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E-HEALTH IN THE LONG-TERM NURSING FOLLOW-UP OF PATIENTS UNDERGOING BARIATRIC SURGERY - PREVALENCE OF METABOLIC RISK FACTORS

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Summary. To analyze the effect of bariatric surgery, physical activity and weight regain on the long-term prevalence of metabolic risk factors through telemedicine. Observational study with retrospective data collection. A total of 84 individuals who underwent gastric bypass bariatric surgery with a follow-up of more than five years participated in the study. Data collection was done by telemedicine to which data from the patients' medical records were added. An evolutionary analysis was performed regarding health data and associated comorbidities, namely metabolic risk factors (diabetes, dyslipidemia, and mean blood pressure) at baseline (before surgery), one year, and five years after surgery. We found a relative improvement in metabolic risk factors one year after surgery, which was maintained at five years after surgery with statistically significant values ($p < 0.007$). The evolution of the prevalence of metabolic risk factors after surgery is not influenced by weight gain or physical activity. All comorbidities showed a significant decrease at the 1st and 5th year, related to the surgery itself, regardless of weight gain and the practice of physical activity, which confirms the effectiveness of surgery as the most effective factor in the treatment of comorbidities. We found no relationship between metabolic syndrome and physical activity or weight gain, which shows us how effective surgery is in reducing comorbidities.

Keywords: Physical Activity, Bariatric Surgery, Weight Gain, Metabolic Risk Factors

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E-HEALTH NO ACOMPANHAMENTO DE ENFERMAGEM A LONGO PRAZO DE PACIENTES SUBMETIDOS A CIRURGIA BARIÁTRICA - PREVALÊNCIA DOS FATORES DE RISCO METABÓLICO

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Resumo. Analisar o efeito da cirurgia bariátrica, atividade física e reganho de peso na prevalência dos fatores de risco metabólico, a longo prazo, através de telemedicina. Estudo observacional com colheita de dados retrospectivos. Participaram no estudo 84 indivíduos submetidos a cirurgia bariátrica de bypass

gástrico com seguimento superior a cinco anos. A recolha de dados foi feita por telemedicina a que foram adicionados dados do processo clínico dos pacientes. Foi feita uma análise evolutiva relativamente a dados de saúde e comorbilidades associadas, nomeadamente fatores de risco metabólico (diabetes, dislipidemia e tensão arterial média) no baseline (antes da cirurgia), um ano e cinco anos após a cirurgia. Verificámos uma melhoria relativamente nos fatores de risco metabólico um ano após cirurgia, a qual se manteve aos cinco anos após a cirurgia com valores estatisticamente significativos (p <0,007). A evolução da prevalência de fatores de risco metabólico após a intervenção cirúrgica não é influenciada pelo reganho de peso nem pela atividade física. Todas as comorbilidades apresentam uma diminuição com significância ao 1º e 5º ano, relacionada com a própria cirurgia, independentemente do reganho de peso e da prática de atividade física, o que vem confirmar a eficácia da cirurgia como sendo o fator mais eficaz no tratamento das comorbilidades. Não obtivemos relação da síndrome metabólica com a atividade física nem com o reganho de peso, o que nos mostra o quanto a cirurgia é eficaz na diminuição das comorbilidades.

Palavras-chave: Atividade Física, Cirurgia Bariátrica, Reganho de Peso, Fatores de Risco Metabólico

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Introduction

Obesity is defined as a condition of the body characterized by excessive fat accumulation that poses a health risk. Characterized as a chronic disease, it is also a risk factor for numerous other diseases, subdivided into various levels depending on the body mass index (BMI) and responsible, on average, for about 3.5 million deaths per year.

The treatment of obesity can occur in several ways, with medical and surgical therapies. Thus, we have bariatric surgery, as a surgery for the treatment of obesity, being nowadays considered a safe and effective procedure in the long term, for the treatment of obesity and its comorbidities. Bariatric surgery is part of the surgical treatment of obesity (PTCO)program with certain criteria for approval, namely BMI of 50 kg/m2; BMI of 40 kg/m2 with or without comorbidities, with unsuccessful medical treatments and individuals with BMI>35kg/m2 with comorbidities and not responding to longitudinal clinical treatments [1].

Bariatric surgery started out as the treatment for severe obesity, when medical responses are not effective. There are several surgical techniques and some of them involve modifications of the gastrointestinal anatomy and physiology, which induces improvements in the metabolic syndrome, since this is a population with a high propensity for the prevalence of metabolic risk factors and other associated diseases [2].

