



Graham, Yitka (2022) Safety of Bariatric Surgery in  $\geq 65$ -Year-Old Patients During the COVID-19 Pandemic. Obesity Surgery, 32. pp. 1-13. ISSN 1708-0428

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ORIGINAL CONTRIBUTIONS

# Safety of Bariatric Surgery in $\geq 65$ -Year-Old Patients During the COVID-19 Pandemic

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Received: 21 January 2022 / Revised: 10 April 2022 / Accepted: 13 April 2022 / Published online: 5 May 2022  
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## Abstract

**Background** Age  $\geq 65$  years is regarded as a relative contraindication for bariatric surgery. Advanced age is also a recognised risk factor for adverse outcomes with Coronavirus Disease-2019 (COVID-19) which continues to wreak havoc on global populations. This study aimed to assess the safety of bariatric surgery (BS) in this particular age group during the COVID-19 pandemic in comparison with the younger cohort.

**Methods** We conducted a prospective international study of patients who underwent BS between 1/05/2020 and 31/10/2020. Patients were divided into two groups — patients  $\geq 65$ -years-old (Group I) and patients  $< 65$ -years-old (Group II). The two groups were compared for 30-day morbidity and mortality.

**Results** There were 149 patients in Group 1 and 6923 patients in Group II. The mean age, preoperative weight, and BMI were  $67.6 \pm 2.5$  years,  $119.5 \pm 24.5$  kg, and  $43 \pm 7$  in Group I and  $39.8 \pm 11.3$  years,  $117.7 \pm 20.4$  kg, and  $43.7 \pm 7$  in Group II, respectively. Approximately, 95% of patients in Group 1 had at least one co-morbidity compared to 68% of patients in Group 2 ( $p = < 0.001$ ).

The 30-day morbidity was significantly higher in Group I (11.4%) compared to Group II (6.6%) ( $p = 0.022$ ). However, the 30-day mortality and COVID-19 infection rates were not significantly different between the two groups.

**Conclusions** Bariatric surgery during the COVID-19 pandemic is associated with a higher complication rate in those  $\geq 65$  years of age compared to those  $< 65$  years old. However, the mortality and postoperative COVID-19 infection rates are not significantly different between the two groups.

**Keywords** Obesity · Older patients · SARS-CoV-2 · Resuming elective surgery · Metabolic surgery

## Introduction

Bariatric surgery is currently the only evidence-based durable treatment option for patients with obesity and related comorbidities. An ageing population worldwide

presents a challenge to all healthcare practitioners, including those involved in providing obesity management services [1, 2]. Previously, advanced age was considered a relative contraindication for bariatric surgery [3]. However, the evolution of laparoscopic techniques and advances in perioperative care protocols have changed perceptions [4, 5].

While some studies confirm good weight loss and acceptable postoperative morbidity and mortality in older individuals, others show significant perioperative morbidity and mortality with varying weight loss results [6–8]. Additionally, the heterogeneity of the studies with different age cutoff points and definitions of the older patients' population prevents the generalisation of these results [9, 10].

Older age is associated with an unfavourable prognosis with COVID-19 should a patient undergoing bariatric

### Key Points

- This study compared the safety of bariatric surgery in patients  $\geq 65$  years of age with those  $< 65$  years of age during the COVID-19 pandemic.
- The 30-day morbidity was higher in those  $\geq 65$  years of age.
- The 30-day mortality and postoperative symptomatic COVID-19 infection rates were not significantly different between the two groups.

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**Table 1** Comparison between the two groups according to demographics

	Group I ( $\geq 65$ ) ( <i>n</i> = 149#)	Group II ( $< 65$ ) ( <i>n</i> = 6923#)	$\chi^2$	<i>p</i>
Age				
Min.–max.	65–76	17–64		
Mean $\pm$ SD	67.6 $\pm$ 2.5	39.8 $\pm$ 11.3		
Sex				
Female	102 (68.5%)	5085 (73.5%)	1.869	0.172
Male	47 (31.5%)	1837 (26.5%)		
Preoperative Weight (Kg)				
Min.–max.	52–268	72–178	U =	0.695
Mean $\pm$ SD	119.5 $\pm$ 24.5	117.7 $\pm$ 20.4	506083.0	
Calculated Preoperative BMI				
Min.–max.	18–100.6	29–68.7	t = 1.208	0.227
Mean $\pm$ SD	43 $\pm$ 7	43.7 $\pm$ 7		
White vs non white				
No	23 (15.4%)	1780 (25.7%)	8.107*	0.004*
Yes	126 (84.6%)	5143 (74.3%)		
Ethnicity of patient				
I, American Indian or Alaska Native	0 (0%)	10 (0.1%)		
II, Asian	8 (5.4%)	390 (5.6%)		
III, Black or African American	1 (0.7%)	86 (1.2%)		
IV, Hispanic or Latino	14 (9.4%)	1280 (18.5%)		
V, Native Hawaiian or Other Pacific Islander	0 (0%)	14 (0.2%)		
VI, White	126 (84.6%)	5143 (74.3%)		

