

Home-Based Exercise During the Coronavirus Pandemic – A Useful, yet Challenging Treatment Strategy for Improvement of Mental Health, Glycemic Control and COVID-19 Outcomes in Patients With Diabetes

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Abstract

Lockdown measures to control disease transmission were implemented at the start of the COVID-19 era, worsening the already existing sedentary lifestyle. Reduced physical activity (PA) and unhealthy eating habits have a negative impact on mental health in chronically ill patients, including diabetes patients. Mental illness, on the other hand, encourages a sedentary lifestyle, exacerbating all components of metabolic syndrome. While well-controlled diabetic patients with an HbA1c of less than 7% had a less severe clinical presentation and COVID-19 mortality rates, the favorable effect of PA on immunomodulation and immunoregulation should not be neglected. Given recent data indicating that a sedentary lifestyle is the third independent risk factor for COVID-19 complications and death (after advanced age and organ transplant), including regular PA has never been more vital. Since PA has a major impact on both glycemic control and mental health, implementing structured home-based activity programs could improve glycemic control and psychological well-being, hence positively impacting COVID-19 outcomes.

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Introduction

Physical activity is defined as any movement produced by skeletal muscles that require energy expenditure (1). It refers to all activities performed while traveling, during leisure time or working hours. Physical activity should be viewed as a continuum, ranging from light to vigorous, while exercise implies planned, structured and repetitive physical activity. Overall, it is crucial for the improvement and/or maintenance of both mental and physical health (2, 3).

Different psychological and physiological mechanisms have been proposed to explain the positive effects of physical activity on mental health, especially on anxiety, depression and stress-related disorders (4, 5, 6). Potential psychological mechanisms include "time out" or distraction from stressors, as well as improved self-efficacy, self-image and confidence, which enhance the sense of control and help to overcome the difficulties faced on a daily basis (7). From the physiological aspect, exercise may induce changes in the hypothalamic-pituitary-adrenal axis modulating stress reactivity (4). It may also boost the levels of endorphins, which help people feel happier and less stressed (8). Besides, the brain-derived neurotrophic factor increases with exercise, thus contributing to the anxiolytic effect of physical activity (9).

It is well known that physical inactivity and sedentary behavior represent the key modifiable factors associated with an increased risk of developing type 2 diabetes (T2D). Nowadays, diabetes is the fastest-growing chronic disease strongly related to rising obesity rates. Regular physical activity constitutes an important part of diabetes/obesity prevention and management. It produces multiple health benefits including enhanced glycemic control, favorable changes in blood lipid levels, reduced low-grade inflammation and improved vascular function (10, 11). Physical activity and exercise also reduce all-cause and diabetes-related mortality in T2D. Mechanisms enabling those benefits are complex and mediated by an increase in glycolipid uptake and utilization,

improved insulin sensitivity, optimized body mass index and modulated DNA methylation (12). Recent findings also suggest that exercise induces significant physiological changes in the immune system, including anti-inflammatory cytokine response (12, 13). For people with type 1 diabetes (T1D), physical activity improves cardiovascular fitness, muscle strength and insulin sensitivity (14, 15).

Many patients suffering from chronic diseases have co-morbid mental health conditions (16). Diabetes and mental health issues share a bidirectional association influencing one another in multiple ways. In patients with diabetes, the prevalence of anxiety and depression is significantly higher than in the general population (17, 18). Depression in combination with behavioral and metabolic risk factors increases the risk for type 2 diabetes development, poor glycaemic control and subsequent risk for micro and macrovascular complications. It is important to emphasize that being diagnosed with diabetes represents a strong stressor by itself, requiring a large number of physical and mental adjustments.

The adoption and maintenance of regular physical activity are beneficial for both, diabetes and mental health disorders. However, many patients neither meet their exercise targets, nor adhere to proposed exercise guidelines. Between 25% and 42% of older diabetics meet the physical activity recommendations, while 13–19% are not even likely to be physically active at sufficient levels compared to non-diabetic persons (19). Additionally, more than 60% of patients with T1D remain sedentary (20). People with severe mental illness engage in significantly less vigorous exercise and express greater amounts of sedentary behavior in comparison with healthy controls (21). Their inactivity is predictive of a range of adverse health outcomes including metabolic syndrome and its components (22).

