OBJN
ONLINE BRAZILIAN JOURNAL OF NURSING

ISSN: 1676-4285

Practice of physical activity in patients undergoing bariatric surgery: a cross-sectional study

Prática de atividade física de pacientes submetidos à cirurgia bariátrica: estudo transversal

Práctica de actividad física en pacientes sometidos a cirugía bariátrica: estudio transversal

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Submission: 01/11/2021
Approved: 07/14/2021

ABSTRACT
Objective: To assess whether patients undergoing bariatric surgery were physically active before and after the surgical procedure, in addition to identifying factors associated with physical inactivity. **Method:** A cross-sectional study conducted with 307 adults undergoing bariatric surgery between 2012 and 2014 in a general hospital in Minas Gerais. Practicing physical activity (>150 minutes/week) before and after the surgical procedure was considered as the outcome variable of this study. The magnitude of the association between the dependent variable and the factors of interest was estimated by the *odds ratios* using the longitudinal logistic model. **Results:** After the bariatric surgery, there was an increase in physical activity. In the multivariate analysis, self-reported Asian or indigenous skin color, body mass index and bad or very bad perception of the health status were associated with PA. **Conclusion:** The practice of physical activity must be encouraged, as it favors change in habits, encompassing the physical, psychological and social spheres.
DESCRIPTORS: Bariatric Surgery; Motor Activity; Epidemiology; Obesity; Obesity Management.

RESUMO
Objetivo: Avaliar se pacientes submetidos à cirurgia bariátrica eram fisicamente ativos, antes e após o processo cirúrgico, além de identificar os fatores associados à inatividade física. **Método:** Estudo transversal, com 307 adultos submetidos à cirurgia bariátrica entre 2012 a 2014 em um hospital geral de Minas Gerais. A prática de atividade física (>150 minutos/semana) antes e após o procedimento cirúrgico foi considerada como variável desfecho deste estudo. A magnitude da associação entre a variável dependente e os fatores de interesse foi estimada pelas *odds ratio* pelo modelo logístico longitudinal. **Resultados:** Após a cirurgia bariátrica, houve aumento da realização da atividade física. Na análise multivariada, cor de pele autorreferida amarela ou indígena, índice de massa corporal e percepção ruim ou muito ruim do estado de saúde associaram-se à AF. **Conclusão:** A prática de atividade deve ser incentivada, visto que favorece mudança de hábitos, englobando os âmbitos físico, psicológico e social.
DESCRITORES: Cirurgia Bariátrica; Atividade Motora; Epidemiologia; Obesidade; Manejo da Obesidade.

RESUMEN
Objetivo: Evaluar si los pacientes sometidos a cirugía bariátrica estaban físicamente activos antes y después de la cirugía, e identificar los factores asociados con la inactividad física. **Método:** Estudio transversal con 307 adultos sometidos a cirugía bariátrica entre 2012 y 2014 en un hospital general de Minas Gerais. La práctica de actividad física (> 150 minutos/semana) antes y después del procedimiento quirúrgico se consideró como variable de resultado de este estudio. La magnitud de la asociación entre la variable dependiente y los factores de interés se estimó mediante el odds ratio utilizando el modelo logístico longitudinal. **Resultados:** Después de la cirugía bariátrica, hubo un aumento de la actividad física. En el análisis multivariante, el color de piel indígena o amarilla autoinformado, el índice de masa corporal y una percepción mala o muy mala del estado de salud se asociaron con la AF. **Conclusión:** Se debe fomentar la práctica de actividad, dado que favorece el cambio de hábitos, en los aspectos físico, psicológico y social.
DESCRIPTORES: Cirugía Bariátrica; Actividad Motora; Epidemiología; Obesidad; Manejo de la Obesidad.

Matozinhos IP, Costa GHS, Naves FSM, Sampaio FA, Silva TPR, Matozinhos FP. Practice of physical activity in patients undergoing bariatric surgery: a cross-sectional study. Online Braz J Nurs [Internet]. 2021 [cited year month day];20:e20216484. Available from: https://doi.org/10.17665/1676-4285.20216484

INTRODUCTION

In recent decades, obesity has assumed epidemic proportions. Data from the World Health Organization (WHO) show that, in 2016, 39% of the adults in the world population were considered overweight and 13% were obese[1]. In Brazil, in 2018, more than half of the population was overweight (55.7%) and 19.8% of the Brazilians were considered obese, with the prevalence of obesity being 18.7% in men and 20.7% in women[2].