In the long term, there remains a threat over the years to regain weight and behavioral influences are believed to play a modulating role in this weight regain. Predictors of significant postoperative weight regain after bariatric surgery include indicators of increased basal food cravings, progressively eating more than they used to, decreased well-being, quality of life, and concerns about addictive behaviors. Behaviors monitored and tracked postoperatively are strongly associated with avoiding weight regain. These data suggest that weight regain can be prevented, in part, during preoperative evaluation and potentially reduced with self-monitoring strategies after bariatric surgery [3].

A healthy lifestyle after bariatric surgery is essential to optimize and maintain weight loss. Observational studies suggest that physical activity after bariatric surgery may be associated with additional weight loss and maintenance of more effective weight loss over time. However, there is little experimental evidence on the effects of supervised exercise on obesity-related outcomes in this specific population [4].

The impact of bariatric surgery on metabolic diseases and other associated comorbidities began to emerge in the 1990s, but it was only towards the end of that decade that the remission of diseases such as diabetes could be independent of weight loss, when,

incidentally, Rubino and Gagner [5] found that just one month after bariatric surgery there was a stabilization of blood glucose in patients with Type 2 Diabetes, before any significant weight loss. On the other hand, decreased insulin resistance is related to significant weight loss and increased secretion of hormones at the gut level, with glucagon-like action [6].

The first recommendations for bariatric surgery for the treatment of Type 2 Diabetes, and in 2015 guidelines recommending bariatric surgery for the treatment of Type 2 Diabetes, appeared in 2007 in patients fitting specific criteria [5].

This type of surgery, as a treatment for obesity, can have more than one objective, such as metabolic and bariatric surgery, where the latter is intended for cases with the primary objective of losing excess weight, as advocated by several authors. However, the primary goal may be metabolic surgery, if the primary intention is to improve the metabolic syndrome, in patients with a risk factor, regardless of BMI greater or less than 35Kg/m2 [5]. Whatever the goal of the surgery, the treatment guideline will always be the chronic disease, whether it is obesity or any of the associated comorbidities, such as diabetes, hypertension, or dyslipidemia.

The aim of this study was to analyze the effect of bariatric surgery, physical activity, and weight regain on the long-term prevalence of metabolic risk factors through telemedicine.

Methodology

In this study, retrospective data collection was done, with analysis and evaluation achieved by observing data over a certain period. These data were then complemented by a retrospective collection done in the present time, so this is a retrospective observational study.

Sample

The study was approved by the Ethics Committee of the Hospital where the patients underwent surgery, and had the participation of 84 individuals who had undergone bariatric surgery more than 5 years ago, with a sample power of 90% calculated by Gpower.

Participation was voluntary and participants who showed interest in participating in the study were asked for informed, free and informed consent, and were subsequently administered a questionnaire during the telephone interview. To complete the questionnaire record, clinical analytical data from the last 5 years after surgery were consulted.

The inclusion criteria for the sample indicated that participants were over 18 years of age, had no contraindications to exercise, had no surgical complications, and agreed to participate in the study. The exclusion criteria were locomotion problems, since they would be patients with no capacity or limitations for physical activity.

Instruments

The instruments used were a health questionnaire, with evaluation of analytical parameters and anthropometric measurements, and the International Physical Activity Questionnaire (IPAQ).

Procedures

Individuals who had surgery more than 5 years ago at this hospital from January to April 2021 were approached in order to assess their willingness to answer the questionnaire. Informed consent was obtained from all participants, ensuring data confidentiality, and health and clinical data were accessed through each patient's electronic medical record. The remaining data were collected by telephone interview and placed on a specially designed form to minimize data entry errors.

Statistical Analysis

The analysis was done using statistical software and characterization of the sample based on gender, age, and weight gain.

The statistical tests were appropriate for each type of variable and relationship to be studied, as well as in the result of the normality tests performed. Normality was analyzed using the Shapiro Wilk test and from this result the most suitable statistical tests were selected. The internal consistency of the dimensions of the questionnaires was checked.

The data collected was productive and several association and correlation analyses were performed between variables. The types of tests used for the various hypotheses were based on the results of the normality tests, so the Chi-square test and the repeated measures ANOVA were used.

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Results

The characterization of the population can be seen in table 1.

Table 1 - Participants' characteristics

	Female		**Male**		**Total**	
	77 (91,7%)		7 (8,3%)		84 (100%)	
Age	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
	49,5	8,5	56,9	8,9	50,1	8,8

Physical activity was characterized in three levels, according to the description of the IPAQ questionnaire, and in the sample studied only two levels were present, sedentary and not very active. Its correlation with weight gain allows us to verify that most patients with weight gain had low levels of physical activity and through the Chi-square test, with p=0.005, it allows us to assume a statistically significant relationship, as presented in table 2.

