

Research progress on the application of telemedicine in patients with insomnia

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Abstract: Telemedicine intervention for patients with insomnia can improve the quality of sleep, enhance the patients' awareness of the disease, reduce the economic burden, shorten the medical treatment time, and provide faster and more efficient treatment. This article introduces the related content of telemedicine, analyzes the application forms and existing problems of telemedicine in the field of insomnia, and reviews the progress of telemedicine for insomnia.

Keywords: Telemedicine; Insomnia; Mobile health

1. Introduction

Insomnia is a sleep disorder characterized by frequent and persistent difficulty falling asleep or staying asleep, leading to dissatisfaction with sleep quality. Insomnia can exist in isolation or be accompanied by mental disorders, physical diseases, or substance abuse^[1]. Studies have shown that the prevalence of insomnia in China is as high as 45.2%^[2]. Insomnia is the most common sleep disorder. The rapid development of society puts increasing pressure on people, resulting in the incidence of insomnia increasing year by year. Long-term insomnia can seriously affect the quality of life, weaken the patient's immune system, and subsequently lead to other health problems. Residents in remote areas often do not seek medical treatment, owing to economic factors, long distances, and the relative scarcity of medical resources. Therefore, telemedicine services are needed to enable doctors to provide patients with remote medical treatment as well as remote disease health knowledge explanation and prevention. With the rapid development of the Internet, the application of telemedicine in the treatment of insomnia is expanding. The emergence of telemedicine can not only help patients with insomnia receive timely and effective diagnosis and treatment, but also solve the difficulties caused by the limitation of time and space. This article reviews the application of telemedicine in patients with insomnia, in order to provide reference for clinical work.

2. Overview

In today's society, the emergence of communication technology tools and the Internet have accelerated the application and development of telemedicine. Telemedicine, in a broad sense, refers to medical diagnosis and treatment provided at a distance. In the narrow sense, it refers to the provision of health care services by all health care professionals, where distance is a key factor. This involves the effective exchange of information using information and communication technology for the diagnosis, treatment, and prevention of diseases and injuries, research and evaluation, as well as the continuing education of health care providers. All of these aim to promote the health of individuals and communities^[3]. The American Telemedicine Association has enumerated four key models of telemedicine services: synchronous and asynchronous telemedicine contact with patients, remote patient monitoring, and mobile health smartphone applications^[4]. Telemedicine is not a replacement for traditional medical treatment, but a combination of the two, so that medical staff can timely and accurately understand the patient's condition and give professional guidance, optimize the medical service system to facilitate patients.

3. Advantages of telemedicine

Telemedicine provides convenience for patients and medical staff. Patients can access long-distance medical services through mobile phones, tablets, computers and other devices. Doctors can provide medical assistance to patients through different remote platforms. Telemedicine can not only save patients' expenses, but also allow them to access high-quality and advanced medical resources. With the support of relevant policies in China, telemedicine is developing rapidly, which provides more possibilities for the construction of health services. During the COVID-19 epidemic, the Gansu Telemedicine Consultation Center immediately adopted the "remote training + remote consultation + remote imaging diagnosis" approach and addressed doubts on the online platform. This "Internet + telemedicine" model demonstrates the benefits of efficiency and convenience. Ma Huijuan^[5] analyzed the situation of telemedicine consultation during the COVID-19 epidemic. It is concluded that telemedicine can save medical resources, save patient diagnosis and treatment costs, and improve the efficiency of epidemic prevention and control in primary institutions. In the application of telemedicine in pediatric sleep, parents can not only focus on talking with the doctor about their children's problems, but also reduce children's fear of seeing doctors in white coats. The doctor can also observe the children's living environment in order to make corresponding treatment measures^[6]. The diversified forms of telemedicine can be suitable for more patients with insomnia and solve the problem of the imbalance in medical resources between urban and rural areas^[7]. It has the potential to enhance communication between doctors and patients, preventing medical disputes and elevating the overall medical service level of primary hospitals. Primary community hospitals can establish an effective cooperative relationship with general hospitals through telemedicine, so as to promote patient referral services^[8].

