

Inna Diemieszczuk¹ , Paulina Głuszyńska¹ , Piotr Gołaszewski¹, Jerzy R. Ładny¹ ,
Klaudiusz Nadolny^{2,3} , Jerzy Łukaszewicz¹, Hady Razak Hady¹

¹ I Department of General Surgery, Białystok, Poland

² Faculty of Medicine, Katowice School of Technology, Katowice, Poland

³ Department of Health Sciences, WSB University, Dąbrowa Górnicza, Poland

The effect of laparoscopic sleeve gastrectomy on body mass index and obesity-related diseases in patients over 50 years old

Corresponding author:

Inna Diemieszczuk
I Department of General Surgery, 24A
Marii Skłodowskiej Curie St,
15-276 Białystok, Poland
e-mail: demeschik.inna@gmail.com

ABSTRACT

Aim of the study: Obesity is a pandemic of the 21st century and may regard people of every age. Persons after 50 years of age are a group especially exposed to severe impact of obesity which is connected, among others, with increased risk of co-morbidities. Along with age, the human body undergoes processes connected with metabolic rate decrease, accumulation of fat tissue, a physical capacity decrease which exacerbates the issue of obesity.

Material and methods: Retrospective analysis of biochemical and clinical parameters was conducted in the group of 102 patients, age 50–66 years old, after sleeve gastrectomy.

Results: During observation, average BMI decreased from 45.52 (41.26–50.87) kg/m² before the surgery to 29.71 (26.08–35.42) kg/m² one year after the surgery ($p < 0.001$). %TWL 12 months after LSG reached 33.91% (27.81–37.6%) ($p < 0.001$), average % EBML was 76.78% (58.71–93.08%). The study revealed that the most frequently coexisting diseases with obesity were: hypertension (89 patients), type 2 diabetes (39 patients), sleep apnea (27 patients), and dyslipidemia (25 patients). One year follow-up revealed remission of hypertension in 37 patients (41.57%), type 2 diabetes in 16 patients (41.02%), sleep apnea in 12 patients (44.44%), and dyslipidemia in 19 patients (76%). In patients after LSG, improvement of biochemical parameters including lipid and carbohydrate balance, as well as improvement or recovery from co-morbidities were observed.

Conclusions: LSG is an efficient method of obesity treatment, especially for patients after 50 years old with co-morbidities, which leads to permanent body mass loss as well as remission or recovery from chronic diseases and improves the quality of life.

Key words: sleeve gastrectomy, obesity, hypertension, dyslipidemia, type 2 diabetes

Med Res J 2022; 7 (1): 61–65

Medical Research Journal 2022;
Volume 7, Number 1, 61–65
DOI: 10.5603/MRJ.a2022.0010
Copyright © 2022 Via Medica
ISSN 2451-2591
e-ISSN 2451-4101

Introduction

Obesity as a pandemics of the 21st century may regard a person of every age and of both genders. Frequently, the problem of obesity begins in childhood and is a prologue to further health issues that significantly increase the risk of developing many chronic diseases.

Along with age, the functioning of all organs and systems deteriorates, what also increases the risk of developing many diseases of the circulatory system,

nervous system, or gastrointestinal tract. Among direct causes, the following may be listed: impairment of tissue repair mechanisms, disruption of the process of cell apoptosis, reduced protection against the harmful effects of oxidative stress, damage to the body's defensive barriers (such as the epidermal or intestinal barrier), or inadequate inflammatory response [1].

Calder et al. describe the phenomenon strictly connected with body aging as *inflammaging* being a connection of two terms: *inflammation* and *aging* [2].

Infalmmaging is characterized by a chronic inflammatory condition of low or moderate severity which intensifies along with age. The essence of this phenomenon is excessive stimulation of the immune system which causes, among others, the increase of proinflammatory cytokines presence in blood [3].

Along with age changes in basic proportion of body structure components occur. So-called 'lean body mass' is reduced and fat content in human body increases. Along with age, muscle circumference changes, and simultaneously the level of fat tissue in muscles increases. The percentage of fast-twitch muscle fibers causes the loss of capacity to perform short and intense efforts. Within articular cartilages, the decrease of water content occur which may result in stiffness of these structures, increasing susceptibility to mechanical injuries, micro-injuries, and intensification of degenerative changes.

