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# PHYSICAL ACTIVITY IN THE TREATMENT OF OBESITY, DIABETES, AND OTHER COMORBIDITIES

## 9. Physical activity in the treatment of obesity or future is in the muscle

Matoulek M
*3rd Internal Clinic, Clinic of Endocrinology and Metabolism, 1st Medical Faculty, Charles University, Prague, Czech Republic*

Physical activity plays probably the most important role not only during weight reduction itself, but also in treatment of comorbidities associated with overweight and obesity. Physical activity alone is not effective for weight reduction. But we have a lot of evidence about the effect of physical activity on various diseases that ultimately lead to more mild morbidity and mortality. We can find a lot of prospective studies on hypertension, diabetes, dyslipidemia, ischemic heart disease or depressive disease associated with physical activity as "drug of choice". For many years, there have been no clear mechanisms as it is possible for physical activity to have effects of seemingly unrelated organs and systems. The discoveries of myokines as active substances produced by the working muscle are gradually explaining most of the effects. Myokines appear to be a future not only as future drugs, but above all as a necessary proof to preserve movement already in prevention. In the Czech Republic, the number of obese patients does not appear to increase in recent years. However, the number of people regularly moving is still falling. This means that the physical fitness of the population is likely to decrease, however, the last data on the population's fitness has been in the 70's within the IBP program. But lower fitness in adolescents is unquestionable by performance tests at elementary schools. The $V0_2max$ parameter is the strongest predictor of cardiovascular mortality over 60 years of age. It is undeniable that by improving fitness we improve the prognosis of patients regardless of the presence of any disease. Physicians, for example, physicians are prescriptions of "training" patients in collaboration with a specialist in the subject. The main problem is so often insufficient too low the intensity or frequency of physical activity for our patients and thus the failure to achieve the expected effect. Only after the decision about regular time for physical activity can we discuss the type (aerobic, resistance training or a combination of both, etc.). It is a big misconception to say that the movement brings joy for all patients. For example, non-depressive patients may have depressive symptoms after exercise. Consequently, we must avoid the greatest mistakes in prescribing and strictly individualize our recommendations, not only for associated illness but also for the possibilities and feelings of obese patients. Each of us has a muscle pharmacy that just needs to be used. It is very cheap and relatively one. I know that often one-off procedures have incredible effects.

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## 10. The effects and mediators of acute and regular exercise on glucose metabolism, cognitive and motor functions in middle-aged sedentary and elderly individuals

Ukropcova B[1], Balaz M[1], Krumpolec P[1], Sobodova L[2], Tirpakova V[3], Janakova Z[2], Vajda M[4], Sutovsky S[5], Cvecka J[4], Ukopec J[6]
[1]*Biomedical Research Center, Slovak Academy of Sciences, Bratislava, Slovakia*
[2]*Institute of Pathological Physiology, Faculty of medicine, Comenius University, Bratislava, Slovakia*
[3]*Institute of Physical Education, Slovak Medical University, Bratislava, Slovakia*
[4]*Faculty of Physical Education and Sports, Comenius University, Bratislava, Slovakia*
[5]*1st Neurology department, Faculty of Medicine & University Hospital Bratislava, Slovakia*
[6]*Biomedical Research Center Slovak Academy of Sciences, Bratislava, Slovakia*

Obesity and sedentary lifestyle increase the risk of both metabolic and neurodegenerative diseases. On the other hand, regular exercise has a substantial potential to slow down or even reverse the progression of early stages of chronic diseases. Evidence suggests that many of regular exercise-induced health benefits are mediated by bioactive molecules, released from contracting skeletal muscle, such as myokines and microRNAs. In our studies, we have observed improved motor and cognitive functions, muscle strength and physical fitness as well as selected metabolic parameters and skeletal muscle phenotypes in different patients' populations. Improvements in clinical and muscle phenotypes were associated with shifts in selected bioactive molecules, supporting their role in the

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adaptive response to exercise. Our results support the role of regular exercise as a supportive treatment of chronic metabolic and neurodegenerative diseases.

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## 11. High-intensity interval training as a therapy for type 2 diabetes?

Pesta D
*German Diabetes Center, Düsseldorf, Germany*

High-intensity interval training (HIIT) is characterized by high intensities close to or above an individual's maximum oxygen uptake ($VO_2$max) and short recovery phases between these high intensity phases. Although this training modality has long been known in a slightly modified form as interval training in elite sports, HIIT has only recently found its way into recreational sport as well as preventive and rehabilitative medicine. But how does HIIT work? Does HIIT live up to its promises? And most importantly, can we use this promising training strategy to provide an increasingly obese and sedentary population with the amount of physical activity indispensable for metabolic health? Numerous studies have shown that many adaptive processes of HIIT-sessions are comparable to those of time-consuming conventional endurance training regimes – despite a significant reduction of time requirement with the former. This also includes promising effects on metabolic health, particularly in those at risk of or with type 2 diabetes by improving important endpoints such as glucose regulation, insulin resistance, $VO_2$max and some cardiometabolic risk factors. HIIT is a novel time-efficient training paradigm that can be used as a strategy to mediate health-protective effects and reduce metabolic risk factors in sedentary populations who otherwise would not adhere to time-consuming conventional endurance training regimes.