4. Application forms of telemedicine in patients with insomnia

4.1 Telemedicine

Cognitive behavioral therapy for insomnia (CBT-I) is considered the first-line treatment for insomnia and has been proven to be more effective and long-lasting than pharmacotherapy^[9]. Due to the continuous expansion of telemedicine technology, telemedicine for insomnia can also utilize both synchronous and asynchronous modes. Cognitive therapy for insomnia includes five aspects: sleep restriction, stimulus control, cognitive therapy, relaxation therapy and sleep hygiene^[10]. Synchronous remote treatment of insomnia refers to the direct communication between patients with insomnia in different geographical locations and CBT-I instructors using dual-line communication tools to understand their condition, so as to make a diagnosis and treatment plan. Asynchronous remote treatment of insomnia means that insomnia patients upload their sleep status to the application, and CBT-I instructors regularly address patients' concerns on the app and propose professional treatment methods^[11]. Peter^[12] et al used CBT-I methods of face-to-face and online intervention to analyze patients with sleep disorders caused by shift work and concluded that online CBT-I intervention for shift workers could improve sleep efficiency, happiness and insomnia symptoms of shift workers. Arizmendi^[13] et al studied the acceptability and feasibility of remote home CBT-I intervention on the basis of primary care for veterans. The study included 27 people and randomly divided them into two groups. The 15 people in the intervention group were given intervention materials and related handouts to each veteran through secure messages or encrypted channels before each training. A sleep diary was completed after the training, which was subsequently reviewed by the training team and sleep habits were adjusted. A control group of 12 people received face-to-face CBT-I intervention, and the results showed that the effect size of both telehealth CBT-I intervention and face-to-face CBT-I intervention are equally high, indicating that continued use of telehealth CBT-I intervention was appropriate. Telemedicine systems are gradually facilitating the treatment of insomnia.

4.2 Remote monitoring

Remote patient monitoring (RPM) refers to the remote collection of physiological data using digital devices for the interpretation and management of patients under a specific treatment plan. Remote sleep monitoring is the use of digital devices to record the relevant parameters during the sleep process of patients, and the management plan for the patients is derived through data analysis. Liu Sijia and others designed a remote monitoring bracelet for sleep. The bracelet is connected to mobile terminal equipment used by both patients and medical staff. By wearing the bracelet, patients can record their

heart rate, breathing rate, and motion parameters during sleep. Consequently, this data is then transferred to a terminal app where medical personnel can analyze it and make adjustments to improve sleep quality. Following the initial clinical test at West China Hospital, some patients, even after being discharged, expressed their willingness to continue using the bracelet^[14]. Bailey^[15] et al used a remote monitoring and integrated platform to assess sleep quality in adult-onset idiopathic cervical dystonia. Patients wore a consumer wrist device (Vivosmart 4, Garmin) on the non-dominant wrist for 7 consecutive days, while a daily sleep diary was completed through a professional application. The results demonstrate the feasibility of wearable devices for estimating sleep measurements on a large scale. Zhang Chan^[16] et al designed the mobile medical system of sleep therapy instrument based on the Android platform, which includes five modules: CES treatment, sleep quality assessment, personal center and doctor consultation. This system combines mobile health software with sleep therapy equipment to monitor the patient's sleep data, and then the data is uploaded to the server side. Medical staff assessed the sleep quality of patients and timely adjusted the treatment plan, achieving the communication and interaction between patients and medical staff as well as meeting the diagnosis and treatment needs of insomnia patients regarding sleep quality. The monitoring of remote devices not only allows patients to monitor their sleep index but also facilitates the regular follow-up process of medical staff.

