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Study on the Influence of Remote Exercise Intervention on Different Diseases from the Perspective of Modern Network Technology

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Abstract: *The increasing popularity of low-cost Internet and communication technology has increased the opportunity for patients with different diseases to choose their own sports programs based on technology-based solutions. This method of remote guidance and monitoring of exercise can ensure that patients better adhere to and monitor exercise, so as to achieve better intervention effect on disease; At the same time, it can provide patients with a customized exercise program. Although it has expanded the application of tele-motion intervention in the field of medical care, it also makes tele-motion intervention face new opportunities and challenges. The purpose of this paper is to study the effects of tele-motion intervention in different diseases, explore the feasibility and limitations of such programs, and accumulate experience and useful reference for the promotion of tele-motion intervention model in China.*

Keywords: *Remote exercise; Diabetes; Parkinson; Heart failure*

1. Introduction

Exercise is beneficial for most chronic diseases, but inappropriate exercise will not benefit patients and may cause unnecessary risks. Traditional sports rehabilitation puts great pressure on patients in terms of time and money. In addition, exercising outside may increase the risk of falling for some elderly people, and exercise may be limited due to changing factors such as season and weather. The exponential growth of the Internet and the Development of new technologies that can be used to remotely manage and direct home exercise programs meet this need[1, 2].

Remote exercise intervention refers to providing remote exercise intervention for patients with different diseases through modern communication technologies such as wearable sensors, SMS and telephone monitoring, face-to-face video teaching and other intervention measures to meet the needs of patients' rehabilitation [3-5]. Remote exercise interventions can enable the same access to exercise rehabilitation for patients unable to perform exercise rehabilitation due to geographical and economic conditions, reducing the social disparities in access to care. Some trials have been published abroad to test the feasibility of remote exercise intervention, and the results all show relatively positive answers [6-8]. Qver the past five years, clinical trials of teletherapy have increased more than fivefold. The market is expected to grow tenfold in the next three to five years [9]. The rapid Development of new technologies such as mobile Internet, cloud computing and wearable devices has brought new opportunities and challenges for remote exercise intervention.

Despite satisfactory scientific results, this remote exercise intervention is not widely disseminated in the country. Moreover, the domestic remote monitoring system is in the primary stage of Development, and there are problems such as immature technology and limited equipment terminal. This paper aims to study the impact of remote exercise intervention in different patients, explore the feasibility of such programs, summarize the problems existing in the program's implementation process, and accumulate experience and useful references for the promotion of the remote exercise intervention model in China.

2. Effect of a remote exercise intervention on type 2 diabetes

Type 2 diabetes mellitus (T2DM) is one of the most prevalent metabolic diseases worldwide. According to the American Diabetes Association recommendations, adults with diabetes should do at least 150 minutes of moderate aerobic exercise per week at moderate intensity [10]. However, it was difficult for patients to follow a healthy exercise protocol beyond regular visits to the hospital. A Meta

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by Daniel et al. showed that general physical activity was not associated with improving HbA1c (HbA1c) levels. At the same time, structured exercise training programs contributed to lower HbA1c levels [11]. Many studies have controlled diabetes via mobile phones, with Internet, mobile phone, and Bluetooth management for assistance with diabetes self-care in clinical populations [12]. Based on this technique, some researchers have proposed a remote exercise intervention for people with diabetes. In implementing a remote diabetes exercise rehabilitation program based on behavior change technology, Leon et al. found that remote exercise could improve exercise self-efficacy in patients with T2DM and improve HbA1c levels in patients with poor glycemic control [13]. The remote exercise personalized treatment in 53 men with HbA1c levels of 6.5% showed that HbA1c levels decreased significantly ($p < 0.05$), and the percentage of the active phase in the health behavior stage increased significantly after six months. The remote exercise intervention improved glycemic control in T2DM and increased patient adherence to exercise [14]. From the current study, most of the effects of remote exercise interventions were beneficial, reducing HbA1c levels and enhancing patient adherence to exercise. Although device problems arise in individual trials, it is undeniable that the use of monitoring devices and the provision of remote exercise may be a convincing, economical, and practical tool to help self-manage patients with type 2 diabetes.

3. The effect of a remote exercise intervention on Parkinson

Treatment of neurodegenerative diseases is often more complicated by some psychosocial factors, which reduces accessibility and compliance with medical services [15]. Furthermore, the effective treatment of movement disorders may be hampered by certain geographical and economic conditions [7]. P.D. is the second most common neurodegenerative disease after Alzheimer's dementia, and studies have observed that most P.D. patients have very limited access to care [15]. Increasing evidence supports the benefits of aerobic exercise in patients with neurological diseases and disorders. Studies have shown that intensive aerobic exercise can reduce the motor symptoms of Parkinson's disease in new drug-naive patients [16]. However, for people with P.D., prolonged adherence to an exercise program is a challenge, and providing supervision may make exercise easier to perform. Vander Kolk et al. designed an aerobic exercise that could contain play elements at home under remote supervision by a professional coach to assess the effects of home-based high-intensity aerobic exercise on motor signs of P.D. We found that a multifaceted aerobic exercise program at home reduced the exercise score of Parkinson's disease rating scale compared with traditional exercise, further confirming the benefit of aerobic exercise on Parkinson's disease symptoms while demonstrating the feasibility of remote exercise for Parkinson's intervention [17].

