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Research Article

Efficacy of Remote Monitoring of Overweight Patients with Connected Health Platform

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ABSTRACT

Background: Mobile technology has emerged as a potentially useful platform to facilitate weight management and tackle the current obesity epidemic.

Objective: To evaluate the efficacy of a remote monitoring platform for overweight patients.

Methods: Multicenter prospective observational study of overweight patients seen in an endocrinology clinic of 5 healthcare centers, between August 2017 and August 2020, who were followed with the Connected Health telemonitoring platform. The mobile phone application connected to a scale and activity wristband, allowed to measure weight, activity, answer health questionnaire and its management by the medical team that could be contacted by video consultation.

Results: 79 patients (57% female) with a mean age of 46,8 (SD 23-70) years were included with a mean follow-up of 12.9 months (SD 4-36). The application allowed to measure weight, activity and quality of life and no patient presented complications. The mean weight of all patients at the beginning of the intervention was 84.1 kg and at the end of the follow-up it was 82.4 kg, with a mean reduction of 1.7 kg ($p<0.05$). The average state of health of all patients at baseline was 62 (SD 34-100) and at the end of the follow-up was 66 (SD 38-100) ($p<0.05$).

Conclusion: Telemonitoring allows a safe remote monitoring of overweight patients. The Connected Health application allowed the measurement of weight, activity and quality of life, and was associated with significant changes in body weight.

Introduction

The emergence of digital health is an increasingly evident reality, with innovative patient-centered care models, promoting accessibility, safety and efficiency in all areas of health, thanks to disruptive technologies such as telemedicine, mobile health, applications, artificial intelligence, sensors and other devices. These new digital technologies allow building a different relationship with the patient, focused on their needs, agile and continuous 24 hours a day, where the user enjoys much more information, participation and autonomy [1].

Mobile devices and applications create the digital channel, where healthcare can be delivered anywhere. The networking of physical devices over the internet allows patients to use connected sensors that measure all kinds of physiological variables, adherence to medication and their perceived state of health, making it easier for doctors to remotely monitor the health of a patient in real time. This has led to the creation of connected health platforms, which allow telemonitoring of patients with wearables linked to mobile applications. The data is managed in the cloud by software that allows alerting healthcare team of a clinical deterioration and thus acting early. There is sufficient evidence that telemedicine reduces healthcare costs, improves the health of the population and the customer experience [2].

Real world data is data related to the patient's health status collected in real time, thanks to smartphones and the Internet of Things. The

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integration of the electronic medical records and biometric data allow creating the digital phenotype of the patient. There is a need for this real data documentation and communication between patients and the medical team. Patients provide information that is complementary but different from that collected by the doctor, since they tend to underestimate the symptoms of the patients. Numerous trials have shown that outpatient symptom monitoring improves communication between the patient and the medical team, quality of life, symptom management and survival, and in turn the satisfaction of the medical team and the support to clinical decision [3, 4].

Over the last decade, mobile technology has emerged as a potentially useful platform to facilitate weight management and tackle the current obesity epidemic. Clinicians are being more frequently asked to give advice about the usefulness of mobile apps and many individuals have already integrated apps into their attempts to manage weight. A number of newly published studies have demonstrated promising results of mobile-based interventions for weight management across different populations, but the extent of their effectiveness remains widely debated. Overall, evidence suggests that mobile applications may be useful as low-intensity approaches or adjuncts to conventional weight management strategies. However, there is insufficient evidence to support their use as stand-alone intensive approaches to weight management. Further research is needed to clarify the extent of utility of these applications, as well as the measures required to maximize their potential both as stand-alone approaches and adjuncts to more intensive programs [5].

In the present study, we evaluated the efficacy of outpatient remote monitoring for overweight patients, by measuring weight, activity and quality of life, and its management by the medical team, through video consultation.