4.3 Mobile Health smartphone applications

Due to the large-scale marketing of smartphones, the digitization of mobile health applications provides the software infrastructure for patients^[17]. People are starting to manage and understand sleep problems by using mobile phone apps. There are currently apps for relaxation and falling asleep, apps for tracking and recording sleep diaries or daily sleep logs, and apps for specific sleep problems^[18]. These programs can help patients fall asleep quickly, thus alleviating the symptoms of insomnia. Zhang Cheng^[19] et al conducted a study on the use of smartphone applications in China for digital cognitive behavioral treatment of insomnia. The study involved 82 participants who were randomly divided into two groups: the observation group received digital cognitive behavioral therapy, while the control group participated in a sleep education program. Both groups used the same interface and application for six weeks. The patients were followed up for 1, 3 and 6 months. The results of this randomized trial showed that a Chinese culturally adapted digital cognitive insomnia treatment app was able to improve insomnia severity compared to sleep education. Chung^[20] et al in Korea studied the feasibility of MIND MORE, a mobile self-help CBT-I application, for elderly patients with insomnia. Forty-one elderly patients were included in the study, and the practice procedure was carried out by the therapist with the volunteers and the relevant questionnaire was filled out before the study. The intervention lasted for 1 week, and then the sleep quality assessment questionnaire was completed. Due to one missing data point, the analysis of 40 data points shows that the developed MIND MORE app is suitable for the elderly population and can also improve the quality of sleep of patients. Mobile health smartphones make it possible for people to monitor their body's sleep index at home, but there are still some problems with the application, which still need further research.

4.4 Distance education

Distance education refers to providing disease knowledge training and psychological guidance for patients with insomnia through the Internet and mobile education platforms. The traditional approach of health education may result in incomplete and insufficient knowledge, which is not detailed enough. Zeng Changqin^[21] randomly divided 100 inpatients with insomnia into two groups. The control group received routine health education, while the WeChat group received routine health education combined with WeChat platform health education. The WeChat platform released the meal precautions for insomnia before each of the three meals every day, and also provided explanations about insomnia before bedtime. Patients completed the health education evaluation form two days before discharge, and the results showed that patients in the WeChat group were more satisfied with the guidance of health education and had a higher level of disease knowledge. Roberts^[22] et al provided face-to-face education for parents of autistic children with insomnia and online interpretation of relevant knowledge. The results, when compared to baseline measurements taken after 4 and 8 weeks of teaching, respectively, show that online learning education can improve the quality of life of parents and also improve the sleep of autistic children. The distance education platform can enhance patients' awareness of insomnia and increase their satisfaction.

5. Application effect of telemedicine in patients with insomnia

5.1 Improve the sleep quality of patients

Remote insomnia therapy can still relieve patients' insomnia. Arnedt^[23] et al included 65 cases and randomly divided them into 6 groups, which were given remote CBT-I treatment and face-to-face CBT-I treatment, respectively. Sleep diaries and daytime function measurements were filled in before and after the treatment and during the 3-month follow-up. The results showed that telemedicine cognitive therapy for insomnia was as effective as face-to-face therapy, not only improving sleep quality, but also improving other sleep and daytime symptoms related to insomnia. Mélinée Chapoutot^[24] et al conducted a randomized controlled trial evaluating the remote CBT-I component of the ACT framework in patients with chronic insomnia and hypnotics dependence. The results showed that Web-based cognitive behavioral therapy for insomnia combined with acceptance and commitment therapy may be an effective option for the treatment of chronic insomnia and hypnotic dependence. It can also improve insomnia symptoms of patients and enhance the quality of life. Lichstein^[25] et al explored remote cognitive behavioral therapy in the treatment of comorbid insomnia and depression in the elderly. By conducting telephone treatment for 5 patients who received CBT-I treatment for insomnia and depression 10 sessions, the patients were evaluated at baseline, after treatment, and at a 2-month follow-up. The results showed that telehealth treatment of insomnia and depression in the elderly was feasible and effective, and insomnia improved after treatment. The above indicate that remote insomnia cognitive therapy can reduce the sleep latency and improve the quality of sleep.

5.2 Improve the efficiency of health services

Telemedicine facilitates the form and content of medical treatment, and improves the efficiency of medical workers. A sleep remote diagnosis center and a sleep remote network have been established in Yinchuan, China. This mode is primarily achieved through the integration of primary care units with remote sleep diagnosis. Patients undergo sleep monitoring in primary care units, and the resulting data is then transmitted to the sleep center for diagnosis. This approach facilitates information management and follow-up of the patient population for medical staff, enabling patients to access high-quality resources in their vicinity and enhancing service efficiency^[26]. With the help of the Internet and mobile devices, providers can cross geographic and transportation barriers to provide home-based sleep promotion and mental health services to rural residents. Li Hongmei^[27] included 114 patients with chronic insomnia and randomly divided them into two groups. The control group was treated with conventional medication for 6 weeks, while the study group was treated with conventional medication combined with remote sleep management for 6 weeks. The results show that the effect of sleep management based on mobile Internet is better than that of the conventional group. This method can not only improve the sleep quality of patients, but also greatly reduce the workload of clinicians and improve the efficiency of medical services. Telemedicine strengthens the relationship between doctors and patients through communication devices, enabling patients to consult doctors at home and receive guidance and help from professionals. Sleep specialists in hospitals can cooperate with doctors in primary care units to provide diagnosis and treatment of sleep disorders for primary care patients, and realize the integration of urban and rural health services procedures.

