ASSESSMENT OF PHYSICAL ACTIVITY

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Introduction

- Physical activity has a fundamental role in the prevention and treatment of chronic disease
- Increasing physical activity is a key component of recommendations to decerease morbidity and mortality *(Haskell WL, Lee IM, Pate RR et al., Med Sci Sports Exerc, 2007)*
- Monitoring physical activity levels is important for surveillance, for assessing the effectiveness of interventions and for physical activity prescription
- Investigation of the dose-response relationship between physical activity and health outcomes is dependent on a reliable and valid responsive assessment of physical activity
- Physical inactivity is defined as the fourth of the major risk factors of global mortality

Introduction

- Approximately 60 years ago, Jeremy Morris and colleagues showed that the incidence of coronary artery disease in bus conductors who climbed up and down stairs of double-deck buses and postal carriers who delivered the mail on foot was lover than that of relatively inactive bus drivers or postal office workers, who spent most of their occupational time sitting
- Since then – numerous other investigators have confirmed the strong link between physical activity and health
- In 1992, the American Heart Association included physical inactivity as a major risk factor for coronary artery disease
- The deleterious effects of physical inactivity are associated with many of the most common chronic diseases - cardiovascular diseases, T2DM, hypertension, obesity, osteoporosis, depression and breast and colorectal cancers

Introduction

- In USA chronic diseases cause 7 in 10 deaths and accout for 70% of all healthcare spending
- The financial impact of physical inactivity for all US adults was 251 billion USD
- The first public health recommendations for physical activity in USA were released and in 2008 EBM culminated in the firs-ever **federal guidelines for physical activity**

- It includes the following recommendations:

- adults should avoid inactivity (some physical activity is better than none)
- substantial health benefits are obtained from accumulating, in bouts of ≥ 10 minutes, 150 mintes per week of moderate-intensity or 75 minutes per week of vigorous-intensity aerobic activity
- additional and more extensive health benefits are obtained by increasing aerobic activity to 300 minutes per week at moderate intensity or 150 minutes per week at vigorous intensity
- muscle strenghtening activities of moderate to high intensity should be performed ≥ 2 days per week

Introduction

- For assessing physical activity we have subjective (self-report) and objective (accelerometry) measurement methods
- The assessment of PA is needed to allow the clinician to provide specific recommendations for patients identified as insufficiently active
- With documented health benefits of physically active lifestyle as its guiding principle, scientific statement recommends that PA be assessed regularly, as are the other risk factors

- The primary objectives of this statement are:

- provide the rationale for the importance of assessing PA
- explain key concepts involved in the assessment of PA
- provide an overview of options for assessment of PA available to clinicians and researchers

Significance and promotion of optimum movement activity in prevention and treatment of civilization diseases

Chronic non-infectious diseases of mass occurrence in the prevention context

- Metabolic diseases (T2D, obesity), cardiovascular diseases, certain oncologic diseases and diseases of the movement apparatus -high incidence in the general population
- Connected with life style and are a result of the discrepancy between slowly changing human genotype and fast changing environment (as a result of anthropogenic acivities)
- Genetic (non-influenced) risk factors are interacting with strong (but influenced) risk factors of environment and life style
- Physical inactivity as risk factor is a cause of 1.9 million of deaths a year worldwide
- Identified as 4th out of the major risk factors of total mortality (6 % deaths worldwide)

Promotion of physical activity – global and European strategy

Documents on promotion of physical activity in Europe:

- are based on a complex preventive program "Global strategy for nutrition, physical activity and health" (WHO 2004)
- The green book (2005): to enforce and promote healthy nutrition and movement activity
- The white book of sport (2007)

The importance of optimal PA for primary prevention of civilization diseases and movement apparatus disorders

- Humans - morphological and functional adaptation for life style which required good physical fitness
- We are phylogenetically adapted to bipedal locomotion, periodical and uniform static and dynamic load
- Current life style – up to 60% of world population suffers from major lack of physical activity, sedentary lifestyle
- Excessive static postures
- Lack of medium intensity dynamic load
- Population groups at risk: women and seniors, children and youth, individuals with special needs (need of targeted applied MA)
- each population group – different requirements on intensity, duration and type of MA to fulfill the criteria for optimum MA

