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The Evolution of Physical Activity Guidelines

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A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
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Abstract

Background: *As the scientific support for the impact of physical activity on health has grown, physical activity recommendations for the public have been modified. The aim of the paper is to present the evolution of physical activity guidelines, which were formulated on the basis of existing research evidence, produced by experts, mainly in physiology and medicine.*

Material/Methods: *A systematic literature review was applied. In order to interpret the content of text data, a qualitative content analysis was used. It was supported by the Qualitative Data Analysis (QDA) computer software package NVivo 9.*

Results: *Recognition of hazards of a sedentary lifestyle has led numerous groups to promulgate public health recommendations for physical activity. Since 1950s leading scientists and science organisations have participated in developing and publicising these guidelines and in revising them to keep up with the pace of modern exercise science. The paper discusses reasons for differences in the guidelines and provides a summary in order to harmonize existing reports.*

Conclusions: *Using epidemiological, clinical and laboratory methods, different expert committees have independently arrived at similar conclusions about the need for physical activity in daily life. However, formulating guidelines regarding an optimal dose of physical activity, which could be universal for everybody, is very problematic. A recommended dose of physical activity must be approachable and adjusted to a particular person or a group.*

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Introduction

A human being has always been adapted for a particular physical activity. People living thousands years ago had to care about their health by proper feeding and most of all, by dosing a right amount of activity. Physical activity was part of human nature. From each generation to another, along with the evolution of people and development of technological conveniences, ways of life were continuously changing. Even just one hundred years ago, people devoted about 90% of energy to work of muscles [1]. Nowadays, in highly developed countries, such an index of energy expenditure equals only 1%. This problem is remarkably illustrated by a theoretical model by R. Winiarski [2]. It applies to changes in the structure of human activity within three last centuries (Fig. 1).

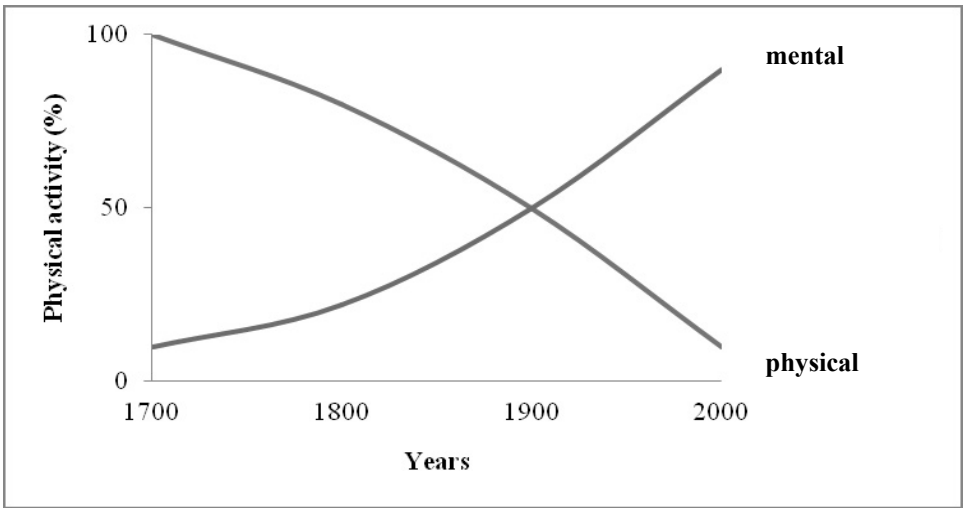

Fig. 1. A theoretical model of changes in the structure of human activity within three last centuries
Source: [2]

The amount of activity of a human being has been substantially reduced. It contributes to the phenomenon of hypokinesia, which has a negative influence on health of individuals and societies. Hypokinesia, i.e. a deficiency in body movement, is a lack of physical activity necessary for health and normal functioning of an organism [3].

The demand to estimate an optimal dose of physical activity started to appear along with the change of human activity structure. First, it is necessary to explain what physical activity dose is. The dose of exercises is a specified amount of physical exercises, necessary to achieve a defined effect [3]. It can be a biological, psychological, efficiency or health-related effect. A dose relates to various forms of physical activity (PA). The main constituents used for defining a PA dose include the type, intensity, frequency and duration of the undertaken physical activities [4]. The amount, or volume of PA, is defined by the product intensity × frequency × duration, most often expressed in units of expenditure of energy, i.e. kcal/day, MET-min/day. The expenditure of energy depends on the size of each factor. Figure 2 presents various matchings of PA constituents, which lead to expenditure of the same amount of energy – about 1,800 kcal per week.

There is a significant interpersonal diversification in most responses about particular doses of physical activity [3]. In order to strictly determine a dose of physical exercises, their design must be unequivocally based on the specificity of a response, in which various mechanisms take part, and also on the efficiency and applicability of particular exercises. A recommended dose of physical activity must be approachable and realisable for particular person or group, in proper average time, space, with specific equipment and at average physical fitness.

