Research Article

Impact of Telemedicine on Post-Bariatric Surgery Outcomes and Patient Satisfaction During the COVID-19 Pandemic: A Retrospective Observational Study

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Introduction: The COVID-19 pandemic presented unique challenges for patients and healthcare providers, especially for those working with obesity and related health problems. E-health has emerged as a crucial tool for the follow-up of users undergoing bariatric surgery during this period, allowing remote monitoring of users' health status and providing access to virtual consultation with health professionals. This study aims to analyze the impact of the use of telemedicine during the COVID-19 pandemic on the results of bariatric surgery, surgical safety outcomes and user satisfaction with this follow-up.

Method: this is an observational study with retrospective data collection. The variables were divided into several groups: health data and associated comorbidities, surgical safety and satisfaction with telemedicine monitoring.

Results: Surgery significantly affected weight loss, in general there is a 75% loss of excess weight. Comorbidities were reversed over time, with 50% of subjects maintaining excellent levels. Most users were satisfied with the monitoring and surgical outcomes are not significant.

Conclusions: The follow-up assured by telemedicine did not modify the results of bariatric surgery, which may allow us to infer that it may be an option to consider for regular monitoring of the post-bariatric surgery process.

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1. Introduction

Obesity is a public health problem and a chronic disease that stems from a variety of factors and requires sustained efforts to control. It is a severe threat to health and a significant risk factor for developing and worsening other diseases[1]. On average, it is responsible for around 3.5 million deaths a year. It is a chronic disease, but also a risk factor for numerous other conditions[2].

Rising levels of obesity are a significant challenge for public health and obesity is considered a disease for priority intervention. Given its high prevalence worldwide, the WHO considers it the global epidemic of the 21st century since its growth is occurring equally in developed and developing countries. Globally, WHO statistics show that more than 39% of adults aged 18 and over were overweight in 2016, with more than 13% of individuals suffering from obesity[3].

Obesity can be treated in various ways, whether with behavioral, pharmacological, or surgical therapy. Bariatric surgery is considered a safe and effective long-term procedure for treating obesity and its comorbidities. Increasingly, this type of surgical intervention is the treatment of choice for people with severe obesity, with or without other associated pathologies[4].

There are no bariatric surgery guidelines regarding postoperative follow-up using e-health technologies[5]. Follow-up, however, is very important because, after bariatric surgery, there remains a lifelong threat of weight regaining, and behavioral influences are believed to play a modulating role[2][6].

Surgical outcomes are positive steps forwards in the progression of healthcare system and they include information about mortality and morbidity, recovery time, re-admissions, re-operations and other complications[7].

According to the WHO, e-health is the use of information and communication technologies in the health sector in a safe and economically viable way to support health[8]. It has been implemented and developed worldwide based on information and communication technologies in health. It should be noted that this is an active part of the WHO's agenda on a global scale, with a view to universalization and uniformity between different countries[9].

In its various forms, E-health makes it possible to boost patient involvement and patient-centered care (PCC). This type of care is recognized as a desirable attribute of health care. It is seen as an approach that considers users' preferences, needs and values, taking a biopsychosocial perspective

based on a solid commitment between the patient and the health professional[9][10]. Studies report that, with the implementation of PCC strategies, there have been improvements in clinical outcomes and patient satisfaction, as well as reduced healthcare costs and resource utilization[11][12]. However, even with a growing recognition of the value of its potential, it has been reported that there needs to be more guidance available on the use of these strategies for the management of bariatric surgery. The impact of e-health on adherence to treatment and follow-up in bariatric surgery remains poorly documented[13].

Among the various levels of operation of health systems, e-health has been responding, from the organizational restructuring of services to users' access to care, proving to be an essential element in combating the sustainability problems that often exist in public/private health systems[14].

In Portugal, implementing e-health has been a fundamental strategy for restructuring the health system. It has also been recommended as an economic-political instrument under the Economic and Financial Assistance Program agreed between the Portuguese Government and the European Union[15] [16]. The fast development of information and communication technologies constitutes an excellent opportunity to reduce costs in the different health sectors and improve efficiency[16].

Recently, with the COVID-19 pandemic, the importance of telemedicine as an e-health tool has been increased[16]. Telemedicine allows many users to attend routine and follow-up appointments from the comfort of their own homes. In this way, it is possible to share useful clinical information to diagnose, prevent and treat health-related problems.

The support of the team of professionals involved in the bariatric surgery process during the pre-and postoperative phases, significantly affects patients' weight loss results. In addition, there is evidence of improvements in various parameters associated with quality of life and mental health. The team of professionals, a surgeon, nurse, nutritionist and psychologist, educates and supports patients in making lifestyle changes for long-term maintenance and self-management[14].