The importance of optimal PA for primary prevention of civilization diseases and movement apparatus disorders

- Optimization of PA especially for untrained population
- The expected effect: increase of health oriented fitness level
- Not a need to reach maximum physical performance regardless the possibility of health complications
- No quantification or evaluation of physical performance – evaluation of PA in regards to risk factors or increased markers of these risk factors, in regard to limitation in clinical state or movement limitations

Optimal level of PA positively supports and affects:

- cardiorespiratory and neurohumoral system
- optimum shape and function of movement system (muscular balance, physiologic vertebra and spinal position, range of motion, joins flexibility and strength)
- PA should not overload movement apparatus, the aim is to add PA to successful functional and morphological adaptation for environmental burden

Recommended PA is “individually optimal” under these conditions:

- Current health status, PA and functional and morphological components of health oriented physical fitness

Functional components of physical fitness: cardiorespiratory system and neuromuscular fitness

Morphological (structural) components of physical fitness: anthropometry (height and weight), selected circumference characteristics and indexes (BMI), assessment of nutrition lifestyle

Negative results of insufficient PA level

- Due to lack of PA, the physiological fitness level decreases during life
- It has major role in occurrence of cardiometabolic and oncologic diseases
- Development of supportive movement apparatus disorders
- Movement apparatus diseases – second place in the cause of absence at work, cause longest lasting absence at work
- MA diseases – low mortality rate

Secondarily, they lead to health complications in late adult and senior age:

-stressing the RF

-limited movement, limits everyday life activity

-movement immobilization leads to health complications (osteoporosis, fractures, bronchopneumonia, urinary infections, depressive state)

Physical acivity assessment - introduction

Observation of actual individual PA levels includes:

- Determination of the type, frequency, intensity and total amount of performed PA
- data are collected using questionnaires
- Disadvantages : under or overestimation
- For ongoing monitoring and obtaining details – use of aids (step meter, accelerometer)
- For the possibility of international comparison of MA level in population – GPAQ/IPAQ
- Observing PA performed not only at leisure time, but also at work and sport
- Observed PA monitored during 7 days (minimum continual PA 10 minutes)
- Total amount of PA displayed in MET minutes
- MET is a unit of intensity of physical load
- 1 MET equals to common oxygen consumption (=3.5 mL/kg/min equals to resting metabolism)= resting energy consumption of organism ca 1 kCal/kg/hour
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Recommended total amount of physical activity

Adults

-600 MET minutes per week – **150 minutes MA of medium intensity**

-frequency: **3-5 times a week**

-recommended also postural therapy, muscular dysbalances therapy

-**for adults over 65, resistance training and balance therapy**

Children (5-17 years old)

-minimum of **60 minutes PA of medium to high intensity**

-variety of exercises

-balanced development of aerobic fitness and muscular strength

-flexibility exercises, deftness and balance

-prevention of one-sided burden

-compensational exercises

Key Concepts for Understanding Physical Activity Assessment

Physical Activity – definition

- The most popular and widely cited definition of PA was published by Caspersen et al. (1985): „any bodily movements produced by skeletal muscles that result in energy expenditure“

- PA can be clasified as structured (planned, or incidental to promote health and fitness benefits) and incidental (not planned and usually is the result of daily activities at work, at home, or during transport)

Dimensions of PA

Table 1. Physical Activity Dimensions: Mode, Frequency, Duration, and Intensity

Dimension	Definition and Context
Mode	Specific activity performed (eg, walking, gardening, cycling). Mode can also be defined in the context of physiological and biomechanical demands/types (eg, aerobic versus anaerobic activity, resistance or strength training, balance and stability training).
Frequency	Number of sessions per day or per week. In the context of health-promoting physical activity, frequency is often qualified as number of sessions (bouts) ≥10 min in duration/length.
Duration	Time (minutes or hours) of the activity bout during a specified time frame (eg, day, week, year, past month).
Intensity	Rate of energy expenditure. Intensity is an indicator of the metabolic demand of an activity. It can be objectively quantified with physiological measures (eg, oxygen consumption, heart rate, respiratory exchange ratio), subjectively assessed by perceptual characteristics (eg, rating of perceived exertion, walk-and-talk test), or quantified by body movement (eg, stepping rate, 3-dimensional body accelerations).

