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Physical Activity for Health: An Overview

Mark L. Wahlqvist

Asia Pacific Health and Nutrition Centre, Monash Asia Institute, Melbourne and International Union of Nutritional Sciences, Melbourne, Australia

The Community Decline in Physical Activity

In general, the trend, with mechanization, computerization, passive leisure, and urbanization, has been for people to reduce their levels of physical activity. However, there are some notable national exceptions, in Finland and Canada, which demonstrate that these trends can be countered [1]. Not only public health strategies, but national leadership and infrastructural programmes are likely to be required from an early age for the reversal of this downward trend in physical activity and associated fitness. It is increasingly clear that, not to do so, invites a major burden of chronic disease and disability and premature death [2, 3].

Until the late 19th and the 20th centuries, there were few examples of *regularized athletics and sports in society*, with the notable exception of the Greeks and Romans. This is because physique and performance needed recognition and admiration and because settlement, organisation and facilities were usually required, and so was relative wealth and the time to pursue such activity. As a matter of fact, the physical requirements of work in servitude, employment or in communities with subsistence agriculture were often so great as to view time to oneself or one's family as time for physical rest. Well into the 20th century, it was a common belief that too much exercise would shorten one's life. Moreover, recent studies demonstrate that extensive sports and work patterns (e.g. lumberjacks) can outstrip energy intakes in their energy requirements and can lead to immune dysfunction [3]. A SWOT (strength, weaknesses, opportunities and threats) analysis of the overall decline in physical activity takes this issue of the health limits of physical activity into account (table 1).

Table 1. Decline in physical activity SWOT analysis

Strengths	*Weaknesses*
• Avoid tissue and system damage through excess	• Detrimental body composition • Decreased system reserve (e.g. CV, respiratory, CNS)
Opportunities • Replace physical activity at work with physical activity as leisure (sport) • More time for education, social networking	*Threats* • Eco-nutritional disease (END) or chronic non-communicable diseases (CNCDs)

Table 2. Physical activity – optima

- Walking or other aerobic activities (6 days/week, 1–2 h/day)
- Strength training through multiple repetitions against resistance (3–4 days/week)
- Integrated with goal
  - Personal development
  - Social development

Table 3. Physical activity – goals

- Include physical activity in workaday week and travel (purposeful physical activity)
- Find enjoyable leisure-time physical activity (personal and social fulfillment)
- Overcome seasonal, locality and situational barriers to physical activity
- Improved sense of well-being
- Reduce burden of disease

The *optima* for physical activity, beyond that which is 'self-paced' (what one does without thought – e.g. gesticulation whilst talking, restless movement whilst awake or asleep), are probably much as shown in table 2.

In turn, physical activity goals and targets could be formulated as in tables 3 and 4.

For World Health Day in 2002, when the theme was 'Move for Health', the degrees of health achievement through exercise were depicted graphically (fig. 2).

Table 4. Physical activity – targets

- Walk most days irrespective of time of year, at least 20 min one way and 20 min return
- Be strong enough, through repetitive resistance movement, to undertake ADL and sudden, unexpected but reasonable demands for strength (e.g. carrying a load upstairs, shoveling snow, moving a log)
- Keep active and strong with advancing years.

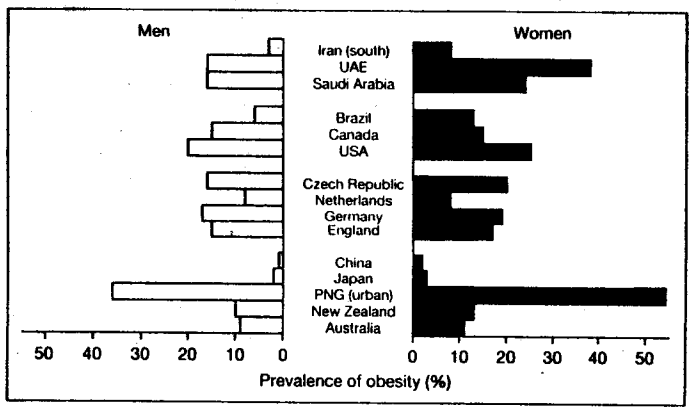

Fig. 1. Global prevalence of obesity. BMI ≥30. UAE = United Arab Emirates; PNG = Papua New Guinea.

