by one key problem: there is no internationally agreed measure of physical activity participation. In fact, it is doubtful if there are even any countries with an agreed standard measure that is used consistently. Although there are a few measures of physical activity participation which have been used in different research studies, it would be fair to say that the great majority of research studies have used different or modified instruments.

The consequence of not having agreed standard measures is that direct comparisons of the results of research projects are, at least, difficult and, at worst, invalid. We fall a long way short of enjoying the full benefits of communicating research results to each other when dif-

ferent measures are employed and the international research effort necessarily remains fragmented. The development and widespread adoption of one (or even a small number of related measures) would allow direct comparisons of research findings, regardless of the country in which they were conducted, and would catapult our knowledge, and practice, forward.

Types of Research

An internationally agreed measure of physical activity participation would contribute to our knowledge in all aspects of physical activity research: population surveys; studies of the health consequences of physical inactivity; studies of the determinants of physical activity participation; and intervention evaluation.

Population Surveys

Data from population surveys are typically used to determine the prevalence, sociodemographic distribution, and trends in physical activity participation. Comparisons of the prevalence and trends in physical activity participation can provide an interesting global view of the behavior. It may be helpful to know if the prevalence and trends are similar across countries or if some countries are significantly different from others. Although this ecological approach is methodologically weak, it may provide some useful clues to policy and environmental differences between countries that may account for some of the observed epidemiological differences.

Studies of the sociodemographic distribution of physical activity participation are conducted to determine if health promotion resources should be differentially allocated to specific population groups and to contribute to our understanding of the determinants of physical inactivity. Cross-cultural comparisons of the population distribution of physical inactivity will help to determine if these patterns are universal or if they are largely culture specific. If sociodemographic patterns of physical inactivity are found to be generally consistent across cultures, some key determinants of participation may consequently be identified.

Health Consequences of Physical Activity

It would be surprising if there were substantial differences across cultures in the health benefits associated with physical activity participation, but use of a common measure would allow direct comparisons between studies and more rapid advances in this sub-discipline.

Determinants of Physical Activity

An understanding of the reasons why people are, or are not, physically active informs the development of effective interventions to promote physical activity participation. Even relatively minor differences in measures of physical activity participation may have a substantial impact on the statistical modelling used to characterize the relationship between the reported behavior and the determinants under study. The use of an internationally agreed standard measure would allow us to identify common and culture-specific determinants and hence advance intervention design at international and national levels.

Intervention Evaluation

The evaluation of planned interventions is the aspect of research in which there is perhaps the strongest international interest. Particularly with the rapid recent increases in the prevalence of overweight and obesity world wide, a greater sense of urgency now attends the development and dissemination of effective strategies to promote greater physical activity participation. International interest in the effectiveness of different intervention strategies is stronger than ever before. The ability to make direct comparisons between studies, regardless of where they are conducted, through their use of the same physical activity participation measure will best serve our research needs.

It is clear that the consequences for health of inadequate physical activity is an issue of global relevance. It should also be clear that more effective collaboration will result in greatly increased benefits for all. Although there are well-established avenues for information sharing, only a small fraction of the full benefit of this sharing is currently being realized. The use of a large number of different measures of physical activity participation greatly hinders direct comparisons between research findings, in all aspects of research. The consequence is a more fragmented, less coherent and less certain body of knowledge than we would otherwise enjoy. The key that will unlock much of this potential is an internationally agreed measure of physical activity participation.

At the time of writing, significant advances toward the development of an internationally-agreed measure have been made by the International Consensus Group on Physical Activity Measurement. Most of the challenges identified in this paper as requiring resolution have been identified through the work of this group.

Challenges to International Agreement: The Issues

Almost every aspect of the assessment of physical activity participation presents some challenge to the development of an internationally-agreed measure. As many challenges as there may be, none of them appear to be insurmountable. The challenges are discussed below, under the headings: meanings of the words "exercise" and "physical activity"; domains of physical activity (leisure-time, gardening/yardwork, household chores, physical activity for transport, occupational physical activity); seasonality of participation; classes of activity versus specific activity; the use of symptoms of activity (sweating, breathlessness) versus examples of types of activity to illustrate questionnaire items; and the impact of different modes of questionnaire administration.