Obesity is an important and potentially lethal chronic disease caused by an association between genetics and lifestyle, in addition to physical health risks such as development of systemic arterial hypertension (SAH), hypercholesterolemia, diabetes *mellitus* (DM) and cardiovascular diseases[3]. It is characterized as a disease that causes stigma, as it also compromises the psychosocial health of the individual, who can develop depression, anxiety and compulsive eating disorders[3]. In this context, bariatric surgery (BS) stands out, which has been considered an intervention possibility for the treatment of obesity[4].

The candidates undergoing surgical treatment are, in most cases, patients with a Body Mass Index (BMI) above 40 kg/m² or with a BMI over 35 kg/m² associated with comorbidities such as SAH, type 2 DM, sleep apnea or dyslipidemia. Selection of the patients requires a minimum period of five years of obesity evolution and a history of documented failure of the clinical treatment carried out by qualified professionals[4].

In isolation, BS does not promote a cure for obesity but its control, and can be associated with short- and long-term nutritional and clinical complications[5]. There are several factors that influence weight loss and maintenance associated with BS, such as age, eating habits, reduced physical activity and hormonal adaptations[6-8]. It is noteworthy that the physical inactivity of patients after BS is related to nutritional and clinical problems, especially the substantial loss of lean body mass[9-10]. As obesity has its origin related to genetic, environmental and behavioral factors, excessive caloric intake and reduced physical activity are the most relevant factors for its onset[5].

Therefore, the importance of physical activity (PA) is highlighted (at least 150 minutes of moderate-intensity aerobic activity per week or at least 75 minutes of vigorous-intensity aerobic activity per week)[11] to reverse or prevent the development of the aforementioned clinical condition. PA is understood as any movement performed by the body produced by the skeletal musculature that requires energy expenditure above the rest level[11-12]. It is noteworthy that physical exercise is a subcategory of PA and is understood as planned, structured, repetitive and purposeful physical activity, with the main objective of improving or maintaining physical fitness, physical performance or health[11].

PA has been recommended for influencing the speed of body weight loss and the preservation or increase of lean mass after BS, in addition to reducing the sensation of hunger and anxiety, presenting itself as an important component for weight control and reduction of other risk factors inherent to overweight[12].

Therefore, this study is justified by the scarcity of national studies on this theme[13], in addition

to the valid search for knowledge about the physiological effects of PA in patients undergoing BS, so that changes in lifestyle habits can be discussed, proposed and encouraged and that the development of more severe obesity conditions can be prevented. A number of studies show that there are several barriers and facilitators for patients undergoing BS to practice PA[14-15]. The barriers to the practice of PA can be: weight restriction, body dissatisfaction, patients' psychological health, and social support. Factors such as post-surgery weight loss, weight maintenance, satisfaction with health, pleasure with the body image, age and support for PA are facilitating agents for the practice of PA in patients after BS[14]. Given the above, the hypothesis of this study is that sociodemographic, clinical and health perception factors of the individuals undergoing BS are associated with the practice of PA.

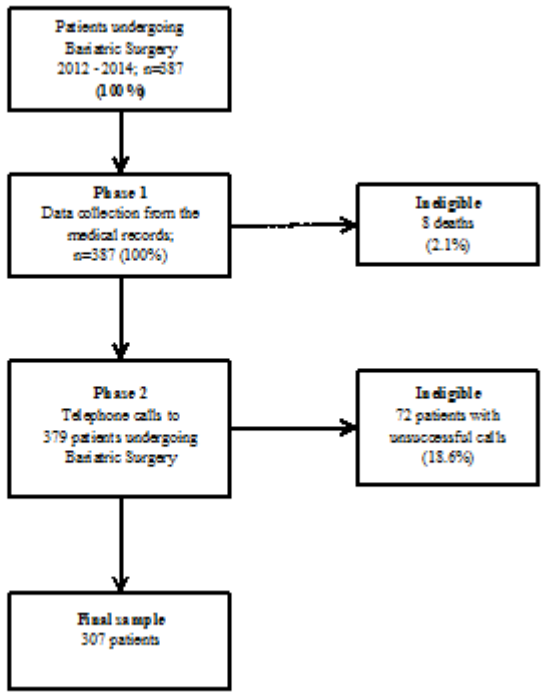
The objective of this study is to assess whether patients undergoing BS were physically active, before and after the surgical procedure, in addition to identifying factors associated with physical inactivity.