The most obvious and impressive consequence of physical inactivity is *obesity*, where prevalence is interesting worldwide, irrespective of the stage of economic development and, often, in the face of protein malnutrition with growth retardation and muscle wasting [4] (fig. 1). This constitutes the so-called '*Double Burden of Disease*' [5, 6].

Energy Throughput, Food Intake and Body Composition

Throughout much of the 20th century, *energy intake* remained largely unchanged, even with economic development [7]. Yet the *prevalence of obesity* began to escalate and, whilst the quantity and quality of food intake have become important issues, most of the obesity epidemic could probably have

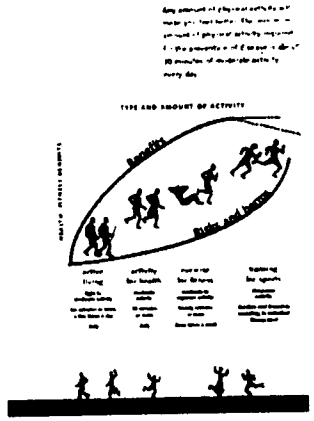

Fig. 2. 'Move for Health': World Health Day 2002. Agita Mundo – Move for Health, the slogan for World Health Day 2002, is a call to individuals, communities and countries to associate action for health with the public health task of prevention. ('Agita' in Portuguese means shake. Agita Mundo means shake the world.)

been avoided if physical activity levels had remained adequate. One of the best example of this is Japan, where people have continued to walk a lot, and obesity (BMI ≥30) prevalences have remained as low as about 3%, compared to the USA where they now exceed 20%.

Also, *sub-groups in the population* have not experienced the general trend towards obesity, where they have been regular exercisers. For example, people who walk, jog or run regularly are generally leaner, without the need to be pre-occupied with food intake.

It is *energy throughput* at higher levels which is more important than energy intake in determining the risk of positive energy balance (and, therefore, overfatness). This is seen by reference to the studies of Peter Wood at Stanford University, where he demonstrated that middle-aged *runners* actually eat more and lose body weight (fat) [8]. If this phenomenon could be generalized across the community, say by making walking, cycling and jogging more attractive, substantial improvement in individual fitness and body composition would be achieved.

People need to understand more clearly *what weight represents* – muscle and bone mass to be optimized, fat stores to be appropriate and directed away from the abdomen – and the nature of intra-daily and day-to-day fluctuations in body water (and sodium). This means education about body composition and not pre-occupation with weight as the key health end-point in physical activity programmes.

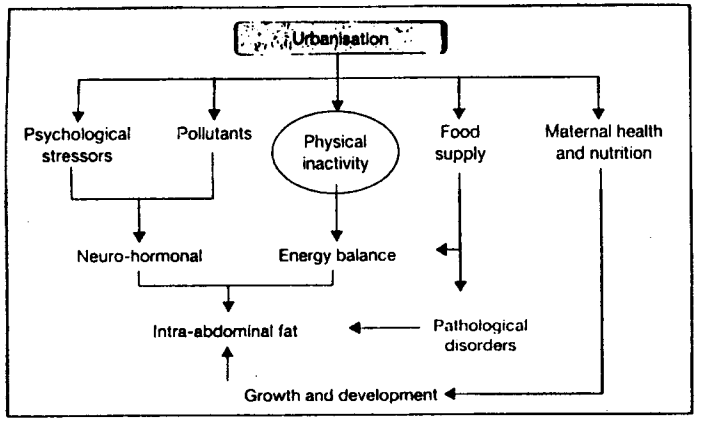

Fig. 3. Pathways to abdominal obesity. From Wahlqvist [15].

It is now appreciated that body composition and fat distribution are major determinants of total and disease specific mortality [9–13].

There is increasing evidence that the *energy density*:

$$\text{Energy density} = \frac{\text{Energy (cal or kJ)}}{\text{Mass of food (g or kg)}}$$

is a determinant of energy balance [14, 15]. However, this will be less critical when one is physically active, since the errors in energy intake are more likely to be corrected (through the set of appetite, and the energy cost of carriage of increased body mass).