$\chi^2$ : Chi-square test; *p*: *p*-value for comparing the two studied groups; \*Statistically significant at  $p \leq 0.05$ ; #Cases with missing data were excluded from the comparison between the two age groups; #*p*-value excluded *missing data* from comparing the studied groups

I: American Indian or Alaska Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment

II: Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam

III: Black or African American. A person having origins in any of the black racial groups of Africa. Terms such as ‘Haitian’ or ‘Negro’ can be used in addition to ‘Black or African American’

IV: Hispanic or Latino. A person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race. The term, ‘Spanish origin’, can be used in addition to ‘Hispanic or Latino’.

V: Native Hawaiian or Other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands

VI: White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa

surgery develop perioperative COVID-19 infection. At the same time, obesity and its associated comorbidities also increase the risk of adverse outcomes with COVID-19 [11–13]. This poses a dilemma for healthcare professionals dealing with older patients seeking bariatric surgery.

The present study aimed to understand the safety of bariatric surgery in  $\geq 65$ -years-old patients during the COVID-19 pandemic. This study was a subset analysis of the GENEVA dataset; a global study aimed to prospectively assess the safety of bariatric surgery during the COVID-19 pandemic [14–16].

## Methods

### Study Design, Setting, and Population

The GENEVA study was a global, multicentre, observational study of Bariatric Surgery (elective primary, elective revisional, and emergency) performed between 1/05/2020 and 31/10/2020 in the adult ( $\geq 18$  years) population. The detailed methods have been described elsewhere [14–16].

**Table 2** Comparison between the two groups according to comorbidity and smoking status

	Group I ( $\geq 65$ )	Group II ( $< 65$ )	$\chi^2$	$p$
Any comorbidity	( $n = 149$ )	( $n = 6923$ )		
No	8 (5.4%)	2193 (31.7%)	47.093*	<0.001*
Yes	141 (94.6%)	4730 (68.3%)		
Type 2 diabetes not on medication	( $n = 149$ )	( $n = 6923$ )		
No	144 (96.6%)	6507 (94%)	1.834	0.176
Yes	5 (3.4%)	416 (6%)		
Type 2 diabetes on oral medication	( $n = 149$ )	( $n = 6923$ )		
No	98 (65.8%)	6116 (88.3%)	69.708*	< 0.001*
Yes	51 (34.2%)	807 (11.7%)		
Type 2 diabetes on insulin)	( $n = 149$ )	( $n = 6923$ )		
No	126 (84.6%)	6694 (96.7%)	62.438*	< 0.001*
Yes	23 (15.4%)	229 (3.3%)		
Overall diabetes	( $n = 149$ )	( $n = 6923$ )		
No	77 (51.7%)	5524 (79.8%)	69.983*	< 0.001*
Yes	72 (48.3%)	1399 (20.2%)		
Hypertension	( $n = 149$ )	( $n = 6923$ )		
No	38 (25.5%)	4851 (70.1%)	135.764*	< 0.001*
Yes	111 (74.5%)	2072 (29.9%)		
Sleep apnea not on CPAP	( $n = 149$ )	( $n = 6923$ )		
No	126 (84.6%)	6091 (88%)	1.604	0.205
Yes	23 (15.4%)	832 (12%)		
Sleep apnea on CPAP	( $n = 149$ )	( $n = 6923$ )		
No	111 (74.5%)	6014 (86.9%)	19.254*	< 0.001*
Yes	38 (25.5%)	909 (13.1%)		
Hypercholesterolemia	( $n = 149$ )	( $n = 6923$ )		
No	87 (58.4%)	5461 (78.9%)	36.233*	< 0.001*
Yes	62 (41.6%)	1462 (21.1%)		
Other comorbidities	( $n = 149$ )	( $n = 6923$ )		
No	87 (58.4%)	4926 (71.2%)	11.516*	0.001*
Yes	62 (41.6%)	1997 (28.8%)		
Smoking status	( $n = 149$ )	( $n = 6922^{\#}$ )		
Current smoker	11 (7.4%)	1027 (14.8%)	28.300*	< 0.001*
Ex-smoker	40 (26.8%)	887 (12.8%)		
Non-smoker	98 (65.8%)	5008 (72.3%)		