METHOD

This is a cross-sectional study, carried out with 307 adult patients (aged 18 years old or more) who underwent bariatric surgery from 2012 to 2014 in a general and private hospital in Minas Gerais, Brazil. This study is part of the cohort project entitled "Assessment of patients undergoing bariatric surgery in a general hospital: An epidemiological and clinical study on obesity", which monitored patients undergoing BS in the period from 2012 to 2014 following them for 5 years after BS.

Data collection took place in 2016, in two phases (sources): in the electronic medical records (data prior to the surgical procedure and immediate postoperative period) and by telephone (in the first year - patients operated on in 2014, in the second year - patients operated on in 2013 and, in the third year - patients operated on in 2012, after the surgery). It is noteworthy that data collection was conducted by duly trained health professionals. Individuals with unsuccessful calls and deaths were excluded. The final sample consisted of 307 patients. The sample selection flowchart can be seen in Figure 1.

Figure 1 - Flowchart of the sample losses. Contagem, MG, Brazil, 2016.



The data collected comprised sociodemographic variables (exposure) (gender, age, skin color, schooling, marital status, income), clinical variables - related to comorbidities and hospitalization (SAH, DM and perception of health status) -, epidemiological variables (BMI) and bowel habit. Practicing physical activity (>150 minutes/week)[11] before and after the surgical procedure (in the first, second and third year after the surgery) was considered as the outcome variable of this study.

To measure the time of physical activity, a combination of two pieces of information was used. The first was: "Have you been practicing any physical activity during the week in the last 3 months, such as: walking, walking on a treadmill, weight training, water aerobics, dance and volleyball/footvolley, running, running on a treadmill, aerobics, soccer/futsal, basketball or tennis?". Those interviewed who answered yes to the variable were asked about frequency ("How many days per week (a) do you usually practice this activity?") and (b) regarding the duration of the activity ("On the day you practice this activity, how long does this activity last?"). These questions were asked about their performance before and after BS.

Afterwards, the patients were categorized into those who practiced PA for at least 150 minutes of moderate-intensity aerobic activity per week or at least 75 minutes of vigorous-intensity aerobic activity per week[11].

The data collected were analyzed using the Stata statistical program, version 14.0.

Frequencies and proportions were calculated for the categorical variables, in addition to the 95% confidence intervals (95%CI) of the proportions. For the quantitative variables, mean and standard deviation (SD) were used,

due to the normal distribution of the variables verified by the Shapiro-Wilk test.

The magnitudes of the associations between the dependent variable (PA before and after BS) and the factors of interest were estimated by the *odds ratio*s (OR) using the longitudinal logistic model, controlled by intra-individual correlation. The *forward* procedure for inclusion of variables was carried out. The final model was evaluated using the *Wald* goodness test. It is noteworthy that the model was controlled by intra-individual correlation, postoperative time of the patients (in months) from the date of the surgery to the date of data collection in 2016, gender and age. A significance level of 5% was adopted for all the analytical procedures.

Prior authorization from the hospital institution was obtained, as well as approval from the Research Ethics Committee of the Federal University of Minas Gerais (CAAE 52657115.2.0000.5149), under opinion No. 1,503,789. All participants gave their verbal consent over the phone, in accordance with the ethical guidelines described in Resolution No. 466 involving research with human beings, dated December 12th, 2012, of the National Health Council. It is noteworthy that signing of the Free and Informed Consent Forms (FICFs) was waived, as the second phase of the research took place by telephone, rendering it impossible to sign them.

RESULTS

The sample consisted of 307 patients, mostly women (87.62%, n=269), with a mean age of 37.10 years old (SD±9.32, n=307), who self-reported being brown-skinned (49.84%, n=153), had completed high school (58.96%, n=181), lived with some type of partner (69.06%, n=212) and had a mean income per household from 1 to 3 minimum wages (54.79%, n=160) (Table 1).