Again, with greater levels of regular physical activity, *food component* (essential macro- and micro-nutrients; other biologically active and favourable food components like phytonutrients) *density* is less critical.

$$\text{Nutrient Density, phytonutrient density} = \frac{\text{Mass of nutrient or phytonutrient or food component (e.g. Mg or μg)}}{\text{or food component density Energy (e.g. 100 kJ)}}$$

The inactive, however, must be careful to have most of their food nutritious as judged by their food component density.

The pathways to abdominal obesity, nevertheless, are several, although physical activity is central (fig. 3).

Table 5. Physical activity as a requisite for human species

- Conception and pregnancy
- Childhood, puberty and adolescence
- The reproductive years
- Later life
- Inter-'life stage' considerations
- Inter-generational considerations

Physical Activity for Life

Just as we have to realize with the long-term effects of maternal nutrition and *intra-uterine life* on later life morbidity and mortality, so it is likely that we will find the same for appropriate levels of maternal physical activity pre-conception and during pregnancy, and lactation (table 5). However, more work is required in this area, as there has been much debate about appropriate work patterns and sporting engagement for pregnant women [16].

Nevertheless, we do know that physical activity affects *gene expression* [17], and plays a role in the expression of *gestational diabetes*, with its inter-generational effects on insulin resistance [18].

Physical Activity, Well-Being and the Domains of Health

There is little doubt that regular physical activity is a key determinant of well-being and mood [19], functional status [20] and perceived health status [21] (fig. 4).

Preventive Physical Activity

The *burden of disease* in contemporary economically advanced societies is located amongst the following health domains:

- Cardiovascular disease
- Metabolic disorders
  e.g. obesity, diabetes
- Neoplasia
- Bone health

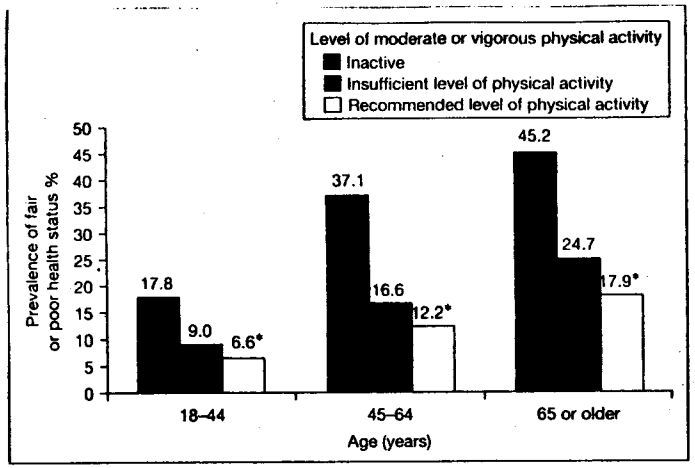

Fig. 4. Prevalence of fair or poor health status by age and level of physical activity. *Significant difference in likelihood of fair or poor health status across physical activity groups after adjustment for age, race/ethnicity, gender, education, smoking status and BMI, $p < 0.001$.

- Immune function
- Cognitive function
- Mood

In Australia, the Burden of Disease and Injury is attributed to selected risk factors as shown in figure 5.

Physical activity features highly in the contribution to Burden of Disease [22, 23] and, therefore, in preventive programmes.

Inter alia, physical activity appears to be protective against disease by

- improving cardio-respiratory function
- improving lipid profiles, blood pressure, abdominal body fatness.

This can be seen in a number of studies of diabetes prevention [24], cancer [25], and osteoporosis [26] (fig. 6).

Resistance or strength training is relevant for quality of sleep and depression [27].

We can expect that regular physical activity will displace the onset of morbidity towards the end of life [28], as well as prolong it [28, 29].

Disease-specific survivals are prolonged with regular physical activity, as evidenced in the Harvard Alumni Study [30, 31] and in Finnish studies by Pekkanen et al. [32].