Methods

Multicenter prospective observational study of overweight patients seen in an endocrinology clinic of 5 healthcare centers (Figure 1), between August 2017 and August 2020. 79 patients were offered a clinical follow-up through the Connected Health telemonitoring platform. To do this, they had to be stable, and agree to participate giving their informed consent. They received at their home a scale (Lifevit BL- 2000) and an activity wristband (Beurer AS97) with Bluetooth connectivity that allowed the connection to the Connected Health application that the patient himself downloaded on his mobile phone. The use of the Connected Health application and data registration was approved by the Center's Research Ethics Committee.

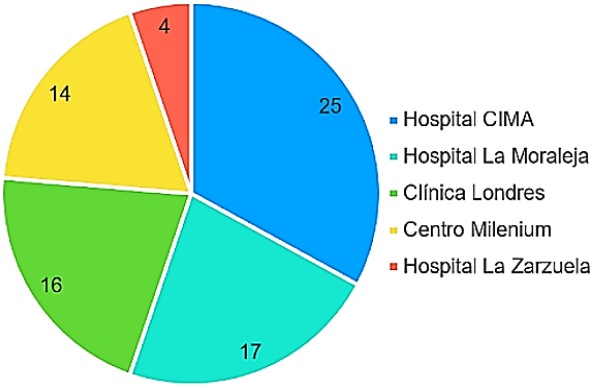

Figure 1: Recruitment of patients by medical centers of Sanitas Hospitals.

Connected Health is a platform for remote monitoring, continuously, anytime, anywhere, connected to the medical team. It allows to measure and see the evolution of vital signs with devices connected to the application and to answer health questionnaires adapted for different disease profiles. The doctor responsible for the patient activates the service directly from the electronic medical record. The intelligent system analyses these measurements and the answers to the questionnaires and allows the detection of anomalies in the measurements. The nursing team periodically reviews the information received and proactively contacts the patients by video consultation, prioritizing according to the information received, and in the event of incidents if they cannot resolve it, a doctor assesses the situation. The application also allows the patient to contact the nursing team by video consultation 24/7. It includes other functionalities, such as treatment reminders, information of interest about the disease, and keeping family members or caregivers informed (Figure 2), which have proven useful in controlling other diseases such as high blood pressure [6].

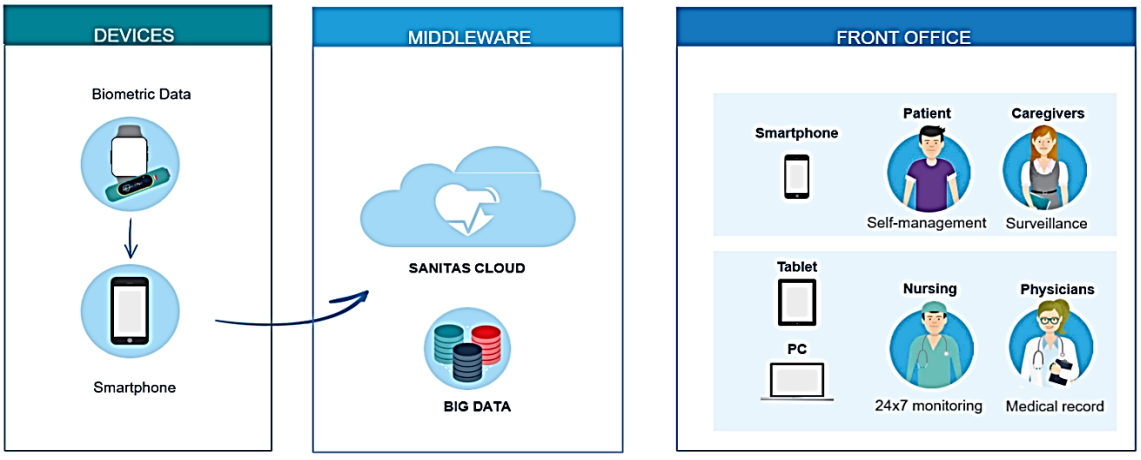

Figure 2: Features of Connected Health telemonitoring platform.

