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Sarcopenia da Obesidade: Efeito das alterações metabólicas da cirurgia bariátrica na quantidade, força e função muscular.

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Orientador: Dr. Júlio Pereira Lima

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Dedicatória

Dedico esta tese a:

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"Que os meus ideais sejam tanto mais fortes quanto maiores forem os desafios, mesmo que precise transpor obstáculos aparentemente intransponíveis. Porque metade de mim é feita de sonhos e a outra metade é de lutas".

Vladimir Vladimirovich Mayakovsky (1893 - 1930)

Resumo

A obesidade é problema de saúde global, afetando cada vez mais o mundo ocidental. Nos Estados Unidos, a condição segue se agravando a cada ano e a projeção é que em 2030 cerca de 50% da população deste país será obesa. No Brasil, os números vêm crescendo da mesma forma. Temos, hoje, 20% da população com obesidade. A sarcopenia é condição em que há diminuição de massa magra com repercussões clínicas, tais como eventos cardiovasculares, inabilidades físicas, quedas e fraturas. Com o passar dos anos, há diminuição progressiva da massa magra e aumento do depósito intramuscular de gordura, principalmente em pacientes obesos. O termo sarcopenia da obesidade se refere a este paciente obeso com baixa massa muscular que, com estes fatores associados, possuem comprovadamente maiores riscos clínicos. A fibra muscular do obeso possui depósitos de gorduras que geram inflamação local e resistência à insulina, tornando-a menos funcional. A cirurgia bariátrica hoje é o tratamento mais eficaz contra a obesidade mórbida e possui inúmeras evidências de melhora metabólica.

No estudo 1, intitulado **"Sarcopenia da obesidade: efeitos da cirurgia bariátrica na quantidade, força e função muscular",** analisamos os efeitos da cirurgia bariátrica em pacientes candidatos ao procedimento em relação à força, quantidade e função muscular. Utilizamos os métodos de bioimpedância, handgrip e teste Timed Up and Go. Verificamos que não existe sarcopenia na população estudada. Ocorre perda de massa magra após a cirurgia, porém com manutenção da força e com melhores resultados na função muscular, corroborando hipótese de que o obeso tem um músculo de pior qualidade.

No estudo 2, intitulado **"Força muscular é o único critério diagnóstico da sarcopenia associado a efeitos metabólicos durante os primeiros meses pós cirurgia bariátrica"**, ao utilizar o mesmo banco de dados, verificamos, através de regressão linear, que os valores de glicemia e ferritina são fatores independentes para a força muscular. Observamos que o paciente com boa resposta metabólica provocada pela cirurgia bariátrica possui um melhor rendimento de sua musculatura, corroborando estudos prévios de que a fibra muscular é importante mediador da resistência insulínica provocado pela obesidade.

O estudo pode inferir a relação inversa da resistência insulínica ao nível muscular com a obesidade e destacar de que não existe sarcopenia no paciente obeso candidato à cirurgia bariátrica.

Palavras-chave: Obesidade, Sarcopenia, Cirurgia Bariátrica, Alterações metabólicas.

Abstract

Obesity is a global health problem, increasingly affecting the Western world. In the United States, a condition continues to worsen each year and by 2030 it is projected that about 50% of the country's population will be obese. In Brazil, the numbers have been growing in the same way. Today we have 20% of the population with obesity. Sarcopenia is a condition in which there is a lean mass with clinical repercussions, such as cardiovascular events, physical disabilities, falls and fractures. Over the years, there is a progressive decrease in lean mass and an increase in the intramuscular deposit of fat, especially in obese patients. The term sarcopenia of obesity refers to an obese patient with low muscle mass, with these associated factors, demonstrably greater clinical risks. A muscle fiber in the obese has fat deposits that generate local inflammation and insulin resistance, making it less functional. Bariatric surgery today is the most effective treatment against morbid obesity and has high metabolic evidence.

In study 1, entitled “Sarcopenia of obesity: effects of bariatric surgery in quantity, strength and muscle function”, it analyzes the effects of bariatric surgery in patients who are candidates for the procedure in relation to strength, amount and muscle functions. We use the bioimpedance, handgrip and Timed Up and Go test methods. We found that there is no sarcopenia in the population studied. Loss of lean mass occurs after surgery, but with maintenance of strength and better results in muscle function, corroborating the hypothesis that obese people have a muscle with worse quality.

In study 2, entitled “Muscle strength is the only sarcopenia diagnosis criteria associated to metabolic effects during the early postoperative months after bariatric surgery”, using the same database, we verified, through linear regression, that glycemia and ferritin values are independent factors for muscle strength. We observed that the patient with a good metabolic response caused by bariatric surgery has a better performance of his muscles, corroborating previous studies that the muscle fiber is an important mediator of insulin resistance caused by obesity.

The study may infer an inverse relationship between insulin resistance at the muscle level and obesity and highlight that there is no sarcopenia in the obese patient who is a candidate for bariatric surgery.

Keywords: Obesity, Sarcopenia, Bariatric Surgery, Metabolic disorders.

Lista de tabelas dos artigos

Artigo 1

Artigo 2:

Lista de abreviaturas da contextualização

IMC: Índice de Massa Corporal

RNM: Ressonância Nuclear Magnética

TC: Tomografia Computadorizada

DXA - *Dual-Energy X-Ray Absorptiometry* – Absortometria de Raio-X de Dupla Energia.

BIA – Bioimpedância

TUG – *Timed Up and Go*

PMG: Perda de massa gorda

PMM: Perda de massa magra

MM: Massa muscular

SPPB - *Short Physical Performance Battery*

TNF-α: Fator de Necrose Tumoral Alfa

IL-6: Interleucina 6

Anexos

Sumário

1. Contextualização

A obesidade é uma epidemia global. Ogden et al. (2014), apontavam que 34,9% dos adultos americanos eram obesos. O sobrepeso chegava até 80% em homens na faixa etária entre 40 e 60 anos. Estudo mais recente projeta que em 2030, 48,9% dos americanos terão obesidade, sendo que 24.2% serão obesos severos com índice de massa corporal (IMC) maior que 35kg/m2 (Ward et al., 2019). A obesidade no Brasil é, também, alarmante: dados do sistema de vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico, o VIGITEL de 2018, indicam o excesso de peso, IMC maior que 25kg/m2, em 55,7% da população brasileira. A prevalência da obesidade, IMC maior que 30kg/m2, é de 19,8%, sendo 20,7% entre as mulheres e 18,7% entre os homens. Nestes, a frequência da condição aumenta com a idade até os 44 anos e nos extremos de escolaridade. Nas mulheres, a frequência aumenta com a idade até os 64 anos e diminuiu notavelmente com o aumento de escolaridade. (VIGITEL, 2018).

A massa muscular e a sua força variam conforme idade. Normalmente, ela aumenta com o passar dos anos até seu pico por volta dos 40 anos de idade, com valores mais altos para homens do que para as mulheres. Após, inicia-se a perda de massa magra (1-2% por ano) e a sua força (1,5-5% por ano) (Bloom et. Al., 2018). Apesar da genética influenciar na massa magra, outros fatores podem intervir durante a vida, tais como desnutrição, doenças crônicas (obesidade) e exercícios (Sayer et al., 2008).

O estudo da sarcopenia se iniciou em pacientes idosos, porém sua presença pode ocorrer antes mesmo dos 50 anos (Cruz-Jentoft et al., 2018). É uma progressiva e generalizada desordem muscular esquelética (Schaap et al., 2018), sendo mais importante sua falta de força do que sua massa muscular total (Santilli et al., 2014). Estima-se que a sarcopenia atinja cerca de 50 milhões de pessoas nos dias de hoje, alcançando mais de 200 milhões de pessoas nos próximos 40 anos (Sousa et al., 2016). Sua presença está associada a uma maior prevalência de quedas e fraturas, inabilidades para o dia a dia e comorbidades em geral na população idosa. Há comprovado aumento de 5 vezes o custo assistencial quando o paciente é sarcopênico (Kalinkovich et al., 2017).

A definição de sarcopenia se baseia na presença ou não da baixa força muscular. Se ela ocorre, os critérios de baixa quantidade e qualidade muscular, associados à baixa performance definem se a sarcopenia é severa ou não. (Schaap et al., 2018) Os parâmetros usados para força muscular foram atualizados no último consenso europeu de sarcopenia em 2018 (Cruz-Jentoft et al., 2018). Este definiu os pontos de corte para o diagnóstico. Os valores dependeram da técnica utilizada bem como a avaliação de estudos de referência e população. O consenso se baseou na população européia e usou como controle indivíduos jovens saudáveis (Cruz-Jentoft et al., 2018). Studesnki et al. (2014), no consenso americano sobre sarcopenia, ratificaram os critérios do europeu, com pequeno ajuste no ponto de corte do método *Handgrip*. A força muscular da mão ou o teste do *Handgrip,* se mostrou como um forte teste preditor de desfechos adversos como tempo de internação hospitalar, limitações funcionais, baixa qualidade de vida e morte. (Ibrahim et al., 2016; Leong et al., 2015). Para a medição do *Handgrip*, o equipamento dinamômetro Jamar, assim como outros já se mostraram válidos para tal. (Sipers et al., 2016). Outro teste, o *Chair Stand Test*, foi validado no consenso recente para avaliar a força. Ele consiste em levantar-se e descer de uma cadeira, sem ajuda das mãos por 5 vezes e medir o tempo para cumprir a tarefa (Cesari et al., 2009; Jones et al., 1999).

Para avaliação de quantidade muscular, são validados diversos métodos e técnicas. A massa muscular pode ser reportada como total ou apenas dos membros. O importante aqui é ajustar estes resultados conforme altura ou IMC, já que indivíduos com massa corporal total maior tendem a ter mais massa muscular. Devemos, também, observar os parâmetros regionais e étnicos (Cooper et al., 2013; Cawthon et al., 2014). Ressonância Magnética (RNM) e Tomografia Computadorizada (TC) são consideradas padrão ouro para quantificar massa muscular. No entanto, são métodos caros e poucos acessíveis. A Absorciometria por Raios-X de Dupla Energia ou, mais conhecida por seu termo inglês, *Dual-energy X-ray absorptiometry* (DXA) é mais acessível, rápida, porém não é portátil. A bioimpedância (BIA) estima a massa muscular através da condutividade elétrica e realiza uma equação. A desvantagem é que ela sofre influência com a hidratação do paciente. (Gonzalez et al., 2017; Reiss et al., 2016)

A performance muscular é definida como a função global muscular associada com a sua locomoção. Vários testes possuem validade. O teste de velocidade de marcha ou *Gait Speed* é considerado rápido, seguro e confiável. Tem valor preditivo para eventos adversos relacionados à sarcopenia, tais como inabilidade, cognição, quedas e mortalidade. (Bruyère et al., 2016; Abellan Van

Kan et al., 2009; Peel et al., 2013; Studenski et al., 2011; Guralnik et al., 2000) O teste consiste em caminhar por 4 minutos e medir a velocidade. Valores <0,8m/s indicam sarcopenia severa. O teste *Timed "Up and Go"* (TUG) consiste em levantar-se da cadeira, caminhar por 3 metros, dar a volta, retornar e se sentar novamente, medindo o tempo (Podsiadlo et al., 1991), possuindo valor preditivo para mortalidade (Bergland et al., 2017). A avaliação ainda pode incluir outros testes como o *Short Physical Performance Battery* (SPPB) e o *400 meters walk*. (Pavasini et al., 2016; Vestergaard et al., 2009).

A sarcopenia da obesidade é um conceito novo em que se observou inicialmente em pacientes idosos, pois existe naturalmente um decréscimo de massa magra e aumento da massa gorda, com o passar dos anos. Esta gordura, vai se depositando ao nível peri-celular da fibra muscular (Lexell et al., 1983). Estas alterações levam a produção pró-inflamatória de citocinas, como o Fator de Necrose Tumoral Alfa (TNF-α) e a Interleucina 6 (IL-6) que geram círculo vicioso de perda de massa magra e força, criando o conceito de sarcopenia da obesidade (Cesari et al., 2006). A obesidade exacerba a sarcopenia, pois há infiltração do tecido muscular com gordura, diminuindo a contratilidade muscular, força e sensibilidade do tecido muscular à insulina. (Barbat-Artigas et al., 2014; Tian et al., 2016; Newman et al., 2013; Dominguez et al., 2007). Além disso, o depósito de gordura intramuscular, gera dano mitocondrial, diminuindo a oxidação de ácidos graxos, aumentando os radicais livres, gerando apoptose das fibras musculares (Marzetti et al., 2013). Quando há associação da sarcopenia com a obesidade, há formação de um círculo vicioso, com comprovado maior fator de risco para desordens metabólicas, eventos cardiovasculares e inabilidades físicas do que quando a obesidade ou sarcopenia isoladas (Stephen et al., 2009; Oliveira et al., 2011; Domenguez et al., 2007;). Nas mulheres pós-menopausa, por exemplo, a sarcopenia da obesidade (SO) foi associada com pior resultado de função muscular e status cardiopulmonar. (Ibrahim et al., 2016). Por fim, há comprovado aumento de mortalidade nestes pacientes. (Kalinkovich et al., 2017; Barbat-Artigas et al., 2014; Tian et al., 2016; Newman et al., 2003).

