Nutritional therapy assessment – Outpatient mobility monitoring (MAM)

Avaliação nutrológica – Monitorização ambulatorial da mobilidade (MAM)

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Final draft: March 11, 2016

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http://dx.doi.org/10.1590/1806-9282.62.09.811

Evidence collection method

This policy followed the pattern of a systematic review with retrieval of evidence based on the principles of evidence-based medicine (EBM), according to which clinical experience is integrated with the ability to critically analyze and rationally apply scientific information, thus improving the quality of medical care. EBM uses existing scientific evidence available at the time, with good internal and external validity, applying its results to the clinical practice.[1,2] (**D**)

Systematic reviews are considered today as level I evidence for any clinical question as systematically summarize information on a particular topic based on primary studies (clinical trials, cohort studies, case-control or cross-sectional studies). The method used for this is reproducible, and integrates information on effectiveness, efficiency, efficacy and safety.[1,2] (**D**)

We use a structured way to ask the question, summarized by the acronym PICO, where P is the patient or population, I intervention or indicator, C comparison or control, and O is the outcome. Based on structured question, the keywords or descriptors that will form the basis of the search for evidence in the various available databases are identified (Annex I).[1,2] (**D**)

Clinical question

What is the role of outpatient mobility monitoring (MAM) in the monitoring of physical activity and energy expenditure in children, adolescents or adults?

Grade of recommendation and strength of evidence

A: Experimental or observational studies of higher consistency.
B: Experimental or observational studies of lower consistency.
C: Case reports/non-controlled studies.
D: Opinions without critical evaluation, based on consensus, physiological studies, or animal models.

Objective

To determine the role of outpatient nutritional therapy assessment in the monitoring of physical activity and energy expenditure of children, adolescents and adults.

Conflict of interest

No conflict of interest was declared by the participants in the development of this guideline.

Introduction

Physical activity is an important health indicator and regular practice provides a broad spectrum of benefits, impacting on the prevention of cardiovascular risk factors and the development of chronic diseases such as obesity, type 2 *diabetes mellitus*, dyslipidemia and hypertension.[3] (**D**) Epidemiological studies have unequivocally demonstrated that mortality from any cause is lower among physically active individuals in contrast to that observed in inactive individuals, respecting the parameters of age, gender, and co-morbidities.[4,5] (**B**) Furthermore, it has been noted that the adequacy of the lifestyle, including the practice of physical activity, is related to a reduction of all causes of mortality, showing unique importance in maintaining functional independence and good quality of life in the elderly population.[6] (**B**) Physical activity as a form of therapeutic exercise is also important in rehabilitation programs for cardiovascular, neuromuscular, motor control and cortical plasticity aspects.[7] (**B**) Thus, with the measurement of physical activity becoming more common in clinical practice, it is imperative to search for simple, practical and non-invasive tools that are suitable for assessing the level of physical activity and energy expenditure.

What are the assessment methods for physical activity and energy expenditure?

Although individuals are able to describe their daily physical activity habits in general terms, detailed and accurate measurement is an extremely difficult task because it is

a complex and multidimensional health-related behavior. The literature has described a variety of measurement methods and techniques, which are classified as direct and indirect. Examples of direct techniques include the use of double labeled water, calorimetry, and portable monitoring through the use of heart rate monitors, pedometers and accelerometers. As for indirect methods, we can highlight questionnaires, and self-reports involving the use of instruments in the form of self-administered questionnaires, interviews and activity diaries.[8-10] (**D**) The combination of the calorimetry and doubly labeled water measurements provides a method for accurate measurement of energy expenditure due to physical activity. However, they require specific knowledge for application and interpretation of the results, in addition to being expensive and inconvenient when used in large populations. Direct calorimetry is based on measuring the amount of total heat produced by the body in a given period of time. In turn, indirect calorimetry is based on the total amount of energy produced from the oxygen consumed in the use of energy substrates and the production of carbon dioxide eliminated by breathing.[11] (**D**)

The method of double labeled water is considered the gold standard for determining energy expenditure. It is based on the ingestion of water labeled with radioactive isotopes of oxygen and hydrogen (the oxygen isotope is eliminated from the body incorporated into carbon dioxide molecules and water; the hydrogen isotope is eliminated only as water). As such, the difference between these two isotopes can predict the measurement of carbon dioxide production and thereby the energy expenditure, indirectly.[12] (**C**) This technique is accurate in assessing the energy expenditure. However, it does not enable an analysis of the type of physical activity, which is the main limitation of this method.

