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Physical Activity to Combat Type 2 Diabetes Mellitus – Biomedical Research and Sports Therapy 2.0

Mit Bewegung gegen Typ-2 Diabetes mellitus – Biomedizinische Forschung und Sporttherapie 2.0

EDITORIAL

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Developing complex cause-effect models that describe adaptations to physical activities in depth can help evaluate the effectiveness and efficiency of sports and physical activity programs in fighting type 2 diabetes mellitus and in optimizing personalized therapy. "Omics" research and data obtained from modern biosensors can provide important information for these purposes.

According to the International Diabetes Federation, the prevalence of diabetes in Germany is more than 15% (7). The number of people with diabetes continues to grow! Over 90% of diabetes patients have type 2 diabetes mellitus. Due to the frequent comorbidities and secondary diseases, the increase in patients with diabetes poses an enormous patient care burden for the healthcare system (9). Strategies and therapeutic interventions to ameliorate the metabolic disease and patients' suffering are needed now more than ever. Sports therapy is a crucial cornerstone of patient care. Regular physical activity can even result in a complete remission of the disease in some patients (10).

Exercise is Medicine: Complex Cause-Effect Models

Advanced sports therapy should be evidence-based. One of the missions of sports-medical research in the field of metabolic diseases is the development of complex cause-effect models that describe biological adaptations to physical activity stimuli at the molecular and cellular level, which can be used to evaluate the effectiveness and efficiency of training programs. If necessary, these programs can then be appropriately adjusted to maximize their beneficial effects. The integration of an increasing number of mechanisms of action in various organ systems and their interactions (organ crosstalk) in such models can ultimately lead to an ever-growing understanding of why specific forms or methods of training are especially suitable for certain patients. Of particular interest in this regard, for example, are the effects of training on chronic inflammation and oxidative stress. Inflammation and oxidative stress can promote insulin resistance and the onset of secondary complications. Numerous studies have shown the anti-inflammatory and anti-oxidative effects of regular physical activity and the up-regulation of protective capacities in the skeletal muscle and blood of patients with type 2 diabetes mellitus (4, 11, 14). The microbiome has recently gained the attention of the research community. It has recently been demonstrated that sports-induced alterations in gut microbiota are strongly correlated with changes in the glucose homeostasis and insulin sensitivity of individuals with pre-diabetes (12). There seems to be an (indirect) connection between gut microbiota and skeletal muscle. Epigenetic modulations, by which gene regulation can be influenced through training, are also an exciting field of research, and their complexity is becoming increasingly apparent. So-called microRNAs, which modulate gene expression post-transcriptionally, represent an interesting piece of the puzzle. Some microRNAs that are dysregulated in diabetes patients, but which can be regulated to reach normal levels through regular exercise, have already been identified (8, 15). A special feature of miRNAs is that they can be involved in crosstalks between organs and can be transported with the help of vesicles from a cell via blood circulation to distant organs.

"Omics" Research as a Key to Personalized Therapy

The application of new analytical methods in metabolomics, genomics, epigenomics, transcriptomics, proteomics and microbiomics generates an ever-greater quantity of data thanks to a high degree of automatization. Accessibility to big datasets, in particular, which facilitates continuous analyses by members of the scientific community, should be promoted. The main challenge consists of filtering out relevant information. "Omics" research will further elucidate inter-individual adaptations and contribute to an explanation why changes in certain variables (glycemic control, cardiovascular fitness, etc.) of some diabetic patients are more or less profound in response to specific exercise stimuli/training programs (16). This may be the key to a more personalized sports therapy in the near future.

Verification of Efficacy Using Modern CGM Technology

New knowledge about cause-effect relationships can also be generated with the help of modern sensor technologies. By using systems for continuous glucose measurement (CGM), which measure glucose in the interstitial fluid of the subcutaneous adipose tissue, new variables for evaluating the effects ›

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of physical activity on the glucose profile are available, such as "time in/out of range", "time in hyperglycemia" or "mean glucose value recorded by the sensor" (5).

Changes in glucose homeostasis can be detected early in interventions using CGM systems, while changes are not detectable so quickly when only glycated hemoglobin (HbA1c), the surrogate parameter for glycemic control, is considered.

Feasibility and Acceptance of Training Programs

Innovative forms of training, such as exergaming (exercise with game consoles) (13) or hypoxia training (3), as well as alternative training methods such as high-intensity interval training (2), or unusual training modalities such as training before breakfast (1), can be analyzed by biomedical research to determine their effectiveness and efficiency. The selection of the "right" training program should by no means, however, be limited to effectiveness and efficiency. Individual complications and possible contraindications should be considered as well. In addition to feasibility, it is crucial to take patients' personal preferences into account. Long-term adherence to training programs should always be a priority, because one thing is certain: you will only proceed if you move! – and that can best be achieved when you enjoy what you're doing and stick with it for life!