$\chi^2$ : Chi-square test; FE: Fisher Exact;  $p$ :  $p$ -value for comparing the two studied groups; \*Statistically significant at  $p \leq 0.05$ ; #Cases with missing data were excluded from the comparison between the two groups  
CPAP, continuous positive airway pressure

We used 65 years as a cutoff point to define the older age group as per the World Health Organisation and The National Institute for Health and Care Excellence (NICE) definitions [17, 18]. We divided patients undergoing primary BS into two groups — those  $\geq 65$  years old (Group I) and those  $< 65$  years old (Group II). The two groups were compared with each other with regard to basic demographics, 30-day morbidity and mortality, postoperative symptomatic COVID-19 infection rates, and procedure choice.

The main outcome measures of this study were 30-day all-cause and COVID-19 specific morbidity and

mortality. Continuous data were presented as mean  $\pm$  standard deviation (SD) or median (IQR) depending on data distribution. Frequencies were used to summarise categorical variables. Independent  $t$ -test or Mann Whitney U test examined differences between continuous variables depending on data distribution. A chi-square test or Fisher's exact test was used to compare categorical variables. Significance levels were set at  $p < 0.05$ . Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) statistical software, version 27.0 (SPSS Inc).

**Table 3** Comparison between the two age groups according to the surgical procedures

	Group I ( $\geq 65$ ) ( $n=149$ )	Group II ( $< 65$ ) ( $n=6923$ )	$\chi^2$	$p$
Surgical procedure				
LSG	76 (51%)	3907 (56.4%)	5.111	0.164
RYGB	49 (32.9%)	2038 (29.4%)		
OAGB	13 (8.7%)	689 (10%)		
Others	11 (7.4%)	289 (4.2%)		

$\chi^2$ : Chi-square test;  $p$ :  $p$ -value for comparing between the two studied groups; \*Statistically significant at  $p \leq 0.05$

LSG, laparoscopic sleeve gastrectomy; OAGB, one anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass

## Results

Data were collected from 179 centres in 42 countries by 470 surgeons (Appendix 1). Seven thousand ninety-two adult patients who underwent primary BS between 01/05/2020 and 31/10/2020 were included. Complete 30-day morbidity and mortality data were available for 7084 (99.88%) patients. The mean age of the entire cohort was  $40.35 \pm 11.9$  years, and 5197 (73.4%) were females. The mean preoperative weight and body mass index (BMI) was  $119.49 \pm 24.4$  Kg and  $43.03 \pm 6.9$  Kg/m<sup>2</sup>, respectively.

Table 1 compares the demographics of the two groups. The mean age for group I was  $67.6 \pm 2.5$  years, and for group II was  $39.8 \pm 11.3$  years. Group I included more patients of white ethnicity (84.6%) than Group II (74.3%) ( $p = 0.004$ ). The rest of the demographic parameters, including pre-operative BMI and weight, were comparable between the two groups (Table 1).

Table 2 details the prevalence of comorbidities and smoking status in the two groups. Nearly 95% of patients in Group I had at least one co-morbidity compared to 68% of patients in Group II ( $p < 0.001$ ). Specifically, a significantly greater proportion of patients in Group I suffered from diabetes mellitus (DM) (48.3% vs 20.2%), hypertension (74.5% vs 29.9%), obstructive sleep apnoea requiring continuous positive airway pressure (CPAP) therapy (25.5% vs 13.1%), and hypercholesterolemia (41.6% vs 21.1%) compared to Group II (all comparisons  $p < 0.001$ ) (Table 2). In Group II, 14.8% of patients were current smokers, compared to 7.4% of Group I ( $p < 0.001$ ).