Table 1 - Sociodemographic profile of people undergoing Bariatric Surgery. Contagem, MG, Brazil, 2016

Variable	n	%	95% CI*
Gender			
Male	38	12.38	9.12-16.58
Female	269	87.62	83.41-90.88
Age in years old**	37.10(9.32)		
Self-reported skin color			
White	102	33.22	28.15-38.72
Black	46	14.98	11.10-19.09
Brown	153	49.84	44.24-55.44
Asian/Indigenous	6	1.96	0.88-4.29
Schooling			

Higher Education	67	21.82	17.53-26.82
High School	181	58.96	53.33-64.36
Elementary School	30	9.77	6.90-13.66
Primary Education	29	9.45	6.63-13.29
Lives with partner			
Yes	212	69.06	63.63-74.00
No	95	30.94	25.99-36.37
Mean Income per Household* **			
No income or up to 1 minimum wage	28	9.59	6.69-13.56
1-3 minimum wages	160	54.79	49.01-60.45
3-5 minimum wages	69	23.63	19.08-28.87
>5 minimum wages	35	11.99	8.71-16.27

Notes: *95% Confidence Interval.
**Mean and Standard Deviation.
***Mean income per household calculated based on the Minimum Wage: R$ 788.00.
Source: Prepared for the purposes of this study.

Of the patients included in the sample, 101 (32.90%) practiced PA before the surgical procedure and 109 (35.50%) reported practicing PA (>150 min/week) after the surgery (data not shown). Table 2 presents the bivariate analyses of the potential sociodemographic, clinical and health perception factors associated with the practice of PA. Asian/Indigenous skin color was associated with a reduction in the chance of physical inactivity (when compared to white-skinned people) and an increase in BMI over time was associated with a greater chance of physical inactivity, in addition to people who assessed their health status as bad or very bad (in relation to those who rated their health status as very good or good).

Table 2 – Bivariate analysis of the factors associated with the practice of physical activity before and after bariatric surgery. Contagem, MG, Brazil, 2016

Physical activity				**Unadjusted model***
Before		**After**		**OR (95%CI)**
Yes	**No**	**Yes**	**No**	
n (%)	**n (%)**	**n (%)**	**n (%)**	

Sociodemographic factors					
Gender					
Male	10(26.32)	28(73.68)	13(34.21)	25(65.79)	1
Female	91(33.83)	178(66.17)	96(35.69)	173(64.31)	0.81(0.46-1.43)
Age*	40 (33-45)	38 (33-45)	38 (32-43)	39 (33-46)	1.00(0.98-1.02)
Skin color					
White	35(34.31)	67(65.69)	35(34.31)	67(65.69)	1
Black	10(21.74)	36(78.26)	14(30.43)	32(69.57)	1.48(0.80-2.72)
Brown	52(33.99)	101(66.01)	58(37.91)	95(62.09)	0.93(0.62-1.39)
Asian/ Indigenous	4(66.67)	2(33.33)	2(33.33)	4(66.67)	0.52(**0.37-0.72**)
Schooling					
Higher Education	16(23.88)	51(76.12)	24(35.82)	43(64.18)	1
High School	64(35.36)	117(64.64)	72(39.78)	109(60.22)	0.70(0.46-1.07)
Elementary School	14(43.75)	18(56.25)	8(25.00)	24(75.00)	0.81(0.40-1.62)
Primary Education	7(25.93)	20(74.07)	5(18.52)	22(81.48)	1.48(0.68-3.23)
Lives with partner					
Yes	76(35.85)	136(64.15)	68(32.08)	144(67.92)	1
No	25(26.32)	70(73.68)	41(43.16)	54(56.84)	0.96(0.66-1.40)
Mean income per household					
No income or up to 1 minimum wage	7(25.00)	21(75.00)	10(35.71)	18(64.29)	1
1-3 minimum wages	57(35.63)	103(64.38)	56(35.00)	104(65.00)	0.79(0.43-1.45)
3-5 minimum wages	20(28.99)	49(71.01)	17(24.64)	52(75.36)	1.18(0.61-2.30)