No mesmo caminho, as alterações metabólicas ao nível muscular, geram e/ou pioram a resistência à insulina. Abbatecola et al. (2011), em ampla revisão sobre o assunto descrevem que a resistência insulínica (RI) aumenta com a idade e é fator independente de fraqueza muscular em idosos (Abbatecola et al., 2005). Da mesma forma, a perda de massa magra se dá 2 vezes mais rápida em pacientes com diabetes do que em não diabéticos (Park et al., 2009). A mitocôndria da musculatura esquelética tem ampla relação com a sinalização de insulina e entrada de glicose nestas células. Estudo observou que, com a injeção de insulina, há aumento da atividade mitocondrial, síntese protéica e produção de ATP na unidade muscular (Stump et al., 2003). A capacidade oxidativa da mitocôndria no paciente obeso fica ainda mais diminuída e é considerada consequência da RI (Hoeks et al., 2010). Há estudo de intervenção com atividade física comprovando melhora da atividade mitocondrial muscular (Short et al., 2003). Dadson et al. (2016), observaram o depósito de glicose e a ação da insulina no tecido adiposo e muscular em pacientes obesos diabéticos e não diabéticos e em controle não obesos. Foi observado, menor sensibilidade à insulina nos tecidos em pacientes obesos e diabéticos, mas de maneira mais pronunciada no tecido muscular que no adiposo. O paciente diabético apresentou menor sensibilidade à insulina e maior tecido adiposo visceral que o não diabético. Outros estudos, corroboram estes dados. (Camastra et al., 2017; Coen et al., 2015). Vijgen et al. (2013) corroboraram esta hipótese ao realizar estudo de análise histológica de fibra muscular com medida de atividade mitocondrial antes e após 1 ano de cirurgia bariátrica. Foi comprovado que a oxidação de gorduras fica prejudicada no paciente obeso, levando à resistência insulínica, mas que é reversível com os efeitos de grande perda de peso com a cirurgia.

A cirurgia bariátrica é reconhecida, atualmente, como a técnica mais efetiva para perda de peso a longo prazo (Buchwald et al., 2004; Adams et al., 2007). Adicionalmente, gera impactante decréscimo na incidência de mortalidade e comorbidades metabólicas associadas, tais como diabetes (Sjostrom et al., 2004; Buchwald et al., 2004; Maggard et al., 2005). A obesidade, por si só, é relatada como um estado inflamatório crônico subclínico, no qual gera atrofia muscular, aumento da presença de macrófagos no tecido e desregulação no metabolismo (Cleasby et al., 2016). A perda de peso, quando ocorre, se dá basicamente pela perda de massa gorda (PMG). No entanto, é inevitável que aconteça também, a perda de massa magra (PMM) e a massa muscular (MM), em si (Chaston et al., 2007). A PMM excessiva é prejudicial, pois ela participa na regulação do metabolismo celular e glicêmico, na sustentação dos ossos e na manutenção da função e qualidade de vida desses pacientes, podendo apresentar até fadiga muscular crônica., conforme já mencionado. É vital reconhecermos e incentivarmos métodos de perda de peso que sustentem a MM (Marks et al., 1996). A perda de peso é diretamente afetada pelos níveis de PMM, sendo estimada após a cirurgia bariátrica em torno de 31% (Chaston et al., 2007). Webster et al. (1984) chegaram a um número limite de PMM de

22% para se ter um emagrecimento saudável. Sabe-se que a célula muscular é envolvida no depósito pós-prandial de glicose e é fator determinante para sensibilidade de insulina. Estes conceitos já foram implicados em estudos prévios como determinantes na perda de peso do paciente e na regulação e sensibilização de insulina (Severino et al., 2016).

Vários estudos já relataram o poder metabólico da cirurgia bariátrica. Hayoz et al. (2018), observaram melhora importante dos parâmetros metabólicos, especialmente nos operados com a técnica de Gastroplastia em Y de Roux (Bypass), tendo melhor controle a curto e médio prazos de diabetes e dislipidemia. Billeter et al., (2018) não observaram diferenças de resolução de comorbidades entre as técnicas Bypass e Gastrectomia Vertical (Sleeve), ocorrendo importante impacto na redução das doenças associadas. Shoar et al. (2016), em outra meta análise de 14 estudos com 5264 pacientes em seguimento de até 76 meses, observaram diferença favorável ao Bypass gástrico em relação a perda de peso no longo prazo, porém sem diferenças em relação às comorbidades.

Considerando os dados expostos de que o paciente obeso possui fator de risco para ser sarcopênico e que a cirurgia bariátrica possui grande poder de resolução de comorbidades associadas, porém com potencial risco de perda de massa magra, desenvolvemos 2 hipóteses para serem observadas nos artigos a seguir: Existe sarcopenia no paciente obeso candidato à cirurgia bariátrica? E, as alterações metabólicas provocadas pela cirurgia bariátrica são capazes de melhorar ou alterar a força e função muscular destes pacientes?

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2. Objetivos

2.1 Artigo 1

2.1.1 Objetivo geral

O objetivo do presente estudo é avaliar a presença ou não de sarcopenia na população obesa candidata à cirurgia bariátrica em um centro de referência.

2.1.2 Objetivos Específicos

- Verificar dados antropométricos
- Verificar dados laboratoriais
- Verificar diferenças entre técnicas cirúrgicas

2.2 Artigo 2

2.2.1 Objetivo geral

Objetivo do presente estudo é avaliar a correlação entre os critérios diagnósticos de sarcopenia e as repercussões metabólicas durante os primeiros 6 meses após a cirurgia bariátrica.

2.2.2 Objetivos específicos

- Verificar dados antropométricos
- Verificar dados laboratoriais
- Verificar diferenças entre técnicas cirúrgicas

Os artigos que contemplam os referidos objetivos são apresentados a seguir:

3. Artigo 1

Sarcopenic obesity: effects of bariatric surgery on muscle quantity, strength, and function: a cohort study.

Short title: Sarcopenic obesity

ABSTRACT

Introduction: Obesity is a global health problem. The concept of sarcopenia is well known and widely studied in older adults, but there is mounting evidence of the harmful effects of sarcopenic obesity, a condition that impacts cardiovascular risks and life expectancy in the obese.

Objectives: To ascertain whether sarcopenia is present in obese candidates for bariatric surgery and to assess if surgery modifies the quantity, strength, and function of skeletal muscle in this population.

Methods: Consecutive patients who presented in search of bariatric surgery were selected following an institutional protocol. Muscle evaluation and laboratory tests were performed at two time points: preoperative baseline and 6 months after bariatric surgery.

Results: A total of 129 patients were selected. Pre- and postoperative data were available for 62 of these. In 41 patients, sleeve gastrectomy was performed and in 21, Roux-en-Y gastric bypass. The mean age of participants was 37.7 years, and 88.4% were female. Overall, 47.8% reported sedentary behavior. The mean BMI was 41.8 kg/m^2. There was a significant reduction in anthropometric parameters such as fat mass, appendicular lean mass, and BMI. Strength test performance remained stable, while muscle performance improved.

Conclusions: We found no evidence of sarcopenia in candidates for bariatric surgery, confirming the hypothesis that the non-elderly obese have quantitatively greater muscle mass, but such muscle mass is less functional and of lower quality. Bariatric surgery was followed by improvement in several anthropometric parameters.

Keywords: Sarcopenic obesity, Bariatric surgery, Muscle strength and function

INTRODUCTION

Sarcopenia was first studied in older adults, but onset can occur even before the age of 50, especially in chronic diseases such as obesity [1]. It is a progressive, generalized disorder of skeletal muscles [2], in which lack of strength is more important than overall muscle mass [3]. Presence of sarcopenia is associated with increased incidence of falls and fractures, loss of independence for activities of daily living, and comorbidities among older adults. There is a proven 5-fold increase in the cost of care for sarcopenic patients [4].

The definition of sarcopenia is based on the presence or absence of reduced muscle strength. If this criterion is present, then reduced muscle quantity and quality—combined with poor muscle performance—define whether sarcopenia is severe [2]. Sarcopenic obesity is a new concept, initially observed in older adults with low lean body mass and increased fat mass (two conditions that become more prevalent with age). Obesity exacerbates sarcopenia; as muscle tissue is infiltrated with fat, it loses function and strength, and the risk of mortality increases [5-8]. When sarcopenia and obesity co-occur, there is greater risk of metabolic disorders, cardiovascular events, and physical disabilities than in either obesity or sarcopenia alone [9,10]. Since both conditions may be synergistic, the aim of the present study is to assess the presence of sarcopenia among obese candidates for bariatric surgery at a referral center and to evaluate if sarcopenia is modified by the surgical procedure by assessing skeletal muscle quantity, strength, and function.

MATERIALS AND METHODS

A prospective cohort of obese patients seeking bariatric surgery at a referral center were selected following an institutional protocol. All patients provided written informed consent for participation. The study protocol was approved by the institutional research ethics committee numbered as 73910017.0.0000.5335. Muscle evaluation and laboratory tests were performed at two time points: preoperative baseline and 6 months after bariatric surgery. Muscle mass was assessed by bioelectrical impedance analysis (BIA) in an InBody 720 device. BIA can provide details of skeletal muscle mass, such as appendicular lean mass which is strongly recommended by an international consensus of sarcopenia [1]. Muscle strength was evaluated by measurement of handgrip strength with a Jamar dynamometer. Handgrip strength is considered a strong predictor of adverse outcomes such as length of hospital stay, functional limitations, poor quality of life, and death [11,12]. The Jamar dynamometer method, used in this study, has already been validated in previous research [13]. Muscle function was assessed by Timed Up and Go (TUG) test. The TUG test consists of getting up from a chair, walking 3 meters, turning around, walking back to the chair, and sitting back down. This process is timed [14]. By the TUG test, we could infer the gait speed test. The gait speed test is considered fast, safe, and reliable. It has good predictive value for adverse events related to sarcopenia, such as disability, cognition, falls, and mortality [15-18]. The test consists of walking for 4 minutes and measuring gait speed throughout. In addition, laboratory data concerning metabolic and nutritional features were analyzed and a physical activity questionnaire applied (IPAQ-International physical applied questionnaire) [19]. Concerning the surgical technique, Roux-en-Y Gastric Bypass (RYGB) was preferably performed when patients presented with metabolic syndrome, diabetes and gastro-esophageal reflux disease.

STATISTICAL ANALYSIS

Quantitative variables were expressed as mean and standard deviation, and categorical variables, as absolute and relative frequencies. Student's *t*-test was applied for comparison of means. Pearson correlation coefficients were calculated to test for association between numerical variables. A generalized estimating equations (GEE) model with Bonferroni adjustment was used to compare variables between the two time points of assessment (before and after surgery).

To control for confounding factors, a linear regression model with backward extraction was run to identify factors independently associated with variation in muscle strength. Variables with $p<0.20$ on bivariate analysis were included in the multivariate model.

The level of significance was set at 5% ($p<0.05$), and all analyses were performed using SPSS Version 21.0.

RESULTS

A total of 129 consecutive patients were selected. Of these, 57 did not complete the study: 21 refused to proceed, 3 became pregnant, and 33 were lost to follow-up. Pre- and postoperative data were ultimately available for 62 patients. The mean age was 37.7 years, and 88.4% of participants were female (Table 1). The mean Body Mass Index (BMI) was 41.8 kg/m^2, and 47.3% of the population was sedentary, according to the IPAQ. Table 1 describes the characteristics of the patients who underwent surgery. Overall, 41 underwent vertical sleeve gastrectomy (SG group), while 21 underwent Roux-en-Y gastric bypass (RYGB group).

Anthropometric parameters: BIA data in the pre- and postoperative periods showed a total weight loss of 31% on average, corresponding to a mean of 11.5 kg/m^2 reduction in the BMI. Lean mass changes: The average lean body mass loss was 4 kg, ranging from 4.6 to 3.5 kg. The appendicular lean mass average declined from 24.4 kg to 20.9 kg. The mean ratio of appendicular lean mass to height (kg/m^2) declined significantly, from 9 to 7.7. The mean ratio of appendicular lean mass to BMI (m^2), ranged from 0.58 to 0.69. The basal metabolic rate also declined, from 1617 to 1486. Fat mass changes: The mean body fat percentage also significantly reduced from 49.1% to 36.9%. Reductions in fat mass could also be observed in body fat percentage (49.1% to 36.9%), waist-to-rip ratio (1.02 to 0.95), obesity grade (195.8% to 142.4%) and visceral fat (19.9m^2 to 14m^2). All these parameters were significant altered after bariatric surgery and there was no difference between both techniques. These data are detailed in Table 2.

Metabolic and nutritional parameters were also improved after surgery (Table 3). There was a significant decrease in mean fasting blood glucose (from 96.3 mg/dL to 83mg/dL), mean total cholesterol (185.6mg/dL to 163.7mg/dL), triglycerides (128mg/dL to 88.7mg/dL), uric acid (5.1mg/dL to 4.4mg/dL) and gamma-glutamyl transferase

(GGT) (34U/L to 24.3U/L). Furthermore, vitamin B_{12} and vitamin D levels improved significantly after bariatric surgery, ranging from 419pg/ml to 630.6 and 22.7ng/ml to 27.9ng/ml, respectively. All these parameters, except for GGT and uric acid were statistically significant and there was no difference between both surgical techniques. (Table 3)

Regarding muscle function, significant improvements were observed in gait speed and in the TUG test after surgery. Patients could achieve the tests 0.3s and 1s faster, respectively. Concerning to strength, handgrip remained stable, 25.7kg to 25.4kg with no statistical difference. (Table 4) The comparison of muscle strength and function scores, metabolic variables, and anthropometric parameters between surgical techniques revealed no significant difference (Table 5).