"Exercise" and "Physical Activity"

Anecdotal evidence suggests that the terms "exercise" and "physical activity" may be understood differently not only by residents in different countries, but even by different population groups within one country. For some people, exercise may refer only to sports participation, to activities of vigorous intensity or to very structured activity. In other cases "exercise" may only be thought of as something one does as a leisure-time activity. In still other cases, any activity that is fun (e.g., dancing or friendly games) is not considered exercise or activity at all: only those activities that are not enjoyable are considered to be exercise. Valid questionnaires must ensure that the respondents have an unambiguous understanding of the types of activity being assessed by each item. The use of several culturally-relevant examples is probably the best way to achieve this.

Domains of Physical Activity

The aspects of daily life (domains) in which physical activity may take place include: leisure-time; gardening or yardwork; household chores; transport or moving from place to place; and occupational physical activity.

Leisure-time Physical Activity

Of the five domains of physical activity participation, the greatest interest has been in leisure-time physical activity because the potential for behavioral change was thought to be greatest for this domain. However, there are clear and consistent socioeconomic differentials in

leisure-time physical activity participation within developed countries (e.g., Ford et al., 1991) with people of lower socioeconomic status (SES) spending less time in leisure-time physical activity than people of higher SES. Some reports suggest that many people of low SES, particularly women, have little leisure-time available to them. If they do have any leisure time, they prefer to rest or report significant barriers to being active during this time (Eyler et al., 1998).

Very little is known about the physical activity habits of people who live in developing countries although it may reasonably be speculated that leisure-time physical activity accounts for a relatively small proportion of total activity. The notion of "leisure-time physical activity" may even be quite alien to much of the world's population. Any international standard measures of physical activity must take into account the different ways in which different populations or population groups accumulate activity throughout the day.

It is interesting to note that more recently-developed physical activity questionnaires place significant emphasis on leisure-time physical activity participation. It is important that future instruments be carefully attuned to the living conditions and the economic and cultural milieu of the respondents, and that they not simply reflect the lifestyles of those who write the questionnaires.

Gardening and Yardwork

Gardens and yards (the land associated with a residence) come in many shapes and sizes. Consequently, the amount of time and effort required to maintain them and the intensity of the activity will vary substantially between individuals and countries. The amount of effort expended in gardening and yardwork may show a strong seasonal effect depending on location and the amount of effort may also depend on whether the garden is primarily for aesthetic pleasure or a source of food. Finally, the effort required to maintain a garden and yard will depend on the extent to which the activities are mechanized.

In some countries or regions within countries, the vast majority of the population may live in medium- to high-density apartments without any open space that requires maintenance (e.g., Singapore, Hong Kong and much of Japan). In those cases, thought should be given to whether or not questions on gardening and yardwork should be included in the questionnaire. The inclusion of items that are very likely to be irrelevant to the respondents may reduce the face validity of the instrument and impact negatively on the data quality.

In countries with a tropical or temperate climate, there may be little variation in the time and effort spent at gardening and yardwork across the year. However, in countries with cold or very cold winters, the effort expended is likely to show a strong seasonal effect. It should

be kept in mind that winter-time energy expenditure will not necessarily be lower than other seasons as clearing snow by hand to allow access may result in higher energy expenditure related to yardwork during winter than other seasons. If a questionnaire uses a "usual week" as the reference period, consideration will need to be given to the season in which the respondent places their "usual week". If the "last week" is used as the reference period, those conducting the surveys may wish to consider conducting surveys in several seasons across the year in order to better understand the physical activity habits of the population.

