

According to the World Health Organisation (WHO), a person's health depends in 50% on one's lifestyle. In addition to proper nutrition, one of the primary determinants of human health is physical activity. The "Bridging the East-West Gap" project showed that Poland is among the countries with the lowest percentage of people doing sport in their free time. Only 10 % of adult Poles declare involvement in regular physical activity. In Poland, as in other countries around the world, there is a visible process of population ageing. In the years 1950 – 2000 the number of the elderly in the total population of our country increased five-fold in urban areas and amounts to 15.4%, while in the countryside it doubled and amounts to 17.6% of the population.. Physical activity is the best way to maintain longevity, health and well-being; it may contribute to extension of the life expectancy through a reduction of risk factors of geriatric diseases, i.e. the locomotor, cardiovascular, and respiratory system diseases. Participation in some sports, such as swimming, cycling, dancing, golf, Nordic walking, and run/walk training, prevents the formation of pathological changes within different systems of our body. However, there are many barriers and limitations to the participation of the elderly in physical activity. Senior citizens usually choose gentle forms of exercise that can be maintained for extended periods of time without experiencing excessive exertion and the accompanying tiredness. Many people regularly practise Nordic walking, which involves a relatively simple walking technique and appropriate poles.

Nordic walking, referred to as Scandinavian walking with poles, was invented by Finns, who introduced the new name and form of exercise in 1997. The activity was created by combining several sports disciplines with the dominant role of aerobic exertion, having a positive impact on human health, fitness and endurance: cross-country skiing, racewalking, and trekking. Nordic walking can be defined as a form of outdoor physical activity involving walking with the use of poles. Compared to walking without poles, Nordic walking is characterized by a higher level of oxygen consumption and energy expenditure, with a lower subjective feeling of fatigue. Nordic walking is one of the most natural forms of physical activity, involving both the circulatory and respiratory systems as well as approximately 90% of all skeletal muscles. It is a form of exercise for anyone regardless of age, level of fitness and endurance. Nordic walking fulfils two basic functions: forces involvement of the upper parts of the body and activates those muscles that are passive during normal gait, partially unloading the lower limbs, which during normal gait may be excessively strained. Those two advantages bring about additional health benefits. The most important ones are: energy expenditure higher by 20- 40 % compared to normal walking, improvement of the overall efficiency of the joints of the upper part of the body through an increase in muscular strength and improved range of motion of those joints, improvement of the overall efficiency of the joints of the lower part of the body through partial unloading of lower limb joints and lower parts of the spine, and maintenance of normal mobility of joints. The heart rate during Nordic walking is higher than in natural walking by 5- 17 beats per minute. Nordic walking improves the overall well-being and psychological comfort thanks to the following: the ability to take part in a high intensity exercise with low subjective feeling of fatigue, walking with poles increases gait safety, improvement of mood, and a sense of good fun. Nordic walking is particularly recommended for the elderly because it brings many health benefits. It reduces the risk of developing osteoporosis, improves cardiovascular fitness, reduces blood pressure, and lowers cholesterol. As in the case of other endurance exercises, systematic practice of this activity improves the respiratory and cardiovascular systems.

The scientific goal of the project is to investigate the effect of walking with Nordic Walking (NW) poles in the rehabilitation using mechatronic poles. The project will involve development of mechatronic poles for NW, fitted with sensors of selected kinematic and dynamic values, as well as a presentation module for those values. Mechatronic poles are to be used to monitor the process of rehabilitation with respect to selected parameters and to provide feedback to the user. Consequently, algorithms will be developed as well as new methods of rehabilitation with the use of biofeedback in the NW gait.

The study will describe the impact of the NW gait technique on moments of force in joints based on the results of dynamic computer simulations with the use of the developed multibody model. The aim of these simulations will be to answer the question whether the NW gait technique affects the selected biomechanical values important during rehabilitation and whether feedback in the form of signals measured by mechatronic poles will allow control of those values. Another aim is identification of the kinetic and dynamic values of proper gait with mechatronic Nordic walking poles with indication of the possibilities of using the mechanism of biofeedback in rehabilitation. An equally important aspect is the development of algorithms that will enable ongoing assessment of the correctness of the NW gait performed by the patient. The information about any irregularities will be transmitted in real time back to the patient with the use of a dedicated application.