ACCELEROMETER WGT3X ADDITION TO STUDIES OF PHYSICAL ACTIVITY

Jarosław **HERBERT,** Wojciech **CZARNY**

Faculty of Physical Education, University of Rzeszow, Rzeszow, Poland

Key words:
- accelerometer,
- physical activity.

Abstract:
Physical activity is important for physical health and well-being, further movement and the simultaneous increase in energy expenditure are crucial aspects of human existence. In this paper, based on the literature review and the acquisition of accelerometer WGT3X discusses the basic tools of physical activity. Also presented new diagnostic tool to complement WGT3X Accelerometr studies physical activity. The use of accelerometric device is a valuable addition to the methods of questionnaire survey aimed at physical activity levels.

Physical activity, health and quality of life are closely related. The human body was designed to move, hence the need for regular physical activity to function optimally and avoid diseases. It has been proven that a sedentary lifestyle is a risk factor for the development of many chronic diseases , including cardiovascular diseases, which are the main cause of death in the Western world (Bouchardet al. 2007, Bauman et al. 2009, Hamer et al. 2011, Sabia et al. 2011, Brown et al. 2012) .

Physical activity tends to decrease with age throughout childhood and adolescence (Corder et al. 2010, Dumith, Gigante, Domingue, Kohl 2011) and inactive children may become inactive adults (Telem et al. 2005), which in turn causes a greater risk of health complications later in life (Khaw et al. 2008). Therefore, knowledge of the potentially modifiable factors contributing to an increase in physical activity is important for the multiplication and health as long as possible (Corder, Ogilvie, Van Sluijs 2009).

In the evaluation lifestyle, for the purpose of strengthening or restoring health is estimated as usual physical activity. Unilateral overload or lack of physical activity are among the most frequently mentioned - and also modified - risk factors for many diseases dependent on physical endurance limit value expressed as oxygen uptake (VO2 max) (Martinson, O'Connor, Pronk 2001).

Well- known are generally the relationship between physical activity and the various factors contributing to the improvement or weakening physical condition. We also often aware of the relationships that exist between physical activity and cardiovascular disease and other diseases. But in order to control the processes of physical activity and determine its sphere of deficiency and excess of the optimum , it is necessary to rely on precise quantitative assessment methods (Osinski 2003 p 320).

The aim of the presentation is description and preliminary evaluation of a new diagnostic device WGT3X (accelerometr) as a complement to the study of physical activity.

To assess physical activity shall be based on objective methods of energy expenditure: direct calorimetry, indirect calorimetry and doubly labelled water method, based on the use of measuring equipment: pedometers, accelerometers and measures of heart rate and subjective methods, among which the most popular is a diagnostic survey using a questionnaire, such as

International Physical Activity Questionnaire (IPAQ) (Osinski 2003 pp. 327-330, Freedson, Melanson 1996).

The effects of physical activity are dependent on the type, volume, intensity and systematic making. Individual measurement of physical activity can not only assess the average human health and the risk of cardiovascular disease or metabolic. It is a tool that allows you to detail make recommendations of physical activity for each person, taking into account the data obtained at baseline. There is an ideal tool for measuring physical activity (Lipert, Eger, 2009). A good solution is to use a questionnaire in parallel with measurements of electronic or mechanical, physical activity (Kemper 1995). This option would allow us a greater extent on the ability to compare youth lifestyle Polish to other countries and assess differences in the indications of possible changes (Groffik, Frömel 2011).

Knowledge of the various methods, their advantages and disadvantages can help in the proper selection methods for an individual or group research and apply the physical activity of man to the current recommendations for physical activity, and thus assist in the effective prevention of many chronic diseases (Lipert, Eger, 2009).

Freedson (1991) investigated the accuracy and reliability of various sensors used in the analysis of physical activity in children. These devices typically allow an assessment of movements of the whole body and its various parts in different planes on the basis of the forces and accelerations differentiation and therefore the evaluation of the intensity and amount of activity undertaken. Demonstrated high accuracy measurement of the combined methods of traffic measurement and analysis of physiological methods based on heart rate (Osinski 2003 p. 325).

Methods for measuring energy expenditure based on kinematic analysis based on the assumption that physical activity is expressed in the movement of the body through the work of the relevant muscle groups, which is directly related to energy expenditure. The measurement is based on the detection and recording of motion (acceleration of the body) in space. The simplest device is a pedometer used, placed at the waist by means of which calculates the number of steps taken by the test person during the day or at another specified time. Its operation is based on the action of the pendulum and record changes in the speed of movement (such as sitting, walking, running), but without the ability to assess the intensity of their operations.