DISCUSSION

We found no evidence of sarcopenia in this sample of candidates for bariatric surgery. The muscle strength criteria for diagnosis of sarcopenia were last defined in a European consensus statement in 2018 [2]. The consensus defined strength cutoff points of <27 kg for men and <16 kg for women. Likewise, the U.S. consensus established the same criteria, but changing the male cutoff point to 26 kg [20]. In our study, no patient exhibited handgrip strength below these levels (and thus diagnostic of sarcopenia). The mean handgrip strength in men was 39.5 kg in the preoperative period, decreasing to 37.1 kg postoperatively. In women, these values were 23.06 kg and 23.1 kg, respectively (Table 6). On the other hand, we found an improvement of muscle functional results. Both TUG and gait speed tests showed better figures, probably because weight loss induced an enhancement in mobility and agility.

In our study, we found that obese candidates for bariatric surgery had good muscle mass, corroborating previous research [21] which found that obesity was associated with an increase in muscle mass, suggesting greater force production capacity. However, this increase in strength is of low quality, since obesity alters muscle function [22,23]. Barbat-Artigas et al. [24] introduced the concept of a muscle quality (MQ) index, which they define as a ratio of muscle strength per unit of muscle mass. In their sample of 47 obese subjects, the authors observed that the higher the BMI, the lower the muscle function index. In other words, obese individuals have greater appendicular lean mass, which possibly makes them capable of generating greater force, but, in a probable compensatory mechanism, this greater force generates equal muscle function.

The present study confirms the findings of Stoklossa et al. [25], who also did not observe sarcopenia in the non-elderly obese. These authors measured muscle mass by dual-energy x-ray absorptiometry (DXA), using an appendicular muscle mass index relative to the patient's height. That study did not include measurements of strength or performance. The mean age was 47 years, and there were no cases of sarcopenia. The authors also report that there is no accurate and standardized parameter for measurement of lean mass in obese patients. Some studies evaluate only total lean mass; others assess appendicular lean mass. These authors also found a wide variability in lean mass among subjects with the same BMI, especially in women, probably due to hormonal factors in the pre- and postmenopausal periods. Another study assessed the possibility of osteosarcopenia in obese subjects and also found no data to support this concept [26]. Choi et al. [27], in a review article, did not consider the term sarcopenic obesity to be appropriate, due to the wide range of definitions and lack of unified criteria.

We found improvements in metabolic parameters such as blood glucose, total cholesterol and triglycerides. Although the difference in mean uric acid and GGT improvements did not reach statistical significance, our data corroborate several studies, which indicate that bariatric surgery improves metabolic features [28,29].

Regarding nutritional findings, we found a significant improvement in levels of vitamin B12 and vitamin D after surgery, that were due to post-operative replacement, according to our institutional protocol.

Limitations of our study include a short-term follow-up (6 months) and that many patients were lost to follow-up. DXA that could be considered the gold standard for measuring lean body mass by some authors was not applied [20]. On the other hand, BIA is a standardized, portable, easy to perform and well-established method for evaluating muscle mass. In addition, the study comprised a considerable sample of operated patients who were analyzed before and after surgery.

This series is probably one of the few studies to date, which prospectively applied all international consensus criteria for the diagnosis of sarcopenia to a cohort of operated obese patients, including muscle mass (quantity), strength, and function. We confirm the findings of several previous studies that sarcopenia does not occur in obese candidates for bariatric surgery, most likely because operated patients are usually young. We acknowledge that, with advancing age, sarcopenia becomes more prevalent and, when co-existing with obesity, clinical outcomes can be worsened. There were no differences between SG and RYGB in any of the parameters of interest in this study, although the sample size was underpowered for such comparisons. In summary, the present study demonstrates that sarcopenia does not occur in obese candidates for bariatric surgery and anthropometric and metabolic variables improve after surgery. Larger studies with longer follow-up are warranted to provide additional evidence and further debate on this topic.

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Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval

The study was approved by the Institutional Review Board with opinion number 73910017.0.0000.5335.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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TABLES

Table 1. Profile of patients who underwent bariatric surgery.

Variable	**Overall sample (*n*=62)**	**Vertical sleeve gastrectomy (*n*=41)**	**Roux-en-Y gastric bypass (*n*=21)**
Age (years), mean ± SD	38.4 ± 10.8	38.1 ± 11.1	39.0 ± 10.4
Sex, n (%)			
Female	52 (83.9)	33 (80.5)	19 (90.5)
Level of physical activity, n (%)			
Inactive	23 (37.1)	17 (41.5)	6 (28.6)
Irregularly active B	15 (24.2)	9 (22.0)	6 (28.6)
Irregularly active A	16 (25.8)	11 (26.8)	5 (23.8)
Active	7 (11.3)	3 (7.3)	4 (19.0)
Very active	1 (1.6)	1 (2.4)	0 (0.0)
BMI (kg/m^2), mean ± SD	42.2 ± 5.4	42.3 ± 5.7	42.1 ± 4.9

BMI-Body mass index
SD- standard deviation
IPAQ (International Physical Activity questionnaire) levels of activity:
Irregularly active B: None of these minimal activities
Irregularly active A: Physical activities of 150 minutes in a week or 5 times in a week

Table 2. Comparison of bioelectrical impedance data preoperatively and 6 months after surgery.

Variable	**Preoperative**	**Postoperative (6 months)**	**Difference (95%CI)**	***P***
	Mean ± SE	**Mean ± SE**		
Total body weight (kg)	113.5 ± 2.2	82.5 ± 1.6	-31.0 (-33.2 to -28.9)	<0.001
BMI (kg/m^2)	42.2 ± 0.7	30.7 ± 0.5	-11.5 (-12.2 to -10.8)	<0.001
Lean body mass (kg)	32.5 ± 0.8	28.5 ± 0.6	-4.1 (-4.6 to -3.5)	<0.001
Fat mass (kg)	55.8 ± 1.3	30.8 ± 1.2	-25.0 (-26.8 to -23.2)	<0.001
Appendicular lean mass (kg)	24.4 ± 0.6	20.9 ± 0.5	-3.4 (-3.8 to -3.1)	<0.001
Appendicular lean mass/height^2 (kg/m^2)	9.0 ± 0.1	7.7 ± 0.1	-1.3 (-1.4 to -1.2)	<0.001
Appendicular lean mass/BMI (m^2)	0.58 ± 0.01	0.69 ± 0.02	0.11 (0.56 to 0.12)	<0.001
Fat mass/Lean mass ratio	1.74 ± 0.03	1.11 ± 0.05	-0.63 (-0.69 to -0.57)	<0.001
Body fat percentage, %	49.1 ± 0.5	36.9 ± 1.0	-12.2 (-13.5 to -10.9)	<0.001
Basal metabolic rate	1617 ± 27.0	1486 ± 22.0	-131 (-150.6 to -111.5)	<0.001
Waist-to-hip ratio	1.02 ± 0.0	0.95 ± 0.01	-0.07 (-0.08 to -0.06)	<0.001
Obesity grade (%)	195.8 ± 3.2	142.4 ± 2.5	-53.4 (-56.5 to -50.2)	<0.001
Visceral fat (m^2)	19.9 ± 0.1	14.0 ± 0.5	-5.9 (-6.9 to -4.9)	<0.001

BMI-Body mass index
CI –Confidence Interval
SE- Standard Error

Table 3. Comparison of laboratory parameters preoperatively and 6 months after surgery.

Variable	**Preoperative**	**Postoperative (6 months)**	**Difference (95%CI)**	***P***
	Mean ± SE	**Mean ± SE**		
Hemoglobin (g/dL)	12.8 ± 0.2	12.5 ± 0.2	-0.3 (-0.7 to 0.1)	0.164
Fasting glucose (mg/dL)	96.3 ± 2.6	83.0 ± 1.3	-13.3 (-18.1 to -8.5)	<0.001
Glycated hemoglobin (A1C) (%)	5.6 ± 0.2	5.4 ± 0.2	-0.2 (-0.8 to 0.4)	0.518
Total cholesterol (mg/dL)	185.6 ± 4.0	163.7 ± 4.2	-21.9 (-30.3 to -13.5)	<0.001
Triglycerides (mg/dL)	128.0 ± 7.5	88.7 ± 6.0	-39.3 (-53.7 to -24.9)	<0.001
High-density lipoprotein (HDL) cholesterol(mg/dL)	50.0 ± 1.9	50.0 ± 2.5	0.0 (-5.8 to 5.7)	0.994
Gamma-glutamyltransferase(U/L)	34.0 ± 2.1	24.3 ± 3.6	-9.7 (-16.7 to -2.7)	0.007
Aspartate aminotransferase(U/L)	21.2 ± 1.1	27.5 ± 2.7	6.3 (0.4 to 12.1)	0.034
Alanine aminotransferase(U/L)	26.1 ± 2.0	31.7 ± 5.9	5.6 (-6.8 to 18.0)	0.379
Vitamin B_{12}(pg/mL)	419.5 ± 22.2	630.6 ± 54.6	211.2 (103.0 to 319.3)	<0.001
Folic acid (ng/mL)	8.5 ± 0.6	9.5 ± 0.8	1.0 (-0.8 to 2.8)	0.284
Vitamin D (ng/mL)	22.7 ± 1.0	27.9 ± 1.4	5.2 (2.4 to 7.9)	<0.001
Zinc (µg/dL)	42.8 ± 9.7	47.8 ± 11.6	5.0 (-20.6 to 30.6)	0.702
Uric acid (mg/dL)	5.1 ± 0.2	4.4 ± 0.2	-0.7 (-1.2 to -0.2)	0.006
Ferritin (ng/mL)	146.0 ± 22.2	217.7 ± 33.0	71.8 (11.0 to 132.5)	0.021
Iron (µg/dL)	77.7 ± 4.2	96.2 ± 16.1	18.4 (-13.6 to 50.5)	0.259

CI –Confidence Interval
SE- Standard Error

Table 4. Comparison of muscle strength and function parameters preoperatively and 6 months after surgery.

Variable	Preoperative	Postoperative (6 months)	Difference (95%CI)	*P*
	Mean ± SE	Mean ± SE		
Handgrip strength (kg)	25.7 ± 1.2	25.4 ± 1.0	-0.3 (-0.7 to 0.9)	0.647
TUG (s)	9.9 ± 0.2	8.9 ± 0.2	-1.0 (-1.4 to -0.6)	<0.001
Gait speed (s)	0.62 ± 0.01	0.69 ± 0.01	0.07 (0.04 to 0.09)	<0.001

TUG: Timed Up and Go Test
CI –Confidence Interval
SE- Standard Error

Table 5. Comparison of change in muscle strength and function scores, metabolic variables, and anthropometric parameters between surgical techniques.

Variable	**Vertical sleeve gastrectomy (*n*=41)**	**Roux-en-Y gastric bypass (*n*=21)**	***P***
	Mean ± SE	**Mean ± SE**	
Handgrip strength (kg)	-0.69 ± 4.99	0.50 ± 5.11	0.380
TUG (s)	-1.19 ± 1.57	-0.73 ± 1.56	0.271
Gait speed (s)	0.08 ± 0.09	0.05 ± 0.12	0.423
Blood glucose (mg/dL)	-15.6 ± 20.4	-18.1 ± 21.6	0.691
Glycated hemoglobin (%)	0.25 ± 2.22	-1.12 ± 2.23	0.101
Appendicular lean mass (kg)	-3.37 ± 1.34	-3.55 ± 1.52	0.641
Appendicular lean mass/height^2(kg/m^2)	-1.23 ± 0.43	-1.34 ± 0.58	0.397
Lean body mass (kg)	-4.18 ± 2.07	-3.80 ± 2.50	0.526
Appendicular lean mass/BMI (m^2)	0.11 ± 0.05	0.11 ± 0.06	0.933
Fat mass/Lean mass ratio	-0.60 ± 0.22	-0.69 ± 0.28	0.185
Percent weight loss (%)	-26.8 ± 5.8	-27.8 ± 4.5	0.471
BMI (kg/m^2)	-11.3 ± 2.9	-11.8 ± 2.5	0.594
Body fat percentage (%)	-11.5 ± 5.0	-13.5 ± 5.8	0.157
Fat mass (kg)	-24.6 ± 7.8	-25.7 ± 6.5	0.574
Visceral fat	-5.41 ± 3.95	-6.95 ± 4.09	0.157
Obesity grade (%)	-52.7 ± 13.6	-54.7 ± 11.6	0.558
Waist-to-hip ratio	-0.07 ± 0.03	-0.08 ± 0.05	0.321

SE- Standard Error
TUG: Timed Up and Go Test
BMI-Body mass index

Table 6. Group statistics.

Strength test	Sex	n	Mean	Standard deviation	Standard error of the mean
	.0	52	23,067	6.9374	.9620
Handgrip1	1.0	10	39,500	9.7297	3.0768
Handgrip2	.0	52	23,173	5.7861	.8024
	1.0	10	37.150	8.4625	2.6761
Deltahand	.0	52	.1058	4.72928	.65583
	1.0	10	-2.3500	6.24077	1.97351

P<0.001 for handgrip 1 and 2. For delta (P=0.159).

4. Artigo 2

Muscle strength is the only sarcopenia diagnosis criteria associated to metabolic effects during the early postoperative months after bariatric surgery.

ABSTRACT

Introduction: An aggravation in pre-existing sarcopenia or the onset of sarcopenia may occur in the scenario of extensive and fast weight loss following bariatric surgery. Although the impact of sarcopenia in patients after weight loss operations is still uncertain, the accurate identification of this outcome and its repercussions is vital for its correct management.