Domains of PA

- Central to undrestanding the assessment of PA

Table 2. Physical Activity Domains

Domain	Contextual Definition or Examples
Occupational	Work-related: involving manual labor tasks, walking, carrying or lifting objects
Domestic	Housework, yard work, child care, chores, self-care, shopping, incidental
Transportation/utilitarian	Purpose of going somewhere: walking, bicycling, climbing/descending stairs to public transportation, standing while riding transportation
Leisure time	Discretionary or recreational activities: sports, hobbies, exercise, volunteer work

Quantifying Units of Measure Indicative of PA Level

- **Exercise (or exercise training)** is a component of leisure time PA, and is where planned, structured and repetitive bodily movements are performed to improve or maintain one or more components of physical fitness *(Howley ET, Med Sci Sport Exerc 2001)*

- Physical fitness (PF) comprises cardiorespiratory endurance (assessed by measured or estimated VO_{2max} , muscle endurance and muscle strenght
- Flexibility, balance, agility nad coordination are additional components of PF
- Distinction between PA and PF is the intraindividual day-to-day variability
- PA will vary on a daily basis, whereas PF will remain relatively static, taking time to change

Quantifying Units of Measure Indicative of PA Level

- PA results in an incerease in **energy expenditure (EE)** above resting levels, and the rate of EE is directly linked to the intensity of the PA
- The energy expended during PA is just of the 3 components of **total daily energy expenditure (TEE):**

  60-75% resting energy expenditure

  15-30% physical activity related energy expenditure (PAEE)

  10% thermic effect of food
- PAEE is the most variable portion of TEE
- In extremly active individuals, PAEE may constitute 60-70% of TEE
- PA are commonly quantified by determining the EE in kilocalories or by using metabolic equivalent (MET) of the activity

Quantifying Units of Measure Indicative of PA Level

Kilocalories

- One liter of oxygen consumption is aproximatelly equal to 5 kcal energy

Example: 70kg individual walking for 30 minutes at 4 mph, which results in an oxygen consumption of 1 L/min. For 30-minute walk, the individual would consume 30 L of oxygen. EE would be 150kcal (30 Lx5 kcal/L).

PAEE would be 112,5 kcal (30 Lx5-1.25[5-1.25 (resting kilocalories expenditure)] kcal/L)

Metabolic Equivalent (MET)

- Is common unit used to express exercise intensity
- 1 MET represents the resting energy expenditure during quiet sitting and is defined as 3.5 mL $O_2.kg^{-1}.min^{-1}$ or 250 mL/min of oxygen consumed, which represents the average value for a standard 70-kg person

Quantifying Units of Measure Indicative of PA Level

Metabolic Equivalent (MET)

- METs can be converted to kilocalories (1 MET=1kcal.kg^{-1}.min^{-1}
- Oxygen consumption increases with intensity of PA, for quantifying the intensity of PA is to use multiples of resting EE

Physical Activity Intensity

- Moderate and vigorous intensity PA can be defined in both absolute and relative terms
- Absolute intensity is determined by the external work performed, whereas relative intensity is determined relative to an individual s level of cardiorespiratory fitness (VO_{2max})

Quantifying Units of Measure Indicative of PA Level

Table 3. Classification of Physical Activity Intensity

	Relative Intensity			Absolute Intensity	
Intensity	$\dot{V}o_2$max (%) Heart Rate Reserve, %*	Maximal Heart Rate, %	RPE	Intensity	METs
Very light	<25	<30	<9	Sedentary	1–1.5
Light	25–44	30–49	9–10	Light	1.6–2.9
Moderate	45–59	50–69	11–12	Moderate	3.0–5.9
Hard	60–84	70–89	13–16	Vigorous	≥6.0
Very hard	≥85	≥90	>16		
Maximal	100	100	20		

METs indicates metabolic equivalents; RPE, rating of perceived exertion; and $\dot{V}o_2$max, maximal aerobic capacity.

*% Heart rate reserve (HRR) formula=Maximal heart rate (HR)–resting HR=HRR; calculate HRR target by (HRR×%value)+resting HR.