Telemedicine and e-health technologies have the potential to enhance the monitoring of bariatric surgery patients, with good results in terms of patient satisfaction, while maintaining a personalized and individualized approach to each patient, promoting the centrality of care. This study aimed to analyze the impact of the use of telemedicine during the COVID-19 pandemic on the results of bariatric surgery safety and users' satisfaction with this follow-up.

2. Materials and Methods

2.1. Study design

This observational, cross-sectional, quantitative study was collected, analyzed, and evaluated by observing data throughout the postoperative period. This data was then supplemented by data collected afterwards, making this a cross-sectional observational study.

2.2. Characterization of the sample

In the database of a Bariatric Center, 108 patients underwent bariatric surgery and made up our population. As inclusion criteria for the sample, participants had to have undergone bariatric surgery in 2020, with follow-up via telemedicine or other e-health technologies and agree to participate in the study. By applying these criteria, we were left with a sample of 80 patients, considered a convenience sample.

Participation was voluntary, and those interested in participating in the study were asked to give their free, informed consent (Appendix A), after which a questionnaire was administered during the telephone interview. Clinical analytical data was consulted to complete the database.

2.3. Instruments

The data collection instrument included three sections. Section 1 collected sociodemographic, health and weight information. Section 2 assessed comorbidities and surgical outcomes. In section 3, we used the questionnaire on user satisfaction with the telephone consultation.

Surgical outcomes included readmissions, complications, re-operations, and mortality, based on the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP)[16] For evaluated satisfaction with telemedicine, an eight-dimensional questionnaire used in validated studies through 16 questions with a Likert scale, was built and validated in Portugal[17].

2.4. Tasks, procedures, and protocols

Individuals who underwent surgery in 2020 at the Hospital do Espírito Santo de Évora, EPE, were approached to assess their willingness to answer the questionnaire. Informed consent was obtained from all participants (Appendix A), guaranteeing the confidentiality of the data. Health and clinical

data, and surgical outcomes were consulted through each patient's electronic medical record. The rest of the data was collected by telephone interview and entered into a form created to minimize data entry errors.

2.5. Variables

The qualitative and quantitative variables to be considered in this study are as follows:

- Clinical Data: Gender, age, weight, body mass index and relevant comorbidities associated with obesity (diabetes, hypertension, dyslipidemia and OSAS);
- Questionnaires: Satisfaction with telemedicine
- Other variables: Surgical quality outcomes

2.6. Statistical treatment

After defining the hypotheses, the analysis was done using IBM® SPSS® Statistic software, version 28. The sociodemographic characterization of the sample was based on gender and age.

The statistical tests were adapted to each type of variable and relationship to be studied and to the results of the normality tests carried out. Normality tests determine whether a normal distribution guides a set of data for a given random variable. Normality was analyzed using the Shapiro-Wilk test, and based on this result, the most appropriate statistical tests were selected. The internal consistency of the questionnaire dimensions was measured using Cronbach's alpha.

The data collected was productive and various analyses of association and correlation between variables were carried out. The types of tests used for the various hypotheses were based on the results of the normality tests, namely the Chi-square, T-student and ANOVA tests.

2.7. Ethical considerations

This research was carried out after authorization from the ethics committee, to which a request was addressed and authorized by the hospital's Board of Directors - CES Opinion no. 010/23 (Appendix A).

Users were invited to participate when contacted by telephone. Those who agreed to participate in the study were subsequently read and given the informed consent form (Appendix A).

About the data collection instruments, the authors have yet to be asked for permission to use them, given their scientific evidence and the fact that they have been published. We consider that the use of

these questionnaires is for personal, academic and non-commercial purposes, thus being considered free use whenever the author is mentioned ("Code of Copyright and Related Rights" (CDADC), established by Decree-Law no. 63/85, of March 14).

3. Results

The final sample used for this study included 80 participants who underwent surgery in 2020 using the Gastric Bypass (RYGP) surgical technique. Mostly women were in this sample (n=68; 85%). The mean age (±SD) was 42.7 years (±9.91), and the %EWL (Excess Weight Lost) was higher in women at 83.6% (±22.6) than in men (Table 1).

	Female	***Male***	***Total***
Sex	68 (85%)	12 (15%)	80 (100%)
Age	42,3±9,86	45±10,3	42,7±9,91
%EWL	83,6±22,6	74,2±14	82,2±21,7

Table 1. Characteristics of participants

EWL*: Excess weight loss*

Assessments were made of the total weight lost and the percentage of excess weight loss (table 2). The mean percentage of weight loss was 33.3% and the average percentage of excess weight lost was 82.2%.