>5 minimum wages	13(37.14)	22(62.86)	19(54.29)	16(45.71)	0.51(0.25-1.05)
Clinical factors					
Arterial Hypertension					
Yes	44(30.77)	99(69.23)	9(34.62)	17(65.38)	1
No	57(34.76)	107(65.24)	92(32.74)	189(67.26)	0.79(0.53-1.17)
Diabetes *Mellitus*					
Yes	25(30.86)	56(69.14)	3(23.08)	10(76.92)	1
No	76(33.63)	150(66.37)	98(33.33)	196(66.67)	0.95(0.60-1.50)
BMI	43.01 (40.57-46.19)	43.87 (40.87-48.06)	27.52 (24.52-29.40)	27.34 (24.46-30.00)	1.01(**1.002-1.036**)
Bowel habit					
Normal	63(35.39)	115(64.61)	80(35.40)	146(64.60)	1
Constipation	37(29.60)	88(70.40)	24(34.29)	46(65.71)	1.00(0.59-1.67)
Diarrhea	1(25.00)	3(75.00)	5(45.45)	6(54.55)	0.62(0.19-1.96)
Health perception					
Very good or good	19(43.18)	25(56.82)	104(37.14)	176(62.86)	1
Fair	32(39.02)	50(60.98)	4(19.05)	17(80.95)	0.91(0.57-1.44)
Bad or very bad	50(27.62)	131(72.38)	1(20.00)	4(80.00)	1.52(**1.03-2.23**)

Notes: * Longitudinal logistic model controlled by intra-individual correlation; 95%CI - 95% Confidence Interval; in bold, it presents a statistically significant difference.

Finally, in the multivariate analysis, using multivariate logistic regression controlled by intra-individual correlation (Table 3), it was verified that sociodemographic and clinical characteristics, as well as subjective conditions, were associated with physical activity.

The results show a reduction in the chance of physical inactivity in Asian or indigenous patients when compared to white-skinned patients, controlled by intra-individual correlation and adjusted for the other variables present in the model (Table 3).

An increase in the chance of physical inactivity was observed in the patients who reported bad or very bad perception of their health status when compared to those who reported very good or good health perception. There was also an increase in the chances of physical inactivity with the increase in BMI. Both findings were controlled by intra-individual correlations and

adjusted by the other variables present in the model (Table 3).

Table 3 – Multivariate analysis of the factors associated with the practice of physical activity after bariatric surgery. Contagem, MG, Brazil, 2016

Variables	OR	95%CI
Skin color		
White	1	-
Black	1.20	0.61-2.35
Brown	0.90	0.57-1.40
Asian/Indigenous	0.39	**0.26-0.59**
BMI	1.04	**1.01-1.08**
Health perception		
Very good or good	1	-
Fair	1.18	0.58-2.40
Bad or very bad	2.31	**1.14-4.67**

Note: Longitudinal logistic model controlled by intra-individual correlation and adjusted for gender, age and time after surgery; 95%CI - 95% Confidence interval; in bold, it presents a statistically significant difference.

DISCUSSION

In this study, after performing the surgical procedure, there was an increase in the proportion of patients who practiced PA. In the multivariate analysis, the sociodemographic characteristics (self-reported Asian or indigenous skin color), clinical characteristics (BMI) and subjective health conditions (bad or very bad perception of health status) were associated with PA.

Increased PA after BS is reported in other studies[16-17]. Such increase can be understood as an improvement in the quality of life of these patients, since they are less concerned about the occurrence of injuries after the surgery and become less inhibited in the practice of PA[18]. Post-surgical PA contributes to the improvement of functional autonomy, being responsible for the maintenance of the body mass lost and reducing the amount of adipose tissue, resulting in an increase in resting metabolism, in addition to reducing fatigue and pain[19].

It was observed that patients who reported bad or very bad perception of their health status had an increased chance of being inactive. The health status self-assessment is an indicator that addresses the emotional components and the individual concept of satisfaction and well-being, which goes beyond the analysis of the individual's current physical-pathological condition[20]. Thus, it is extremely important when analyzing PA, since this practice is related to a large number of benefits, such as

improving mental health, mood, self-concept, emotional stability, self-control and well-being, as well as the reduction in the stress levels and in the depression and anxiety conditions[21].