What is more, along with age the disappearance of functionally active cells of various organs and their replacement by connective tissue occur as well as a decrease of maximum exhaust capacity, a decrease of renal plasma flow and a decrease of intestinal peristalsis. Obesity further intensifies health issues in middle age and elderly patients significantly influencing the health condition and quality of life. The aging process is an inevitable part of life that cannot be avoided but can be delayed by preventing related ailments.

Since 1975, over a threefold increase of obesity occurrence worldwide has been observed — in 2016 almost 2 billion adults were overweight and over 650 million were obese. In Poland obesity regards approximately 8 million adults. Research conducted among adult Europeans from 20 countries revealed that overweight and obesity occur in more than half of them (53.1%) [4]. In the WOBASZ II research, the frequency of occurrence of obesity was 24.4% in men and 25.0% in women and overweight respectively — 43.2% and 30.5%. On the other hand, abdominal obesity (defined as waist circumference ≥ 102 cm in men or ≥ 88 cm in women) was recognized in 32.2% of men and 45.7% of women [5]. Eurostat data from 2008–2019 show the increase of overweight occurrence from 54% to 58.1% as well as increase in obesity occurrence from 16% to 19% among adults in Poland [6].

Significant increase in the number of obese persons (both adults and children), the negative impact of overweight and obesity on human organism, complications connected with obesity, and insufficient results of preservative treatment led to the development of bariatric surgery. Among all bariatric procedures, laparoscopic sleeve gastrectomy (LSG) is assumed to be one of the most efficient methods leading to long-term body mass loss and improvement or remission of diseases connected with obesity [7]. LSG is the most common bariatric procedure performed worldwide and it is highly

recommended as a sole procedure of the first choice for high-risk patients: candidates for kidney and liver transplantation, morbidly obese patients with metabolic syndrome, patients with BMI between 30 and 35 kg/m² with co-morbidities; patients with unspecific enteritis and morbidly obese in the middle or older age [8].

The aim of the study was the analysis of clinical and biochemical parameters in patients with morbid obesity after 50 years old with co-morbidities who underwent laparoscopic sleeve gastrectomy as well as the assessment of the influence of the procedure on improvement or remission of co-morbidities.

Material and methods

A retrospective study was conducted among patients between 50 and 66 years old with co-morbidities of obesity in which, between January 2013 and December 2018, one-stage LSG was performed in University Hospital in Białystok. All patients were qualified for morbid obesity surgical treatment in accordance with European Guidelines on Metabolic and Bariatric Surgery [9]. Inclusion criteria were: incapacity to permanently lose weight in preservative treatment, BMI ≥ 40 kg/m² or 35–40 kg/m² with at least 2 comorbidities of obesity, such as type 2 diabetes, hypertension, cardiovascular diseases, obstructive sleep apnea, non-alcoholic liver steatosis and non-alcoholic steatohepatitis, hyperlipidemia, depressive disorders, and others. Surgical procedure was performed by the same surgeon and 2 assistants. Patients were excluded from the study when perioperative complications occurred and the data was missing. All patients were informed about the risk of surgical treatment and written consent was obtained from every participant before the surgery.

The study group included 102 patients, 49 men and 53 women (48%/52%), median age of 57 (50–66 years old). The average BMI before the surgery was 46.27 ± 6.76 kg/m². Control visits took place in Surgical Outpatient Clinic on the set dates, 1–3–6–12 months after the surgery. Clinical data was gathered prospectively along with multi measures of chosen laboratory parameters. Preoperative tests included fasting glucose and insulin concentrations, glycated hemoglobin concentration, alanine aminotransferase, aspartate aminotransferase gamma-glutamyl transpeptidase, LDH, uric acid, total bilirubin, total cholesterol, and its fractions, triglycerides, and C-reactive protein. Bariatric effect was assessed using the following formulas:

$$\text{Total body weight percent (\% TWL) \% TWL} = \frac{\text{initialweight} - \text{currentweight}}{\text{initialweight}} \times 100$$