Modified from *Physical Activity and Health: A Report of the Surgeon General.*[3(p33)]

Available Methods of Assessing PA

- Subjective methodologies rely on the individual either to record activities as they occur to recall previous activities (questionnaires and diaries/logs)

- Objective methodologies include all wearable monitors that directly measure 1 or more biosignals, such as acceleration, heart rate, or some other indicator of PA or EE, as they occur.

Table 1 Overview of methods used to assess physical activity with reference to outcomes, validity and indications for use

Method	Measurement	Primary (1°) and secondary (2°) outcomes	Validity for assessing primary outcome and energy expenditure (EE)	Study sample and resources	Appropriate research aim
Doubly labelled water	CO_2 production	1° – total energy expenditure	1°– valid	Suitable for all populations Moderate respondent burden Expensive	Precise measure of TEE does not provide information about the intensity, frequency, or duration of PA
Accelerometry	Acceleration of the body or body segments in one or more directions	1°– acceleration 2°– estimates of the intensity, frequency and duration of body movement	1°– valid Validity for measuring PAEE varies between monitors and types of activities. Valid at group level for free-living PAEE estimates	Suitable for all populations Low respondent burden Relative ease of data collection Software packages have improved, simplifying analysis Monitors have become cheaper making them feasible for large-scale studies	An objective measure of overall PA and time spent in activities of varying intensities, and provides an indicator of frequency and duration of activities
Heart rate monitoring	Heart rate i.e. beats per minute	1°– heart rate; intensity, frequency and duration of MVPA–VPA 2°– PAEE estimated using regression equations derived from individual or group calibration	1°– valid Valid at group level for estimating energy expenditure for higher intensity activities, improved by using individual calibration	Suitable for all populations Low respondent burden for short wearing times but may be problematic over longer periods Easy and quick for data collection and analysis Relatively cheap	An objective measure of PAEE and of time spent in different intensities of activity, also provides an indicator of frequency and duration of these activities
Combined heart rate and accelerometer devices	Acceleration of body and heart rate	1°– acceleration and heart rate; PAEE, intensity, frequency and duration of PA	1°– valid Valid for estimating PAEE at group level, evidence for validity in individuals emerging	Suitable for all populations Low respondent burden Relative ease of data collection Data analysis relatively complex Monitors relatively expensive, but are likely to become cheaper and have been used in large-scale studies	An objective measure of time spent in activities of varying intensities, and provides an indicator of frequency and duration of activities Evidence suggests suitable to measure PAEE
Pedometry	Step count	1°– number of steps taken	1°– valid Not valid to estimate EE during free living	Suitable for all populations; children may tamper or alter behaviour in response to readings in an open box monitor Low respondent burden Ease of data collection and analysis Cheap	Suitable to measure steps taken during walking
Direct observation	Categorization of activity	1°– number of bouts and time spent in activities of varying intensity 2°– estimates of energy expenditure by ascribing MET values	1°– valid to estimate PAEE	Traditionally been used in paediatric studies Software programs now available to ease data collection and recording No respondent burden Expensive as labour intensive	Detailed quantitative and qualitative information on PA undertaken for a specific time frame
Self-report	Time spent in different types of activities with varying intensities Time allocated to different domains of activity	1° – number of bouts and time spent in activities of varying intensities 2° – energy expenditure estimated by ascribing METs to reported activities for specified durations	1° – valid Not valid to estimate EE at individual level; varying validity for categorizing individuals into groups; and for ranking of individuals	Suitable for all populations; proxy reporters required for children and possibly the older person Low respondent burden Ease of data collection and analysis Cheap	Provides information on intensity, frequency, duration of activities and the domain(s) of activity Some tools provide qualitative information (types of activities) Surveillance tool

EE, energy expenditure; MET, metabolic equivalent; MVPA, moderate and vigorous physical activity; PA, physical activity; PAEE, physical activity energy expenditure; TEE, total energy expenditure; VPA, vigorous physical activity.

Subjective Methods of Assessing PA

Consideration for researchers when using questionnaires

- What exactly is the questionnaire designed to measure: which dimension (s) and domain (s) of PA?
- What is the time frame for the questionnaire?
- Has the instrument been tested for reliability?
- Has appropriate validation been undertaken, that is, against an objective measure?
- Was the validation undertaken in a similar population?
- What is the primary outcome of the questionnare and does this fit with the research question?
- How will the questionnaire be administered (face-to-face, by telephone, Internet, through post)?
- How will be data cleaned, reduced and analysed?
- What will constitute an outlier or an invalid recording?
- What will be done with missing data, and in case of inputing data what will the basis of these decisions be?
- For which population has the questionnaire been designed?
- What is the responsiveness of the questionnaire?