Objective: To evaluate the correlation between the diagnosis criteria for sarcopenia and metabolic repercussions during the first 6 months following bariatric surgery.

Methods: A prospective single-center cohort study was conducted. Convenience sampling was performed among severely obese patients undergoing pre-operative evaluation for bariatric surgery at the same obesity unit. Skeletal muscle mass was evaluated through bio-electrical impedance analysis (BIA). Skeletal muscle strength was evaluated through hand grip test. Skeletal muscle performance was evaluated through Timed get-up and go test and Gate Speed test. Metabolic and nutritional evaluation were determined by laboratory blood testing. Physical Activity Questionnaire was applied for sample characterization. Overall evaluation was performed before surgery and 6 months later.

Results: A total of 129 patients were selected, 62 participants were included in the final analysis. Mean age was 37.7 years and 88.4% of participants were women. Mean

body mass index was 41.8 kg/m2 and 47.8% of patients were sedentary. Sleeve gastrectomy was performed in 41 patients and Roux-en-Y gastric bypass in 21 patients. Significant improvement regarding muscle strength and function after surgery was observed. Sarcopenia criteria were not met by any participant before and after surgery. Blood glucose and ferritin levels remained independently associated with change in muscle strength.

Conclusion: Functional evaluation methods did not reflect the reduction in skeletal muscle mass demonstrated in BIA 6 months after bariatric surgery in comparison to the preoperative baseline. Improvement in muscle strength was followed by improvement in metabolic parameters.

INTRODUCTION

Sarcopenia is a condition defined by progressive and generalized loss of skeletal muscle mass and function (strength or performance)[1]. It involves muscle mass/fat ratio imbalance characteristic of aging - but also obesity. The simultaneous existence of sarcopenia and obesity have been called sarcopenic obesity and its occurrence is likely to escalate concurring with the increasing prevalence of obesity[1-4]. Sarcopenia is associated with unfavorable health outcomes, such as metabolic syndrome, cardiovascular disease, liver impairment and osteoporosis [3-11]. Adverse outcomes also include functional and physical disability, decreased quality of life, and mortality[1].

Bariatric surgery remains the most effective treatment for severe obesity. When compared to intensive lifestyle intervention and optimized clinical management, long term follow up after bariatric operations shows superior and sustained weight loss [12-15]. In addition to Body Mass Index (BMI) reduction, weight loss surgery also leads to broad metabolic benefits; significant improvement in obesity-related comorbidities; decrease in cardiovascular risk and events; reduction in cancer risk; mitigation of psychosocial adversities and in overall mortality [16-32].

Propelled by its results, the performance of bariatric surgery has been on the rise. According to the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO), at least 830,000 patients underwent weight loss surgery throughout 61 countries in 2019 - almost as double as the 394,431 operations registered in 51 countries in 2018[33]. The increasing number of post-bariatric patients brings challenges in the evaluation of weight loss quality and its effects.

An aggravation in pre-existing sarcopenia or the onset of sarcopenia may occur in the scenario of extensive and fast weight loss following bariatric surgery and its identification and metabolic effects are not well documented [34-37]. Muscle strength is the key for sarcopenia diagnosis, and it can be assessed through qualitative and quantitative evaluation. The approach to sarcopenia remains a medical challenge and current strategies are often ineffective. Although the impact of sarcopenia in patients after weight loss operations is still uncertain, the accurate identification of this outcome and its repercussions is vital for its correct management. The objective of this study is to evaluate the correlation between sarcopenia diagnosis criteria and metabolic repercussions during the first 6 months following bariatric surgery.

METHODS

Subjects

A prospective single-center cohort study was conducted. Convenience sampling was performed among severely obese patients undergoing pre-operative evaluation for bariatric surgery at the same obesity treatment referral center between September of 2017 and December of 2018. Criteria included: (1) Age between 18 and 65 years old; (2) Obesity with BMI ≥40 or BMI ≥35 associated with comorbid conditions and not responding to medical treatment for 2 years; (3) No psychological contraindication for surgery; (4) No previous bariatric surgery.

Pre- and post-operative evaluation

Overall evaluation was performed before surgery and 6 months later. Skeletal muscle mass was evaluated through bio-electrical impedance analysis (BIA) [38]. Skeletal muscle strength was evaluated through hand grip test (HG) [39]. Skeletal muscle performance was evaluated through Timed get-up and go test (TGUG) [40] and Gate Speed test (GS) [41]. Metabolic and nutritional evaluation were determined by laboratory blood testing. Physical Activity Questionnaire (IPAQ) [42] was applied for sample characterization. Sarcopenia was determined according to the European consensus strength cutoff points of <27kg for men and <16kg for women.

Bodyweight and height were measured using standard equipment. Body mass index (BMI) was calculated as weight/height². BIA estimates the volume of lean body mass and fat and was performed in an InBody 720 device. HG test was evaluated with a Jamar dynamometer and the median of three measurements was considered. TGUG test is a measure of the time needed for the subject to stand up from a chair, walk for 3 meters distance, turn around, return and sit down again. GS test is a measure of gait speed throughout a 4-minute walk. IPAQ validated questionnaire evaluates the time each subject spends being physically active in the last 7 days - including work, house and yard routine, commute, and spare time for recreation, exercise or sport. Patients are classified in levels of activity that include irregularly active B (no activity), irregularly active a (physical activities for 150 minutes a week or 5 times a week), and active (physical activities for more than 150 minutes a week or more than 5 times a week). Laboratory testing parameters included the following biological markers: hemogram, fasting blood glucose, glycosylated hemoglobin (HbA1c), total cholesterol, triglyceride, LDL-cholesterol, HDL-cholesterol, total cholesterol, triglycerides, high density lipoprotein cholesterol, alanine aminotransferase (ALT), aspartate aminotransferase (AST), vitamin B12, folic acid, vitamin D, zinc, uric acid, ferritin and iron.

Surgical procedures

All patients went laparoscopic sleeve gastrectomy (SG) or Roux-en-Y gastric by-pass (RYGB) at the same obesity treatment center and according to patient and multidisciplinary team judgement. RYGB was preferably performed in patients who presented with metabolic syndrome or gastro-esophageal reflux disease.

Statistical Analysis

Quantitative variables were expressed as mean and standard deviation and categorical variables as absolute and relative frequencies. Comparison of means was performed through Student's t-test. Association between numerical variables was calculated through Pearson correlation coefficients. Generalized estimating equations (GEE) model with Bonferroni adjustment was used to compare variables between the two time points of assessment (before and after surgery). To control for confounding factors, linear regression model with backward extraction was run to identify factors independently associated with variation in muscle strength. Variables with $p<0.20$ on bivariate analysis in association with change in handgrip strength were included in a multivariate linear regression model with backward extraction to identify factors independently associated with this outcome. Level of significance was set at 5% ($p<0.05$). All analyses were performed using SPSS Version 21.0.

Ethical Considerations

Written informed consent was obtained from all participants. The study protocol and the informed consent procedure were approved by the institutional ethics committee under the registration number 73910017.0.0000.5335.

RESULTS

A total of 129 patients were selected. Fifty-seven patients were excluded - 21 patients refused to participate, 3 patients became pregnant, and 33 patients were lost to follow-up. A total of 62 participants were included in the final analysis and their characteristics are presented in Table 1. Mean age was 37.7 years and 88.4% of participants were female. Mean BMI was 41.8 kg/m2. SG was performed in 41 patients and RYGB was performed in 21 patients. According to IPAQ questionnaire, 47.8% of patients were sedentary.

Body composition assessment through BIA demonstrated an average weight loss of 31% - a mean 11.5kg/m² reduction in BMI (from 68.8% to 22.8% excess BMI). The average lean body mass and fat mass lost was 4kg and 25kg, respectively. The mean ratio of appendicular lean mass to height (kg/m²) was significantly reduced from 9 to 7.7. The mean body fat percentage was significantly reduced from 49.1% to 36.9% (Table 2).

Significant improvement was observed regarding muscle strength and function evaluated by the TGUG test and gait speed test postoperatively. HG test results remained stable (Table 3). Sarcopenia criteria were not met by any participant during the 6-month follow up period.

Significant decrease in fasting blood glucose was detected (mean - 13.3mg/dL). Parameters such as total cholesterol and triglycerides were also significantly improved. Vitamin B12 and D levels increased significantly after surgery (Table 3)

Comparison of muscle strength and function scores, metabolic variables, and anthropometric parameters between surgical techniques revealed no significant difference (Table 4).

After adjustment by the multivariate model, change in blood glucose and ferritin levels remained independently associated with change in muscle strength, as shown in

Table 5 and Table 6. Percent weight loss was borderline significant after adjustment. For every 1 mg/dL reduction in blood glucose levels after surgery, there was an average increase of 0.08 units in handgrip strength after multivariate adjustment (Figure 1). For every 1-unit reduction in ferritin levels after surgery, there was an average increase of 0.02 units in handgrip strength.

DISCUSSION

Reduced skeletal muscle mass may be associated with the development of metabolic disease, such as type 2 diabetes. Likewise, skeletal muscle mass gain and strength is related with a lower risk of type 2 diabetes [43]. Although a reduction in skeletal muscle mass after surgery was detected in some studies [44,45], as well as, in our sample, this muscle mass decrease did not affect muscle function and was not enough to independently affect blood glucose levels. In our study, loss of skeletal muscle mass did not present any correlation with metabolic factors worsening. Moreover, patients in this sample presented an increase in muscle strength after surgery, although their significantly lean body mass loss, an outcome that has been correlated with improvement in glucose metabolism disorders [46]. The inverse relation between muscle strength and type 2 diabetes presented a linear positive correlation, what may be due to a greater peripheral insulin action.

Serum ferritin levels are an important marker of systemic inflammation and their values are directly correlated with other inflammatory markers levels, like HbA1c [47]. Serum ferritin also reflects body iron stores. It is suggested that increased serum ferritin levels in obese patients may be associated to a raise in fatty acids values and consequently, to an aggravation of insulin resistance due to iron metabolism imbalance [48]. A linear correlation between reduction in serum ferritin levels and increase in muscle strength was found in our analysis.

The contradictory association between loss of skeletal muscle mass, increase in muscle strength and improvement in metabolic parameters may strengthen the hypothesis that skeletal muscle tissue in the morbid obese patient is of lower functional and metabolic quality. Young severely obese patients have a greater quantity of skeletal muscle mass than the one expected for their weight, yet evidence suggests it is of lower quality. Due to fat infiltration into muscle tissue, its function may be impaired. A prior study evidenced a negative correlation between muscle strength and the degree of fat infiltration in the muscle tissue [49]. These findings reinforce the importance of adequate interpretation of skeletal muscle mass evaluation parameters and diagnosis criteria for sarcopenia. An isolated measurement of skeletal muscle mass may induce a false diagnosis. Loss of muscle mass after bariatric surgery may be considered a metabolic adaptative process, since factors related to muscle quality (like strength) and metabolic syndrome markers show significant improvement after surgery.

The high rate of weight loss in the early postoperative period of our patients did not induce the development of sarcopenia, what reinforces the safety of bariatric surgery as a weight loss strategy. Nevertheless, further studies on continuous loss of skeletal muscle mass must be conducted to evaluate the occurrence and long-term outcomes of this initial loss of lean body mass.

Limitations of this study included the non-individual analysis of the group of diabetic patients; the lack of direct markers of glucose intolerance; and general aspects of non-intervention studies, such as the lack of control over physical training and postoperative nutritional supplementation.

CONCLUSION

Functional evaluation methods (TGUG test, GS test and HG test) did not reflect the reduction in skeletal muscle mass demonstrated in BIA 6 months after bariatric surgery in comparison to the preoperative baseline. Improvement in muscle strength was followed by improvement in metabolic parameters.