It is reasonable to assume that number of physically inactive people with diabetes and mental health disorders increased during the coronavirus pandemic. Knowledge of commonly perceived barriers to physical

activity, along with psychological factors contributing to these barriers may help in overcoming challenges of sedentarism both in non-pandemic and pandemic COVID-19 times.

The challenge of physical activity in non-pandemic times

According to current guidelines, people with diabetes should engage in five sessions of moderate aerobic activity weekly (at least 150 min/weekly, i.e. five days per week with no more than two consecutive days between the activity) to maintain the exercise-induced improvements in insulin action. Besides aerobics, resistance training is recommended three times weekly on nonconsecutive days (23). Transcribed into parameters of glucoregulation, a decrease in HbA1c by up to 0.85% can be expected, which matches the reductions seen with some newer antidiabetic agents. So, the intriguing question is why physicians do not prescribe physical activity more persuasively, and why are patients so frequently noncompliant and nonadherent? The assumptions for successful prescription of physical activity imply that medical professionals know how to prescribe, monitor and evaluate the effectiveness of the exercise prescribed (adapting exercise type, frequency, intensity and duration according to patients' individual health status and interests) which is generally not the case. Other known obstacles to physical activity promotion include lack of time and lack of perceived efficacy in changing physical activity behavior in patients (24). The most typical barriers perceived by T2D patients are lack of time, pain and discomfort, being overweight and finding physical activity boring (25). Interestingly, a commonly reported reason for avoiding exercise among overweight T2D females is embarrassment about their appearance. In contrast, in T1D patients, fear of hypoglycemia pops up as the most prevalent reason behind not exercising (26). Patients with diabetes are sedentary, spending too much time viewing TV, which represents an independent risk factor for the increase of all-cause mortality (27). In the case of co-morbid mental health issues, mental health symptoms and tiredness may further complicate exercise performance.

For people with severe mental disorders, additional factors that hamper physical activity include medication side effects, complications from obesity and poor physical health, lack of resources and absence of professional support (28).

COVID-19 pandemic and restrictions related to physical activity

The COVID-19 pandemic imposes challenges for people with diabetes and mental health disorders, tackling their health and well-being. Lockdowns and mobility restrictions impacted the ability to be active during work and leisure time. Many people worked through home-based offices, leaving little or no time for movement and increasing screen time, sedentarism and unhealthy meal plans (29). Moreover, pandemic-driven economic and financial distress distracted people from engaging in physical activity (30) and weakened their motivation to exercise (31). Studies reported direct negative effects on glucoregulation of T1D patients during lockdown (32). Furthermore, high physical inactivity found in most T2D patients before the COVID-19 pandemic additionally worsened during the lockdown (33). At the same time, public health measures such as quarantine, self-isolation and social distancing contributed to the deterioration of mental health and increased stress, anxiety, depression and feelings of isolation (34, 35).

In light of the coronavirus pandemic, the beneficial effects of physical activity on immune function and inflammation can be especially important for people with T2D and mental health issues, as they both have a higher risk of COVID-19 hospitalization and death (36, 37). Also, the favorable impact of physical activity on glycemic control is not negligible because it may help reduce the chance of severe COVID-19 in diabetic patients (38). It is important to point out that only advanced age and a history of organ transplant are stronger independent risk factors for severe COVID-19 outcomes than physical inactivity (39). On the contrary, engaging in various types of exercise is considered to be a coping strategy for mitigating the negative

effects of the coronavirus pandemic on mental health and enhancing general well-being (40).

Home-based exercise – could it make a difference?

As a part of the COVID-19 social distancing measures, the use of gyms, health clubs and public spaces was either reduced, not recommended, or not permitted, especially for the high-risk populations. The restricted collective activities during the pandemic imposed the importance of physical activity through alternative forms of exercise, especially home-based exercise (HBE). Therefore, knowing the benefits of regular physical activity and exercise on glycemic management and mental health, HBE training emerges as an important approach and coping strategy to promote physical and psychological well-being during the pandemic times.