Traditionally, subjective methods such as self-administered questionnaires, notes in diaries and interviews (surveys) are the techniques used the most for estimating the total amount of daily or weekly physical activity, remaining as low-cost tools, and the option used the most in epidemiological studies.[7] (**B**) Nevertheless, there are limitations inherent in these instruments, given that they ate dependent on individual observation and subjective interpretation and therefore prone to inconsistent evaluations. The use of motion sensors such as accelerometers and pedometers has been consolidated as the most frequently used objective methods for measuring physical activity.[8] (**D**)

A study analyzing the Physical Activity Scale for the Elderly (PASE) questionnaire aimed at quantifying the level of physical activity in patients undergoing total knee arthroplasty demonstrated deficiencies in the validity and reproducibility of the results when compared to the accelerometer.[13] (**B**) However, in view of the low cost and simplicity, in epidemiological research, especially large-scale observational studies, questionnaires are generally used in the assessment of physical activity, with measurement of varying complexity from the self-administered form to interviews.

Questionnaires generally provide descriptions of the patterns of physical activity and can estimate how much energy individuals spend on a given activity. However, despite their large scale applicability, the reliability and validity of the measurement are low.[14,15] (**B**) A systematic review conducted in order to evaluate questionnaires aimed at the young population (under 18 years of age) found that none of the 61 questionnaires identified were reliable and valid. The same findings were identified when the focus of the analysis was the adult population.[16,17] (**A**) To compare the subjective methods (via questionnaires) with the objective methods (using accelerometers), for the assessment of physical activity in the population of children and adolescents (from 3.7 to 19 years), it has been shown that subjective methods overestimated physical activity by more than 70% to the detriment of the objective methods.[18] (**A**)

Another method for the objective assessment of physical activity is heart rate monitoring based on the linear relationship between heart rate and energy expenditure. Relatively inexpensive and with the capacity for minute by minute heart rate storage, continuous recording by means of monitors is a method considered feasible and attractive for the assessment of physical activity. However, factors such as age, proportion of muscle mass, emotional and cardiorespiratory stress, state of hydration and fatigue can influence the heart rate/oxygen consumption ratio. Another limitation is due to the fact that monitoring can mask the patterns of activity given that even after the cessation of motion the heart rate tends to remain high, and that in sedentary individuals the heart rate measured over 24 hours barely surpasses the rest limits, making it difficult to distinguish between light and moderate activities.[19] (**D**)

On the other hand, mechanical and electronic motion detectors such as pedometers and accelerometers eliminate many problems of subjectivity by providing an objective measurement of physical activity. However, as with all assessment methods, they possess measurement limitations, such as the ability to discriminate the different activity types and the seasonal bias inherent at the moment when the mechanical device is applied.[20] (**C**)

Pedometers are the simplest portable sensors used for monitoring human movement and record movements in response to vertical acceleration. Using a mechanism that detects the impacts produced by steps during locomotion, it is possible to calculate the distance covered and therefore the energy expenditure. The main disadvantages are the inability to evaluate static activities, isometric exercises and activities involving the arms, thereby resulting in inaccurate energy expenditure estimates. To analyze the effectiveness of physical activity based on the use of pedometers among adults in an outpatient setting, a study identified that pedometer users significantly increased their physical activity by around 2,500 steps per day compared to participants in the control group (who did not use the pedometer), as well as being associated with a reduction in body mass index and systolic blood pressure.[21] (**A**) Another systematic review analyzing the use of the pedometer identified that this intervention provided a modest, yet significant reduction in body weight, while the magnitude of the weight loss was associated with the time using the device.[22] (**A**) The use of pedometers by overweight or normal weight children was identified as an imprecise method at slower speeds, and was shown to be more accurate at higher speeds. For the control group, a smaller error was identified at all speeds, and it was concluded that for overweight or obese children the use of the pedometer is related to a lack of precision.[23] (**B**)