Total subjects	*n=80*
Gender (Female %)	85%
Age (years)	42,7 (±9,91)
Initial weight (kg)	114 (±15,4)
Initial BMI (kg/m^2)	42,8 (±4,37)
TWL (%)	33,3 (±9,25)
EWL (%)	82,2 (±21,7)
Dyslipidemia (initial prevalence)	82,5%
Diabetes (initial prevalence)	78,8%
Hypertension (initial prevalence)	83,8%
OSAS (initial prevalence)	17,5%

Table 2. General characterization of the sample

***TWL**: Total weight loss*; ***EWL**: Excess weight loss*

An evolutionary analysis was made of weight and associated comorbidities, particularly metabolic conditions. This evolution comprises two assessments: Baseline (before surgery) and three years after surgery and after the COVID-19 pandemic. We mostly see a downward trend, with lower values 3 years after surgery, with statistically significant values ($p < 0.001$) (table 3). When we specifically evaluate each metabolic risk factor, we have an initial assessment of 67 patients with hypertension, which fell to 4 after three years of surgery. With diabetes, we had 63 patients at Baseline, which reduced to 9 after three years. With dyslipidemia, we initially had 66 users taking medication to control the disease, decreasing to 5 in the third year, as with OSAS, which decreased from 14 to 2 users.

Patient's surgical safety outcomes and showed no complications at 30-days post-surgery. Three years after surgery there was one readmissions, two visits to the emergency department, and no re-operations or mortality.

Variables	*Baseline*	*3 years*	*Sig.*
***Weight** (Kg)*	114±15,4	75,6±13,4	*p*=< 0,001 *
***BMI** (Kg/m²)*	42,8±4,37	28,4±4,28	*p*=< 0,001 *
***Dyslipidemia** (%)*	82,5%	6,3%	*p*=< 0,001 +
***Diabetes** (%)*	78,8%	11,3%	*p*=< 0,001 +
***HTA** (%)*	83,8%	5%	*p*=< 0,001 +
***OSAS** (%)*	17,5%	2,5%	*p*=< 0,001 +

Table 3. Characterization of weight and metabolic risk factors

*Note: *Statistically significant variation obtained by the Student's t-test; +Statistically significant variation obtained by the McNemar test.*

***HTA**: Hypertension; **OSAS**: Obstructive Sleep Apnea Syndrome; **BMI:** Body Mass Index*

Levels of satisfaction with telemedicine were measured, with 71.3% of users being satisfied with the follow-up after surgery that included this e-health technology (Table 1).

	Satisfied	*Not Satisfied*
Level of Satisfaction	71,3%	28.7%

Table 4. Level of satisfaction with telemedicine

4. Discussion

The study aimed to analyze the impact of the use of telemedicine during the COVID-19 pandemic on the results of bariatric surgery, surgical outcomes and users' satisfaction with this follow-up.

We wanted to evaluate if the process of managing the treatment of obesity via telemedicine in the postoperative period had a negative or positive impact on weight control and comorbidities associated with obesity, as well as safety and patient's satisfaction.

Bariatric surgery is a weight loss procedure that allows people with severe obesity to achieve significant and sustained weight loss. However, bariatric surgery patients need ongoing care and support to optimize results, maintain a healthy weight and avoid complications[18]. eHealth, the use of electronic technologies to manage health and well-being, has emerged as a promising tool to facilitate the monitoring of users in various clinical areas, which may include bariatric surgery. It has the potential to provide several benefits, including greater user involvement and better access to care and improved communication between users and healthcare providers[16].

The COVID-19 pandemic has significantly impacted many aspects of follow-up after bariatric surgery, including physical and mental health, weight control and eventually weight regain. This impact was due to increased sedentary behavior and reduced levels of physical activity, which translated into an essential need for support from the post-bariatric surgery follow-up team[19].

The pandemic has resulted in a significant shift towards telemedicine as a means of providing healthcare services, including follow-up consultations for bariatric surgery patients, with the potential for several advantages, including greater accessibility, convenience and reduced healthcare costs, as showed in more recent studies[20][21]. However, it needs to be clarified how bariatric surgery patients understand telemedicine as a follow-up modality and whether it adequately meets their needs. This difficulty may explain the percentage who was not satisfied with the follow-up, in this study.