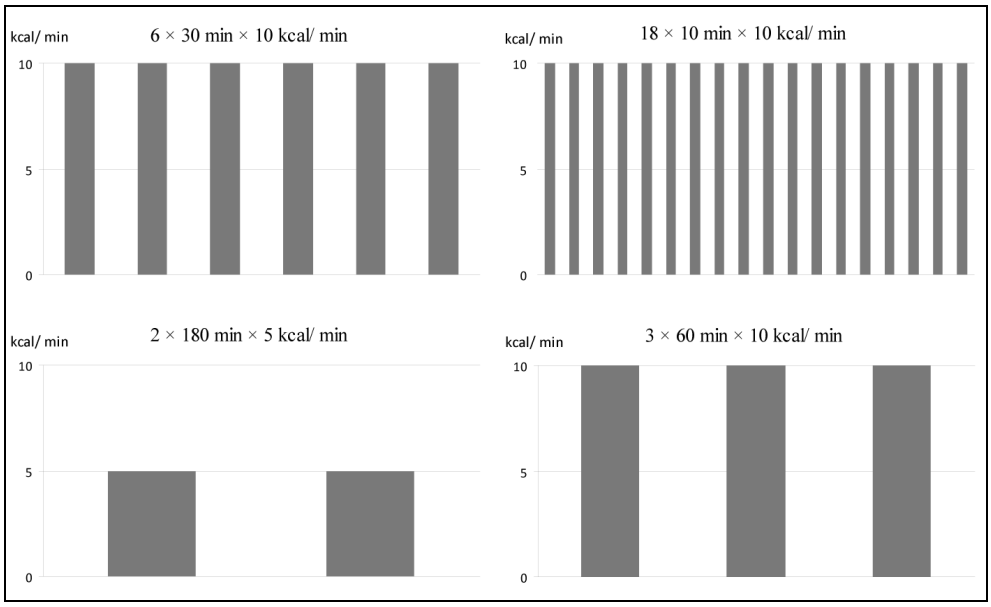

Fig. 2. Elements of physical activity, leading to expenditure of the same amount of energy
Source: [4]

Literature also specifies an optimal dose of physical activity or physical exercises. An optimal dose implicates not only reducing the level of ischemic heart disease risk but mainly providing well-being [3].

Hypokinesia occurs when a person does not provide his/her own body with the so-called minimum of physical activity. The minimum of physical activity is the lowest recommended daily or weekly dose of activity, which is necessary to maintain good health and well-being [3].

The problem of rules of dosing physical activity and determining its minimum began to be noticed as early as at the beginning of the 19th century, but intensification of this interest took place much later – in the 1970s. It was analysed in what way, how often, at what intensity and for what period one should exercise in order to keep physical, mental and social well-being. Numerous health-related and medical prescriptions were published as a result of this continuous debate over specifying an optimal dose of physical activity and ways of its propagating. On the basis of results of studies on the state of health and the level of physical activity, experts, mainly in medicine and physiology, developed guidelines for an optimal dose of exercises. Recommendations evolved along with the advance in these fields of science. Some aspects related to the diversity of these recommendations result from indeterminacy of biomedical sciences, what has an influence on methodological differences in collecting and subsequent interpreting of existing data [5]. Other incoherencies result from the fact that researchers focus on various health effects addressed to various groups. Needs of motor activity are totally individualised and depend on e.g. the stage of growth (recommendations for children and adults are different), sex, living conditions, health status, the level of physical fitness or genetic results [6]. Additionally, it is natural that the minimum for keeping good health is different from the one for improving the state of health.

As the scientific support for the impact of physical activity on health has grown, physical activity recommendations for the public have been modified. The aim of the paper is to present the evolution of physical activity guidelines, which were formed on the basis of existing research evidence, produced by prominent experts, mainly in physiology and medicine.

Material and Methods

The process used in literature review was highly systematic and comprised a number of distinct phases: 1) searching – a systematic identification of potentially relevant studies on physical activity guidelines or health-enhancing physical activity recommendations. The following databases were searched: ISI, SPORTDiscus and NLM; 2) screening – an application of pre-determined inclusion

and exclusion criteria derived from the review question to report titles, abstracts and full texts; 3) data-extraction – an in-depth examination of studies, meeting the pre-determined inclusion and exclusion criteria, to assess the quality of the study and extract evidence in support of the in-depth review; 4) synthesis – a development of a framework for data analysis and identification of key themes; 5) reporting and dissemination – a presentation of the review findings. In order to interpret the content of text data, a qualitative content analysis was applied. It was supported by Qualitative Data Analysis (QDA) computer software package NVivo 9.