Subjective Methods of Assessing PA

A) Physical Activity Questionnaires

- To identify the dimensions and domains of PA behaviors from either self-reported responses or interviews

1. Global Physical Activity Questionnaires

- Provide a quick overview of a person s PA level
- Typically short (2 – 4 items) and used to identify whether an individual meets a PA standard (e.g. 150 min/wk of moderate to vigorous PA) or provide a classification (e.g. active versus inactive)
- Preferred in many clinical settings, epidemiological studies and surveillance settings for their ease administration, brevity and ability to determine a PA score

2. Short Recall Physical Activity Questionnaires

- Provide a quick assessment of the total volume of PA classified by dimension of intensity level or by domain
- Are often used to determine the proportion of adults meeting national PA guidelines in surveillance and descriptive epidemiology settings and to identify PA behavior change in intervention studies
- Generally have from 7 to 12 items and can be self-administered or interviewer administered
- A physical activity score can be a simple ordinal number, with higher numbers reflecting greater levels of activity, or a volume score computed by multiplying the frequency in sessions pre week (or month), minutes per session, and intensity of the activity recalled. The intensity often expressed as METs.
- International Physical Activity Questionnaire (IPAQ)

Subjective Methods of Assessing PA

- The „Compendium of Physical Activities of Energy Costs of Human PA“ was published in 1993, with updates in 2000 and 2011.
- This publication provides a comprehensive list of physical activity MET values for use in scoring PA questionnaires

3. Quantitative History Physical Activity Questionnaires

- Are detailed surveys often performed over the past month of year or over a lifetime
- May contain 20 to 60 detailed questions and are usually interviewer administered
- Are used in epidemiological studies to understand what types and intensities of PA contribute to mortality, as well as to examine various types of morbidities and health-enhancing behaviors
- Bone Loading History Questionnaire (PA performed at various ages from childhood to the past year for determination of hip and spine weight-bearing and bone-loading activities)

Subjective Methods of Assessing PA

B) Physical Activity Diaries/Logs

- Often used to obtain a detailed hour-by-hour or activity-by-activity record of one s PA and sedentary behaviors
- To evaluate the psychometric properties of PA questionnaires and as an adjunct to objective monitoring
- Are completed by the user and can be form of a paper-and-pencil booklet or a cell phone programmed to remind the performed in the past 1 to 4 hours.
- Recorded informations: the time an activity started and stopped,a rating of intensity, and the mode/type of activity
- Can be scored by use of the „Compendium of Physical Activities“
- The Bouchard Physical Activity Record is a well-known PA log that has users identify 1 of 9 types of movement behaviors preformed every 15 minutes. The activities are rated on a 1 to 9 scale that corresponds to a range of 1.0 to 7.8 METs

Objective Methods of Assessing PA
Accelerometers

Considerations for researchers when using accelerometers

- One, two or three-dimensional accelerometry?
- Decide the primary outcome of the study; total activity, type, time spent at different intensity, or estimates PAEE
- At the outset make a decision about the minimal wearing time to constitute a valid day
- What will constitute an outlier or an invalid recording?
- What time interval will be selected?
- What will be dome with missing data?
- How many days will be measured?
- Is there going to be a time lag between initializing the monitor and participant wearing? If so, can the data analysis programme handle this delay?
- How are accelerometers going to be distributed and returned (face-to-face/mail)?
- Have sufficient instruction on placement, wearing and contact details been supplied?
- Are participants going to be contacted by phone, SMS or mail during the planned assessment to encourage compliance?
- Are participants going to be asked to keep concurrent activity logs or detail wearing and non-wearing times?