The most common operation type in both groups was laparoscopic sleeve gastrectomy (LSG) (Group 1: 51.0%; Group 2: 56.4%). This was followed by Roux-en-Y gastric bypass (RYGB) (Group 1: 32.9%; Group 2: 29.4%) and one-anastomosis gastric bypass (OAGB) (Group 1: 8.7%; Group 2: 10.0%). Other forms of procedures were performed in 7.4% (Group 1) and 4.2% (Group 2) of

individuals. There were no significant differences in procedure choice between the two groups ( $p = 0.164$ ) (Table 3).

There were significantly more complications in Group I (11.4%) compared to Group II (6.6%) ( $p = 0.022$ ; Table 4). There was one (0.7%) mortality in Group I and eight (0.1%) in Group II ( $p = 0.17$  on Fisher's exact test). Additionally, 38 (0.5%) patients in Group II had symptomatic COVID-19 infection within 30 days of the surgical operation compared to none in Group I ( $p = 1.000$ ).

Table 5 presents 30-day morbidity and mortality analysed by procedure type in both groups. Differences in morbidity and mortality were only significant for LSG.

## Discussion

This study has demonstrated that 30-day morbidity was significantly higher for patients  $\geq 65$  years of age receiving bariatric surgery compared to those  $< 65$  years of age during the COVID-19 pandemic. However, there was no significant difference in 30-day mortality or 30-day symptomatic post-operative COVID-19 infection rates between the two groups.

The finding of increased 30-day morbidity in patients  $\geq 65$  years old maybe because 94.6% of patients in Group I had at least one co-morbidity compared to 68.3% in Group II. This is similar to the findings by Susmallian et al. who identified that 77% of patients  $\geq 65$  years of age had at least one comorbidity [7]. Similarly, Bhandari et al. demonstrated that 47.3%, 84.2%, and 17.9% of patients  $\geq 65$  years old

**Table 4** Comparison between the two age groups according to the outcome parameters

	Group I (≥ 65) (n =149)	Group II (< 65) (n =6923)	$\chi^2$	$p$
Complications				
No	132 (88.6%)	6463 (93.4%)	5.265*	0.022*
Yes	17 (11.4%)	460 (6.6%)		
Clavien-Dindo (CD) Score				
0	132 (88.6%)	6463 (93.4%)	0.822	FE p= 1.000
1	3 (2%)	162 (2.3%)		
2	4 (2.7%)	132 (1.9%)		
3A	4 (2.7%)	29 (0.4%)		
3B	4 (2.7%)	91 (1.3%)		
4A	1 (0.7%)	31 (0.4%)		
4B	0 (0%)	7 (0.1%)		
5 (Mortality)	1 (0.7%)	8 (0.1%)		
COVID within 30 days				
No	149 (100%)	6885 (99.5%)	0.822	FE p= 1.000
Yes	0 (0%)	38 (0.5%)		

$\chi^2$ : Chi-square test; FE: Fisher Exact;  $p$ :  $p$ -value for comparing the two studied groups; \*Statistically significant at  $p \leq 0.05$

CD, Clavien-Dindo Score; COVID, Novel Coronavirus 2019

**Table 5** Morbidity and Mortality rates in each group sub-divided by procedure type

			Overall	Group I	Group II	<i>p</i> -value
Total patients			( <i>n</i> = 7072)	( <i>n</i> = 149)	( <i>n</i> = 6923)	CD grade as a binary variable
LSG	30-day Morbidity		233/3983 (5.8%)	12/76 (15.8%)	221/3907 (5.7%)	< 0.001
	30-day mortality		4/3983 (0.10%)	1/76 (1.32%)	3/3907 (0.08%)	
RYGB	30-day Morbidity		166/2087 (8.0%)	4/49 (8.2%)	162/2038 (7.9%)	0.956
	30-day mortality		0	0	0	
OAGB	30-day Morbidity		53/702 (7.5%)	0/13	53/689 (7.7%)	0.298
	30-day mortality		3/702 (0.43%)	0	3/689 (0.44%)	
Other	30-day Morbidity		25/300 8.3%	1/11 (9.1%)	24/289 (8.3%)	0.926
	30-day mortality		2/300 (0.67%)	0	2/289 (0.69%)	

LSG, laparoscopic sleeve gastrectomy; OAGB, one anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass

Chi-square test performed (age more than 65 compared against presence/ absence of morbidity/ mortality)

suffered from diabetes, hypertension, and coronary heart disease compared to 20.1%, 23.4%, and 3.8%, respectively, in the younger age group [19].