Results and Discussion

The earliest recommendations for physical activity to achieve fitness and health benefits were based on systematic comparisons of effects from different profiles of exercise training. Findings presented by Karvonen, Kentala and Mustala [7] have become a classic in exercise science. They observed the effects of treadmill running on endurance fitness in a small number of medical students. They reported that training intensity corresponding to the heart rate of at least 60% of the maximal heart rate was required to produce significant gains in cardiorespiratory fitness. Karvonen's program was presented in terms of minima for the frequency, duration and intensity of training.

Other recommendations were published by Cooper[1] who developed the Aerobics Point System as a way to quantify exercise [8]. The Aerobics Point System is calculated on the basis of the type, intensity and duration of an aerobic exercise. Cooper has documented 41 aerobics exercises that provide aerobic benefit. The top 5 are cross-country skiing, swimming, running or jogging, cycling and walking. The system recommended accumulating 120 aerobic points each month (or 30 points per week) to score the beneficial effects of different aerobic exercises on the heart, lungs, and the circulatory system. Table 1 provides examples of point values assigned to particular exercises by Cooper.

Tab. 1. Examples of point values in Cooper's point system

Activity	Time	Point value
Walking/ running 2 miles	16-20 min	9
Cycling 2 miles	< 6 min	2.5
Swimming 300 yards	< 5 min	3.75
Cross-country skiing	60 min	18
Fencing	50 min	5

Source: [9]

In the 1960s and the 1970s, expert panels and committees, operating under auspices of health- or fitness-oriented organizations, began to recommend specific physical activity programs or exercise prescriptions for improving health.

The American College of Sports Medicine (ACSM) was an early leader in providing specific recommendations by publishing *Guidelines for Graded Exercise Testing and Exercise Prescription* in 1975 and a position statement by ACSM T*he Recommended Quantity and Quality of Exercise for Developing and Maintaining Fitness in Healthy Adults* issued in 1978. The key guidelines of ACSM based on substantial clinical experience are presented in Table 2. This statement is effective, with little alterations, till the present day. Due to its medical character, ACSM mainly focused on heart and pulmonary efficiency and cardiologic rehabilitation but also on prevention of the osseous system diseases [10].

[1] Dr. Kenneth H. Cooper (M.D., M.P.H.) joined the military in 1957, served in the U.S. Army and U.S. Air Force, Dr. Cooper served as a flight surgeon and director of the Aerospace Medical Laboratory in San Antonio. He dreamed of becoming an astronaut and worked with NASA to help create the conditioning program preparing America's astronauts for space and in-flight anti-deconditioning program used on board spacecraft.

Tab. 2. Evolution of physical activity minimum, recommended by ACSM

Year of publishing	Physical activity			Objective
	Frequency (day/week)	Duration time (min/day)	Intensity (% of max. heart rate)	
1975	3-5	20-45	70-90	cardio-respiratory fitness
1978	3-5	15-60	50-85	cardio-respiratory fitness
1980	3-5	15-60	50-85	cardio-respiratory fitness
1986	3-5	15-60	50-85	cardio-respiratory fitness
1990	3-5	20-60	50-85	cardio-respiratory fitness and body composition
1991	3-5	15-60	40-85	cardio-respiratory fitness
1995	3-5	20-60	40-85	cardio-respiratory fitness
1998	3-5	≥20	40-85	cardio-respiratory fitness and body composition
2000	7	≥20	40-85	health promotion

Source: [5]

Establishing a medical approach to recommending exercise drew on research performed on heart patients. In 1975, the American Heart Association (AHA) published guidelines on exercise prescription for patients with cardiovascular diseases. They assumed the frequency of exercise at 3–4 times a week, the intensity at 70-85% HR_{max} and the duration of 20–60 minutes. AHA's first guidelines were important as they helped to establish a place for exercise in medical practice [4].

A universal model of training, considering optimal recommendations regarding the frequency, volume and intensity, was the rule 3×30×130 (11). According to this rule, one should train three times a week for 30 minutes with such intensity that his or her heart rate was equal to 130 beats per minute. A specified intensity level is a prerequisite for shaping physical capacity, which is conditioned by efficiencies of the cardiovascular and respiratory systems [12]. It is related to processes of transport and use of oxygen, which is necessary to process energy while conducting work. It was a general rule regarding a dose of physical activity, which was to be used by all adults, not working manually. As far as children and youth are concerned, there was a proposed enriched model, which considered higher motor demands of a developing organism and also a diversity and versatility of motor activities. Each child should be physically active every day for 2–3 hours, of which some activity should be intensive enough for the heart rate to increase to 130–140 HR/min in 2–3 continuous 5–10-minute periods [11].