Although these effects are widely discussed, the mechanisms responsible for these psychological changes are not completely known, so as to provide the existence of several hypotheses that seek to explain this relationship based on the mechanisms involved in physical exercise. The most classic of these hypotheses relates well-being to the increased concentration of endorphins during and after the practice of PA, which would lead to a pleasant sensation associated with euphoria and a reduction in pain, anxiety, tension and anger[22].

Another theory about the improvement in the perception of health status refers to monoamines, explaining the improvement in mood after the practice of PA based on the increasing levels of neurotransmitters, such as serotonin. This neurotransmitter is known to be reduced in depressed people and may be related to the mood mechanism[22]. In addition to serotonin, physical exercise also increases the enzyme activity of the calcium-calmodulin system, which results in increased calcium levels in the brain, which in turn stimulates dopamine synthesis[23]. Dopamine is a neurotransmitter that stimulates the dopaminergic receptors and generates a sensation of well-being and euphoria. In addition to that, dopamine also influences motivation, sleep, mood and learning[24].

In this study, another variable that presented a significant difference in relation to the practice of physical activity was BMI over time. This difference is justified because practicing PA is directly related to weight reduction and to the preservation of lean mass, so that physically active participants tend to have lower weight when compared to sedentary individuals. For weight loss to occur, a negative energy balance is necessary, that is, the total daily energy expenditure must be greater than energy consumption. Thus, one of the main causes of weight reduction related to physical activity is the increase in the Metabolic Rate in Rest (MRR), which is high during and after PA[25]. This rate corresponds to the minimum energy expenditure necessary for all vital functions of the body to be kept functioning. Considering that this rate is the main component of the total daily energy expenditure[26], its increase provided by PA can lead to the establishment of a negative energy balance, resulting in weight loss.

It is also noteworthy that skin color was another factor that revealed a significant difference in this study. However, no data or evidence was found in the literature to justify this fact, but it is suggested that this result may be related to the cultural issue of these individuals.

Given the above, the findings of this study confirm the study hypothesis that the sociodemographic, clinical and health perception factors of individuals undergoing BS are associated with the practice of PA. The findings of this study highlight the importance of the multidisciplinary team before and after BS, aiming to provide care targeted at the lifestyle change process[17]. Finally, it is important to consider the limitations of this study, including sample loss during data

collection, which may have influenced the lack of statistical significance in some of the results presented. However, it is noteworthy that sensitivity analyses were performed between the losses and the final sample and, for most of the variables, no significant differences were found between them. In addition, some variables used in this paper are self-reported, but many of them have been widely used as an acceptable method in epidemiological studies.

To our knowledge, there is scarcity of national research focused on the theme. This study undoubtedly contributes to a better understanding of the physiological effects of PA in patients undergoing BS.

CONCLUSION

There was an association of bariatric surgery with the practice of PA, which must be encouraged, as it favors change in habits, encompassing the individual's physical, psychological and social spheres. The results of this study can assist the multidisciplinary team professionals in developing strategies, aiming to improve the health condition of patients undergoing BS and to reverse complications resulting from this surgical procedure, such as loss of lean mass.