Table 2 - Chi-square for comparison of weight gain as a function of physical activity levels

Level of Physical Activity					
Reganho Weight		*Sedentary*	*Not very active*	*Total*	*Sig*
	No	21 (54%)	18 (46%)	39	
	Yes	37 (82%)	8 (18%)	45	
	Total	58 (69%)	26 (31%)	84	*p=0,005*

An evolutionary analysis was performed regarding health data and associated comorbidities, namely metabolic risk factors. This evolution comprises three assessments, the baseline (before surgery), one year after surgery, and five years after surgery.

We have mostly lower values in the first year after surgery, but increasing at five years after surgery, with statistically significant values ($p < 0.007$), which implies that we have a positive effect regarding the surgery itself. Emphasize that the Vitamin D values are adjusted with pharmacological treatment, since the vast majority of patients had pharmacological Vitamin D support treatment during some period of the postoperative period (table 3).

Table 3 - Distribution of metabolic risk factors

Variables	*Baseline*	*1 year*	*5 years*	*Sig*
***Weight** (Kg)*	113,86±17,76	74,92±10,55	78,42±12,90	*p*=<0,001
***BMI** (Kg/m2)*	44,77±4,99	27,54±3,78	31,85±9,20	*p*=<0,001
***Cholesterol (**mg/dl)*	167,51±39,90	158,55±34,12	168,29±36,87	*p=0*,007
***Glucose (**mg/dl)*	95,93±25,70	86,26±10,17	94,13±20,31	*p*=<0,001
***TAM** (mmHg)*	96,24±13,40	86,86±8,93	86,66±10,29	*p*=<0,001
***Vit D** (ng/ml)*	19,10±6,16	18,90±7,46	21,78±6,70	*p=0*,001

Note: Statistically significant variation obtained by ANOVA test
TAM: Mean Blood Pressure
BMI: Body Mass Index

When we specifically evaluate each metabolic risk factor we have an initial assessment of 23 patients with medication controlled hypertension, which decreased to 8 after one year of surgery. At five years after surgery we have an increase to 12, of patients with disease taking medication to control their hypertension. It should be noted that after surgery there are no patients with uncontrolled hypertension.

In diabetes we have at baseline 10 patients with controlled disease with clinical measures, which decreases to 7 in the first year and to 4 in the fifth year after surgery. In dyslipidemia, we have at the first evaluation 21 patients taking medication to control the disease, which dropped to 7 at the first year, but by the fifth year rose to 9 patients needing clinical measures to control the disease.

We also evaluated the comorbidities of Obstructive Sleep Apnea Syndrome which there were 7 people with the disease controlled with clinical measures, which decreased to 2 in the first year and maintained at 5 years post surgery.

We can see in table 4 the relationship between metabolic risk factors, physical activity, and weight gain, whose p-values show no significant differences between the different levels of physical activity or weight gain as a function of time. We can only infer that there may be a biased relationship between cholesterol, mean blood pressure, and physical activity, where moderate levels of physical activity are related to lower levels of cholesterol and mean blood pressure.

Table 4 - Repeated measures ANOVA for comparison of the evolution of metabolic risk factors as a function of physical activity levels and weight gain

Level of Physical Activity (NAF)					***Weight gain (PR)***		
		Sedentary	*Not very active*	*Time*NAF*	*Yes*	*No*	*Time*RP*
Cholesterol	*baseline*	173,29±41,13	154,61±34,29	*p= 0,059*	*174,36±39,10*	*159,62±39*,83	*p= 0,134*
	1 year	161,16±35,23	152,73±31,39		160,62±30,08	156,15±38,54	
	5 years	172,83±38,46	158,15±31,39		174,11±34,48	161,56±38,81	
Glucose	*baseline*	96,33±27,39	95,04±21,95	*p= 0,765*	*96,04±26*,44	*95,80±25*,17	*p= 0,701*
	1 year	85,48±8,27	88,00±13,53		84,76±8,21	88,00±11,92	

	5 years	93,86±19,35	94,73±22,70		93,67±18,98	94,67±21,98	
TAM	*baseline*	97,35±13,75	93,77±12,49	*p= 0,082*	*98,022±12,53*	*94,18±14,23*	*p= 0,224*
	1 year	87,31±9,47	85,85±7,65		87,47±7,86	86,31±10,11	
	5 years	88,57±10,82	82,39±7,54		88,65±10,58	84,36±9,56	

TAM: Mean Blood Pressure

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¶ (12 points)

Discussion and conclusions

The main objective of the present study was to analyze the effect of bariatric surgery, physical activity, and weight regain on the long-term prevalence of metabolic risk factors through telemedicine.