For the follow-up of overweight patients, a profile was created, collecting the weight and activity measurements (steps performed, calories burned and heart rate) with a scale and wristband (Figure 3). The application also allowed asking a daily generic self-completed EQ5D3L

quality of life questionnaire [7], that measures a general health score on a scale of 0 (the worst health condition imaginable) to 100 (the best one). For the analysis of the data, usual descriptive statistical techniques have been used. Comparison between weight and quality of life measures, initially and after the follow-up, was done with Student's t test for independent data. All analyses were performed using the statistical significance level considered for calculation of the sample size (α=.05) with SPSS for Windows (version 12.0).

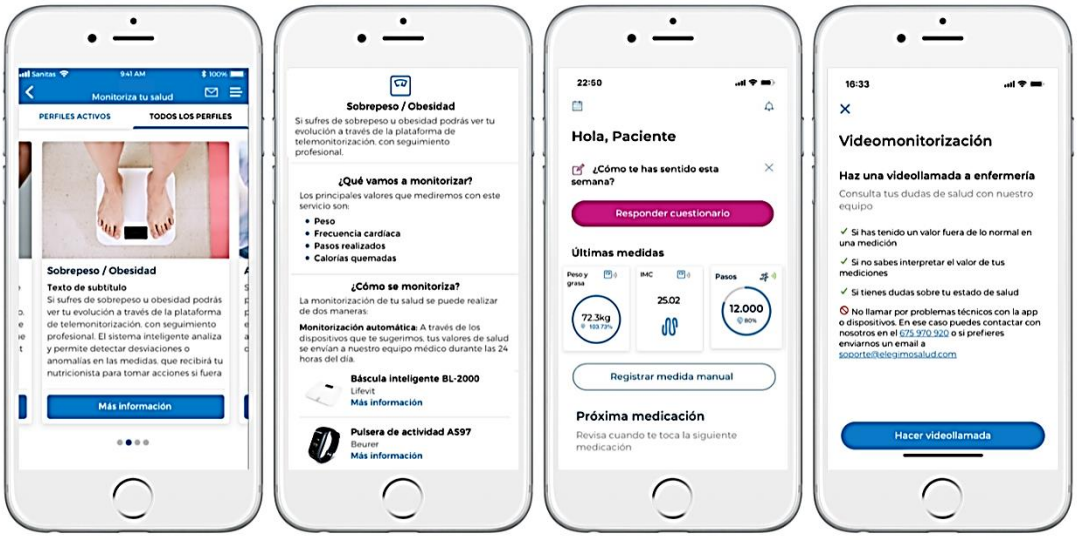

Figure 3: Connected Health application: screenshots.

Results

Of the 79 patients included in the study, 34 (43%) were men and 45 (57%) women, with a mean age of 46,8 years (SD 23-70) and with a mean follow-up of 12.9 months (SD 4-36). The application allowed to measure weight, activity and quality of life. The mean weight of all patients at the beginning of the intervention was 84.1 kg and at the end of the follow-up was 82.4 kg, with a mean reduction of 1.7 kg ($p<0.05$). The average state of health of all patients at baseline was 62 (SD 34-100) and at the end of the follow-up was 66 (SD 38-100) ($p<0.05$). No patient presented serious complications, nor did they need to go to the emergency department or hospital readmission.

Discussion

This study demonstrates the efficacy of the Connected Health platform for the remote monitoring of overweight patients. The application facilitated the measurement of weight, activity and quality of life, and was associated with significant changes in body weight.

The use of mobile, wireless technologies and wearable devices for improving health care processes is promising for health promotion among patients with chronic diseases such as obesity, but there is discrepancy on which is the best type and duration of the intervention. Our results agree with those published in a meta-analysis that examined published mHealth intervention studies for obesity treatment, categorized into 3 types: mobile phone text messaging, wearable or portable monitoring devices, and applications running on smartphones, concluding their effectiveness to weight loss (an average loss of 1.97 kg) with all modalities [8]. Other studies showed varied results in the efficacy of mHealth interventions, but all reviews concluded that mHealth was a feasible option and had the potential for weight reduction (-1.0 kg to -2.4 kg body weight) when compared with standard care [9].