Several randomized control trials, including people at risk for contracting T2D, patients with T2D and different cardiovascular profiles and

women with gestational diabetes mellitus showed health advantages of HBE (primarily moderate-intensity aerobic exercise 3–5 times weekly and less often combined aerobic and resistance exercise), during the time of intervention and follow-up (Table 1). Benefits were, besides glycemic control, seen in lipid profile, body composition, cardiorespiratory fitness and psychological health (41). Patients adherent to the HBE program had a significantly reduced incidence of cardiovascular disease compared to nonadherent patients (42). In addition, none of the studies reported adverse events during the HBE programs or follow-up. Studies provided material about the exercise program, education on diabetes self-management, heart rate monitors and oximeters which helped the participants in safe exercising (43, 44). Unfortunately, no studies assessed the safety and effectiveness of HBE programs in T1D individuals, but with modern technologies such as continuous and flash glucose monitoring and the use of insulin pumps, one can speculate their usefulness and safety during COVID-19 (45).

Table 1. Selected findings from different studies regarding the effectiveness of various exercise programs

| Author | Title | Source | Findings |
|---------------------|--|--|--|
| Francesco Cosentino | 2019 ESC Guidelines on diabetes, pre-diabetes and cardiovascular diseases developed in collaboration with the EASD | European Heart Journal | Clinical trials in adults with DM have provided evidence of the HbA1c-lowering value of resistance training, and of an additive benefit of combined aerobic and resistance exercise. |
| S. F. Lee | An investigation and comparison of the effectiveness of different exercise programs in improving glucose metabolism and pancreatic β cell function of type 2 diabetes patients | The International Journal of Clinical Practice | The accumulated million steps group had better glucose metabolism and pancreatic β cell function compared with those in the aerobic exercise group. |
| Jos J Kraal | Clinical and cost-effectiveness of home-based cardiac rehabilitation compared to conventional, center-based cardiac rehabilitation: Results of the FIT@Home study | European Journal of Preventive Cardiology | Patients in the home-based group were more satisfied with their CR program compared to patients in the center-based group (home-based: 8.7/10, center-based: 8.1/10, $p = 0.02$). |

The Italian National Association of Athletes with Diabetes (ANIAD) issued a series of daily activities that could be performed home-based, and with an intensity comparable to a one-hour brisk walking with an energy expenditure of 150–200 Kcal (46). The above-mentioned could not only secure the reaching and attainment of recommended physical activity guidelines for people with diabetes, but also enhance access to exercise and its adjustment to patients' lifestyles, daily schedules, and integration with regular home routines, all of which are often depicted by patients as barriers and obstacles for participation in regular physical activity. HBE does not always have to be high-tech and designed on platforms aimed exclusively at diabetes patients. Those narrowly specialized platforms would be best, but their reach could be limited, resulting in a low number of users. The solution might be in general platforms, which give the possibility to choose the location and type of activity. The newest addition is online programs. As the infrastructure already exists, there is a possibility to offer online programs explicitly created for diabetes patients. The collaboration between diabetes centers and such platforms would speed up the online exercise offer by using existing software solutions and a large pool of members.

Nearly all types of physical activity are helpful since both physical exercise and relaxation training can buffer the negative effects of stress on mental health (47). HBE can include aerobic activities such as dancing (35), balance and flexibility training, such as yoga (48), muscle strengthening exercises, such as weightlifting (35), endurance training and others. Participation in physical activities at home has been shown to alleviate a wide range of mental illness

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symptoms, improve anxiety, mood, social and emotional health (34, 49). Studies have shown that yoga, as an example of indoor physical activity, can reduce perceived stress, enhance emotional control and improve self-efficacy, self-confidence and overall quality of life (50). It can be used alone or in combination with other interventions (48), and it is one of the important measures to prevent or control mental health problems during the pandemic. Exergames, which are exercises based on video games, can encourage younger people to exercise at home, while the internet may further enable social interaction with friends remotely (51).

Conclusions

Physical inactivity emerges as an important issue with deleterious physical and mental health consequences. In patients with diabetes, regardless of the disease type, regular exercise has well-known and proven benefits on glycemic control and cardiovascular health. Moreover, physical activity can reduce psychological pressure, promote mental health and improve the quality of life. In the context of the COVID-19 pandemic, maintaining regular exercise is especially beneficial, and engaging in alternative modes of physical activity such as HBE can be a key strategy to maintain mental health and physical well-being.

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