REFERENCES

1. World Health Organization (WHO). Obesity and overweight. [Internet] Geneva: WHO; 2018 [cited 2020 May 22]. Available from: http://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight.
2. Ministério da Saúde (BR), Secretaria de Vigilância em Saúde, Departamento de Vigilância de Doenças e Agravos não Transmissíveis e Promoção de Saúde Vigitel Brasil 2019: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico [Internet]. Brasília: Ministério da Saúde; 2019 [cited 2020 May 22]. 160 p. Available from: https://www.saude.gov.br/images/pdf/2019/julho/25/vigitel-brasil-2018.pdf.
3. Haddad M do CL, Leroux AMR, Santos CF, Loman H, Oliveira SG. Qualidade de vida após gastroplastia. Ciênc Cuid Saúde [Internet]. 2008 [citado em 2020 May 22];2(1). Available from: http://www.periodicos.uem.br/ojs/index.php/CiencCuidSaude/article/view/5566
4. Zeve JL de M, Novais PO, Oliveira Júnior N de. Técnicas em cirurgia bariátrica: uma revisão da literatura. Ciência & Saúde [Internet]. 2012 [cited 2020 May 22];5(2):132-40. Available from: http://dx.doi.org/10.15448/1983-652X.2012.2.10966
5. Coelho EML, Fontela PC, Winkelmann ER, Schwengber MSV. Perda de peso, estado de saúde e qualidade de vida durante 2 anos após cirurgia bariátrica. Ciência & Saúde [Internet]. 2016 [cited 2020 May 22];9(3):174-81. Available from: http://dx.doi.org/10.15448/1983-652X.2016.3.23377
6. Monaco-Ferreira DV, Leandro-Merhi VA. Weight Regain 10 Years After Roux-en-Y Gastric Bypass. Obes Surg [Internet]. 2016 [cited 2020 May 22];27(5):1137-44. Available from: http://dx.doi.org/10.1007/s11695-016-2426-3
7. Bastos ECL, Barbosa EMWG, Soriano GMS, Santos EA dos, Vasconcelos SML. Determinants of weight regain after bariatric surgery. Arq Bras Cir Dig [Internet]. 2013 [cited 2020 May 22];26(Suppl 1):26-32. Available from: http://dx.doi.org/10.1590/S0102-67202013000600007
8. Barhouch AS, Padoin AV, Casagrande DS, Chatkin R, Süssenbach SP, Pufal MA et al. Predictors of Excess Weight Loss in Obese Patients After Gastric Bypass: a 60-Month Follow-up. Obes Surg [Internet]. 2016 [cited 2020 May 22];26(6):1178-85. Available from: https://doi.org/10.1007/s11695-015-1911-4
9. Silva AA da, Araújo RP de, Gurgel LA, Aguiar JB de. Influência do exercício físico sobre a composição corporal após gastroplastia. Rev Aten Saúde [Internet]. 2014 [citado em 2020 May 22];11(38):25-31. Available