Objective Methods of Assessing PA Accelerometers

- When a person moves, the body is accelerated in relation to muscular forces responsible for the acceleration of the body and to EE
- Measure in one (vertical), two (vertical and medo-lateral) or three (vertical, medo-lateral and anterior-posterior) planes by measuring the amplitude and frequency of acceleration
- The device is enclosed in a case and then attached to the body (hip, ankle, wrist, lower back)
- Able to record high-resolution data data, as well as store data for several weeks

Objective Methods of Assessing PA Accelerometers

Accelerometer Data Transformation

- The main data outcome from accelerometers is a recording of body acceleration and deceleration
- This measurement (raw data) is typically recorded in units of acceleration due to gravity (g) and expressed as acceleration in meters per second squared (m/s^2)
- This is then further transformed into other units, most common unit of measure is the count, which can be expressed in different ways: counts per second, counts per minute, or summed as total counts per day.
- Detailed data are collected between 5 and 60 s
- Published data on cut point for sedentary activities from one the most frequently used bands typically ranges from 100-800 counts per minute, for moderate activities 1900-8200

Objective Methods of Assessing PA Accelerometers

Accelerometer Data Converted to Meaning Physical Activity Outcomes

- The strongest relationship is seen in walking and jogging activities
- Typically used to determine habitual activity, which necessitates measurement over multiple days (4-9 days children, 3-5 days adults)
- Is important, that the recording period allows for the measurement of activity during the week and also at weekends.
- To correctly interpret the information from the recording period, it is important to account for the fact that the activity level may also vary according to the season (higher level during spring and summer coimpared with autumn and winter)
- For assessment of PA, accelerometers must be calibrated to translate monitor signals into energy expenditure units (kcal or METs) or activity intensity categories

- More information: *Ward DS, Evenson KR, Vaughn A, Rodgers AB, Troiano RP. Accelerometer use in physical activity: best practices and research recommendations. Med Sci Sports Exerc 2005; 37:S582-588.*

Objective Methods of Assessing PA
Heart Rate Monitoring

- There is a linear relationship between the increase in HR and the increase in EE during dynamic exercise involving the large muscle groups
- Relationship varies within and between individuals; factors such as age, sex, weight and fitness level modulate this relationship as do ambient temperature, body posture and emotional state (anxiety or stress)
- Measures of PA derived from HR monitoring are typically time spent in physical activities at different intensity levels (moderate and vigorous) and PAEE
- The accuracy of estimating outcomes indicative of PA from HR monitoring is improved by calibrating an individual s heart rate nad EE response (via oxygen consumption measurement) to different levels of activity, thus accounting for variation across individual HR response

Objective Methods of Assessing PA
Heart Rate Monitoring

Considerations for researchers when using HR

- What level of calibration is required?
- If individual calibration is to be undertaken using indirect calorimetry, decide on which activities most likely will be performed by the volunteers while free living
- How many days will the monitor be worn?
- In data analysis what is going to constitute an outlier?
- Provide practical information on how to use the monitor
- How are monitors going to be distributed and returned (face-to-face, mail), have sufficient instructions on placement and wearing and contact details been supplied?
- Are participants going to be contacted by phone, SMS or email during the planned assessment to encourage compliance? Can incentives be used?

Objective Methods of Assessing PA
Combined Accelerometer and Heart Rate Monitors

- An important development in the assessment of PA
- An early model was developed and piloted nearly 10 years ago
- In these devices, the pros of each method are combined

- At lower levels of intensity, HR is less accurate at estimating EE; this is the level that accelerometers are most accurate at

- Advantage is, that these new monitors are waterproof and the intention is that participants do not remove, except to replace pads that have perished
- The combined motion sensor is an accurate predictor of EE

Objective Methods of Assessing PA
Combined Accelerometer and Heart Rate Monitors

Consideration for researchers when using combinad accelerometer and HR monitor sensors

- What level of calibration is required? Will calibration methods used commonly for fitness testing be adequate?
- Is the participant confident and competent at placing the device, that is, have sufficient explanation and written instructions have been given?
- Supply participants with additional pads to replace as required

Objective Methods of Assessing PA
Pedometers

- Pedometers are relatively simple and inexpensive devices, which measure the number of steps taken
- Better accuracy has been reported at faster walking speeds but not running
- Most pedometers are accurate in the measurement of the number of accumulated steps during walking, and may be useful when monitoring the effect of an intervention aimed to increasing walking
- One of the most promising uses of pedometers is as a motivational tool to achieve a predetermined target of daily accumulated steps
- An advantage of pedometers is that they can also be used in elementary school children and preschool children