Accelerometers are electronic devices that measure the acceleration of body's movement in the vertical and horizontal direction by means of a microprocessor that scans and filters the acceleration signal and converts it into a numerical sign, presenting this value as movement counts over a time interval. As such, they provide an objective way of quantifying the frequency, duration and intensity of physical activity given that they are able to assess the magnitude and the total volume of movement as a function of time. They are classified into uniaxial, unidirectional or triaxial, based on their ability to measure the acceleration of movement on one or more planes (vertical, mid-lateral and anteroposterior).[24] (**D**) The combination of heart rate monitoring and accelerometer as a way of measuring energy expenditure compensates for the limitations of both techniques, especially with regard to discriminating between different types of physical activity. A study with the aim of estimating energy expenditure used the combination of accelerometry and heart rate as a measurement method, identifying a good level of agreement with the adopted gold standard (double labeled water).[25] (**B**)

Recommendation

Technological development has enabled the establishment of techniques for the assessment of physical activity and the quantification of energy expenditure. Each method has advantages and disadvantages that depend heavily on the type of activity, age group and body composition. As such, until an instrument that fulfills all of the desired features is identified, a combination of methods could provide more reliable and accurate data. It is important to apply an objective questionnaire that helps monitor the increase or reduction in physical activity, as well as to identify the style of activity practiced, which may be associated with heart rate monitoring and accelerometry.

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Annex I

Clinical question

What is the role of outpatient mobility monitoring (MAM) in the monitoring of physical activity and energy expenditure in children, adolescents or adults?

Structured question

P: Children, adolescents or adults
I: Outpatient ambulatory monitoring
C: ----------
O: Monitoring of physical activity and energy expenditure

Strategy for search of evidence

PubMed-Medline

Strategy 1: (Weight reduction OR Weight Loss OR Diet, Reduction OR Nutrition Disorder OR Nutritional Disorders OR Nutritional Disorder OR Nutritional Status OR Nutrition Status OR Nutrition Assessment OR Nutrition Disorders OR Malnutrition OR Deficiency Diseases OR Overnutrition OR Obesity OR Avitaminosis OR Ascorbic Acid Deficiency OR Vitamin A Deficiency OR Vitamin B Deficiency OR Vitamin D Deficiency OR Vitamin E Deficiency OR Vitamin K Deficiency OR Magnesium Deficiency OR Potassium Deficiency OR Protein Deficiency OR Protein-Energy Malnutrition OR Swayback OR Scurvy OR Choline Deficiency OR Folic Acid Deficiency OR Hyperhomocysteinemia OR Pellagra OR Riboflavin Deficiency OR Thiamine Deficiency OR Beriberi OR Wernicke Encephalopathy OR Vitamin B 12 Deficiency OR Anemia, Pernicious OR Subacute Combined OR Degeneration OR Vitamin B 6 Deficiency OR Rickets OR Osteomalacia OR Renal Osteodystrophy OR Steatitis OR Kwashiorkor OR Overweight OR Obesity, Abdominal OR Obesity, Morbid OR Wasting Syndrome) = 623,855.

Strategy 2: (Activities of Daily Living OR Mobility OR Wireless Technology OR Motor Activity OR Physical Activity OR Daily Ambulatory Activity OR Walking OR Exercise Test OR Energy OR Monitoring, Ambulatory OR Ambulatory Monitoring of Mobility) = 1,029,052.

Strategy 3: (Strategy 1 AND Strategy 2) = 77,330.

Methodological search filter: (Strategy 4) = ((specificity[Title/Abstract]) OR random* OR ((prognos*[Title/Abstract] OR (first[Title/Abstract] AND episode[Title/Abstract]) OR cohort[Title/Abstract]))) = 1,813,617.

Total 1[a] Retrieval: (Strategy 3 AND Strategy 4) = 12,535.

Studies retrieved

Database	Number of studies
Primary	
PubMed-Medline	12,535

Number of studies retrieved using search strategies. Final search: 12/20/2014.

Exclusion criteria

Selection of studies, assessment of titles and abstracts obtained from the search strategy in the consulted databases was conducted by two researchers with skills in the preparation of systematic reviews, both independent and blinded, who separated the studies with potential relevance. Whenever the title and the summary were not enlightening, researchers sought the full article.

Articles that did not meet the specificities of PICO, that were not available for access in full, and those written in languages other than English, Portuguese or Spanish were excluded.