5.3 Improve the satisfaction and compliance

Mobile technology devices such as remote medical platforms and smartphone-based calls can improve patient satisfaction and medication compliance. Corkum^[28] et al studied the effects of remote phone calls on children with insomnia and attention deficit/hyperactivity disorder. The intervention manual and weekly telephone support were provided to the families of 61 patients. After 6 months of follow-up, sleep problems decreased, psychosocial functioning improved, and family members expressed satisfaction with the intervention. Zhang Lihong^[29] et al conducted a remote consultation platform at Shanghai Qingpu JinZe Town Community Health Service Center. The ways of medical treatment mainly include three parts: community doctors making appointments with some hospitals with telemedicine, entering patient information through the remote collaboration platform, and community doctors accompanying patients for remote outpatient treatment. Additionally, community doctors accompany patients during remote consultation. Community doctors have a detailed and comprehensive understanding of the patients' basic condition, allowing them to clearly communicate the patients' condition during treatment. This improves treatment efficiency and patient satisfaction. Miller^[30] et al in the United States evaluated the cognition of clinical CBT-I doctors on the CBT-I

Coach application software. The study included 108 clinicians who used the software for a period of 1 year, and the opinions and feedback of clinicians were analyzed. The results showed that 50% of the clinicians used the program, of which 98% expressed willingness to continue using it. The doctors reported that the program improved the integrity of sleep diary recording and compliance with treatment tasks. Telemedicine enables patients to receive medical consultations from the comfort of their own homes and enhances overall patient satisfaction.

6. Challenges and suggestions in the application of telemedicine in patients with insomnia

In summary, telemedicine can not only solve insomnia for patients in remote areas, but also provide convenience for children with autism, elderly patients, veterans, and others who suffer from insomnia. Telemedicine can help patients improve the quality of sleep and enhance their understanding of insomnia. It can also strengthen communication between doctors and patients, preventing disputes. Patients can consult doctors at home, access nearby medical resources, further optimize the treatment process and thereby enhance the efficiency of healthcare services. Through literature review, many foreign studies have shown that remote cognitive behavioral therapy for insomnia, wearable equipment, and applications have great advantages in improving the insomnia of patients. However, there are still considerable challenges in the treatment of insomnia by telemedicine in China. Such as: (1) Lack of CBT-I professional mentor: the number of patients with insomnia is growing, the need to strengthen the training of professionals, the hospital for the treatment of insomnia experts should carry out relevant training courses, online and offline combination of training professional couple; (2) There are still limitations in the applicability of wearable devices to specific population: children will pay excessive attention to the device due to curiosity and operate the device during the monitoring period, which will affect the final test results. Therefore, the design of wearable devices should have children's mode. (3) Mobile applications need to be more practical and scientific: The usage process and precautions of each mobile software are different, and whether the program interface designed by the developer is practical for each user^[31]. Therefore, the application should be developed in collaboration with sleep experts and verified by clinical patients before its release. (4) At present, many randomized controlled studies require patients to fill out sleep scales, which is too subjective. In randomized controlled trials, instrument measurement data should be used as the final outcome index to make the study more scientific. (5) Telemedicine, which relies on the Internet, poses a risk of patients' privacy and data related to the diagnosis and treatment process being leaked, thus network information security needs to be strictly safeguarded.

7. Summary and Outlook

Telemedicine is based on the Internet. As a new type of medical service, it is used to treat insomnia in the population, including remote treatment, remote monitoring, intelligent mobile applications, and distance education. The advantages of telemedicine for insomnia patients are evident, but we still need to explore and address the problems and challenges that exist in the implementation process. This will make telemedicine a safer and more effective application in the diagnosis and treatment of patients.

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