Between 1978 and 1990, most exercise recommendations ware based on 1978 ACSM position statement, even though it addressed only cardiorespiratory fitness and body composition. These guidelines proved invaluable as far as promoting cardiorespiratory endurance is concerned, although many people overinterpreted them as guidelines for promoting overall health.

In the 1990s in the USA, a series of recommendations for pro-health exercises was published. They concerned the prevention of particular diseases not a promotion of health in a wider sense. Recommendations of the American Heart Association applied to the positive role of physical exercises in preventing ischemic heart disease and cardiologic rehabilitation [13–16]. The American Association of Cardiovascular and Pulmonary Rehabilitation also published guidelines regarding the influence of exercises on cardiologic [17, 18] and pulmonary rehabilitation [19].

Over the time interest developed in potential health benefits of more moderate forms of physical activity. ACSM 1998 guidelines concern the amount and quality of physical activity, leading to a development and maintaining heart-pulmonary efficiency, proper body composition, strength and muscle endurance and suppleness [20]. The guidelines include: 1) frequency, 2) intensity, 3) duration time and 4) type of activity:

1) frequency - 3–5 days a week,
2) intensity - 55/65%–90% of max. frequency of the heart beat, or
   - 40/50%–85% of reserve of max. oxygen uptake (VO_2R) or heart rate reserve (HRR),

- for persons not physically fit: 55–64% of max. heart beat frequency or 40–49% of VO_2 reserve,

3) duration – 20–60 minutes of continuous or discontinuous physical effort.
   However, it must be stressed that effort can be recorded when it lasted at least 10 minutes continuously. Thus, it is necessary to sum 10-minute doses within the whole day. Duration time also depends on the intensity of the activity. Physical activity of lower intensity should be undertaken for a longer period of time (30 minutes or more), while in the case of people professionally training sport, this time is reduced to at least 20 minutes.
4) type – it is recommended to do any activity which activates large muscle groups, can be done without breaks, is based on rhythmical and aerobic exercises, i.e. hikes, jogging, cycling, cross-country skiing, aerobics, rowing, swimming, rollerblading or skating.

ACSM also recommends endurance exercises as a supplement of training for adults. Obviously, such exercises should be adjusted to individual needs of a particular person and should be a stimulus for developing the main muscle groups. A set of 8–10 exercises should be repeated 8–12 times, 2–3 times a week. What is more, ACSM advises stretching training, both static and dynamic, done at the same frequency as endurance exercises.

The concept of cumulating exercises, lasting minimum 8–10 minutes, which can bring advantageous health results, was presented as a common stance, accepted by the Centre for Disease Control and Prevention and the American College of Sports Medicine (ACSM) [21]. However, these guidelines were based mainly on indirect data from observations of circulatory system diseases and results of some experimental research [4]. Results of these studies indicate that there are no significant differences between effects of short and long periods of physical activity. There are many propagators of the opinion that repeated short doses of physical activity are less effective than the longer ones [22, 23]. However, there are works which show that effects of shorter but cumulated exercises are similar to those of longer activities. [24–26]. Haskel et al. [4] stress that there are few studies arguing for an 8-10 minutes dose of activity, yet they regard this concept as important and still valid.

The 1995 guidelines were a breakthrough in considerations regarding the evolution of a physical activity dose as they did not focus on preventing a particular disease but concerned improvements in health on a general-population scale. It was stressed that each adult person should undertake physical activity for most days of the week or even everyday. Everyday physical effort of moderate intensity should last at least 30 minutes. A daily dose of physical activity can be a walk for 3–3.5 km or other motor activities, which require the expenditure of 200 kcal a day or 1,400 kcal a week, i.e. recreational physical activity, physical effort at work or household chores.

After publishing the report of CDC and ACSM, other organisations, i.e. US Surgeon General [27], National Institutes of Health [28], WHO and the International Organisation of Sports Medicine [FIMS] [29–31] adopted a similar position in the scope of promoting physical activity. All these organisations propagate pro-health ways of life, try to increase societies' consciousness regarding the role of potential values resulting from undertaking physical activities regularly, i.e. improving human mental, physical and social well-being. They also stress the risk emerging from a sedentary way of life, having influence on development of numerous chronic diseases. Their strategies also stress the role of national authorities in developing pro-health policies and resulting programmes, based on activating the society to engage in various forms of physical activity.

It also seems interesting to present guidelines of Japanese scientists, who determine a minimum of physical activity at about ten thousand steps a day, in the form of a walk [32]. Hatano noted that pedometers, presented by Leonardo da Vinci over 500 years ago, appeared on the market in 1965, using the name "*manpo-meter*" ["manpo" in Japanese means 10,000 steps]. Both the concept itself and the device were accepted by the whole world and started to be used by clubs which organise hiking excursions. The concept of 10,000 steps seems to be a reasonable dose of everyday physical activity for healthy people, which is based on numerous research results [33, 34]. However, initial reports show that the aim of 10,000 steps is impossible to be achieved by elderly people and those who suffer from chronic diseases. On the other hand, this dose seems to

be too low for children and for people trying to fight their obesity. On the basis of regular review of the subject literature, C. Tudor-Locke and A. Myers [34] described norms for particular groups (Fig. 3).