In many developing countries gardens are more likely to be maintained as a source of food than for aesthetic pleasure. Consequently, "gardening" may be understood differently by different people. For many respondents in developed countries, gardening is more likely to be understood as a leisure activity and in many developing countries, gardening is more likely to be interpreted as work or as part of one's occupational activities. In any case, care should be taken to ensure that gardening and yardwork is not reported more than once under different categories of activity.

Neither "gardening" nor "yardwork" is an homogenous activity and the intensity may vary from light (general pruning) to very hard (vigorous digging or cultivating). The extent to which chores are mechanized will, of course, also have a great impact on the amount of effort or energy required for a particular task. For example, lawn mowing may be done with a ride-on mower, a power mower that is pushed or an unpowered mower. It is therefore not appropriate to simply ask about the time spent doing garden or yardwork tasks, but questions should seek to clarify the time spent in specific activities (e.g., sweeping, hard digging, weeding) or the time spent in classes of activity (e.g., light, moderate, or vigorous intensity).

Household Chores

Like gardening and yardwork tasks, "household chores" is not an homogenous activity. Household chores may vary from light dusting and tidying to walking long distances carrying a heavy load of water or fuel. However, if household chores are restricted to activities in and around the home, there are unlikely to be substantially different issues across countries. Perhaps the greatest unresolved issue at present is whether, for most people, most household chores are sufficiently vigorous to provide any health benefit and therefore to warrant inclusion in questionnaires. It may be necessary for studies to be undertaken in different countries to identify what is understood by "household chores" and to determine accurately the energy associated with each major task or to determine which chores may be classified as light, moderate, or vigorous intensity.

Transport

The most common forms of person-powered transport are walking and cycling, and the former, at least, is a universally-recognized activity. At first glance, it would appear that assessing the time spent walking or cycling should be straightforward. However, people may walk or cycle for different reasons and under different conditions. In developed countries, the main reasons for walking are for recreation/health or for transport and most walking is unlikely to be over difficult terrain or with heavy loads.

In developing countries, walking may involve carrying heavy loads or moving over steep or otherwise difficult terrain; resulting in a much greater rate of energy expenditure. It is important to identify the conditions under which walking is taking place and to assign the appropriate rate of energy expenditure. The same issues are relevant to cycling; it is important to identify the general conditions, loads and speed of cycling to identify the correct rate of energy expenditure. Walking or cycling may serve several purposes simultaneously so researchers must ensure that these activities are not over-reported by recording them under more than one questionnaire item.

Occupational Physical Activity

Like household chores, it is not yet clear which aspects of occupational activity should be included in questionnaires. In developed countries, relatively few jobs require a high rate of energy expenditure, so exclusion of occupational activity may have little impact on the prevalence of physical activity (although it may have an impact on the sociodemographic distribution of physical activity). However, in developing countries, many occupations may involve physically demanding work and inclusion or exclusion of questions related to occupational physical activity is likely to have a large impact on prevalence estimates.

It is not clear whether people of different cultures share the same notions of "occupation". In developed countries, one's occupation is usually conducted in a place other than the home and involves a discrete set of activities. However, in many developing countries where much of the population may be engaged fully or partially in subsistence agriculture, the notion of "occupation" may not be familiar and work may be difficult to discern from the rest of one's activities. Clearly, careful thought will have to be given to the wording of the questions so they are culturally relevant and understood by the interviewee.

Seasonality

As already mentioned, the climates of some countries will have little impact on activity across the year whereas in others, the amount or type of activity may vary a great deal across seasons. Although seasonality may have little impact on the nature of the questions used to assess physical activity participation, it will have an important impact on the timing of questionnaire administration. If physical activity participation varies across the year, administration of the questionnaire only in one season may not provide an adequately comprehensive view of the physical activity habits of the population. If activity is markedly lower in some seasons, the authorities may wish to target interventions to specifically address that issue.