As frequent face-to-face care might impose a limitation for accessible programs, Senecal *et al.* demonstrated that a weight loss program based on a mobile application, wireless scale, and nutritional program but no face-to-face care, can achieve clinically significant short- and midterm weight loss [10]. Weighing everyday matters. Another intervention focused on daily weighing for weight loss using an e-scale that transmitted weights to a study website, along with weekly e-mailed lessons and tailored feedback on daily weighing adherence and weight loss progress, showed that weighing every day led to greater adoption of weight control behaviours and produced greater weight loss compared with weighing most days of the week [11]. The higher the weight, the more effective the telemonitoring. A study with 8275 individuals with a baseline BMI ≥35 kg/m^2 who used a remote weight-loss program combining mobile applications, frequent self-weighing, and calorie restriction, resulted in weight loss (8.1 kg at 42 days and 14kg at 120 days) and a decrease in body-fat percent equally among men and women who were active users [12].

The use of mobile app interventions to promote not just weight loss but also to boost physical activity is fascinating, but evidence regarding the impact of only a mobile phone app on weight loss and increase in physical activity is scarce. A meta-analysis comparing the use of a mobile phone app with a control group, was associated with significant changes in body weight (-1.07 kg) and body mass index (-0.45 kg/m2) and increase in physical activity [13]. Another systematic review yielded a higher adherence to behavioural weight management interventions using lifestyle mHealth self-monitoring, greater than other interventions. Subgroup analyses showed that smartphones were the most effective mHealth approach to achieve weight management [14].

The health-related quality of life is the way in which the patient perceives her illness and is of utmost importance to know the state of health of an individual [15]. There are few studies that analyse the quality of life in patients with overweight under remote monitoring, and it is difficult to compare them due to the use of different health tests. We have used

generic instruments (instead of disease-specific) because they are repeatable and sensitive to change, and besides they detect the global effects on quality of life and are applicable to different populations with different diseases.

Song *et al*. using EQ-5D-3L questionnaire showed that there are gender differences in the impact of obesity on health-related quality of life. Women who were severely obese had 31% significantly lower health-related quality of life than women with normal weight, however, the same trend was not found in men [16]. Other studies showed how overweight affects people's health and quality of life. Obesity is significantly negatively associated with quality of life, with an increase of 1 BMI unit is associated with decreases in physical function and self-esteem and increases the prevalence of anxiety (70.3%) and depression (66.2%) [17]. These results have clinical implications, so there is a need for the incorporation of strategies to improve mental well-being into multi-disciplinary weight management interventions. Few studies evaluate the impact of remote technologies on psychological well-being and quality of life of obesity patients. Our results are similar to those published by Pogosova *et al.*, who showed that a long-term (1 year) remote support targeting obese patients resulted in a better quality of life, with an improvement of measures of global health score, psychological status, a decline of anxiety, stress and depression symptomatology, compared with the standard follow-up [18].

This study should be interpreted with caution due to certain limitations. The study was conducted in different hospitals but without a control group, so it should be confirmed in larger samples and with control groups, which help define the role of telemedicine in overweight patients. These results cannot be extrapolated to the monitoring of other diseases. To enhance the effectiveness of mHealth interventions, future studies are warranted with larger study samples, longer intervention and follow-up periods (≥ 12 months), for the optimal formats, the frequency of contacting patients, better tailoring of messages, and enhancing usability, which places a greater emphasis on maintaining effectiveness over time.

Conclusion

This study has shown how the Connected Health platform allows a safe remote monitoring of overweight patients, facilitating the measurement of weight, activity and quality of life, and its management by the medical team through video consultation. Although new clinical trials are needed to demonstrate the effectiveness of these digital health tools in obesity and other diseases in the long-term, the satisfactory experience in this and other studies will certainly create good expectations about the convenience and accessibility of virtual care.

Conflicts of Interest

None.

Funding

None.

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