Accelerometers allow not only quantitative but also a qualitative determination of motion. This small device is placed on the bar at the waist or wrist. It registers the change speed of the body, and the microprocessor recorded information can be converted into energy expenditure, expressed in kcal. Thus, the device is also used in the control of energy balance in individuals (Osinski 2003 p 327). In this way, direct attempts to measure activity and collect data for further analysis. Most have a built-in accelerometer piezoelectric and a seismic mass, and their operation utilizes the phenomenon piezoelectric. As a result of acceleration of seismic mass element causes the deformation of piezoelectric (bending, stretching, compression), which in turn generates a signal of change in the output voltage which is proportional to the acceleration. Due to the number of planes axis, which can be measured acceleration, distinguished by uniaxial accelerometers (measured on the vertical axis), and two or three (in addition to the transverse and sagittal axes).

On the market there are monitors or second generation. The first is a single accelerometer, worn on the waist, wrist or ankle (Caltrac, Tritrac -R -3D, RT3, ActiGraph, Actical, Actiwatch) and accelerometers second generation is multi-sensory devices (multisensor), mounted on different segments of the body (the idea MINISUN) and combine speed detection with the registration of physiological parameters such as heart rate, body temperature (ActiHeart, ActiTrainer) (Frączek 2013).

The accelerometer is a device that can measure physical activity and periods of inactivity, yet easy to wear and does not affect the ability to walk . Allows you to evaluate the intensity, frequency and duration of exercise. Measurements can be performed in three different positions: vertical position only, the vertical position and central- lateral and vertical position, mid - lateral and anterior- back.

Three-axis accelerometers, such as the Actigraph Tritrac R3D (eg Hemokinetics Inc.). Measure acceleration in three dimensions, and the resulting values are converted to a single value called the size of the vector. It is the square root of the square sum of the activity measurements in each vector (Hussey, Bell, Gormley 2007 Midorikawa, Tanaka, Kaneko, et al. 2007).

ActiGraph WGT3X – Accelerometr it is a wireless device having software for analysis and objective physical activity data analysis tools can be configured to achieve specific research. ActiGraph provides objective information for 24 hours (physical activity and sleep). In addition, information is available on energy expenditure, body position and the amount of sleep, light sensor provides valuable information about the environment, measure your pulse, blood pressure, and is fully compatible with other devices ActiGraph .

Fig 1. Sensor Actigraph (WGT3X)