Table 1. Characteristics of study group

Co-morbidities	Statistical data
Arterial hypertension, n (%)	89 (87.25%)
Type 2 diabetes mellitus, n (%)	39 (38.24%)
Obstructive sleep apnea, n (%)	27 (26.47%)
Dyslipidemia, n (%)	25 (24.51%)
Varicose veins, n (%)	18 (14.65%)
Chronic joint disease, n (%)	16 (15.69%)
Hemorrhoides, n (%)	13 (12.75%)
Non-alcoholic fatty liver disease, n (%)	13 (12.75%)
Coronary artery disease, n (%)	16 (15.69%)
Gastro-oesophageal reflux disease, n (%)	8 (7.84%)
Chronic obstructive pulmonary disease, n (%)	8 (7.84%)
Asthma, n (%)	6 (5.88%)
Cholelithiasis, n (%)	6 (5.88%)
Depression, n (%)	5 (4.90%)
Nephrolithiasis, n (%)	4 (3.92%)
Peptic ulcer disease, n (%)	3 (2.94%)
Oesophageal varices, n (%)	2 (1.96%)
Hiatal hernia, n (%)	2 (1.96%)

$$\text{Excessive BMI loss percent (\% EBML) \% EBML} = \frac{\text{initialBMI-postoperativeBMI}}{\text{initialBMI}-25} \times 100$$

()/() Also, the effect of bariatric treatment on the most frequent co-morbidities was assessed. Improvement was considered when the doses of taken drugs were reduced, hypertension parameters improved as well as results of laboratory tests. Remission was considered when the patient totally ceased to take drugs, parameters of hypertension were normative since the last ambulatory visit, and results of laboratory tests were normative in comparison to the last visit in Surgical Outpatient Clinic.

Statistical analysis

Data were analyzed using Statistica 13.5 software (StatSoft®, Tulsa, Oklahoma, United States of America). Continuous values were presented as means with standard deviations, or medians with interquartile ranges as appropriate. Quantitative variables were compared using the repetitive measures ANOVA with post-hoc multiple comparisons of variations or Friedman's ANOVA with multiple comparison of mean ranges (nonparametric). P-values ≤ 0.05 were considered statistically significant.

Results

In conducted analysis of the study group, it was stated that the most frequent comorbidities were hypertension (89 patients), type 2 diabetes (39 patients), sleep apnea (27 patients), and dyslipidemia (25 patients) (Tab. 1).

Repeated measurements of chosen laboratory parameters in all patients at the beginning of the study and during control visits are presented in Table 2. In statistical analysis, it was confirmed that liver enzymes values improved, lipid balance components decreased including cholesterol and LDL fraction, triglycerides, glucose, and insulin.

During observation period, average BMI decreased from 45.52 (41.26–50.87) kg/m² before the surgery to 29.71 (26.08–35.42) kg/m² 1 year after the surgery ($p < 0.001$). Average % TWL 12 months after LSG reached 33.91% (27.81–37.6%) ($p < 0.001$), average % EBML was 76.78% (58.71–93.08%) (Tab. 3).

After bariatric treatment in one-year follow-up successive improvement and remission of co-morbidities was observed. In patients with hypertension, 1 month after LSG, improvement was observed in 33.7% (30 patients), remission in 11.23% (10 patients) and after 12 months remission was observed in 41.57% (37 patients) and improvement in 58.4% (52 patients). Similar satisfying results were obtained in type 2 diabetes, sleep apnea, and dyslipidemia in patients after LSG. Results are presented in Table 4.

Discussion

Obesity is one of the main components connected with the risk of chronic diseases occurrence including metabolic syndrome, hypertension, dyslipidemia, type 2 diabetes, cardiovascular diseases, and others in middle age and elderly patients [10, 11]. Cross-sectional studies show that BMI gradually increases in adults, reaching its highest values at age of 60 and after 60 years old it has a tendency to decrease [12].

Polish National Health Test 2021 by Medonet.pl showed that excessive body mass is observed in 26% of subjects between 18 and 24 years old, 68% of 45–54 years old, and 78% over 65 years old. What is more, during this test it was stated that 58% of adult Polish people have a problem with excessive body mass. Among them, 45% of men and 28% of women are overweight and 26% of men and 19% of women are obese [13]. A rapidly growing number of cases of obesity results in the development of many severe co-morbidities, such as hypertension, type 2 diabe-

Table 2. Results of repetitive measurements of chosen laboratory parameters. Repetitive