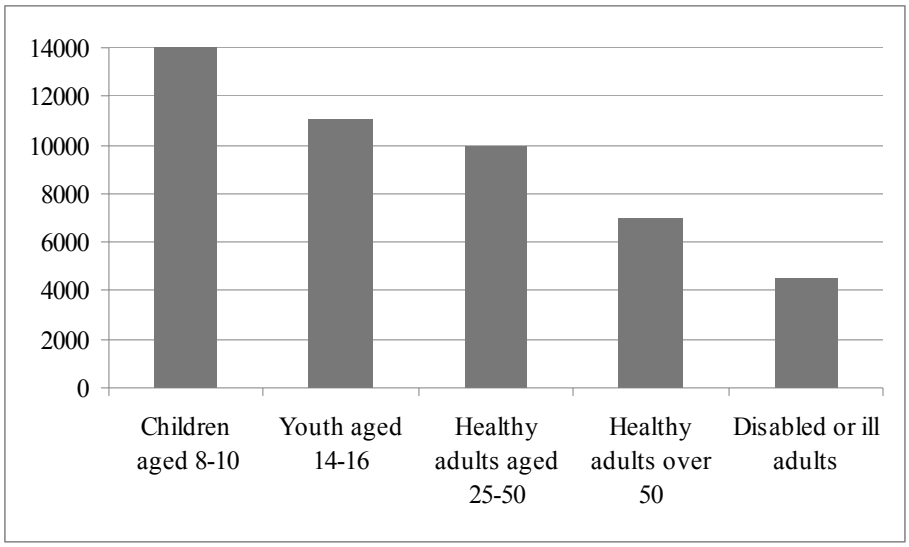

Fig. 3. Anticipated number of steps for particular groups of people. Source: [35]

Considering research results, it is recommended that children aged 8–10 walk from 12,000 to 16,000 steps a day. Of course, a lower norm is addressed to girls and for women in further cases. Youth aged 14–16 should march 11–12 thousand steps a day. It is advised that healthy adults aged 20–25 should walk 7,000–13,000 steps a day. In the case of elderly people, a recommended dose of activity is lower – 6,000–8,500 steps a day is an advised dose for persons over 50 years old. Disabled people or persons suffering from chronic diseases should also undertake physical activity and a daily dose for them, expressed in steps, should be equal to 3,500–5,500 steps.

On the basis of the number of steps, C. Tudor-Locke and D. Basset [33] determined levels of physical activity for healthy population (Tab. 3).

Tab. 3. Classification of pedometer-determined physical activity in healthy adults

Number of steps	Level of physical activity
<5000	Sedentary lifestyle index
5000–7499	Low active
7500–9999	'somewhat' active
≥10000	Active
>12500	highly active

Source: [33]

According to experts, it is obligatory to walk at least 15,000 steps a day in order to lose overweight. There are lists of activities, in which a minute of physical activity is recalculated into steps (Tab. 4). It enables a comparison of the conducted activity with recommendations regarding the number of steps. Thus, for example, 30 minutes of washing a car would be equal to 2,610 steps and 30 minutes of playing handball to 10,440 steps.

It is worth referring the guidelines regarding the number of steps to traditional recommendations of international organisations. Welk et al. [36] estimated that 3,800–4,000 steps correspond to a 30-minutes walk with moderate intensity, so it would be a sufficient effort according to the 1995 CDC and ACSM guidelines. However, it does not meet guidelines regarding number of steps. It mainly results from the complexity of movements which is present in other than

marching physical activities, which results in the fact that it is not recommended to directly compare traditional guidelines with those of Japanese scientists.

Tab. 4. Exemplary activities, recalculated to the number of steps

Physical activity	Number of steps per minute
Boxing	349
Raking leaves	125
Ice-skating	203
Yoga	72
Mowing	160
Washing car	87
Handball	348
Squash	348

Source: www.10k-steps.com (26.10.2007)

Another unit used in determining an optimal physical activity dose is PAL (Physical Activity Level). The PAL value specifies a daily energy expenditure as a multiplicity of the basal metabolic rate [37, 38]. It is calculated on the basis of the ratio of the total energy expenditure (TEE) to the basal energy expenditure (BEE) – thus, PAL=TEE/BEE. Table 5 presents a classification of the population according to the current PAL. According to the WHO report [37], it is recommended that people undertake physical activity during the whole life and that the activity level be maintained at the minimum level of PAL=1.75. This dose is also advised in order to avoid the problem of obesity.