## 12. Does fat loss require fat burning? Role of exercised skeletal muscle

Kuo C-H
*Department of Sports Sciences, University of Taipei, Taiwan*

Exercise training as an effective intervention to lower visceral obesity has been supported by numerous evidence. Since exercise is seen as an energy-consuming behavior, fat burning concept has been widely used to explain its fat loss outcome. This concept is predicated by a believe that the most important way to lose abdominal fat is the conversion of fatty acid to carbon dioxide during and after exercise. This intuitive thought is further strengthened by the evidence of increased plasma glycerol concentration during exercise together with elevated oxygen consumption. Despite most of exercise physiologists understand that carbohydrate, not fat, is the main fuel supporting fast muscle contraction, fat burning concept remains not much questioned in the past. The major challenge against the fat burning concept comes from the following key evidence. First, exercise training at various forms (low intensity aerobic exercise, high intensity anaerobic exercise, resistance exercise) does not actually elevate 24-h fat oxidation based on reliable data from several whole-room indirect calorimetric studies, demonstrating that exercise is not fat burning. Second, exercise training combined with hypoxia recovery effectively decreases fat mass. If visceral fat loss must rely on fat burning, hypoxia should prevent fat loss simply because fatty acid oxidation cannot occur without oxygen. We have previously found that a small decreases in blood oxygen saturation under hypoxic conditions (blood oxygen saturation decreased to 93 %) increases blood distribution toward skeletal muscle under glucose ingested condition, suggesting a shift of more circulating glucose and insulin to skeletal muscle under systemic hypoxia. This implicates that carbon-source redistribution among tissues in the body is more important than fat burning for abdominal fat loss. Third, high-intensity sprinting training (anaerobic-based exercise) decreases body fat more effectively than steady state moderate intensity exercise training (aerobic-based exercise) when overall energy expenditures of both are similar. In conclusion, exercise challenges skeletal muscle, which in turn increases its capability to attract more carbon-source than adipose tissues. High intensity exercise recruits greater muscle fibers, depletes more carbon fuel, and causes greater damage in skeletal muscle than low-intensity exercise. This fat burning-independent scenario increases its demand on postprandial carbon sources, insulin, stem cells, and neutrophil/macrophage leading to a reciprocal size change between muscle and fat.

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## 13. Effectiveness of complex non-pharmacological treatment of obese patients in Bardejov Spa

Belovicova M[1,2,3,4], Matula P[5]
[1]Bardejov Spa a.s., Bardejov, Slovakia
[2]Remedium s.r.o., Internal Clinic for Liver Disease Diagnosis and Treatment, Bardejov, Slovakia
[3]St. Elizabeth University of Health and Social Sciences, Bratislava, workplace Presov and Michalovce, Slovakia
[4]Slovak Society of Practical Obesitology – SSPO, Bardejov, Slovakia
[5]Department of Radiotherapy and Oncology, East Slovakia Cancer Institute, Kosice, Slovakia