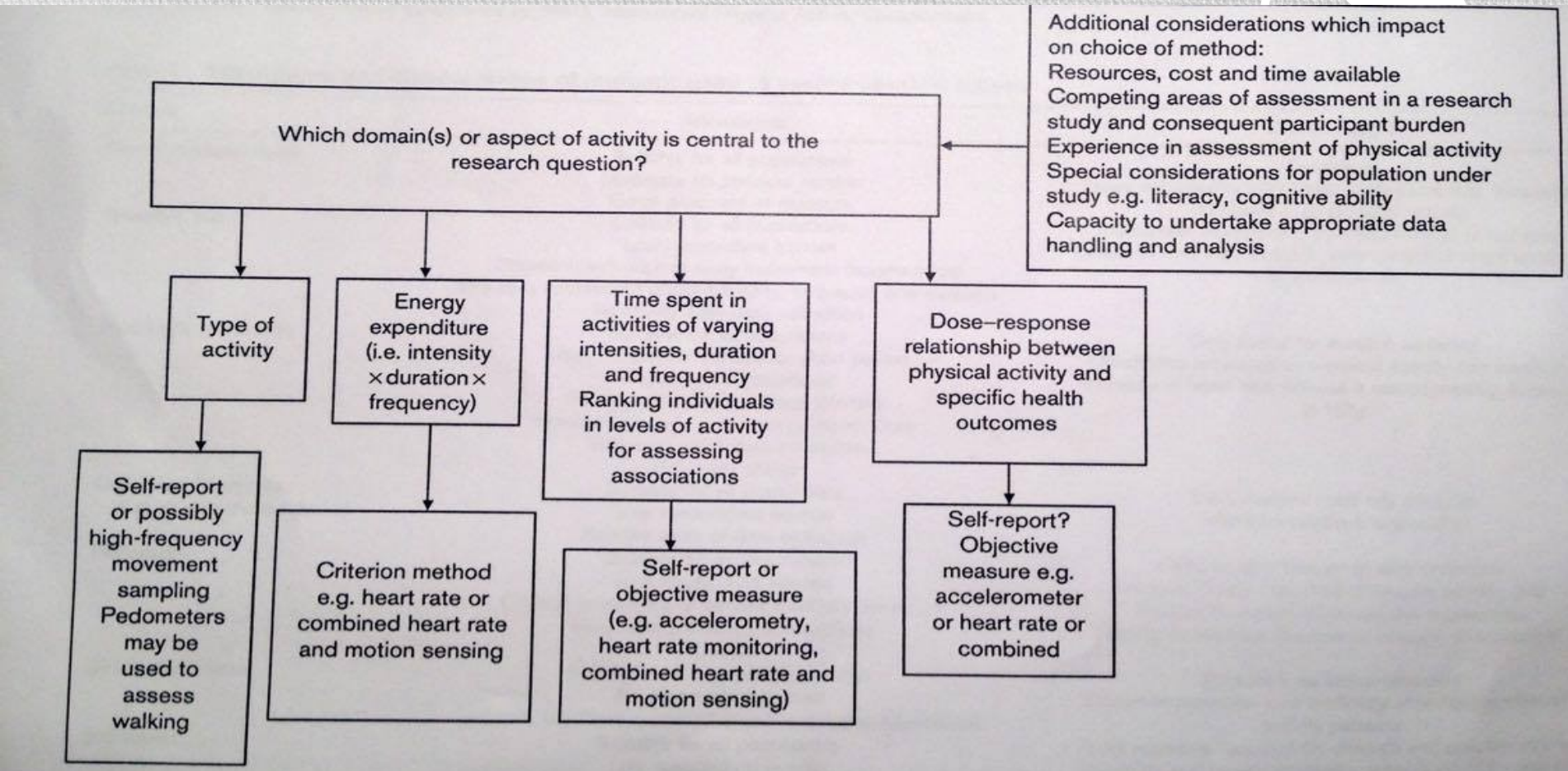
Objective Methods of Assessing PA
Pedometers

Consideration for researchers when using pedometers

- The aims and primary outcome of the study should be carefully considered to ascertain whether a pedometer would be an adequate measure of activity
- What type of activities is the population to be studied likely to engage in?
- Number of monitored days, what will constitute valid wearing time

Selection of an appropriate tool to assess PA

- Selection of the method is a crucial decision
- Careful consideration must be given to the research question in the first place, and the dimension or domain of PA to be assessed



Guidance for the selection of an appropriate tool to assess physical activity.