Growing evidence suggests that bariatric patients are generally satisfied with the follow-up care provided through telemedicine. Telemedicine allows healthcare providers to monitor users remotely and provide timely interventions, improving outcomes and overall patient satisfaction[16]. We validated in our study that users are generally satisfied with telemedicine follow-up.

Another study showed that patients undergoing bariatric surgery who received telemedicine monitoring reported high satisfaction with their care[22]. In addition, it also concluded that user who received telemedicine follow-up had better weight loss results than those who receive face-to-face follow-up. In our study, we also found that the quantitative results relating to bariatric surgery, namely the loss of excess weight, are in line with the literature results described on weight loss after

bariatric surgery and with data previously published in this center, so there were no differences caused by the introduction of telemedicine and the change in the way follow-up was managed.

In another study, patients undergoing bariatric surgery who received telemedicine follow-up reported similar levels of satisfaction compared to those who received face-to-face follow-up[23]. This study also found that telemedicine follow-up was associated with a lower rate of missed appointments, suggesting that it may be a more convenient and accessible option for users. This data was also validated by the sound levels of satisfaction obtained.

In general, the available evidence suggests that patients undergoing bariatric surgery are generally satisfied with the follow-up care provided through telemedicine[20][24]. It is also essential to ensure that telemedicine services are provided to maintain users' privacy and confidentiality and that users receive adequate education and support to use the technology effectively[20][25].

The evidence shows that surgery is effective, but it requires long-term follow-up to ensure that the patient maintains weight loss and general health. Traditional postoperative follow-up appointments require a lot of time and resources, which can challenge the patient and healthcare professionals. Telemedicine can provide an alternative method of follow-up in bariatric surgery, which can positively impact surgical outcomes.

Evidence also shows that the success of bariatric surgery depends mainly on the patient's ability to maintain healthy habits and behaviors in the long term. Regular follow-up appointments with healthcare professionals are crucial to monitoring progress, detecting complications, and providing ongoing support and guidance to these patients[26].

The restrictions imposed, along with limited access to the hospital during the COVID-19 pandemic, have led to an increase in the level of anxiety, worse surgical outcomes and weight regain[21]. In this study, there were no different results in terms of weight loss, which clearly shows that the fact that they were monitored by telemedicine during the COVID-19 pandemic did not affect the results.

Metabolic risk factors, when present, have significant repercussions on comorbidities, particularly diabetes, hypertension, dyslipidemia and OSAS[24]. Bariatric surgery is the most effective treatment for control of comorbidities[4][7][27]. This study only included patients who had undergone RYGP, so we attribute the favorable resolution of comorbidities to this type of surgical procedure[28]. Data shows that after three years of follow-up, most patients have their comorbidities under control.

Several studies have also shown that the improvement in comorbidities is independent of weight loss[7][27].

Obesity is a significant public health problem worldwide and can lead to numerous complications. Bariatric surgery is a widely used method for achieving significant and sustainable weight loss in individuals who cannot achieve it through conventional methods. However, the long-term success of bariatric surgery is highly dependent on adequate, patient-centered follow-up.

5. Limitations

As far as the limitations of this study are concerned, the inherent limitations of cross-sectional studies are present, namely that it is impossible to establish a cause-effect relationship. However, it is an important starting point for future research.

It is essential to highlight the difficulties inherent in telephone contacts.

On the other hand, other motivational variables could have been assessed, such as the barriers and facilitators to accessing health care and hospitals in the Alentejo region and the motivational profile during this post-surgical process. In this sense, controlling and differentiating these variables in future studies could be interesting.

6. Conclusions

Bariatric surgery is a form of weight loss treatment for those with severe obesity. However, follow-up care is crucial to ensure the success and safety of the procedure. ehealth technologies can play a significant role in post-bariatric surgery follow-up.

Telemedicine allows healthcare providers to monitor patients remotely via videoconferencing, messaging and other digital means. This technology can save time and resources for both users and caregivers, while ensuring effective follow-up.

In conclusion, eHealth technologies can be very useful for post-bariatric surgery follow-up.

Statements and Declarations

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Author Contributions

Conceptualization, C.M. and M.C.; methodology C.M. and M.C.; software, C.M. and M.C.; validation, C.M., M.C. AR and O.Z.; formal analysis, C.M. and M.C.; investigation, C.M. and M.C.; writing—original draft preparation, C.M., M.C. AR and O.Z.; writing—review and editing, O.Z and AR.; supervision, O.Z. and AR; All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Hospital do Espírito Santo de Évora (protocol code 010/23 on 31/01/2023).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest

The authors declare no conflicts of interest.

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