If multiple cross-sectional studies are to be conducted in order to create trend data, it is essential that they be conducted at the same time of year in countries with marked seasons and may even be important in more temperate climates. Apart from the role of the seasons, local holidays and holiday periods may influence physical activity habits. Generally, it is preferable to conduct surveys at times well distant from major holidays or celebrations so that the behaviors sampled are typical of usual or habitual behaviors. Of course, this will vary between countries or even regions and a standard time of year cannot be determined for surveys in all countries.

Classes of Activity versus Specific Activities

Self-report instruments may ask about participation in specific activities (e.g., tennis, soccer, cycling, swimming) or about participation in broad classes of activity (e.g., moderate-intensity or vigorous-intensity activity), or a combination of both. If questionnaire items refer to participation in specific activities, the only way to equate participation across different activities is to ascribe a rate of energy expenditure to each and then to calculate the overall quantum of energy expenditure.

This approach requires, however, that the rate of energy expenditure is known or can be reasonably estimated from reference tables for all activities. Although the rate of energy expenditure has been determined for many activities, they mostly include activities common in Western societies and the rate of energy expenditure of many of the activities common in developing or non-Western countries have not been determined. Consequently, although this approach may be possible for some Western countries, it is not appropriate to many cultures.

Symptoms of Activity versus Examples to Illustrate Questionnaire Items

In questionnaires which include questions about participation in different classes of activity based on intensity (e.g., light, moderate, vigorous), the question can be illustrated with examples of common activities of the appropriate intensity or may refer to the physiological symptoms which best reflect the intensity of the group of activities. For example, moderate-intensity activities may be described as those that produce a slight increase in breathing or heart rate or may be illustrated with examples such as moderate-paced cycling, walking, or doubles tennis. There are advantages and disadvantages with both approaches. The use of symptoms of exercise may be confounded by the ambient temperature and clothing whereas specific activities may be traditionally performed at different intensities in different cultures.

Method of Administration

Depending on the type of research being conducted, physical activity questionnaires may be administered by telephone interview, face-to-face interview, or may be self-completed. There appears to be a general move toward administering population health surveys by telephone as Computer-Assisted Telephone Interviewing (CATI) systems become more widely available. Indeed, the use of telephone surveys is becoming more commonplace for intervention study follow-up surveys and in determinants research. This approach does require, however, that household telephone ownership be very high to avoid sampling bias and requires access to costly infrastructure. These two requirements may not be met in a large proportion of countries.

It is quite plausible that respondents react differently depending on the mode of administration of a questionnaire. Demand characteristics (a desire to please the investigator or to appear to be a "good" health citizen) may be greater when questionnaire administration is conducted face-to-face compared with self-completion or telephone interview administration. Although this is unlikely to be a critical issue, it would be worthwhile to determine if there are, in fact, systematic differences associated with the mode of questionnaire administration and, if so, the magnitude and direction of these differences so they might be taken into account.

The International Consensus Group for Physical Activity Measurement: Progress

Considerable progress has been made toward the successful development of an internationally-agreed set of measures of physical activity participation. The Consensus Group was formed in 1995 and is coordinated by Dr. Michael Pratt of the Centers for Disease Control and Prevention, Atlanta and the present author. The Consensus Group has members representing approximately 20 countries and has met on several occasions.

By late 1999 a set of measures had been developed and pilot tested and a reliability and validity testing protocol had been developed and by mid-late 2000, reliability and validity testing had been conducted in more than a dozen countries.

Conclusion

This paper has argued that the health consequences of physical inactivity are prevalent, serious, and involve developed and developing countries alike. It is also argued that the benefits of an international physical activity assessment instrument to research, and thence to public health practice, are substantial and well worth the effort. The challenges to the development of an instrument that is reliable, valid, and acceptable to most, if not all countries, were identified and none of them appear to be insurmountable. Indeed, considerable progress has already been made toward this end by the International Consensus Group on Physical Activity Measurement and the Consensus Group hopes to meet its objectives by the end of 2001.

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Author's Notes

The author gratefully acknowledges the helpful comments of Weimo Zhu on a draft of this paper.