We can see that in the long term, the higher the levels of physical activity, the less weight gain, but we cannot say the same about metabolic risk factors, since it is not possible to verify a relationship between physical activity and weight gain.

When we approach weight gain in bariatric surgery, we consider a weight gain of more than 5% of the minimum weight achieved [7], which in our sample was mostly achieved in the first year after surgery. The correlation between weight gain, infers a strong connection with the practice of physical activity, as mentioned in other studies, changes in lifestyle, with monitoring or not, allows decreasing the rates of weight gain [3]. Already in 2011, Livhits (2001) reported that weight regain occurs on average 27 months after bariatric surgery and that it arises mostly and is greater in patients who have low levels of physical activity [8].

The characterization of our sample regarding the practice of physical activity showed that the levels of physical activity are only two and most practice it in a light way, which is in line with several studies that state that these patients, postoperatively, fall far short of the EASO recommendations regarding the practice of physical activity for the prevention of weight gain [9].

Although we only had patients with low and moderate levels of physical activity, the patients who practiced physical activity, regardless of the level, had no weight gain on average at 5 years after bariatric surgery, which is in line with what other authors have said, that physical activity allows for the maintenance of long-term weight loss [4]. However, those who had moderate levels of physical activity had fewer instances of weight regain. We emphasize that, in addition to none of the patients having vigorous or high activity, none had structured physical exercise, which reinforces the need for follow-up by an exercise professional in the multidisciplinary evaluation of these patients.

Metabolic risk factors, when present, infer important repercussions on comorbidities, namely diabetes, hypertension, dyslipidemia, and Obstructive Sleep Apnea Syndrome [10]. All comorbidities have a significance at the first and fifth year, related to the surgery itself. As stated in a recent study that bariatric surgery is the most effective treatment for comorbidities, regardless of weight gain and physical activity [11]. Only patients who underwent gastric bypass were included in our study, so we relate the

positive resolution of comorbidities to performing combined surgical procedures with restricted and poor absorption [12].

Our data show that after 5 years there are no patients with uncontrolled pathology, however without any statistically significant relationship with weight gain or physical activity, which we can verify in several studies, which prove that the improvement of comorbidities is independent of weight loss [5]. These results are in line with other studies, namely a 2019 RCT study of 165 patients with an intervention program, in which there was no difference in metabolic risk factors between the control and intervention groups [13].

The results of this study allowed inferences to be made about how weight gain and physical activity may be related to metabolic risk factors in patients undergoing bariatric surgery.

Metabolic risk factors were addressed in our study with a lot of exploration of the whole framework, namely, regarding their improvement, or not, over the postoperative period. In fact, there are benefits, but we can only associate them with the surgical intervention, since we have no significant relationship that allows us to say that the metabolic risk factors decrease or maintain their decrease with the non-occurrence of weight gain or with the practice of physical activity.

Weight gain is one of the most important predictors of surgical failure, yet we have simple and useful tools to eliminate or decrease this factor. We noticed that the practice of physical activity is initiated autonomously, with no or little monitoring, which allows us to once again reinforce that the monitoring of these patients by professionals with the skills to do so would be an added value for all involved and for the national health system, since it will prevent several surgical procedures, several follow-up visits due to the deterioration of the patients' physical and psychological condition, as well as the development of new pathologies.

Metabolic risk factors respond well in the first year after surgery, but mostly can only be maintained with long-term levels of physical activity. It should be noted that diabetes is the pathology with the best response, that is, surgery has a strong potential for metabolic improvement, technically it is effective in resolving them, and the concomitant practice of physical activity does not seem to be significant or with contradictory results. This fact may be related to the level of the sample range used, in this case less than 95%.

Also in our study, the results were in line with this, as there was an initial decrease in metabolic risk factors and some increased one or two years after surgery with patients needing to resume medication and no positive relationship with physical activity and weight gain, only the mean blood pressure in some approximation.

This point is central and extremely relevant to the goal of our work, with the perception that these patients need guidance regarding the practice of regular physical activity, not only by prescription and monitoring, but by a whole referral in order to achieve the best results for all involved in this process, focusing on the patients and their needs. Bariatric surgery is successful in treating severe obesity, with great potential to be maintained if fueled by physical activity.

Regarding the limitations and future research of this study, we believe that the barriers and facilitators of physical activity, as well as the motivational profile, could be addressed during this post-surgical process. Also the fact that the study is retrospective, with self-reported data collection, becomes a limitation of the data collected, as well as the sample size and type.

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