Influence of study type on methodology choice

- The specific study type and design has an important bearing on the choice of method to measure PA

Table 2 The assessment of physical activity with reference to study type

Study type	Study outcomes	Appropriate tool
Surveillance systems and surveys	Monitoring trends Comparisons within populations over time and between populations Walking specifically	Questionnaires which have demonstrated reliability and validity internationally i.e. IPAQ, GPAQ Pedometer
Observational large scale cohort studies (e.g. European Prospective Investigation into Cancer (EPIC) [111] Nurses Health Study [112] National Institute for Health-American Association of Retired Persons Diet and Health Study [113])	Association analyses between exposure(s) and outcome(s)	Self-report questionnaires that have been shown to be reliable and valid
Observational large-scale cohort studies in young people (e.g. European Youth Heart Study [114] Avon Longitudinal Study of Parents and Children [115])	Association analyses between exposure(s) and outcome(s)	Objective monitoring i.e. accelerometers or combined heart rate and motion sensing
Interventions and randomized controlled trials	Treatment and intervention effects	Objective monitoring i.e. accelerometers, heart rate monitoring and combined heart rate and motion sensing Doubly labelled water if investigating change in TEE or PAEE Pedometer if the intervention seeks to increase walking

GPAQ, Global Physical Activity Questionnaire; IPAQ, International Physical Activity Questionnaire.

Assessment of cardiorespiratory fitness – outputs for prescription of cardiometabolic or other internal diseases

Need of **evaluation of absolute and relative contraindication of physical training before** any prescription of PA!

Perform complex examination and cardiorespiratory fitness examination:

- determine **maximal aerobic capacity by stress test = CPX = cardiopulmonary exercise testing** (spiroergometry)
- always risk factors CVD
- also for asymptomatic individuals, who have been inactive for more than 3 years and are planning on doing systematic PA of medium to high intensity (men below 40, women below 50)

The benefits: exact evaluation of physical fitness and effective setting up of PA training plan, finding of non-physiological states unprofound until now

Assessment of cardiorespiratory fitness – outputs for prescription of cardiometabolic or other internal diseases

- Need of finding any possible contraindications before testing (blood circulation insufficiency, inflammation of myocardium, any other serious cardiopulmonary diseases)

Outputs:

- **assessment of maximal aerobic capacity ($VO_{2\ max}$),** volume of exhaled CO_2, ratio of respiratory exchange, breath frequency, total ventilation, lung volume, hemodynamic reaction to stress
- maximum heart rate
- anaerobic thershold

Assessment of cardiorespiratory fitness – outputs for prescription of cardiometabolic or other internal diseases

- Parameter VO_2max shows the maximum oxygen amount that can be transported from outside, absorbed and used to cover energy needs during PA by individuals
- Cardiac patients – parameter VO_2peak

Average listed values for the Czech untrained population:

- women 35 mL/kg/min
- men 45 mL/kg/min

Maximum aerobic capacity is displayed in the multiples of one metabolic equivalent: 1 MET=3.5 mL/kg/min

Assessment of cardiorespiratory fitness – outputs for prescription of cardiometabolic or other internal diseases

Recommended training intensity with cardio protective results:

- **50-85 % VO_2max**
- by percentage of heart rate reserve **(HRR) 50-85%**

- Start at low end of HRR percentage (min 10 minutes of training), after 30 minutes slowly increases load intensity
- During training: check HR and blood pressure (pause-load-rest), check symptoms during training (emphysema, tiredness, chest pain, lower limb pain)

VO_2max is an important prognostic marker for individuals with CVD

- **Kavangh et al.** (2002, 2003) reports that with **every improvement of VO_2max by 1 mL/kg/min improves the prognosis by 9%**

(Kavanagh T, Mertens DJ, Hamm LF, et al. Prediction of long-term prognosis in 12 169 men reffered for cardiac rehabilitation. Circulation. 2002;106(6):666 671.)

- reaching 22 mL/kg/min is an optimum results (prognosis improved by 40-60%)

Thank you for your attention!

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