The 30-day morbidity in our series was significantly higher in the older patients at 11.4% compared to 6.6% in the younger age group. A previous analysis of the National Surgical Quality Improvement Program (NSQIP) database demonstrated similar findings with increased rates of serious morbidity in the older age group compared to younger patients [20]. Another study reported a higher overall complication rate of 8.42% in older patients compared to 5.59% in the younger group, with significant differences in CD grades 3B and 4A [7].

In the current study, there was one mortality in the older age group (*n* = 149) and eight in the younger group (*n* = 6923), representing 0.7% and 0.1%, respectively. Though the difference did not reach statistical significance, this may be due to the small sample size. Bariatric teams should, therefore, be careful in offering bariatric surgery to patients in this age group. In contrast, a recent meta-analysis found that the mortality rate after LSG was similar at 0.2% in patients > 60 years and those ≤ 60 years of age whereas the mortality after RYGB was 2.2% and 0% (0/182), respectively [21]. However, those authors used 60 years as the cutoff which is no longer used to define older patients by WHO and other such bodies.

LSG was unsurprisingly the most commonly performed operation type in both groups (Group 1: 51.0%; Group 2: 56.4%) (Table 3). Importantly, there were no significant differences in procedure choice between the two groups.

Although the 30-day morbidity was significantly higher for LSG with Group I (15.8% vs 5.7%), it is difficult to draw firm conclusions from this due to the relatively low patient numbers (*n* = 76). All other procedures had comparable morbidity rates in both groups but once again there is potential for type II error due to small numbers. We cannot make any justifiable conclusions regarding morbidity and mortality of different procedures in two groups based on the data in our study. Authors would however suggest that procedure selection is made in the usual manner on an individualised basis for each patient taking into account their wishes and specific characteristics.

## Strengths and Weaknesses

This study has several weaknesses. Firstly, it only included data from participating centres and might therefore not represent the complete global picture. Additionally, we cannot guarantee that all contributors submitted all their consecutive patients during the study period, though collaborators were repeatedly reminded to do so. It is also possible that all adverse outcomes were not reported, but it is hoped that anonymous data collection and reporting would have discouraged any underreporting. Lastly, there were only 149 patients in the older age group, meaning that there is a potential for Type II error concerning the difference in mortality which indeed appears to be higher in the older population (0.7% vs 0.1%).

At the same time, this is the first international study examining the safety of bariatric surgery in those ≥ 65 years

of age during the COVID-19 pandemic, which is known to have affected older people disproportionately. Moreover, this study included a broad range of patients representing a wide range of demographics, geographical distribution, stage of COVID-19 pandemic severity in the host population, and surgeon and centre experiences. Other strengths of this study include the large sample size, the global reach of the study, high data completion rate, and nearly complete follow-up.

## Conclusion

Bariatric surgery during the COVID-19 pandemic was associated with higher 30-day morbidity in older patients ( $\geq 65$  years old) compared to younger patients. The mortality and postoperative COVID-19 infection rates were comparable to the younger age group.

**Author Contribution** RS: conceptualization, methodology, investigation, formal analysis. IO: formal analysis, writing — original draft preparation, discussion of the results, writing — review & editing. BM, YR, YG, AAT, CL, and TW: investigation, data curation. KM: conceptualization, methodology, writing — review & editing, supervision. All authors have seen the final manuscript and approved it. The study was designed and conducted by the study group and the authors on behalf of GENEVA collaborators.

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**Funding** The study was funded by the bariatric unit's research funds at University Hospitals Birmingham NHS Foundation Trust (Birmingham, UK).

**Data Statement** The data used to support the findings of this study can be released upon request.

## Declarations

**Ethics Approval** This project was registered as a multinational audit (number: 5197) at the University Hospitals Birmingham NHS Foundation Trust, UK. Each site project lead was responsible for obtaining local governance approvals and data sharing agreements before entering data into the registry.

**Consent to Participate** No informed consent was needed for an audit of this nature.

**Conflict of Interest** KM has been paid honoraria by various NHS trusts and Ethicon®, Medtronic®, Gore Inc®, and Olympus® for educational activities related to bariatric surgery. Other authors have no conflicts of interest.

**Statement of Human and Animal Rights** Not Applicable


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**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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