Tab. 5. Lifestyle vs. the PAL level

Lifestyle	Current PAL	Recommended PAL
Sedentary	1.40	≥ 1.75
Limited activity	1.55–1.60	≥ 1.75
Physically active	≥ 1.75	≥ 1.75

Source: [37]

American IOM (Institute of Medicine) also uses PAL to determine recommendations concerning doses of physical activity [39]. IOM advises a daily physical activity at the minimum PAL level of 1.6. It corresponds to physical activity of moderate intensity, lasting 60 minutes (e.g. a walk or jogging at a pace of 3–4 miles per hour) or a shorter dose of more intensive effort lasting 30 minutes (e.g. jogging at the speed of 5.5 miles/hour)[2]. Such an amount of physical activity is a base of an active lifestyle.

It is known that physical activity is also necessary to maintain proper weight and to prevent gaining excess kilograms. IASO (International Association for the Study of Obesity) convened an experts panel in order to evaluate data regarding amounts of physical activity necessary for maintaining healthy body mass and for reducing excess fat in adults [40]. Scientists reached an agreement and warned that a 30-minute dose is not sufficient to fight obesity. For preventive aims in the case of previously obese people, it is necessary to undertake physical activities of moderate intensity lasting from 60 to 90 minutes or shorter but more intensive efforts. Despite a lack of more detailed data, IASO claims that everyday physical activity of moderate intensity, lasting 45–60 minutes is necessary for preventing overweight or obesity. It corresponds to PAL=1.7.

[2] One English mile equals to 1,609.34m, which means that moving at the speed of 3 miles per hour, one covers a distance of 4,828m in this period of time.

Table 6 presents recommendations of physical activity according to the physical activity level (PAL).

Tab. 6. Comparison of PAL recommendations of different panels

Report	Recommended PAL	Walking equivalent
WHO	1.75	X
IOM	1.60–1.70	60 minutes
IASO	1.70	45–60 minutes

Source: [38]

It has been over 10 years since CDC and ACSM published their guidelines in 1995. Within this period, a series of studies on biological mechanisms according to which physical activity has a positive influence on health and the quality of life has been conducted. Scientists observed that recommendations regarding the necessity of 30-minute moderate effort during most of the days was not met and the sedentary lifestyle still remained a substantial problem, which affects many people. In order to present broader and more specific guidelines regarding an optimal dose of physical activity, researchers from ACSM and AHA observed progresses from 1995 and made an update to the report from ten years before [41]. New recommendations concern healthy adults, aged 18–65. In order to improve and keep a good state of health, one must undertake physical activity of moderate intensity for at least 30 minutes a day, five days a week or intensive physical effort for at least 20 minutes a day, three days a week. It is also possible to combine intensive and moderate activities, for example 30 minutes of fast marching twice a week and 20 minutes of jogging on two other days. This dose of physical activity should be a supplement to everyday activities, i.e. cooking, shopping or activities lasting less than 10 minutes, like walking around a house, an office or coming from a parking lot to a house. Haskell, Lee et al. [41] also advice exercises improving muscle strength and increasing body endurance at least twice a week. The authors add that these should not be consecutive days. A set of 8 to 10 exercises for developing the main muscle groups should be repeated 8–12 times. People who want to improve their physical fitness and to reduce the risk of chronic diseases incidence should exceed the recommended minimum of physical activity. In order to avoid gaining overweight, one must increase the dose to a level adjusted to individual needs of a body, which provides an energetic balance.

Apart from guidelines for healthy adults, stressing the role of physical activity in the process of healthy ageing, ACSM and AHA published recommendations regarding physical activity for elder people, aged over 65 and for people aged from 50 to 64 who suffer from chronic diseases and functional constrains [42]. These recommendations do not substantially differ from the mentioned earlier; however, they specifically define physical activity intensity, according to the physical fitness of an older person. In order to improve and keep a good state of health, one must undertake physical activity of moderate intensity for at least 30 minutes a day, five days a week or intensive physical effort for at least 20 minutes a day, three days a week. Using a 10-point scale, where “0” corresponds to sitting and “10” is given to activities done using whole power, moderate physical activity, leading to a slightly raised heart beat and faster breathing, would be marked 5-6 and intensive activity, leading to substantially higher heart beat and breathing – 7–8. Due to the diversification of levels of physical fitness of elderly people, some would regard a moderately intensive walk as a slow march, other as a fast march. In order to raise muscle strength and increase body endurance, it is recommended to do a set of 8–10 exercises, with 10–15 repetitions, at least twice a week. Elderly people should also do exercises to increase body suppleness, lasting at least 10 minutes, done twice a week and also do exercises improving balance, which would prevent collapsing.