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TABLES

Table 1 - Sample characteristics

Variable	Overall sample (n=62)	SG (n=41)	RYGB (n =21)
Age (years), mean ± SD	38.4 ± 10.8	38.1 ± 11.1	39.0 ± 10.4
Sex, n (%)			
Female	52 (83.9)	33 (80.5)	19 (90.5)
BMI (kg/m2), mean ± SD	42.2 ± 5.4	42.2 ± 5.7	42.1 ± 4.9
Level of physical			
activity, n (%)	23 (37.1)	17 (41.5)	6 (28.6)
Inactive	15 (24.2)	9 (22.0)	6 (28.6)
Irregularly active B	16 (25.8)	11 (26.8)	5 (23.8)
Irregularly active A	7 (11.3)	3 (7.3)	4 (19.0)
Active	1 1.6)	1 (2.4)	0 (0.0)

SD: Standard
CI: Confidence Interval
BMI: Body Mass Index
SG: Sleeve Gastrectomy
RYGB: Roux-en-Y Gastric Bypas

Table 2 - Comparison of BIA results before surgery and 6 months after surgery

Variable	Before surgery	6 months	Difference (95%CI)	P
	Mean ±SE	Mean ±SE		
Total body weight (kg)	113.5 ±2.2	82.5 ±1.6	-31.0 (-33.2 to -28.9)	<0.001
BMI (kg/m2)	42.2 ±0.7	30.7 ±0.5	-11.5 (-12.2 to -10.8)	<0.001
Lean body mass (kg)	32.5 ±0.8	28.5 ±0.6	-4.1 (-4.6 to -3.5)	<0.001
Fat mass (kg)	55.8 ±1.3	30.8 ±1.2	-25.0 (-26.8 to -23.2)	<0.001
Appendicular lean mass (kg)	24.4 ±0.6	20.9 ±0.5	-3.4 (-3.8 to -3.1)	<0.001
Appendicular lean mass/height2 (kg/m2)	9.0 ±0.1	7.7 ±0.1	-1.3 (-1.4 to -1.2)	<0.001
Appendicular lean mass/BMI (m2)	0.58 ±0.01	0.69 ±0.02	0.11 (0.56 to 0.12)	<0.001
Fat mass/Lean mass ratio	1.74 ±0.03	1.11 ±0.05	-0.63 (-0.69 to -0.57)	<0.001
Body fat percentage, %	49.1 ±0.5	36.9 ±1.0	-12.2 (-13.5 to -10.9)	<0.001
Basal metabolic rate	1617 ±27.0	1486 ±22.0	-131 (-150.6 to -111.5)	<0.001
Waist-to-hip ratio	1.02 ±0.0	0.95 ±0.01	-0.07 (-0.08 to -0.06)	<0.001
Obesity grade (%)	195.8 ±3.2	142.4 ±2.5	-53.4 (-56.5 to -50.2)	<0.001
Visceral fat (m2)	19.9 ±0.1	14.0 ±0.5	-5.9 (-6.9 to -4.9)	<0.001

BIA: Bioimpedance
SE: Standard Error
CI: Confidence Interval
BMI: Body Mass Index

Table 3 - Comparison of muscle parameters before surgery and 6 months after surgery

Variable	Before surgery	6 months	Difference (95%CI)	P
	Mean ±SE	Mean ±SE		
Hand grip strength (kg)	25.7 ±1.2	25.4 ±1.0	-0.3 (-0.7 to 0.9)	0.647
TUG *(s)	9.9 ±0.2	8.9 ±0.2	-1.0 (-1.4 to -0.6)	<0.001
Gait speed (s)	0.62 ±0.01	0.69 ±0.01	0.07 (0.04 to 0.09)	<0.001

SE: Standard Error
CI: Confidence Interval
*Timed Up and Go

Table 4 - Comparison of laboratory parameters before surgery and 6 months after surgery

Variable	Before surgery	6 months	Difference (95%CI)	P
	Mean ±SE	Mean ±SE		
Hemoglobin (g/dL)	12.8 ±0.2	12.5 ±0.2	-0.3 (-0.7 to 0.1)	0.164
Fasting glucose (mg/dL)	96.3 ±2.6	83.0 ±1.3	-13.3 (-18.1 to -8.5)	<0.001
Glycated hemoglobin (A1C) (%)	5.6 ±0.2	5.4 ±0.2	-0.2 (-0.8 to 0.4)	0.518
Total cholesterol (mg/dL)	185.6 ±4.0	163.7 ±4.2	-21.9 (-30.3 to -13.5)	<0.001
Triglycerides (mg/dL)	128.0 ±7.5	88.7 ±6.0	-39.3 (-53.7 to -24.9)	<0.001
High-density lipoprotein (HDL) cholesterol(mg/dL)	50.0 ±1.9	50.0 ±2.5	0.0 (-5.8 to 5.7)	0.994
Gamma-glutamyltransferase(U/L)	34.0 ±2.1	24.3 ±3.6	-9.7 (-16.7 to -2.7)	0.007
Aspartate aminotransferase(U/L)	21.2 ±1.1	27.5 ±2.7	6.3 (0.4 to 12.1)	0.034
Alanine aminotransferase(U/L)	26.1 ±2.0	31.7 ±5.9	5.6 (-6.8 to 18.0)	0.379
Vitamin B12(pg/mL)	419.5 ±22.2	630.6 ±54.6	211.2 (103.0 to 319.3)	<0.001
Folic acid (ng/mL)	8.5 ±0.6	9.5 ±0.8	1.0 (-0.8 to 2.8)	0.284
Vitamin D (ng/mL)	22.7 ±1.0	27.9 ±1.4	5.2 (2.4 to 7.9)	<0.001
Zinc (µg/dL)	42.8 ±9.7	47.8 ±11.6	5.0 (-20.6 to 30.6)	0.702
Uric acid (mg/dL)	5.1 ±0.2	4.4 ±0.2	-0.7 (-1.2 to -0.2)	0.006
Ferritin (ng/mL)	146.0 ±22.2	217.7 ±33.0	71.8 (11.0 to 132.5)	0.021
Iron (µg/dL)	77.7 ±4.2	96.2 ±16.1	18.4 (-13.6 to 50.5)	0.259

SE: Standard Error
CI: Confidence Interval

Table 5 - Comparison of change in muscle strength and function scores, metabolic variables, and anthropometric parameters between surgical techniques

Variable	SG (n=41)	RYGB (n=21)	P
	Mean ±SE	Mean ±SE	
Handgrip strength (kg)	-0.69 ±4.99	0.50 ±5.11	0.380
TUG** (s)	-1.19 ±1.57	-0.73 ±1.56	0.271
Gait speed (s)	0.08 ±0.09	0.05 ±0.12	0.423
Blood glucose (mg/dL)	-15.6 ±20.4	-18.1 ±21.6	0.691
Glycated hemoglobin (%)	0.25 ±2.22	-1.12 ±2.23	0.101
Appendicular lean mass (kg)	-3.37 ±1.34	-3.55 ±1.52	0.641
ALM*/height2(kg/m2)	-1.23 ±0.43	-1.34 ±0.58	0.397
Lean body mass (kg)	-4.18 ±2.07	-3.80 ±2.50	0.526
ALM/BMI (m2)	0.11 ±0.05	0.11 ±0.06	0.933
Fat mass/Lean mass ratio	-0.60 ±0.22	-0.69 ±0.28	0.185
Percent weight loss (%)	-26.8 ±5.8	-27.8 ±4.5	0.471
BMI (kg/m2)	-11.3 ±2.9	-11.8 ±2.5	0.594
Body fat percentage (%)	-11.5 ±5.0	-13.5 ±5.8	0.157
Fat mass (kg)	-24.6 ±7.8	-25.7 ±6.5	0.574
Visceral fat	-5.41 ±3.95	-6.95 ±4.09	0.157
Obesity grade (%)	-52.7 ±13.6	-54.7 ±11.6	0.558
Waist-to-hip ratio	-0.07 ±0.03	-0.08 ±0.05	0.321

* Appendicular lean mass
**Timed Up and Go
SE: Standard Error
CI: Confidence Interval
BMI: Body Mass Index
SG: Sleeve Gastrectomy
RYGB: Roux-en-Y Gastric Bypas

Table 6 - Multivariate linear regression analysis of factors independently associated with change in muscle strength

Variable	b (IC 95%)	Beta	P
Blood Glucose(Δ)	-0,08 (-0,16 a -0,01)	-0,405	0,028
Ferritin (Δ)	-0,02 (-0,03 a -0,00)	-0,402	0,026
Percentage of Weight Loss	0,35 (-0,01 a 0,70)	0,332	0,057

(Δ): variation between factors before surgery and after surgery

FIGURES

Figure 1 - Association between blood glucose variations and hand grip variations through Pearson correlation coefficients (r= 0.378; p=0.011)

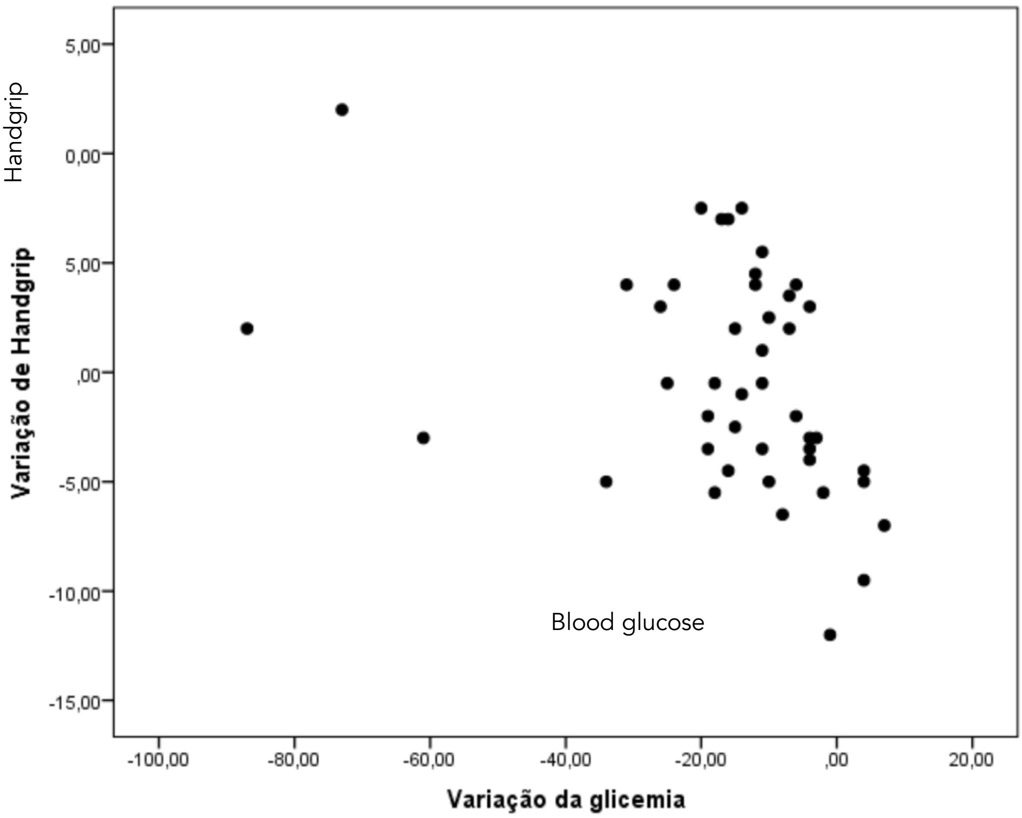

Figura 1 – Associação entre as variações de glicemia e Handgrip através do coeficiente de correlação de Pearson (r=-0,378; p=0,011)

5. Conclusões

Nosso projeto se propôs em analisar dados antropométricos, laboratoriais e testes de força e função muscular em pacientes que foram submetidos à cirurgia bariátrica.

Concluímos que a cirurgia bariátrica é excelente método para perda de peso e resolução das doenças associadas à obesidade. Verificamos melhora de todos dados antropométricos relativos à perda de gordura corporal de maneira significativa. Por outro lado, observamos a perda de massa magra junto com o emagrecimento, apontando para o tema da sarcopenia na obesidade.

Com os métodos utilizados, observamos que, apesar da perda de massa magra durante o emagrecimento, a força e função muscular ficaram preservadas, ratificando estudos prévios de que obesidade impede o bom funcionamento da fibra muscular. As alterações metabólicas provocadas pela cirurgia, como a melhora dos níveis glicêmicos, foram capazes de melhorar a fibra muscular ao ponto de criar uma relação inversa entre o delta glicêmico e a força muscular.

Não houve diferenças entre as técnicas cirúrgicas, apesar de a amostra ser pequena e com seguimento curto para adequada avaliação deste dado.

Os dados laboratoriais, além de evidenciarem melhora metabólica, nos mostraram preservação e melhora de níveis vitamínicos, corroborando uma boa reposição de nutrientes no pós-operatório.

Por fim, não observamos sarcopenia na população estudada. O paciente obeso jovem possui boa massa muscular numa provável ação reativa ao aumento de peso, mesmo que essa musculatura não seja com boa função. Além disso, nossa população era bastante jovem.

ANEXOS

Anexo A – Termo de Consentimento Livre e Esclarecido

Anexo B – Aprovação no Comitê de Ética em Pesquisa

Anexo C – Questionário de atividade física – IPAQ

Anexo D – Normas do Periódico *Obesity Surgery*

Anexo E – Normas do Periódico *Surgery for Obesity and Related Diseases*

ANEXO A:

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Título da Pesquisa: FATORES DETERMINANTES NA PERDA DE MASSA MAGRA E MUSCULAR EM PACIENTES SUBMETIDOS À CIRURGIA BARIÁTRICA. Nome do Pesquisador Principal ou Orientador(a): Júlio Pereira Lima. Nome do(s) Pesquisadores assistentes/alunos: Roberto Viña Coral

1. **Natureza da pesquisa**: A cirurgia bariátrica é o método mais efetivo para perda de peso a longo prazo. Ocorre grande perda de massa gorda, mas também massa magra/muscular. O músculo esquelético é importante sede no metabolismo da glicose e insulina. Estudos prévios ja verificaram associação entre a sarcopenia (baixa massa muscular) e doenças como esteatose hepática, resistência à insulina e obesidade. Objetivo do projeto é verificar se a perda de massa magra/muscular tem influência na perda de peso e em índices metabólicos em pacientes submetidos à cirurgia bariátrica. Sendo assim, o Sr (a), está sendo convidado a participar desta pesquisa.

2. **Participantes da pesquisa**: Pacientes que procuram o Centro de Tratamento de Obesidade do Hospital Santa Casa de Porto Alegre, RS, Brasil.

3. **Envolvimento na pesquisa**: ao participar deste estudo a sra (sr) permitirá que os pesquisadores Júlio Pereira Lima e Roberto Viña Coral, utilizem seus dados coletados com o único intuito para pesquisa, sem divulgar nomes ou expondo sua pessoa. A sra (sr.) tem liberdade de se recusar a participar e ainda se recusar a continuar participando em qualquer fase da pesquisa, sem qualquer prejuízo para a sra (sr.) (...). Sempre que quiser poderá pedir mais informações sobre a pesquisa através do telefone 32148473 e, se necessário através do telefone do Comitê de Ética em Pesquisa.