**Introduction:** Obesity significantly increases morbidity and mortality, impairs quality of life and brings serious socio-economic problems. **Aim of the research:** Evaluate the effectiveness of non-pharmacological treatment of obesity in patients who underwent the two-week reduction stay in Bardejov Spa a.s. in years 2012–2016. We intended to find out whether the non-pharmacological treatment of obesity will positively affect values of total cholesterol (CHOL), triglycerides (TG), HDL cholesterol (high density lipoprotein), LDL-cholesterol (low density lipoprotein), uric acid (KM) and glycemia and whether the changes reach statistical significance. We have also been interested in the question of possible correlation between severity of obesity and the presence of liver fibrosis. **Methodology:** Bardejov Spa a. s. has developed a complex specialized two-week spa stay aimed at weight reduction, which was put into practice in May 2012 (Belovicova M, Belovicova L, Svirkova H, Niemasikova G, Bachulak V, Nikulin A). During this stay clients gain new knowledge regarding proper diet and physical activity while being under medical supervision. During the stay they undergo testing for early detection of cardiovascular disease and liver diseases. Clients also undergo an ultrasound scan of the abdominal cavity and examination on Fibroscan 502 touch device, which uses painless non-invasive methods (transient elastography – TE) to measure stiffness of the liver tissue. **Results:** 184 clients has completed the weight reduction stay. For evaluation purposes, we did not include into this file clients who underwent the weight reduction stay repeatedly. Average weight loss after completing the course was 3.8 kg (3.78739 kg). Waist circumference was reduced by an average of 5.5 cm (5.49727 cm). The values of weight loss and waist circumference reduction were highly statistically significant ($p = 0.001$). Transient elastography was applied on clients at the beginning of the course. It could be realized with 165/184 clients, which represents 89.6 % of the group. We conducted a correlation analysis of the relation of BMI and the degree of liver fibrosis. The degree of fibrosis – liver damage – increases with the increasing degree of obesity. With the consent of the clients, we took them control samples at the end of their weight reduction stay. Average CHOL decrease was 0.72 mmol / l (0.72840), average TAG decrease was 0.4 mmol/l (0.39699), average LDL decrease was 0.6 mmol/l (0.62987, average Gly decrease was 0.7 mmol/l (0.71083). The values of decrease in total cholesterol, TAG, LDL, and blood glucose levels were higly statistically significant ($p = 0.001$). Changes in the levels of HDL and of uric acid (KM) were not statistically significant (HDL $p = 0.627$, KM $p = 0.076$). **Conclusions:** The most effective method in the prevention of obesity is targeted intervention aimed at improving dietary habits, increasing physical activity and overall change of ones' lifestyle. We see the contribution of our weight reduction courses in their complexity (diet, physical activity, education, motivation and psychological support) and in the presence of feedback (we communicate with the course participants even after its completion).

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## 14. Prevention of type 2 diabetes through diet and physical activity: the PREVIEW study

Handjieva-Darlenska T[1], Larsen TM[2], Westerterp-Plantenga M[3], Macdonald I[4], Martinez JA[5], Brand-Miller J[6], Poppitt S[7], Boyadjieva N[1], Handjiev S[1], Fogelholm M[8], Raben A[9]
[1]*Department of Pharmacology and Toxicology, Medical University, Sofia, Bulgaria*
[2]*Department of Nutrition, Exercise and Sports, University of Copenhagen, Denmark*
[3]*Department of Human Biology, Maastricht University, Netherlands*
[4]*Faculty of Medicine & Health Sciences, University of Nottingham, Medical School, Nottingham, UK*
[5]*Department of Nutrition, Food Science, Physiology and Toxicology, University of Navarra, Pamplona, Spain*
[6]*Boden Institute of Obesity, Nutrition, Exercise and Eating Disorders, Charles Perkins Centre and School of Life and Environmental Biosciences, The University of Sydney, Australia*
[7]*The Human Nutrition Unit, University of Auckland, New Zealand*
[8]*Department of Food and Environmental Science, Division of Nutrition, University of Helsinki, Finland*
[9]*Department of Nutrition, Exercise and Sports, University of Copenhagen, Denmark*
*on behalf of the PREVIEW consortium*

**Introduction:** Type 2 diabetes is one of the growing disease which takes epidemic proportions throughout the world. The aim of the PREVIEW trial (**PREV**ention of diabetes through lifestyle **I**ntervention and population studies in **E**urope and around the **W**orld) was to assess which is the best diet in combination with physical activity to prevent the development of type 2 diabetes in a population at risk. **Materials and methods:** The project is a 3-year multi-centered randomized controlled trial in adults. Eight intervention centers were involved (Denmark, Finland, UK, the Netherlands, Spain, Bulgaria, Australia, New Zealand). The enrolled subjects were pre-diabetic overweight/obese individuals from both genders randomized to different dietary and physical activity groups. The intervention started with an 8-week on a low-calorie diet (Cambridge Weight Plan®) followed by a randomized 146-week weight maintenance intervention in 4 dietary arms (high/low protein content and high/ moderate glycemic index in combination with high/moderate physical activity intensity). Data were collected at different time points for blood, urine, faeces, anthropometric and body composition measurements, blood pressure, pulse, accelometers, different questionnaires, 4-day food diaries. **Results:** 2,300 subjects were eligible for inclusion to the study. Of these, 2,224 (1,504 women; 720 men) started the 8-week low calorie diet. At the end of the 8 week, 2,020 completed the weight reduction period. Women lost 10.2 ± 0.4 kg compared to men -11.8 ± 0.5 kg with a mean difference of -1.6 ± 0.1 kg ($P < 0.001$). Then, they followed the 146-week weight maintenance intervention. **Conclusion:** The PREVIEW study is the largest, multinational study for prevention of type 2 diabetes among pre-diabetic individuals with a combination of diet, physical activity and behavior modification.