	0	1 month	3 months	6 months	12 months	P-value
Bilirubin	0.55 (0.39–0.74)	0.64 (0.46–0.83)	0.68 (0.51–0.87)	0.72 (0.49–0.98)	0.61 (0.45–0.86)	< 0.001
CRP	7.95 (4.5–11.6)	5.8 (2.79–10.6)	5.87 (3.1–8.3)	6.54 (2.66–13.41)	2.54 (0.92–5.8)	< 0.001
Glucose	113 (103–142)	111.5 (103–122)	105.5 (99–113)	103 (95.5–112.5)	100 (95–108.5)	< 0.001
Insulin	27.25 (16.9–37.2)	13.7 (8.3–19.3)	11.25 (8–15.7)	8 (5.6–17.6)	8.65 (7.1–11.9)	< 0.001
Uric acid	6.21 (5.07–7.36)	6.4 (4.87–8.07)	5.91 (4.75–6.89)	5.45 (4.65–6.33)	6.42 (5.53–7)	< 0.001
ALT	34.1 (22.9–44.7)	35.3 (26–44)	24 (18–32.9)	20.45 (15.2–30.55)	21.40 (15.45–27.35)	< 0.001
AST	29 (20–41.6)	27 (22–34)	22.3 (17.4–29.35)	22.1 (17–30.6)	21.05 (16.35–25.05)	< 0.001
GGT	39.6 (27.5–61.2)	23.9 (18.8–31.5)	19.8 (14.1–26)	16.5 (12.5–25.3)	21.6 (15.2–34.75)	< 0.001
Cholesterol	210 (178–239)	180.5 (156–213)	187 (165–212.5)	197 (166–218.5)	188 (168–213.5)	< 0.001
LDL	138.4 (103–174.7)	117.3 (98–139)	127.45 (106.05–147.5)	123 (98.35–138.55)	113.5 (95.15–135)	0.003
Triglycerides	165 (138–208)	156 (113–178)	142.5 (102–163.5)	142.5 (102–163.5)	113 (87–149.5)	< 0.001
HDL	46 (39–59)	38 (33–44)	43.5 (36–49)	53 (45–64.5)	56 (48–61)	< 0.001
HbA1c	6.05 (5.7–6.8)	5.8 (5.5–6.4)	5.8 (5.4–6)	5.5 (5.1–5.7)	5.4 (5.2–5.7)	< 0.001
LDH	212.5 (194–230)	185 (170–237)	203.5 (172.5–217.5)	208 (172–231)	193.5 (157.5–227.5)	0.293

Table 3. Effects of bariatric treatment among patients

	0	1 month	3 months	6 months	12 months	P-value
BMI	45.52 41.26–50.87)	41.31–37.04–46.47)	36.31 33.23–42.77)	32.83 30.44–38.87)	29.71 26.08–35.42)	< 0.001
% TWL	n/a	9.64% 8.22–11.81%)	17.83% 15.64–20.79%)	26.02% 21.85–29.23%)	33.91% 27.81–37.6%)	< 0.001
% EBMIL	n/a	22.10% 18.07–27.90%)	40.36% 32–50%)	59.82% 47.31–67.81%)	76.78% 58.71–93.08%)	< 0.001

Table 4. Effects of the treatment of most frequent co-morbidities of obesity after LSG

	0	1 month		3 months		6 months		12 months	
		Improvement	Remission	Improvement	Remission	Improvement	Remission	Improvement	Remission
Hypertension	89 (87.25%)	30 33.7%)	10 11.23%)	39 43.82%)	27 30.33%)	48 53.93%)	35 39.32%)	52 (58.4%)	37 41.57%)
T2DM	39 (38.24%)	11 28.2%)	3 7.69%)	15 38.46%)	10 25.64%)	21 53.84%)	15 38.46%)	23 (58.97)	16 (41.02%)
Obstructive sleep apnea	27 (26.4 %)	5 18.5)	3 11.11%)	8 29.62%)	7 25.92%)	15 55.55%)	10 37.03%)	15 55.55%)	12 (44.44%)
Dyslipidemia	25 (24.51%)	12 48%)	6 24%)	16 64%)	9 36%)	13 52%)	16 48%)	6 24%)	19 76%)

tes, metabolic syndrome, circulatory diseases, sleep apnea, osteoarticular diseases, depressive disorders, and other [14].