4. **Sobre as entrevistas**: Serão realizados testes de laboratório que já são os testes necessários para se submeter ao procedimento que você está se propondo. Adicionalmente, serão realizados testes para avaliar sua massa muscular de maneira simples e objetiva, sem acarretar dor ou

desconforto. Ao final, serão submetidos a questionários sobre sua qualidade de vida e sobre suas atividades físicas. Este procedimento será realizado em uma de suas consultas no período anterior a sua cirurgia e aos 3 e 12 meses após ao procedimento.

5. **Riscos e desconforto**: a participação nesta pesquisa não traz complicações legais. Os possíveis riscos e desconfortos serão relativos às medidas antropométricas e se submeter aos testes físicos (aperto de mão, levantar de uma cadeira e caminhar 3 metros e responder a questionários). Os procedimentos adotados nesta pesquisa obedecem aos Critérios da Ética em Pesquisa com Seres Humanos conforme Resolução no. 510/2016 do Conselho Nacional de Saúde. Nenhum dos procedimentos usados oferece riscos à sua dignidade, assim como a continuidade do seu tratamento na instituição.

6. **Confidencialidade**: todas as informações coletadas neste estudo são estritamente confidenciais. Somente os pesquisadores terão conhecimento dos dados. Os dados serão armazenados pelo pesquisador principal durante 5 (cinco) anos e após totalmente destruídos.

7. **Benefícios**: ao participar desta pesquisa a sra (sr.) não terá nenhum benefício direto. Entretanto, esperamos que este estudo traga informações importantes sobre a melhor maneira de promover o emagrecimento, de forma que o conhecimento que será construído a partir desta pesquisa possa beneficiar a todos num futuro próximo, onde pesquisador se compromete a divulgar os resultados obtidos. O pesquisador se responsabiliza por qualquer dano comprovadamente relacionado à pesquisa.

8. **Pagamento**: a sra (sr.) não terá nenhum tipo de despesa para participar desta pesquisa, bem como nada será pago por sua participação. Todo e qualquer custo da pesquisa será custeado pelos pesquisadores.

Após estes esclarecimentos, solicitamos o seu consentimento de forma livre para participar desta pesquisa. Portanto preencha, por favor, os itens que se seguem.

Obs: Não assine esse termo se ainda tiver dúvida a respeito.

Consentimento Livre e Esclarecido

Tendo em vista os itens acima apresentados, eu, de forma livre e esclarecida, manifesto meu consentimento em participar da pesquisa. Declaro que recebi cópia deste termo de consentimento, e autorizo a realização da pesquisa e a divulgação dos dados obtidos neste estudo.

______________________	______________________	______________________
Nome do Sujeito de Pesquisa (letra de forma)	Data	Assinatura do Sujeito de Pesquisa

______________________	______________________	______________________
Nome do Pesquisador (letra de forma)	Data	Assinatura e Carimbo do Pesquisador

Pesquisador Principal : Júlio Pereira Lima

Demais pesquisadores: Roberto Viña Coral – (51) 993278977

Comitê de Ética em Pesquisa da Irmandade Santa Casa de Misericórdia de Porto Alegre – sob coordenação Dra. Elizete Keitel, telefone 3214.8571, Endereço: Av. Independência, 155 – 6º andar- Hospital Dom Vicente Scherer - POA/RS – para questões sobre a pesquisa e sobre os direitos dos pacientes envolvidos ou sobre problemas decorrentes da pesquisa.

ANEXO B:

Aprovação no Comitê de Ética em Pesquisa

IRMANDADE DA SANTA CASA DE MISERICORDIA DE PORTO ALEGRE - ISCMPA

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA
Título da Pesquisa: FATORES DETERMINANTES NA PERDA DE MASSA MAGRA E MUSCULAR EM

PACIENTES SUBMETIDOS A CIRURGIA BARIATRICA **Pesquisador:** Julio Carlos Pereira Lima

Área Temática:
Versão: 1
CAAE: 73910017.0.0000.5335
Instituição Proponente: Irmandade da Santa Casa de Misericordia de Porto Alegre - ISCMPA
Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER Número do Parecer: 2.272.220

Apresentação do Projeto:

A cirurgia bariátrica é o método mais efetivo para perda de peso a longo prazo. Ocorre grande perda de massa gorda, mas também massa magra/muscular. O músculo esquelético é importante sede no metabolismo da glicose e insulina. Estudos prévios ja verificaram associação entre a sarcopenia (baixa massa muscular) e doenças como esteatose hepática, resistência à insulina e obesidade. Objetivo do projeto é verificar se a perda

de massa magra/muscular tem influência na perda de peso e em índices metabólicos em pacientes submetidos à cirurgia bariátrica. No projeto serão
selecionados pacientes candidatos à cirurgia bariátrica do CENTRO DE TRATAMENTO DE OBESIDADE do Hospital Santa Casa de Porto Alegre,RS, Brasil. Serão realizados testes de antropometria, bioimpedância, exames laboratoriais e performance muscular nos momentos pré-operatório e aos 3 e 12 meses de pós operatório.

Objetivo da Pesquisa:

Objetivo Primário:
verificar se a perda de massa magra/muscular tem influência na perda de peso e em índices metabólicos em pacientes submetidos à cirurgia
bariátrica

Objetivo Secundário:
Determinar a perda de peso (PP) dos pacientes conforme sarcopenia. Estudar as relações PMG/PMM, PP/PMM, PP/MM.Determinar a influência de
parâmetros clínicos no resultado de PP, tais como glicemia e insulina. Determinar a influencia da técnica cirúrgica nos resultados. Determinar a
influencia da atividade física nos resultados.Determinar a influencia do sexo nos resultados.

Avaliação dos Riscos e Benefícios:

Riscos:
Aos pacientes não serão oferecidos riscos adicionais, pois os mesmos já procuram o centro especializado para tratar a obesidade.Adicionalmente ao
protocolo padrão, será feito teste de performance e dinamometria já descrito que será acompanhado por profissional capacitado.
Benefícios:
Trazer conhecimentos sobre o emagrecimento, de maneira que possa se orientar melhor o paciente no pós- operatório

Comentários e Considerações sobre a Pesquisa:

Vide conclusão.

Considerações sobre os Termos de apresentação obrigatória:

Apresentados e adequados.

Recomendações:

De acordo,sem recomendações.

Conclusões ou Pendências e Lista de Inadequações:

De acordo com a Resolução 466/12 vigente,que regula a pesquisa clínica.

Considerações Finais a critério do CEP:

Após avaliação do protocolo acima descrito, o presente comitê não encontrou óbices quanto ao desenvolvimento do estudo em nossa Instituição e poderá ser iniciado a partir da data deste parecer.

Obs.: 1 - O pesquisador responsável deve encaminhar à este CEP, Relatórios de Andamento dos Projetos desenvolvidos na ISCMPA. Relatórios Parciais (pesquisas com duração superior à 6 meses), Relatórios Finais (ao término da pesquisa) e os Resultados Obtidos (cópia da publicação).

2 – Para o início do projeto de pesquisa, o investigador deverá apresentar a chefia do serviço (onde será realizada a pesquisa), o Parecer Consubstanciado de aprovação do protocolo pelo Comitê de Etica.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento

Informações Básicas do Projeto Cronograma

Projeto Detalhado / Brochura Investigador Declaração de Pesquisadores Recurso Anexado pelo Pesquisador Declaração de Pesquisadores Declaração de Pesquisadores Declaração de Instituição e Infraestrutura Orçamento

Folha de Rosto

Situação do Parecer:

Aprovado

PORTO ALEGRE, 13 de Setembro de 2017

Assinado por:

ELIZETE KEITEL (Coordenador)

Endereço: R. Profo Annes Dias,295 Hosp.Dom Vicente Scherer

Bairro: 6o andar - Centro
UF: RS **Município:** **Telefone:** (51)3214-8571

CEP: 90.020-090
Fax: (51)3214-8571 **E-mail:** cep@santacasa.tche.br

PORTO ALEGRE

ANEXO C:

Questionário de atividade física – IPAQ

1.
QUESTIONÁRIO INTERNACIONAL DE ATIVIDADE FÍSICA

– FORMA CURTA -

Nome:____
Data: ___/ ___ / ___ Idade : ____ Sexo: F ( ) M ( )
Você trabalha de forma remunerada: ( ) Sim ( ) Não
Quantas horas você trabalha por dia: _________
Quantos anos completos você estudou: _______
De forma geral sua saúde está:
( ) Excelente ( ) Muito boa ( ) Boa ( ) Regular ( ) Ruim

Nós estamos interessados em saber que tipos de atividade física as pessoas fazem como parte do seu dia a dia. Este projeto faz parte de um grande estudo que está sendo feito em diferentes países ao redor do mundo. Suas respostas nos ajudarão a entender que tão ativos nós somos em relação à pessoas de outros países. As perguntas estão relacionadas ao tempo que você gasta fazendo atividade física em uma semana **NORMAL, USUAL** ou **HABITUAL**. As perguntas incluem as atividades que você faz no trabalho, para ir de um lugar a outro, por lazer, por esporte, por exercício ou como parte das suas atividades em casa ou no jardim. Suas respostas são MUITO importantes. Por favor responda cada questão mesmo que considere que não seja ativo. Obrigado pela sua participação !

Para responder as questões lembre que:
- atividades físicas **VIGOROSAS** são aquelas que precisam de um grande esforço físico e que fazem respirar MUITO mais forte que o normal
- atividades físicas **MODERADAS** são aquelas que precisam de algum esforço físico e que fazem respirar UM POUCO mais forte que o normal

Para responder as perguntas pense somente nas atividades que você realiza **por pelo menos 10 minutos contínuos** de cada vez:

1a. Em quantos dias de uma semana normal, você realiza atividades **VIGOROSAS** por pelo menos 10 minutos contínuos, como por exemplo correr, fazer ginástica aeróbica, jogar futebol, pedalar rápido na bicicleta, jogar basquete, fazer serviços domésticos pesados em casa, no quintal ou no jardim, carregar pesos elevados ou qualquer atividade que faça você suar **BASTANTE** ou aumentem **MUITO** sua respiração ou batimentos do coração.

dias _____ por **SEMANA** ( ) Nenhum

1b. Nos dias em que você faz essas atividades vigorosas por pelo menos 10 minutos contínuos, quanto tempo no total você gasta fazendo essas atividades **por dia**?
horas: ______ Minutos: _____

2a. Em quantos dias de uma semana normal, você realiza atividades **MODERADAS** por pelo menos 10 minutos contínuos, como por exemplo pedalar leve na bicicleta, nadar, dançar, fazer ginástica aeróbica leve, jogar vôlei recreativo, carregar pesos leves, fazer serviços domésticos na casa, no quintal ou no jardim como varrer, aspirar, cuidar do jardim, ou qualquer atividade que faça você suar leve ou aumentem **moderadamente** sua respiração ou batimentos do coração **(POR FAVOR NÃO INCLUA CAMINHADA)**

dias _____ por **SEMANA** ( ) Nenhum

2b. Nos dias em que você faz essas atividades moderadas por pelo menos 10 minutos contínuos quanto tempo no total você gasta fazendo essas atividades **por dia**?

horas: ______ Minutos: _____

3a. Em quantos dias de uma semana normal você caminha por pelo menos 10 minutos contínuos em casa ou no trabalho, como forma de transporte para ir de um lugar para outro, por lazer, por prazer ou como forma de exercício?

dias _____ por **SEMANA** ( ) Nenhum

3b. Nos dias em que você caminha por pelo menos 10 minutos contínuos quanto tempo no total você gasta caminhando **por dia**?

horas: ______ Minutos: _____

4a. Estas últimas perguntas são em relação ao tempo que você gasta sentado ao todo no trabalho, em casa, na escola ou faculdade e durante o tempo livre. Isto inclui o tempo que você gasta sentado no escritório ou estudando, fazendo lição de casa,visitando amigos, lendo e sentado ou deitado assistindo televisão.

Quanto tempo **por dia** você fica sentado em um dia da semana?

horas: ______ Minutos: _____

4b. Quanto tempo **por dia** você fica sentado no final de semana?

horas: ______ Minutos: _____

ANEXO D:

Normas do Periódico *Obesity Surgery*

OBESITY SURGERY - INSTRUCTIONS FOR AUTHORS

1.

ABOUT OBSU

Obesity Surgery is published by Springer Nature and is the official journal of the International Federation for the Surgery of Obesity and metabolic disorders (IFSO). Requirements are in accordance with the "Uniform Requirements for Manuscripts submitted to Biomedical Journals," www.icmje.org.

All manuscripts submitted to OBSU are blind-reviewed and decisioned through Editorial Manager (EM) (http://www.editorialmanager.com/obsu) . Letters to the Editor and Invited Replies do not need to be blinded.
Articles accepted for publication are done so with the understanding that they or their substantive contents have not been and will not be submitted to any other publication.

SUBMISSION REQUIREMENTS CHECKLIST

All items below must be ready and available upon submission.