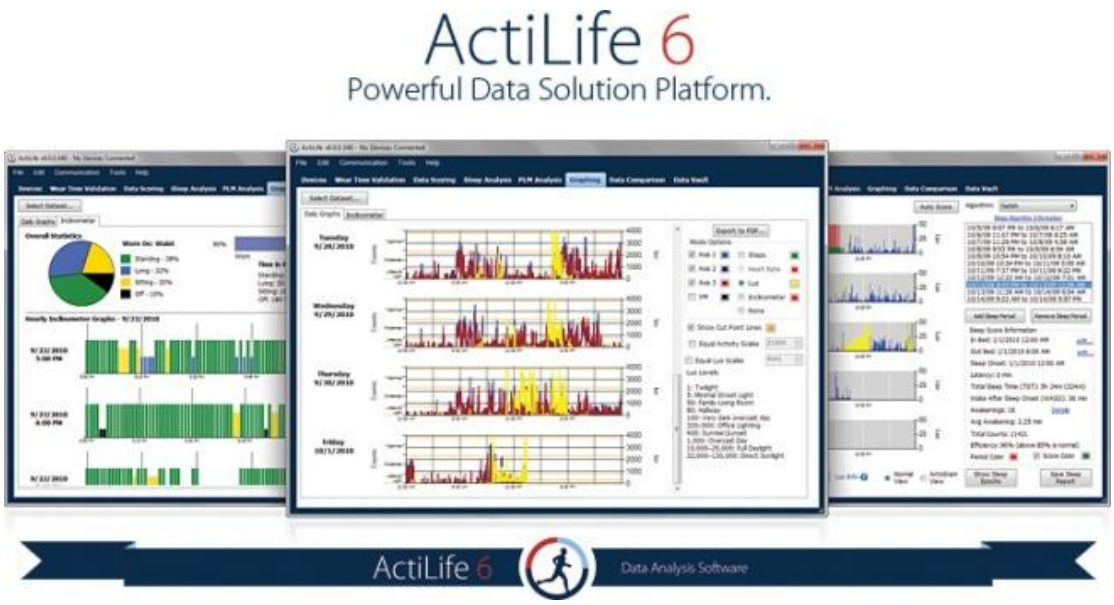

Fig 2. Software to collect and analyze data Actigraph

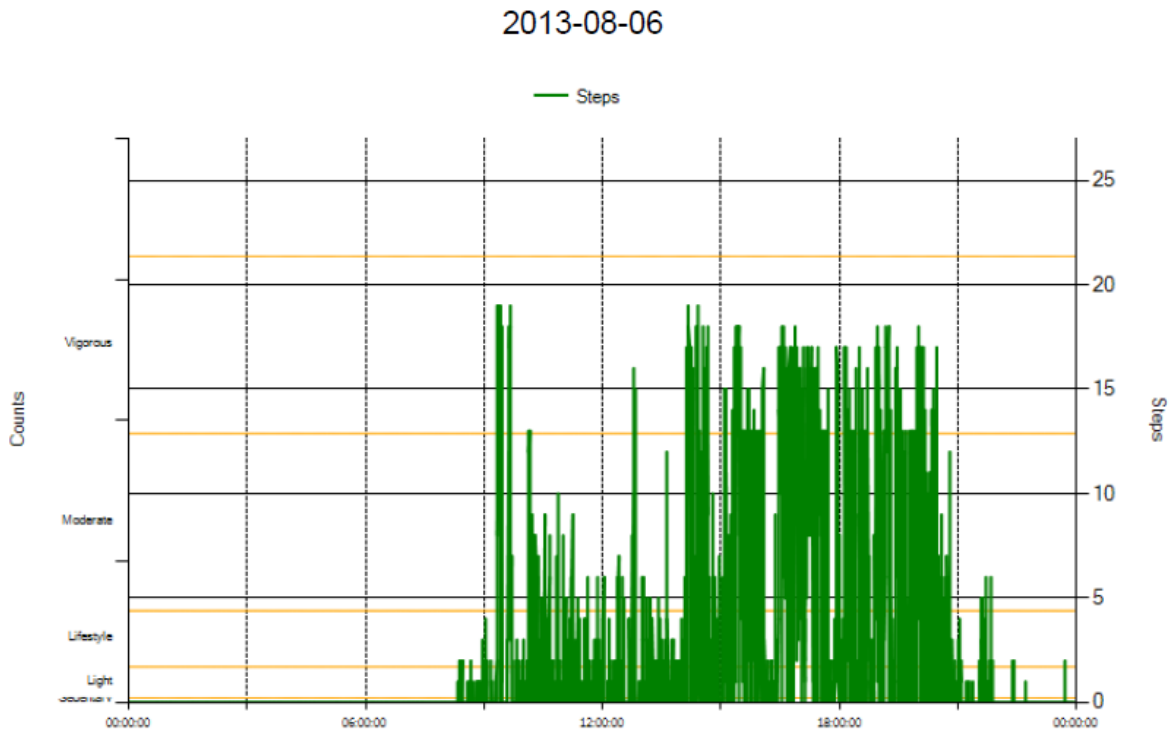

Fig. 3. An exemplary illustration of the number of steps per day

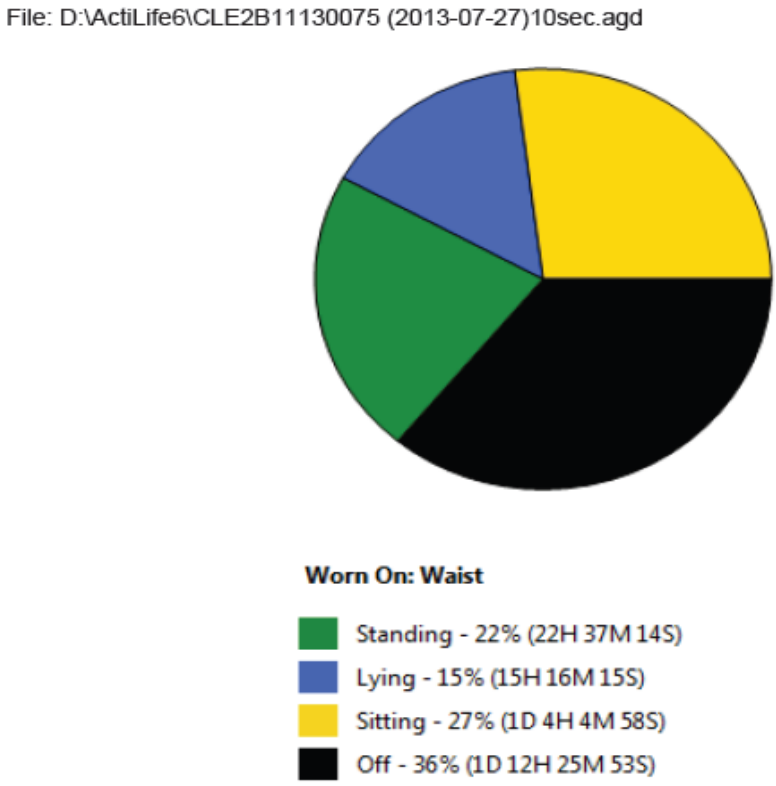

Fig. 4. An exemplary illustration of the value lying down, sitting and standing, and lack of activity in a few days.