Furthermore, a case report detailing the remote exercise program for patients with Parkinson's disease showed positive clinical health-related outcomes, including functional activity [18]. Quinn et al. used a remote tool for up to 1 year of remote home exercise intervention, including 1:1 guidance, goal setting, physical activity monitoring, and a disease-specific workbook to support a safe exercise intervention. Results showed improved physical activity rates over one year in P.D. patients with behavior change and individualized exercise intervention via mobile devices and 100% compliance to remote exercise therapy, compared to patients without the technology. Due to the uncertainty posed by the current epidemic situation, this study demonstrates a remote exercise intervention as a sustainable platform for physical activity guidance programs for patients with Parkinson's disease and those with other neurodegenerative diseases [19]. Overall, the impact of a remote exercise intervention on Parkinson's is positive. This way, in the future, it may become a big trend. But for, many patients with Parkinson's disease need expert guidance to overcome obstacles, set realistic goals, and provide personalized advice for their culture and mother tongue. To optimize exercise absorption and persistence, this scheme's widespread promotion is a major problem to be solved.

4. Effect of a remote exercise intervention on heart failure

Heart failure (H.F.) is a complex clinical syndrome that has become a public health concern worldwide. It was demonstrated that patients with H.F. can benefit from proper exercise [20]; however, only a few H.F. patients regularly participate in exercise rehabilitation, mainly due to poor patient compliance. Furthermore, unmonitored improper exercise may lead to adverse cardiovascular events such as myocardial infarction, arrhythmia, and sudden death. Cardiac telerehabilitation using monitoring devices to communicate with patients is now increasingly used in hospitals' long-term management of the cardiovascular disease [21]. Li et al. Through family-based cardiac exercise rehabilitation combined with remote electrocardiogram monitoring the Effectiveness of patients with chronic heart failure, the

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intervention will improve the patient's physical activity level and quality of life. The effect is better than no monitoring routine exercise rehabilitation, helping to improve patient compliance and reduce the risk [22]. In an experiment on whether a tablet-based safety application affected self-care activities in heart failure, Lloyd et al. found that exercise guidance by using exercise videos from the computer app enhanced their motivation and ability to exercise and increased their adherence to self-care practice [23]. Effective exercise prescription implementation and ensuring exercise safety are the main problems in home cardiac exercise rehabilitation. The feasibility of a remote accelerometer application in chronic heart failure patients with precision within 99% was demonstrated early in 2013 by Jehn et al. [24]. Worringham et al. have also developed a walking-based cardiac rehabilitation system that programs smartphones to transfer patients' heart rate, GPS-based speed, and location to a secure server for real-time monitoring and guidance by qualified exercise scientists. This experiment greatly reduces the risk of exercise and has high compliance [6]. The impact of Internet-based remote exercise monitoring in patients with chronic heart failure is feasible and acceptable in the current study and can address the above problems. Although telemonitoring offers great potential in a greater scope to support the self-management of patients with chronic conditions such as heart failure, further research is needed to refine these evolving strategies to achieve effective care outcomes.

5. Limitations of the remote exercise intervention

Limited evidence indicates a high experimental acceptance rate of remote exercise intervention, showing optimal feasibility. However, its therapeutic value and overall safety still need to be determined through appropriately designed trials. We found that most experiments had a shorter period [14,17]. The recruited study subjects were not regionally or ethnically representative [19], .and some of the study indicators, in the form of self-report, may be affected by recall bias [8], .so further studies are still needed to confirm these preliminary findings. And in the early stages of the trial, the remote monitoring system had relatively frequent technical problems, which may cause some participants to quit the trial. For older patients, using remote monitoring technology is an inevitable problem [3]. We recommend engaging patient stakeholders early in the design phase of a technology program and listening to the technology end users to better understand how to create attractive and effective exercise interventions and programs.

6. Summary and Outlook

The potential benefits of tele-exercise therapy for patients, healthcare providers and the healthcare system are enormous and far-reaching. Advances in A.I., coupled with the central role of Internet technology in everyday life, have expanded the application of remote exercise interventions in healthcare. Compared to face-to-face rehabilitation approaches, remote exercise interventions may increase accessibility to medical rehabilitation services, addressing major barriers that may negatively affect patient engagement (including costs, mobility restrictions, or service availability in remote rural areas) to enable patients to conduct self-management interventions. The emergence of remote exercise intervention has brought new opportunities and challenges. How to seize this opportunity to build a safer and more effective remote exercise rehabilitation mode for more patients with different diseases needs to be discussed together.

The future hopes to build a large platform in the context of the Internet and artificial intelligence to support patients in managing complex chronic diseases. And tailoring personal care to the needs of different patients by tracking and analyzing key dimensions of health. It will be synchronized with other data sources (e. g., activity tracker, sleep tracker, tremor) to encourage patients to complete regular, brief assessments of non-motor symptoms (e. g., anxiety, mood, cognition) and exercise status (e. g., intensity, heart rate, gait, balance), and to combine these assessments with data on medication time. Relevant data will be shared and analyzed for expert guidance (e. g., goal setting, exercise planning, reminders, rewards) and personalized remote interventions to address the rehabilitation needs of different people at different times and locations.

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