TITLE PAGE

χ Full Title and Short Title for Running Head
χ All Contributing Authors, Full Names/Degrees, and Email Addresses/Affiliations χ "Corresponding Author" Information
χ Detailed Acknowledgments, Funding Information, and non-blinded COI Statement

MANUSCRIPTS (EITHER ALL TEXT OR DYNAMIC ARTICLE WITH EMBEDDED VIDEO)

χ Abstract (N/A for Letters to the Editor; optional for Brief Communications) χ Manuscript text (no Title Page) must be blinded for review purposes
χ Required Ethical, COI, and Human/Animal Rights Statements (blinded)

χ References in PubMed® style
χ Optional: Embedded tables, schemes, figures and captions
χ Video not to exceed three (3) minutes each in length (blinded)
χ Video in either .MP4 or .MOV file format.
-OR-
MULTIMEDIA ARTICLE (submission in which the heart of the article is the video)
χ Video Abstract, required Ethical, COI, and Human/Animal Rights statements, and references. χ Video not to exceed ten (10) minutes in length (blinded)
χ Narration in English
χ Video in either .MP4 or .MOV file format, not to exceed 500 MB.

FIGURES/IMAGES/MEDIA

χ For vector graphics, the preferred format is EPS; for halftones, use TIFF format.
χ Figure width should be 39 mm, 84 mm, 129 mm or 174 mm, and no higher than 234 mm χ No identifying information about patients
χ Patient and/or publisher permissions, if needed

OFFICIAL ICMJE CONFLICT OF INTEREST FORM(S):

χ One form completed by each author (ex: 5 authors = 5 forms) FOR REVISIONS ONLY:

χ Revised text, tables and figures - One clean copy and one annotated copy

χ A Point-by-Point Reply to Reviewer Comments (blinded for review purposes)
INSTRUCTIONS FOR AUTHORS – 1

2.

3. IMPORTANT SUBMISSION INFORMATION

3a. SYSTEM REQUIREMENTS

Authors will need the following items in order to use EM:

- Internet access
- A current Adobe Acrobat browser plug-in
- Electronic files of all required documents

3b. YOUR AUTHOR ACCOUNT

Authors entering the journal's EM site for the first time can create a new account at http://www.edmgr.com/obsu/ by clicking "Register Now," and then following the online prompts in order to create your account and submit a manuscript. NOTE: If you have previously accessed the system, always use your existing account for ALL subsequent submissions. If you have forgotten your Username or Password, use the "Send Login Details" link at the OBSU Login Page.

3c. ONLINE SUBMISSION

After you have logged into your account and entered your Submission Center, EM will lead you through a step-by-step manuscript submission process. The required documents for all online submissions include the main, blinded manuscript document, a separate Title Page document, and a Conflict of Interest (COI) form, which must be completed by each contributing author.

Note: Always keep original copies of your word-processing, graphic, video, and COI files.

Make sure that all required online fields are completed before attempting to submit; the system won't allow you to submit if any required fields are not completed. If you cannot finish your submission in one visit, you can save a draft and later re-enter the process at the same step by clicking on the "Incomplete Submissions" link in your Author Main Menu.

3d. SUPPORT AND ASSISTANCE

If you have questions or need assistance at any point during the submission and review process, contact our OBSU Managing Editor:

Attn: Deana Rodriguez
Managing Editor, OBSU Editorial Office Phone: +001 (562) 961-9928 E-mail: obsu.rodriguez@gmail.com

4. MANUSCRIPT PREPARATION

4a. JOINT STATEMENT BY THE SURGERY JOURNAL EDITORS GROUP 2018

We, the editors of surgery journals, believe that conducting sex-inclusive biomedical and clinical research is imperative to improving health outcomes of men and women. Recent studies have shown that the majority of biomedical research in the field of surgery and related topics is conducted on male

1

animals and male cells, even when studying diseases prevalent in women.

Human clinical research

2,3

the National Institutes of Health (NIH) has now asked that sex be considered as a biologic variable in all

4

suffers from a lack of sex-based reporting and sex-based analysis of the results.

Given these findings,

NIH-funded research.
animal, tissue, and cell research in ALL manuscripts published in our journals. If only one sex is reported, authors must include a justification statement as to why only a single-sex study was conducted. We also will require sex-based reporting and analysis of data for all human, animal, tissue, and cell research. As a group, we will require this among all our collective surgery journals.

INSTRUCTIONS FOR AUTHORS – 2

As such, we support uniform, defined reporting of the sex used for human,

References

1. Yoon DY, Mansukhani NA, Stubbs VC, Helenowski IB, Woodruff TK, Kibbe MR. Sex bias exists in basic science and translational surgical research. Surgery. 2014;156(3):508-516.
2. U.S. Government Accountability Office. National Institutes of Health: Better Oversight Needed to Help Ensure Continued Progress Including Women in Health Research.2015
3. Mansukhani NA, Yoon DY, Teter KA, Stubbs VC, Helenowski IB, Woodruff TK, Kibbe MR. Determining If Sex Bias Exists in Human Surgical Clinical Research. JAMA Surg. 2016 Nov 1;151(11):1022-1030.

4. National Institutes of Health Office of Extramural Research. Consideration of Sex as a Biological Variable in NIH-funded Research. 2015

4b. MANUSCRIPT TERMINOLOGY

Please make note of the required manuscript terminology standards.

Mandatory

Weight loss must be expressed as change in BMI or %total weight loss (%TWL)

The term for the operative procedure that was previously labeled “Mini Gastric Bypass (MGB)” should no longer be used. Instead, use the accepted term “One Anastomosis Gastric Bypass (OAGB)”.

In addition, weight loss may also be expressed as % Excess Weight Loss (%EWL), with the calculation of ideal body weight as that equivalent to a BMI of 25 kg/m^2 and/or % Excess BMI Lost (%EBMIL)

with excess BMI > 25 kg/m^2 as well as % total body weight loss. The percent of Excess Weight Loss should not replace Total Weight Loss but may also be included in the text.

Data extending beyond 30 days must include lost to follow-up information in the Abstract and Results section, including all tables and figures, with the denominator provided as to how many patients were available at each time point and the number of patients actually seen.

4c. MANUSCRIPT SECTIONS AND FILE ITEMS

When you upload your manuscript documents to EM, the system will ask you to indicate the manuscript file “Item.” Your manuscript should be submitted in various parts; for example, your blinded “Manuscript” should be uploaded separately from the “Title Page” and “Official Conflict of Interest Form.” Images should be submitted separately, as should any electronic supplementary material (or “Other”) and videos (either as supplementary videos or dedicated Multimedia Article).

Use the following text format guidelines.

- • Use a normal, plain font (e.g., 12-point Times Roman) for text.
- • Double-space the text and set page borders at one inch.
- • Use italics for emphasis.
- • Use the automatic page numbering function to number the pages.
- • Use tab stops or other commands for indents; do not use the space bar for indents.

i. File Item: Title Page (required)

In the "File Upload" section of EM, your Title Page should be submitted separately from the blinded text of the manuscript, under the category, "Title Page." This page will not be seen by reviewers and should include the following:

- • Complete title of the article and a shortened title (max 30 characters, including spaces). Complete

  names, titles, departments and institutional addresses of each contributing. "Correspondence to" followed by the name and contact information for the corresponding author.

- • Any detailed grant information and an acknowledgment of grant support.
- • Acknowledgments: Should only be included in the Title Page. List individuals other than authors

who directly participated in the work. If any authors have contributed equally, you may include

the following statement: “Authors (name) and (name) have contributed equally to this work.”

ii. File Item: Blinded Manuscript – Main Text (required)

In the "Attach Files” step (final step) of your submission, the “Manuscript” file should include the Main Text (which should include blinded statements regarding conflict of interest, consent and ethics), References, and Figure Legends (if any). Tables may also be included at the end of the text document or submitted separately.

The main text document should be double-spaced and for most submissions include: Abstract (required for all but Letters; optional for Brief Communications); Introduction/Purpose; Materials and Methods; Results; Conclusion; Blinded Conflict of Interest Disclosure Statement; Statements regarding ethics and consent (see details below); References (see details below); Tables, and any Figure Legends (if applicable). Additional format requirements and details for specific manuscript types are included in the “Manuscript Types and Formats” section below.

Conflict of Interest Disclosure, Ethical Statement and Consent Statement

Three required statements are required just before the list of References. For each author, the blinded COI statement must declare potential conflict of interest for each author (“author 1, author 2,” etc.), or state, “no conflict of interest.” For more information, refer to “Ethical Responsibilities of Authors” below.

References

- • Use Medline®/Pubmed® Style. Visit the following website for sample references: http://www.nlm.nih.gov/bsd/uniform_requirements.html.
- • Type references double-spaced; list them in consecutive, numerical order as they appear in the text.
- • Identify reference citations in the text by numbers in square brackets (e.g., [1]). Once a reference is

cited, all subsequent citations should be to the original number.

- • Cite all references within the text or tables.
- • Papers that have been accepted for publication or are in press may be listed in theReferences,

however OBSU does not reference unpublished data or personal communications.

Tables

- • Use the table function (not spreadsheets) to make tables.
- • Number all tables using Arabic numerals.
- • Always cite tables in the text in consecutive, numerical order.
- • For each table, supply a title; it should explain clearly and concisely the components of the table.
- • Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for

  significance values and other statistical data) and included beneath the table body.

- • All tables should be on separate page(s) at the end of the main document and be cited in the text.

  iii. File Item: Official Conflict of Interest Form – (required)

  Every contributing author must electronically complete the official ICMJE Conflict of Interest (COI) form. Click on http://www.icmje.org/coi_disclosure.pdf to download a PDF of the form. During submission, please make sure that you upload all COI forms at the end of your submitted document list. If any author's COI form is missing from the submission, it will be returned to the author for correction prior to review. Each author must complete the form even if no conflict of interest exists. All details in the ICMJE COI forms must correspond with the COI Disclosure Statement included in the manuscript text. Reviewers will not see these forms.

  Important Note: If you have trouble viewing the ICMJE COI form after downloading it, make sure to open the PDF directly from your "downloads" folder via Adobe Reader rather than through your internet browser. Also, once uploaded to the submission site, the forms may not appear clearly in the PDF proof, depending on your browser. Please simply make sure that a completed form has been uploaded for each contributing author before you complete your submission.

  INSTRUCTIONS FOR AUTHORS – 4

iv. File Item: Cover Letter (optional; non-blinded)

You may submit a non-blinded Cover Letter under this File Item, as well as any other non- blinded documents such as Permission documents or Language Editing certificates.

v. File Item: Figure / Image (optional; blinded for review)

Common graphics files such as GIF, JPEG, EPS, TIFF and many others are supported. Do not upload figures as PDF files.

All figures must be numbered using Arabic numerals. Figure parts should be denoted by lowercase letters. Figures should always be cited in text in consecutive numerical order. For each figure, include the figure legends at the end of the manuscript text. Name your figure files with "Fig" and the figure number, e.g., Fig1.eps.

Photographs of patients in which the subject is identifiable must either have the face masked out, or be accompanied by written permission from the individual in the photograph for publication.

If you include figures that have already been published elsewhere, you must obtain permission from the copyright owner(s) for both the print and online format.

Vector Graphics: The preferred format is EPS; for halftones, please use TIFF format. MSOffice files are also acceptable. Vector graphics containing fonts must have the fonts embedded in the files.
Line Art: Must be black and white with no shading. Ensure that all lines and lettering within the figures are legible at final size. All lines should be at least 0.1 mm (0.3 pt) wide. Scanned line drawings and line drawings in bitmap format should have a min. resolution of 1200 dpi.

Halftone Art (photographs, drawings or paintings with fine shading, etc.): If magnification is used in photographs, indicate this by using scale bars within the figure. Halftones should have a minimum resolution of 33 dpi.

Combination Art (combination of halftone and line art): Combination artwork should have a minimum resolution of 600 dpi.

Color Art: Color art is free of charge for online publication. If artwork is to be published in black and white, make sure that details are visible; many colors are not distinguishable when converted to black and white. You may choose to use patterns rather than colors in such instances. Color illustrations should be submitted as RGB (8 bits/channel).

Lettering and Numbering in Figures: Helvetica and Arial (sans serif fonts) text are preferred. Keep lettering size consistent throughout (preferably 2-3 mm / 8-12 pt). Avoid shading and other text features, and do not include titles or captions within your figures.

vi. File Item: Multimedia Article (blinded for review)

A Multimedia Article submission consists of a dedicated video no more than 10 minutes in duration. Keep the video length / size as precise as possible, as some authors and reviewers may experience problems when uploading, downloading or viewing larger files, depending on server speed and other external factors.

Requirements for Multimedia Articles

- • Multimedia Articles must be accompanied by a textual Abstract.
- • Must use either .mp4 or .mov files.
- • Video files must not exceed ten (10) minutes in length.
- • For any Multimedia Article files larger than 500 MB, authors may upload compressedfiles

  (e.g., zip files), or submit in separate video sections.

- • All narration must be in English.

  vii. FileItem:Dynamic(supplementary)Video

  Dynamic Video files may be included as additional information that cannot be printed: animations, video clips, etc. If supplying a dynamic video file, the manuscript text must make specific mention

of the material as a citation (e.g., "as shown in Animation 3"). Keep the video length / size as precise as possible, as some authors and reviewers may experience problems when uploading, downloading or viewing larger files, depending on server speed and other external factors. Upon submission of articles that include video, the author(s) will be required to submit according to the following specifications.

Requirements for Dynamic Articles

- • Video files should not exceed three (3) minutes in length.
- • Always use either .mp4 or .mov files.
- • All narration must be in English.

viii. File Item: Other (optional; blinded for review)

If your submission file does not fit any of the above file designations, you may submit as "Other," but any document submitted under this File Item must be blinded for review purposes and will be evaluated for appropriateness.