During the European Congress of Obesity (ECO) in Glasgow, Great Britain (28 April–1 May 2019) data from the study conducted between January 2000 and July

2018 from UK Clinical Practice Research Datalink was announced, where BMI, health, and mortality of 2.8 million adults were analyzed (average age 51). Results show that adults with morbid obesity (BMI 40–45 kg/m²) are 12 times more at risk of type 2 diabetes development and 22 times more at risk of sleep apnea than subjects

at the same age with normal body mass. Subjects with I class of obesity (BMI 30–35 kg/m²) are at 70% higher risk of heart failure [15]. Obesity increases the risk of co-morbidities and contributes to the reduction of life expectancy. It was revealed that obesity reduces life expectancy by 5.8 years in men and 7.1 years in women after 40 years old [16].

Preservative treatment of obesity includes intensified physical activity, changes in diet and pharmacological treatment [17]. Obtained results are usually unsatisfying and short-term and in case of morbid obesity — usually insufficient for the significant improvement of patient's health [18]. The study conducted by Wojciak et al. revealed that LSG is one of the most efficient methods of obesity treatment and meets the criteria of adequate metabolic syndrome treatment along with diet, psychological treatment, lifestyle modification and all other methods of augmentative therapy [19].

Carlos Rodrigues-Otero Luppi et al. in the one-year follow-up of patients after LSG > 60 years old showed that after the surgery improvement was observed in 75% of patients with hypertension, 44% of patients with type 2 diabetes, 23% — with dyslipidemia, and 11% — with sleep apnea [20]. Similar results, showing improvement or remission of co-morbidities were obtained in this study. It was revealed that patients after 50 years old who underwent LSG permanently lost body mass in one-year follow-up (average BMI before the surgery 45.52 vs. after 12 months 29.71). What is more improvement of laboratory parameters was observed including liver enzymes, lipid and carbohydrates balance, cholesterol, and its fractions. Permanent body mass loss and improvement of biochemical parameters directly influence co-morbidities of obesity. Even in a short period of observation after LSG improvement or remission was observed which significantly decreases the risk of premature death connected with cardiovascular diseases, improves the quality of life and extends life in health.

Limitations Data assessment for this study was limited to a 12-month patient observation period after undergoing the operation.

Conclusions

Results of this study show that LSG is an efficient method of obesity treatment especially for patients after 50 years old with co-morbidities. It leads to permanent body mass loss, improvement or remission of chronic diseases and improves quality of life.

Conflict of interest: None.

Funding: None.