The accelerometer has an advantage over pedometer through its ability to distinguish between walking, running and rest. In addition, many of the newer version of the accelerometer can be separated from the movement of human traffic such as mechanical vibrations that may result from such drive. Currently accelerometers are regarded as the standard in assessing the level of physical activity. Accelerometers are widely accepted among others ActiGraph. Current technology allows you to collect accelerometer data using short sampling intervals (ie epoch - epoch).

SUMMATION

Keep in mind that the choice of method depends, among others. the age of the subject, the type of research, the hardware capabilities, collaboration with the person with whom we make the measurement, and the purpose for which it is intended to test. It should also be noted that there is an ideal tool for measuring human physical activity. Choosing a method for measuring daily energy demand or costs of specific types of exercise, you should consider the advantages and disadvantages of the various methods of measuring physical activity. Certainly, the above methods, in addition to methods of questionnaire, can be classified as objective methods. The use of accelerometric device is a valuable addition to the methods of questionnaire survey aimed at physical activity levels.

BIBLIOGRAPHY

1. Bauman A. et al. (2009) "The International Prevalence Study on Physical Activity": results from 20 countries. International Journal of Behavioral Nutrition and Physical Activity, 6:21.
2. Bouchard C., Blair, S. N., Haskell W. (2007) "Why Study Physical Activity and Health?" In: C. Bouchard, S. N. Blair & W. Haskell (Eds.), Physical Activity and Health: Human Kinetics.
3. Brown W.J., et al. (2012) "Physical activity and all-cause mortality in older women and men", Br J Sports Med.
4. Corder K., et al. (2010) "Changes in children's physical activity over 12 months: longitudinal results from the SPEEDY study", Pediatrics, 126: s.926–935.
5. Corder K., Ogilvie D., van Sluijs EM. (2009) "Invited commentary: physical activity over the life course–whose behavior changes, when, and why?" Am J Epid, 170, s. 1078–1081.
6. Dumith SC., Gigante DP., Domingues MR., Kohl HW. (2011) "Physical activity change during adolescence: a systematic review and a pooled analysis", Int J Epid 2011, 40, s. 685–698.
7. Frączek B. (2013) „Metody pomiaru wydatku energetycznego osób aktywnych fizycznie", http://dieta.mp.pl/sport/show.html?id=72237, (pobrano 23-08-2013), AWF, Kraków.
8. Freedson P. S. (1991) "Electronic Motion Sensors and Heart Rate as Measures of Physical Activity in Children", J. of Sch. Health, 61, s. 220-223.
9. Freedson P. S., Melanson E. L. (1996) "Jr. Measuring physical activity", W: Measurement in pediatric exercise science, ED. D. Docharty. Human Kinetics, Champaign, s. 261-283.
10. Groffik D., Frömel K. (2011) „Nowoczesne narzędzia badawcze w ocenie aktywności fizycznej", W: Efekty kształcenia i wychowania w kulturze fizycznej po red. J. Ślężyński, AWF Katowice, s. 88-89.
11. Hamer, M., et al. (2012) "Physical activity and cardiovascular mortality risk: possible protective mechanisms?" Med Sci Sports Exerc. 44(1): p. 84-8.

12. Hussey J., Bell Ch., Gormley J., (2007) "The measurement of physical activity in children", Phys Ther Rev, 12, s. 52-58.
13. Kemper H. C. G. (1995) "The Amsterdam growth study. A longitudinal analysis of health, fitness, and lifestyle", Human Kinetics, Champaign.
14. Khaw K-T., et al. (2008) "Combined impact of health behaviours and mortality in Men and women: the EPIC-norfolk prospective population study", PLoS Med, 5, s. 12.
15. Lipert A., Jagier A. (2009) „Metody pomiaru aktywności ruchowej człowieka", Medycyna Sportowa, 3(6); Vol. 25, s. 155-168.
16. Martinson BC., O'Connor PJ., Pronk NP. (2001) "Physical inactivity and short-term all-cause morality in adults witch chronic disease", Arch. Intern. Med. 161, s. 1173-1180.
17. Midorikawa T., Tanaka S., Kaneko K., et al. (2007) *Evaluation of low intensity physical activity by triaxial accelerometry.* Obesity (Silver Spring), 15 (12), s. 3031-3038.
18. Osiński W. (2003) *Antropomotoryka*, wyd. II rozszerzone, AWF, Poznań, s. 320-330.
19. Sabia, S., et al. (2011) "Effect of Intensity and Type of Physical Activity on Mortality: Results From the Whitehall II Cohort Study", Am J Public Health.
20. Telema R., et al. (2005) "Physical activity from childhood to adulthood a 21-year tracking study", Am J Prev Med, 28, s. 267–273.