4d. MANUSCRIPT TYPES AND FORMATS

The manuscript types include Original Contributions, New Concepts, Review Articles, Brief Communications, Letters to the Editor, and Multimedia Articles. You may submit your manuscript either as Format I, II, or III (detailed in the table below). Each manuscript type requires a specific submission format. When required by the nature of the report, manuscripts that do not follow these formats may be considered. Please note that the page, word and figure limits shown in the table below should be used as a guideline rather than a rule; the editors and reviewers make the final evaluations. Please remain succinct in your wording.

4e. ADDITIONAL SUBMISSION DETAILS

i. Language Editing Services

Language Editing Services, when needed, can be acquired through the Springer author service http://authorservices.springernature.com/ .

ii. Special Characters

The Journal does not assume responsibility for errors in conversion of customized software, newly released software, or special characters. Indicate any special characters used in the file (e.g., Greek, math symbols) by providing a clarifying list of abbreviations at the end of your manuscript text.

iii. Abbreviations, Drug Names, Digits

Use the standard abbreviations and units listed in Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers, Sixth Edition (Reston, Va., Council of Biology Editors, 1994). The first time an uncommon abbreviation appears in the text, it should be preceded by the full name for which it stands. Generic names for drugs and chemicals should be used the first time the drug or chemical is mentioned in the text and, preferably, thereafter. If an author wishes, the trade name may be inserted in parentheses following the generic name the first time the generic name appears, and the manufacturer name and city should also be included. Express digits as numerals except when they are the first word in a sentence, and decimals should be written in North American format. Express units of measurement in the metric system whenever possible and abbreviate them when used with numbers.

5. ETHICAL RESPONSIBILITIES OF AUTHORS

This journal is committed to upholding the integrity of the scientific record. As a member of the Committee on Publication Ethics (COPE) the journal will follow the COPE guidelines on how to address potential acts of misconduct.

Authors should refrain from misrepresenting research results that could damage the trust in the journal and ultimately the entire scientific endeavor. Maintaining integrity of the research and its presentation can be achieved by following the rules of good scientific practice, which includes: The manuscript has not been submitted to more than one journal for simultaneous consideration.

- • The manuscript has not been published previously (partly or in full), unless the new work concerns an expansion of previous work (provide transparency on the re-use of material to avoid the hint of text- recycling ("self-plagiarism")).
- • A single study is not split up into several parts to increase the quantity of submissions and submitted to various journals or to one journal over time (e.g. "salami-publishing").
- • No data have been fabricated or manipulated (including images) to support yourconclusions
- • No data, text, or theories by others are presented as if they were the authors own ("plagiarism"). Proper

  acknowledgements to other works must be given (this includes material that is closely copied (near verbatim), summarized and/or paraphrased), quotation marks are used for verbatim copying of material, and permissions are secured for material that is copyrighted.

- • Important note: note: the journal may use software to screen for plagiarism.
- • Consent to submit has been received from all co-authors and responsible authorities atthe

  institute/organization where the work has been carried out before the work is submitted.

- • Authors whose names appear on the submission have contributed sufficiently to the scientificwork and

  therefore share collective responsibility and accountability for the results.

  INSTRUCTIONS FOR AUTHORS – 8

In addition:

- • Changes of authorship or in the order of authors are not accepted after manuscript acceptance.
- • Requests to add or delete authors at revision are a serious matter and may be considered onlyafter receipt

  of written approval from all co-authors and detailed explanation about the role/deletion of the new/deleted author. The "Authorship Change" form can be requested from the Editorial Office. The decision to accept the change(s) rests with the journal's Editor-in-Chief.

- • Upon request authors should be prepared to send relevant documentation or data to verify the validity of the results. This could be in the form of raw data, samples, records, etc.
- • If there is a suspicion of misconduct, the journal will carry out an investigation following the COPE guidelines. If, after investigation, the allegation seems to raise valid concerns, theaccused author will be contacted and given an opportunity to address the issue. If misconduct has been proven, this may result in the Editor-in-Chief's implementation of the following measures, including, but not limited to:

o If the article is still under consideration, it may be rejected and returned to the author.
o If the article has already been published online, depending on the nature and severity of the

infraction, either an erratum will be placed with the article or in severe cases complete retraction of the article will occur. The reason must be given in the published erratum or retraction note. • The author's institution may be informed.

5a. DISCLOSURE OF POTENTIAL CONFLICT OF INTEREST

Authors must disclose all relationships or interests that could influence or bias the work. Althoughan author may not feel there are conflicts, disclosure of relationships and interests affords a more transparent process, leading to an accurate and objective assessment of the work. Awareness of real or perceived conflicts of interests is a perspective to which the readers are entitled and is not meant to imply that a financial relationship with an organization that sponsored the research or compensation for consultancy work is inappropriate. Examples of potential conflicts of interests that are directly or indirectly related to the research may include but are not limited to the following:

- • Research grants from funding agencies (give the research funder and the grant number) Honoraria for speaking at symposia
- • Financial support for attending symposia Financial support for educational programs Employment or consultation
- • Support from a project sponsor
- • Position on advisory board or board of directors or other type of management relationships
- • Multiple affiliations
- • Financial relationships, for example equity ownership or investment interest Intellectual property rights

  (e.g. patents, copyrights and royalties from such rights); holdings of spouse and/or children that may have financial interest in the work

  In addition, interests that go beyond financial interests and compensation (non-financial interests) that may be important to readers should be disclosed. These may include but are not limited to personal relationships or competing interests directly or indirectly tied to this research, or professional interests or personal beliefs that may influence your research.

  The corresponding author collects the conflict of interest disclosure forms from all authors. In author collaborations where formal agreements for representation allow it, it is sufficient for the corresponding author to sign the disclosure form on behalf of all authors.

  The corresponding author will include a blinded summary statement in the text of the manuscript in a separate section before the reference list that reflects what is recorded in the potential conflict of interest disclosure form(s). For review purposes, the affiliations may be identified, but the authors may not.

  INSTRUCTIONS FOR AUTHORS – 9

See below for examples of disclosures:

- • "Funding: This study was funded by X (grant number X)."
- • "Conflict of Interest: Author 1 has received research grants from Company A. Author 2 has received a

  speaker honorarium from Company B and owns stock in Company C. Author 3 is a member of committee D."

  If no conflict exists, the authors should state:

• "Conflict of Interest: The authors declare that they have no conflict ofinterest."

5b. STATEMENT OF HUMAN AND ANIMAL RIGHTS

When reporting studies that involve human participants, authors should include a statement that the studies have been approved by the appropriate institutional and/or national research ethics committee and have been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

If doubt exists whether the research was conducted in accordance with the 1964 Helsinki Declaration or comparable standards, the authors must explain the reasons for their approach, and demonstrate that the independent ethics committee or institutional review board explicitly approved the doubtful aspects of the study.

The following statements should be included in the text before the References section:

i. Ethical Approval

"All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards."

The welfare of animals used for research must be respected. When reporting experiments on animals, authors should indicate whether the institutional and/or national guidelines for the care and use of animals were followed.

For studies with animals, the following statement should be included:
"All applicable institutional and/or national guidelines for the care and use of animals were followed."

If articles do not contain studies with human participants or animals by any of the authors, Springer recommends including the following sentence:
"This article does not contain any studies with human participants or animals performed by any of the authors."

For retrospective studies, add the following sentence: "For this type of study formal consent is not required."

INSTRUCTIONS FOR AUTHORS – 10

ii. Informed Consent

All individuals have individual rights that are not to be infringed. Individual participants in studies have the right to decide what happens to the (identifiable) personal data gathered and to what they have said during a study or an interview as well as to any photograph that was taken. Hence it is important that all participants gave their informed consent in writing prior to inclusion in the study. Identifying details (names, dates of birth, identity numbers and other information) of the participants that were studied should not be published in written descriptions, photographs, and genetic profiles unless the information is essential for scientific purposes and the participant (or parent or guardian if the participant is incapable) has given written informed consent for publication. Complete anonymity is difficult to achieve in some cases, and informed consent should be obtained if there is any doubt. For example, masking the eye region in photographs of participants is inadequate protection of anonymity. If identifying characteristics are altered to protect anonymity, such as in genetic profiles, authors should provide assurance that alterations do not distort scientific meaning.

The following statement should be included:
Informed consent: “Informed consent was obtained from all individual participants included in the study.”

If identifying information about participants is available in the article, the following statement should also be included:

“Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.”

6. RESEARCH DATA POLICY

The OBSU journal encourages authors, where possible and applicable, to deposit data that support the findings of their research in a public repository. Authors and editors who do not have a preferred repository should consult Springer Nature’s list of repositories and research data policy.

List of Repositories http://www.springernature.com/gp/authors/research-data-policy/repositories/12327124?countryChanged=true

Research Data Policy http://www.springernature.com/gp/authors/research-data-policy/faqs/12327154?countryChanged=true

General repositories - for all types of research data - such as figshare and Dryad may also be used. Datasets that are assigned digital object identifiers (DOIs) by a data repository may be cited in the reference list. Data citations should include the minimum information recommended by DataCite: authors, title, publisher (repository name), identifier.

DataCite
Springer Nature provides a research data policy support service for authors and editors, which can be contacted at researchdata@springernature.com.

This service provides advice on research data policy compliance and on finding research data repositories. It is independent of journal, book and conference proceedings editorial offices and does not advise on specific manuscripts.

INSTRUCTIONS FOR AUTHORS – 11

7. MANUSCRIPT SUBMISSION

7a. SUBMISSION STEPS

i. Submission Process

Please view a copy of the Submission Checklist at the beginning of this document. We recommend that you have all items listed in the checklist complete and ready for upload before starting your online submission. Make sure to submit a separate title page that includes complete authors’ names, affiliations, and addresses in proper author order. Please submit all other documents first (main text, figures, tables, etc.) before uploading your COI forms.

ii. Review Your Submission

After uploading the files for your submission, the system will convert the files to PDF. Make sure to review the PDF of your submission before you confirm your submission. Please note that documents that are not viewable to reviewers (cover letter, title page, COI forms, etc.) may not appear in your PDF proof; simply make sure that they have been successfully uploaded in your list of uploaded documents. Once you have reviewed your PDF document for completeness, click "Submit" and all contributing authors will receive an emailed confirmation. If the submission is not complete when the editorial office receives it, it will be returned to your Author Center, with an e-mail notification indicating the need for additional information or correction. Once a complete manuscript is correctly submitted, your manuscript will be properly reviewed.

7b. KEEPING TRACK

After submission, you may monitor the progress of your submission through the review process. Only the designated corresponding author can view the submission and must enter their same UserName and Password to access the submission details.

7c. EDITORIAL REVIEW AND ACTION

The editorial staff examines submitted manuscripts for accuracy and completeness and will customarily send most manuscript submissions to two reviewers. We aim for quick reviewer turnaround times and rely on the promptness and thoroughness of our volunteer reviewers.

8. AFTER ACCEPTANCE

If your manuscript is accepted, you will receive an email from Springer's Production Office with questions related to:

8a. COPYRIGHT TRANSFER STATEMENT

After acceptance of a paper, a copyright transfer statement signed by the corresponding author is required and must be uploaded to Production via the My Publication stage.

8b. AUTHOR PROOFS

After a submission is accepted and the copyright has been completed, the author receives e-mailed notification of proofs from the Springer Production Office. The author is solely responsible for ensuring that the author-approved proofs are complete and accurate before approving them. Substantial changes in content are not allowed at the proofs stage, and no changes can be made after an article proof has been approved and has been officially published Online First. If changes are required after this stage, an erratum may be necessary.

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Color figures are reproduced without charge in the electronic version of the journal. However, color figures appearing in the print version are charged to the author at $1,150 per article. You may provide your choice at the Springer web page.

8e. OFFPRINTS/ REPRINTS

Can be ordered via the Springer webpage.

9. TRANSFER DESK OPTION

If your submission is rejected but is scientifically valid for potential publication in a more suitable journal, Obesity Surgery offers authors an option to transfer their manuscript to the Transfer Desk. For more information, visit:
https://www.springer.com/us/authors-editors/journal-author/the-springer-transfer-desk

Springer

http://www.springer.com/journal/11695

Anexo E:

Normas do Periódico *Surgical Obesity Related Diseases*

INFORMATION FOR CONTRIBUTORS

Authors of manuscripts submitted to *SURGERY FOR OBESITY AND RELATED DISEASES (SOARD)* will receive a timely review and will be notified within two months as to whether their work is accepted, rejected, or requires revision. Submit manuscripts to the SOARD Editorial Office via the Elsevier Editorial System (EES) website for this journal; go to http://ees.elsevier.com/SOARD and select "Submit Manuscript". All correspondence regarding submitted manuscripts will be handled via e-mail through EES. Send all other correspondence to:

David Newcombe
Managing Editor
Phone 508-732-6767 x11
Fax 508-732-6766
Email: Obesity@Stellarmed.com

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1. IMAGES IN OBESITY SURGERY: Concise, one-page pictorial description of a unique case will be published as space permits.
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3. CASE REPORTS: *SOARD* will only consider non-video case reports if they will be of GREAT IMPORTANCE to the field of bariatric surgery. **Beginning May 1, 2017, non-video case reports will incur an article processing fee of $750, and they will be printed in the journal.** Case Reports need to conform to the following Guidelines: it must contain an Introduction, Case Presentation and Management and Discussion without an abstract.

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1. Fetner R, McGinty J, Russell C, Pi-Sunyer FX, Laferrere B. Incretins, diabetes, and

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Updated August 2014