Literatur

(1) **BRINKMANN C, WEH-GRAY O, BRIXIUS K, BLOCH W, PREDEL H-G, KREUTZ T.** Effects of exercising before breakfast on the health of T2DM patients-A randomized controlled trial. Scand J Med Sci Sports. 2019; 29: 1930-1936. doi:10.1111/sms.13543

(2) **BRINKMANN C.** Hochintensives Intervalltraining (HIIT) und Typ-2-Diabetes mellitus. B & G. 2019; 35: 62-65. doi:10.1055/a-0860-1300

(3) **BRINKMANN C, BLOCH W, BRIXIUS K.** Exercise during short-term exposure to hypoxia or hyperoxia - novel treatment strategies for type 2 diabetic patients?! Scand J Med Sci Sports. 2018; 28: 549-564. doi:10.1111/sms.12937

(4) **BRINKMANN C, CHUNG N, SCHMIDT U, KREUTZ T, LENZEN E, SCHIFFER T, GEISLER S, GRAF C, MONTIEL-GARCIA G, RENNER R, BLOCH W, BRIXIUS K.** Training alters the skeletal muscle antioxidative capacity in non-insulin-dependent type 2 diabetic men. Scand J Med Sci Sports. 2012; 22: 462-470. doi:10.1111/j.1600-0838.2010.01273.x

(5) **DIDYUK O, ECONOM N, GUARDIA A, LIVINGSTON K, KLUEH U.** Continuous glucose monitoring devices: past, present, and future focus on the history and evolution of a technological innovation. J Diabetes Sci Technol. 2020; 1932296819899394 [Epub ahead of print]. doi:10.1177/1932296819899394

(6) **GUAY C, REGAZZI R.** Exosomes as new players in metabolic organ cross-talk. Diabetes Obes Metab. 2017; 19: 137-146. doi:10.1111/dom.13027

(7) **DIABETES ATLAS IDF.** 2019. https: //www.diabetesatlas.org/en/ [8th May 2020].

(8) **IMPROTA CARIA AC, NONAKA CKV, PEREIRA CS, SOARES MBP, MACAMBIRA SG, SOUZA BSF.** Exercise training-induced changes in microRNAs: beneficial regulatory effects in hypertension, type 2 diabetes, and obesity. Int J Mol Sci. 2018; 19: E3608. doi:10.3390/ijms19113608

(9) **KÄHM K, LAXY M, SCHNEIDER U, ROGOWSKI WH, LHACHIMI SK, HOLLE R.** Health care costs associated with incident complications in patients with type 2 diabetes in Germany. Diabetes Care. 2018; 41: 971-978. doi:10.2337/dc17-1763

(10) **LEAN MEJ, LESLIE WS, BARNES AC, BROSNAHAN N, THOM G, MCCOMBIE L, PETERS C, ZHYZHNEUSKAYA S, AL-MRABEH A, HOLLINGSWORTH KG, RODRIGUES AM, REHACKOVA L, ADAMSON AJ, SNIEHOTTA FF, MATHERS JC, ROSS HM, MCILVENNA Y, STEFANETTI R, TRENELL M, WELSH P, KEAN S, FORD I, MCCONNACHIE A, SATTAR N, TAYLOR R.** Primary care-led weight management for remission of type 2 diabetes (DiRECT): an open-label, cluster-randomised trial. Lancet. 2018; 391: 541-551. doi:10.1016/S0140-6736(17)33102-1

(11) **DE LEMOS ET, OLIVEIRA J, PINHEIRO JP, REIS F.** Regular physical exercise as a strategy to improve antioxidant and anti-inflammatory status: benefits in type 2 diabetes mellitus. Oxid Med Cell Longev. 2012; 2012: 741545.

(12) **LIU Y, WANG Y, NI Y, CHEUNG CKY, LAM KSL, WANG Y, XIA Z, YE D, GUO J, TSE MA, PANAGIOTOU G, XU A.** Gut microbiome fermentation determines the efficacy of exercise for diabetes prevention. Cell Metab. 2020; 31: 77-91.e5. doi:10.1016/j.cmet.2019.11.001

(13) **MASOUD M, BRINKMANN C.** Exergaming für PatientInnen mit metabolischem Syndrom?! Wien Med Wochenschr. 2020; 170: 171-177. doi:10.1007/s10354-019-00719-z

(14) **MOGHADDAM DA, HEBER A, CAPIN D, KREUTZ T, OPITZ D, LENZEN E, BLOCH W, BRIXIUS K, BRINKMANN C.** Training increases peroxiredoxin 2 contents in the erythrocytes of overweight/obese men suffering from type 2 diabetes. Wien Med Wochenschr. 2011; 161: 511-518. doi:10.1007/s10354-011-0037-0

(15) **OLIOSO D, DAURIZ M, BACCHI E, NEGRI C, SANTI L, BONORA E, MOGHETT P.** Effects of aerobic and resistance training on circulating microRNA expression profile in subjects with type 2 diabetes. J Clin Endocrinol Metab. 2019; 104: 1119-1130. doi:10.1210/jc.2018-01820

(16) **SPARKS LM.** Exercise training response heterogeneity: physiological and molecular insights. Diabetologia. 2017; 60: 2329-2336. doi:10.1007/s00125-017-4461-6