Conclusions

Accurate quantification of physical activity behaviours is important to epidemiologists, physiologists and behavioural scientists as well as to health practitioners challenged to address the public health threat to sedentarism.

Using epidemiological, clinical and laboratory methods, different expert committees have independently arrived at similar conclusions about the need for physical activity in daily life. The traditional, structured approach involved rather specific recommendations regarding the type, frequency, intensity and duration of an activity. Recommended activities typically included fast walking, running, cycling, swimming, or aerobics classes. More recently, physical activity recommendations have adopted a lifestyle approach to increasing activity. It includes common activities, such as climbing stairs instead of taking the lift), doing more household work, and engaging in recreational activity.

Formulating guidelines regarding an optimal dose of physical activity which could be universal for everybody is very problematic. A recommended dose of physical activity must be approachable and adjusted to a particular person or a group. Therefore, it must be recognised that all recommendations should be used in the context of participant's needs, goals and initial abilities.

While determining a dose of physical exercises, one must consider various aspects of physical activity. Along with increasing physical effort, the risk of injury grows [4].

Due to the above, when planning a programme of physical activity, one must especially focus on the intensity of effort, as it is often a cause of medical complications. There is a lack of study results which could specify a moment when an increase in physical activity would not provide additional pro-health advantages. Physical activity of high intensity, e.g. running, will have a more positive influence on a particular biological parameter but moderate physical activity, e.g. a faster march, provides a more advantageous general pro-health effect due to a low risk of collapsing, hurting or injuring oneself. While creating guidelines, one must pay attention to maximising the advantages coming from undertaking physical activity regularly and keeping a risk rate at the minimal level. Emphasis should be placed on factors that result in permanent lifestyle change and encourage a lifetime of physical activity.

References

1. Grabowski H. Teoria fizycznej edukacji [in Polish] [Theory of physical education]. Warszawa: Wydawnictwa Szkolne i Pedagogiczne; 1999.
2. Winiarski R. Wstęp do teorii rekreacji [in Polish] [Introduction to theory of recreation]. Kraków: AWF; 1989.
3. Wolańska T, editor. Leksykon - sport dla wszystkich - rekreacja ruchowa [in Polish] [Lexicon - sport for all - movement recreation]. Warszawa: Wydawnictwo AWF; 1997.
4. Haskell WL. Dose-Response Issues in Physical Activity, Fitness, and Health. In: Bouchard C, Blair SN, Haskell WL, editors. *Physical Activity and Health*. Champaign: Human Kinetics; 2007,1030-1039.
5. Blair SN, LaMonte MJ, Nichaman MZ. The evolution of physical activity recommendations: how much is enough? *Am J Clin Nutr* 2004 May;79(5):913S-20S.
6. Kucera M. Ilościowa ocena potrzeb ruchowych dzieci [in Polish] [Quantitive assessment of movement needs of children]. *Wychowanie Fizyczne i Higiena Szkolna* 1983;8:323.
7. Karvonen MJ, Kentala E, Mustala O. The effects of training on heart rate; a longitudinal study. *Ann Med Exp Biol Fenn* 1957;35(3):307-15.
8. Cooper KH. Aerobics. New York: Bentam Books, Inc.; 1968.
9. Cooper KH. The point system. Appendix. In: Cooper KH, editor. *The Aerobics Program for Total Well-Being*; 1982.
10. Shephard RJ. Physical activity, health, and well-being at different life stages. *Res Q Exerc Sport* 1995 Dec;66(4):298-302.
11. PRON. Stanowisko Komisji Ochrony Zdrowia Rady Krajowej PRON w sprawie stanu kultury fizycznej dzieci i młodzieży [in Polish] [Statement of Health-Protection Committee of Domestic Council *PRON* on the state of physical culture in children and youth]. *Kultura Fizyczna* 1988(7-8):1-6.
12. Kasperczyk T. Ilościowe i jakościowe aspekty aktywności fizycznej człowieka dorosłego [Quantitive and qualitive aspcects of physical activity of an adult] [in Polish]. *Fizjoterapia Polska* 2001;1(1):74-5.