from: https://doi.org/10.13037/rbcs.vol11n38.1975

10. Carey DG, German JP, Robert LR. Body composition and metabolic changes following bariatric surgery: effects on fat mass, lean mass and basal metabolic rate: six months to one-year follow-up. Obes Surg [Internet]. 2006 [cited 2020 May 22];16(12):1602-8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/17217636
11. World Health Organization (WHO). WHO Guidelines on Physical Activity and Sedentary Behaviour [Internet]. Geneva: WHO; 2020 [cited 2021 July 14]. Available from: https://apps.who.int/iris/bitstream/handle/10665/336656/9789240015128-eng.pdf
12. Donnelly JE, Blair SN, Jakicic JM, Manore MM, Rankin JW, Smith BK. American College of Sports Medicine Position Stand. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. Med Sci Sports Exerc [Internet]. 2009 [cited 2020 May 22];41(2):459-71. Available from: https://doi.org/10.1249/MSS.0b013e3181949333
13. Aguiar JB, Gurgel LA, Santos ALB, Arruda SPM. Barriers to Physical Exercise and Associated Factors in the Pre- and Postoperative Periods of Bariatric Surgery. Obes Surg [Internet]. 2021 [cited 2021 Jun 30];31(4):1696-1704. Available from: https://doi.org/10.1007/s11695-020-05183-y
14. Dikareva A, Harvey WJ, Cicchillitti MA, Bartlett SJ, Andersen RE. Exploring Perceptions of Barriers, Facilitators, and Motivators to Physical Activity Among Female Bariatric Patients: Implications for Physical Activity Programming. Am J Health Promot [Internet]. 2016 [cited 2021 Jun 30];30(7):536-44. Available from: https://doi.org/10.4278/ajhp.140609-QUAL-270
15. Hayotte M, Nègre V, Gray L, Sadoul JL, d'Arripe-Longueville F. The transtheoretical model (TTM) to gain insight into young women's long-term physical activity after bariatric surgery: a qualitative study. Obes Surg[Internet]. 2020 [cited 2021 Jun 30];30(2):595-602. Available from: https://doi.org/10.1007/s11695-019-04220-9
16. Boscatto EC, Duarte M de F da S, Gomes M de A. Comportamentos ativos e percepção da saúde em obesos submetidos à cirurgia bariátrica. Rev Bras Ativ Fís Saúde [Internet]. 2012 [cited 2021 Jun 30];16(1):43-7. Available from: https://rbafs.org.br/RBAFS/article/view/556
17. Barros LM, Frota NM, Moreira RAN, Brandão MGSA, Caetano JA. Mudanças de hábitos de vida de pacientes em pós-operatório da cirurgia bariátrica. RBONE - Revista Brasileira De Obesidade, Nutrição E Emagrecimento [Internet]. 2018 [cited 2021 Jun 30];12(74):812-19. Available from: http://www.rbone.com.br/index.php/rbone/article/view/800
18. Wouters EJ1, Larsen JK, Zijlstra H, van Ramshorst B, Geenen R. Physical activity after surgery for severe obesity: The role of exercise cognitions. Obes Surg [Internet] 2011 [cited 2020 May 22];21(12):1894-9. Available from: https://doi.org/10.1007/s11695-010-0276-y
19. Fonseca-Junior SJ, Sá CGA de B, Rodrigues PAF, Oliveira AJ, Fernandes-Filho J. Exercício físico e obesidade mórbida: Uma revisão sistemática. ABCD Arq Bras Cir Dig [Internet]. 2013 [citado em 2020 mai. 22];26(Suppl 1):67-73. Available from: http://dx.doi.org/10.1590/S0102-67202013000600015
20. Instituto Brasileiro de Geografia e Estatística (IBGE). Pesquisa Nacional de Saúde 2013: percepção do estado de saúde, estilos de vida e doenças crônicas – Brasil, Grandes Regiões e Unidades da Federação. Rio de Janeiro: IBGE; 2014 [cited 2020 May 22]. Available from: https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=291110
21. Ravelli MN, Merhi VAL, Mônaco DV, Aranha N. Obesidade, cirurgia bariátrica e implicações nutricionais. Revista Brasileira em Promoção da Saúde [Internet]. 2012 [cited 2020 May 22];20(4):259-66. Available from: https://dx.doi.org/10.5020/1036
22. Miranda REEPC, Mello MT de, Antunes HKM. Exercício Físico, Humor e Bem-Estar: Considerações sobre a Prescrição da Alta Intensidade de Exercício. Revista

Psicologia e Saúde [Internet]. 2011 [cited 2020 May 22];3(2):46-54. Available from: https://doi.org/10.20435/pssa.v3i2.102

23. Vorkapic CF. Neurociência do Exercício, Saúde Mental e Aprendizagem. Caminhos da Educação Matemática em Revista (Online) [Internet]. 2016 [cited 2020 May 22];4(2). Available from: https://aplicacoes.ifs.edu.br/periodicos/index.php/caminhos_da_educacao_matematica/article/view/77
24. Antunes HKM, Andersen ML, Tufik S, Mello MT de. Privação de sono e exercício físico. Rev Bras Med Esporte [Internet]. 2008 [cited 2020 May 22];14(1):51-6. Available from: http://dx.doi.org/10.1590/S1517-86922008000100010
25. Hannibal D, Zolet NE, Souza JC de, Speretta GFF, Leite RD, Prestes J. Exercício físico e obesidade: o impacto das diferentes modalidades. RBPFEX-Revista Brasileira de Prescrição e Fisiologia do Exercício [Internet]. 2011 [cited 2020 May 22];4(20). Available from: http://www.rbpfex.com.br/index.php/rbpfex/article/view/240
26. Bonganha V, Conceição MS, Santos CF dos, Chacon-Mikahil MPT, Madruga VA. Taxa metabólica de repouso e composição corporal em mulheres na pós-menopausa. Arq Bras Endocrinol Metabol [Internet]. 2009 [cited 2020 May 22];56(4):755-59. Available from: http://dx.doi.org/10.1590/S0004-27302009000600010
27. Werneck FZ, Bara Filho MG, Ribeiro LCS. Mecanismos de melhoria do humor após o exercício: Revisitando a hipótese das endorfinas. Rev Bras Ci e Mov [Internet]. 2005 [cited 2020 May 22];13(2):135-44. Available from: https://portalrevistas.ucb.br/index.php/RBCM/article/viewFile/634/645