References

1. Szymaszkiewicz A, Szymaszkiewicz K, Fichna J, et al. Ocena zmian zachodzących wraz z wiekiem w jelitowym układzie nerwowym i ich wpływ na perystaltykę przewodu pokarmowego. *Postępy Biochemii*. 2021; 67(1): 34–43.
2. Calder PC, Bosco N, Bourdet-Sicard R, et al. Health relevance of the modification of low grade inflammation in ageing (inflammageing) and the role of nutrition. *Ageing Res Rev*. 2017; 40: 95–119, doi: [10.1016/j.arr.2017.09.001](#), indexed in Pubmed: [28899766](#).
3. Krabbe KS, Pedersen M, Bruunsgaard H. Inflammatory mediators in the elderly. *Exp Gerontol*. 2004; 39(5): 687–699, doi: [10.1016/j.exger.2004.01.009](#), indexed in Pubmed: [15130663](#).
4. Marques A, Peralta M, Naia A, et al. Prevalence of adult overweight and obesity in 20 European countries, 2014. *Eur J Public Health*. 2018; 28(2): 295–300, doi: [10.1093/eurpub/ckx143](#), indexed in Pubmed: [29036436](#).
5. Stepaniak U, Micek A, Waśkiewicz A, et al. Prevalence of general and abdominal obesity and overweight among adults in Poland. Results of the WOBASZ II study (2013–2014) and comparison with the WOBASZ study (2003–2005). *Pol Arch Med Wewn*. 2016; 126(9): 662–671, doi: [10.20452/pamw.3499](#), indexed in Pubmed: [27535012](#).
6. European Commission. Statistics Eurostat: Obesity rate by body mass index (BMI). https://ec.europa.eu/eurostat/databrowser/view/sdg_02_10/default/table?lang=en (08.01.2022).
7. Jarzynkowski P, Książek J, Piotrkowska R. Surgical treatment of obesity: the role and tasks of the interdisciplinary team. *Nursing and Public Health*. 2016; 6(4): 323–329, doi: [10.17219/pzp/64701](#).
8. Diemiszczuk I, Woźniewska P, Golaszewski P, et al. Does weight loss after laparoscopic sleeve gastrectomy contribute to reduction in blood pressure? *Pol Arch Intern Med*. 2021; 131(7–8): 693–700, doi: [10.20452/pamw.16023](#), indexed in Pubmed: [34075736](#).
9. Fried M, Yumuk V, Oppert JM, et al. International Federation for the Surgery of Obesity and Metabolic Disorders - European Chapter, International Federation for Surgery of Obesity and Metabolic Disorders-European Chapter (IFSO-EC), European Association for the Study of Obesity (EASO). Interdisciplinary European guidelines on metabolic and bariatric surgery. *Obes Surg*. 2014; 24(1): 42–55, doi: [10.1007/s11695-013-1079-8](#), indexed in Pubmed: [24081459](#).
10. National Task Force on the Prevention and Treatment of Obesity. Overweight, obesity, and health risk. *Arch Intern Med*. 2000; 160(7): 898–904, doi: [10.1001/archinte.160.7.898](#), indexed in Pubmed: [10761953](#).
11. Villareal DT, Apovian CM, Kushner RF, et al. American Society for Nutrition, NAASO, The Obesity Society, American Society for Nutrition, NAASO, The Obesity Society. Obesity in older adults: technical review and position statement of the American Society for Nutrition and NAASO, The Obesity Society. *Am J Clin Nutr*. 2005; 82(5): 923–934, doi: [10.1093/ajcn/82.5.923](#), indexed in Pubmed: [16280421](#).
12. Ogden CL, Carroll MD, Curtin LR, et al. Prevalence of overweight and obesity in the United States, 1999–2004. *JAMA*. 2006; 295(13): 1549–1555, doi: [10.1001/jama.295.13.1549](#), indexed in Pubmed: [16595758](#).
13. Medonet. <https://www.medonet.pl/strefa-mamy-i-dziecka/dbam-o-zdrowie-dziecka-i-rodziny,otylosc-wsrod-dzieci--powazny-problem-ktory-generuje-kolejne,artykul,50415210.html> (08.01.2022).
14. Hady HR, Wojciak P, Pawluszewicz P, et al. Laparoscopic sleeve gastrectomy (LSG) as a operative method of morbid obesity treatment and resolution of its comorbidities. *Postępy Nauk Medycznych*. 2018(2): 81–88, doi: [10.25121/pnm.2018.31.2.81](#).
15. Haase CL, Eriksen KT, Lopes S, et al. Body mass index and risk of obesity-related conditions in a cohort of 2.9 million people: Evidence from a UK primary care database. *Obes Sci Pract*. 2021; 7(2): 137–147, doi: [10.1002/osp4.474](#), indexed in Pubmed: [33841883](#).
16. Tam BT, Morais JA, Santosa S. Obesity and ageing: Two sides of the same coin. *Obes Rev*. 2020; 21(4): e12991, doi: [10.1111/obr.12991](#), indexed in Pubmed: [32020741](#).
17. Woźniewska P, Diemiszczuk I, Hady HR. Complications associated with laparoscopic sleeve gastrectomy — a review. *Prz Gastroenterol*. 2021; 16(1): 5–9, doi: [10.5114/pg.2021.104733](#), indexed in Pubmed: [33986881](#).
18. Williams S, Cunningham E, Pories WJ. Surgical treatment of metabolic syndrome. *Med Princ Pract*. 2012; 21(4): 301–309, doi: [10.1159/000334480](#), indexed in Pubmed: [22222561](#).
19. Wojciak PA, Pawluszewicz P, Diemiszczuk I, et al. Laparoscopic sleeve gastrectomy: a study of efficiency in treatment of metabolic syndrome components, comorbidities and influence on certain biochemical markers. *Wideochir Inne Tech Maloinwazyjne*. 2020; 15(1): 136–147, doi: [10.5114/witm.2019.84718](#), indexed in Pubmed: [32117497](#).
20. Luppi CRO, Balagué C, Targarona EM, et al. Laparoscopic sleeve gastrectomy in patients over 60 years: impact of age on weight loss and co-morbidity improvement. *Surg Obes Relat Dis*. 2015; 11(2): 296–301, doi: [10.1016/j.soard.2014.05.021](#), indexed in Pubmed: [25088486](#).