13. AHA. Statement on exercise: benefits and recommendations for physical activity programs for all Americans: a statement for health professionals by the Committee on Exercise and Cardiac Rehabilitation of the Council on Clinical Cardiology. *Circulation* 1992;86:340-344.
14. AHA. Cardiac rehabilitation programs. A statement for healthcare professionals from the American Heart Association. *Circulation* 1994 Sep;90(3):1602-10.
15. AHA. Exercise standards: a statement for healthcare professionals from the American Heart Association. *Circulation* 1995;91:580–615.
16. Blair SN, Powell KE, Bazzarre TL, et al. Physical inactivity. Workshop V. AHA Prevention Conference III. Behavior change and compliance: keys to improving cardiovascular health. *Circulation* 1993 Sep;88(3):1402-5.
17. AACVPR. American Association of Cardiovascular and Pulmonary Rehabilitation. Guidelines for cardiac rehabilitation programs. Champaign, IL: Human Kinetics; 1991.
18. Vuori I. Exercise and physical health: musculoskeletal health and functional capabilities. *Res Q Exerc Sport* 1995 Dec;66(4):276-85.
19. AACVPR. American Association of Cardiovascular and Pulmonary Rehabilitation. Guidelines for pulmonary rehabilitation programs. Champaign, IL: Human Kinetics; 1993.
20. ACSM. American College of Sports Medicine Position Stand. The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Med Sci Sports Exerc* 1998 Jun;30(6):975-91.
21. Pate RR, Pratt M, Blair SN, et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 1995 Feb 1;273(5):402-7.
22. Woolf-May K, Kearney EM, Owen A, Jones DW, Davison RC, Bird SR. The efficacy of accumulated short bouts versus single daily bouts of brisk walking in improving aerobic fitness and blood lipid profiles. *Health Educ Res* 1999 Dec;14(6):803-15.
23. Jakicic JM, Wing RR, Butler BA, Robertson RJ. Prescribing exercise in multiple short bouts versus one continuous bout: effects on adherence, cardiorespiratory fitness, and weight loss in overweight women. *Int J Obes Relat Metab Disord* 1995 Dec;19(12):893-901.
24. Macfarlane DJ, Taylor LH, Cuddihy TF. Very short intermittent vs continuous bouts of activity in sedentary adults. *Prev Med* 2006 Oct;43(4):332-6.
25. Schmidt WD, Biwer CJ, Kalscheuer LK. Effects of long versus short bout exercise on fitness and weight loss in overweight females. *J Am Coll Nutr* 2001 Oct;20(5):494-501.
26. Hardman AE. Issues of fractionization of exercise (short vs long bouts). *Med Sci Sports Exerc* 2001 Jun; 33(6 Suppl):S421-7; discussion S52-3.
27. CDC. Surgeon General's report on physical activity and health. From the Centers for Disease Control and Prevention. *JAMA* 1996 Aug 21;276(7):522.
28. NIH. Physical activity and cardiovascular health. NIH Consensus Development Panel on Physical Activity and Cardiovascular Health. *JAMA* 1996 Jul 17;276(3):241-6.
29. Waxman A. WHO global strategy on diet, physical activity and health. *Food Nutr Bull* 2004 Sep; 25(3):292-302.
30. Blair SN, Bouchard C, Gyarfas I, Holmann W, Iwane H, Knuttgen HG, et al. Exercise for health. WHO/FIMS Committee on Physical Activity for Health. Bulletin WHO. 1995.
31. WHO. Steps to health: a European framework to promote physical activity for health. Regional Office for Europe. 2007.
32. Hatano Y. Use of the pedometer for promoting daily walking exercise. *Intern Council for Health, Phys Educ, and Recreation* 1993(29):4-8.
33. Tudor-Locke C, Bassett DR, Jr. How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Med* 2004;34(1):1-8.
34. Tudor-Locke CE, Myers AM. Methodological considerations for researchers and practitioners using pedometers to measure physical (ambulatory) activity. *Res Q Exerc Sport* 2001 Mar;72(1):1-12.
35. Tudor-Locke C. Taking steps toward increased physical activity: using pedometers to measure and motivate. *President's Council on Physical Fitness and Sports Research Digest* 2002;3(17).
36. Welk GJ, Differding JA, Thompson RW, Blair SN, Dziura J, Hart P. The utility of the Digi-walker step counter to assess daily physical activity patterns. *Med Sci Sports Exerc* 2000 Sep;32(9 Suppl):S481-8.
37. WHO. Obesity: preventing and managing the global epidemic: report of a WHO Consultation on Obesity, Geneva, 3-5 June 1997.WHO Consultation on Obesity. Geneva, Switzerland; 1998.
38. Brooks GA, Butte NF, Rand WM, Flatt JP, Caballero B. Chronicle of the Institute of Medicine physical activity recommendation: how a physical activity recommendation came to be among dietary recommendations. *Am J Clin Nutr* 2004 May;79(5):921S-30S.

39. Trumbo P, Schlicker S, Yates AA, Poos M. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids. *J Am Diet Assoc* 2002 Nov;102(11):1621-30.
40. Saris WH, Blair SN, van Baak MA, Eaton SB, Davies PS, Di Pietro L, et al. How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement. *Obes Rev* 2003 May;4(2):101-14.
41. Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc* 2007 Aug;39(8):1423-34.
42. Nelson ME, Rejeski WJ, Blair SN, et al. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc* 2007 Aug;39(8):1435-45.