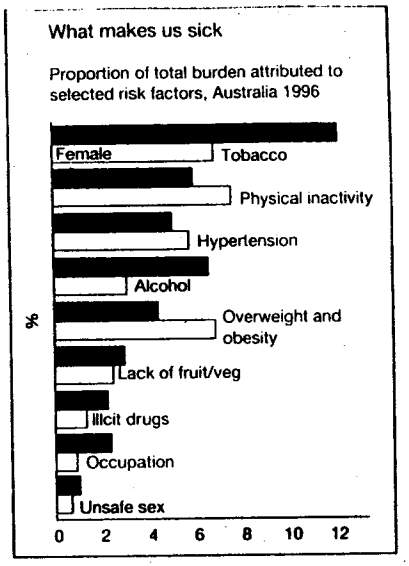

Fig. 5. 'The Burden of Disease and Injury in Australia'. Published by the Australian Institute of Health and Welfare, 1999.

Therapeutic Physical Activity

The clear preventive health role of physical activity may well be translated into therapeutics. To some extent, there is overlap between secondary and tertiary prevention and therapeutics in any case.

Of great importance, with ageing populations is the reduction in the problems of:

- Sarcopenia and frailty
- The growing burden of nutritional and metabolic diseases
- Senescence

At least some cases of sarcopenia can be expected to be preventable and reversible [33, 34].

Eco-Nutrition and Physical Activity

Healthy habitats and precincts, conducive to regular physical activity are essential for community health. Not to have them is to encourage Eco-nutritional Disease (END).

Favourable eco-nutritional precincts will:

- Link family life, leisure and work

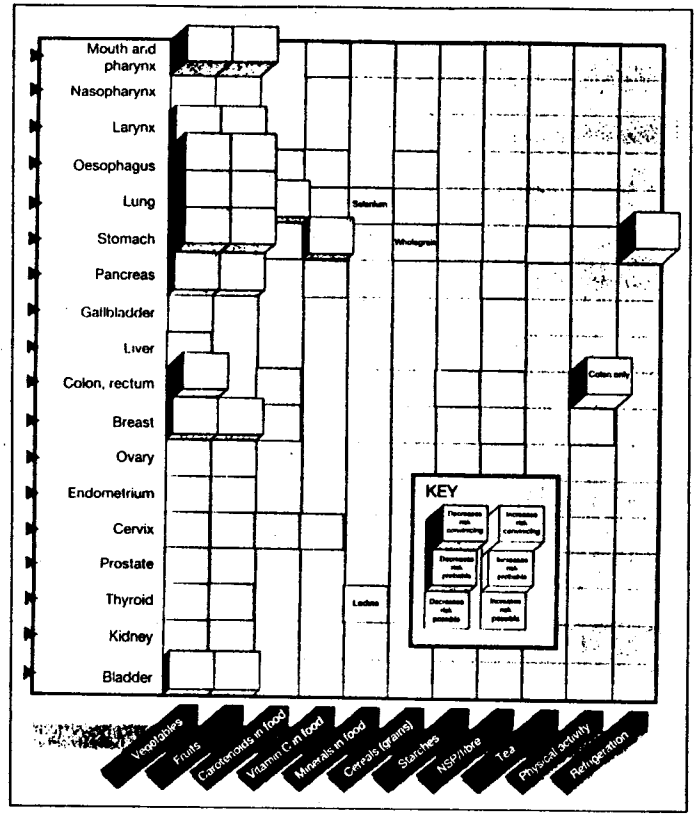

Fig. 6. Nutrition and physical activity in the prevention of cancer.
Source: World Cancer Research Fund/American Institute for Cancer Research, 1997.

- Be safe and congenial for walking, climbing, cycling, playing, swimming, skipping, dancing, skiing or gardening
- Provide contact with various plant and other animal species.

The term 'chronic disease' says nothing about the aetiology or pathogenesis. The logic of describing chronic disease as 'eco-nutritional disease' becomes apparent when considering:

- The major importance of food, its variety and the requirement for biodiversity on human health
- Movement, best achieved in safe, pleasurable and sustainable precincts
- The required 'environmental buffer zones' to minimize the risk of known and emerging transmissible pathogens [35, 36].

Conclusion

We seek a unifying strategy for both *health advancement* and *health optimization* which is sustainable. This must involve us continuing as our own machines, moving, thinking, socializing and integrated with the natural world.

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Prof. Mark L. Wahlqvist
Asia Pacific Health and Nutrition Centre, Monash Asia Institute
Floor Menzies Building, Monash University, Wellington Road
Clayton, Melbourne, Victoria 3800 (Australia)
E-Mail mark.wahlqvist@adm.monash.edu.au

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