The United Kingdom National Bariatric Surgery Registry

The NBSR
NATIONAL BARIATRIC SURGERY REGISTRY
of The British Obesity & Metabolic Surgery Society

Third Registry Report

2020

Prepared by

Peter Small RD MD FRCSEd
on behalf of the NBSR Data Committee

Kamal Mahawar MS MSc FRCSEd

Peter Walton MBA FRCP
Dendrite Clinical Systems

Robin Kinsman BSc PhD

The UK National Bariatric Surgery Registry

Third Registry Report

2020

Prepared by

Peter Small RD MD FRCSEd
Kamal Mahawar MS MSc FRCSEd
on behalf of the NBSR Database Committee

Peter Walton MBA FRCP
Robin Kinsman BSc PhD
Dendrite Clinical Systems

NBSR
NATIONAL BARIATRIC SURGERY REGISTRY

The NBSR Committee

The UK National Bariatric Surgery Registry operates the Registry in partnership with Dendrite Clinical Systems Limited. The Society gratefully acknowledges the assistance of Dendrite Clinical Systems for:

- building, maintaining & hosting the web registry
- data analysis and
- publishing this report

Dendrite Clinical Systems Ltd is registered under the Data Protection Act;
Data Protection Act Registration Register Number Z88 55 307

Price: £40.00

August 2020 A catalogue record for this book is available from the British Library

ISBN 978-1-9160207-2-6

Published by

Dendrite Clinical Systems Ltd

Fifth Floor, Reading Bridge House, George Street

Reading RG1 8LS, United Kingdom

phone +44 1491 411 288

fax +44 1491 411 377

e-mail publishing@e-dendrite.com

DENDRITE CLINICAL SYSTEMS

Printed and bound by

cpl PRINT & DESIGN associates

Foreword

Obesity is very much in the news as I write this. The Covid 19 pandemic has ravaged health systems across the world with some 6 million reported cases thus far. A consistent finding amongst the many analyses of risk factors for contracting the disease has been obesity.

Whilst surgery is not the only treatment for morbid obesity, this the third report of the National Bariatric Surgery Registry is timely. It holds data on 19,104 procedures with an in hospital mortality of 0.04% and a complication rate of 2.4%.

These are remarkably good outcomes in a high risk group of patients even in the pre-Covid era. Of particular interest is the reduction in the prevalence of type 2 diabetes mellitus from 30% to 14% one year after surgery. But the authors acknowledge that there are gaps in their data capture and improvements to be made, and there is a rising incidence of revisional surgery.

The registry is a remarkable achievement ensuring that surgeons are sharing their outcomes with each other and their patients. Only by doing this in an open and honest way will the highest standards of technical and peri-operative care be maintained.

In order to make a case for the wider availability of bariatric surgery, registry data like these will be invaluable. As we begin to restore planned surgical services after the first wave of the pandemic there will be many calls on operating room availability. This report will allow the British Obesity and Metabolic Society to make a strong argument for surgery as a solution to obesity, not only as a risk factor for Covid 19, but its many other well recognised sequelae.

Neil Mortensen

President of the Royal College of Surgeons of England

NBSR - the most precious jewel in the crown of BOMSS

I am delighted to introduce the third report of the BOMSS National Bariatric Surgery Registry (NBSR).

NBSR is an example of what we can achieve collectively for the benefit of our patients. Bariatric teams up and down the country should be credited for the hard work it takes to enter such a large amount of data on tens of thousands of patients, work often done in their own time and with little support from administrative or managerial staff. They are prioritising data collection for NBSR along with front-line clinical duties because they know how important it is to assess the quality of our services and identify areas for future improvement.

This is real data, from real patients and in my opinion, it is the most accurate assessment there is of the risks and benefits of modern bariatric surgery in the United Kingdom. Because of the large number of patients in the database, it overcomes many of the statistical issues we sometimes see with small studies, even randomised ones. Presentations and publications from the NBSR are of the highest quality available to the wider bariatric community. I would like to thank the past and the present members of the NBSR committee for their persistent efforts in making the NBSR a reality.

This third report once again highlights the exceptional safety and efficacy of bariatric surgery in the United Kingdom. There are many firsts in this report that deserve a special mention. For the first time, we have attempted to analyse data for each United Kingdom nation separately, and for England, we have broken it down by region. I am sure local commissioners and clinicians will find this extremely useful. When it comes to surgical procedures, for the first time, the report contains data on a large number of One Anastomosis Gastric Bypass procedures and a whole section on Revisional Surgery, which is undoubtedly becoming more common globally. The comparisons between different revisional procedures are particularly interesting.

At the time of writing, we are still in the midst of a global pandemic and the immediate future for bariatric surgery might seem difficult. But our speciality will survive simply because of the way it transforms lives. In months to come, we will be required to demonstrate that the United Kingdom's exceptional record for safe bariatric surgery can be maintained as we negotiate our way through the damage that coronavirus has wreaked on the delivery of healthcare. And one of the most potent instruments that we have to achieve this is the NBSR itself. We propose to use the power of the NBSR to closely monitor in near-real time our surgical outcomes as bariatric surgery restarts, so that we can detect any upward inflection of complication rates at the earliest opportunity and adapt our strategy accordingly.

As we resume bariatric surgery in different parts of the country, I would urge bariatric multidisciplinary teams to improve ways of recording their complication data into the NBSR and promptly bring any unusual complications to the attention of colleagues on the NBSR committee. That will be the only way for us to learn of any challenges and effectively deal with them. And be under no illusion, there will be new challenges!

David Kerrigan

President of BOMSS

Executive summary

This third report of the National Bariatric Surgery Registry (NBSR) builds on the previous two and includes data on an additional 38,388 patients taking the overall total to 70,461 patients. The total number of primary procedures performed (both public and private sector) has stayed relatively constant at around 6-7 thousand *per annum* over the past decade with National Health Service (NHS) funded procedures accounting for approximately three-quarters of all recorded activity.

Overall it seems that males seek bariatric surgery later in the course of their disease, as the registry data shows they generally have a higher body mass index (BMI) and more obesity-related disease than female patients. A trend towards lower BMI for all patients (both males and females) at the time of surgery reflects increasing acceptance of surgery within the United Kingdom, but an average BMI of 47.1 kg m^{-2} for males and 45.9 kg m^{-2} for females in 2018 probably means we have some way to go before bariatric (and metabolic) surgery can become a treatment option for all those who could benefit from it.

For the first time, this report attempts to examine access to bariatric surgery in individual countries of the United Kingdom. It seems that the number of procedures reported from North Ireland, Scotland, and Wales are disproportionately lower, emphasising the need to encourage use of NBSR in these regions as well as promotion of publicly funded bariatric surgery in these regions. There could be various reasons for these differences, potentially including lower compliance with NBSR data entry. However, it is generally agreed that Northern Ireland, Scotland, and Wales perform fewer procedures than England, which, in turn, lags significantly behind other countries with similar demographics and disease burden [1]. To correct the *status quo* would require careful planning and political will. Hopefully, this report will provide patients' advocates and the bariatric surgery community with the requisite tools to guide policy-makers.

Another interesting feature of this report is the analysis by region for England, which shows a variation in NHS funding as well as the kinds of procedures performed. But Roux-en-Y gastric bypass (RYGB) remains the commonest operation in all regions of England followed by sleeve gastrectomy (SG) for the period analysed.

The third report concentrates on operations recorded between 2013 and 2018 and includes data for 19,104 RYGB procedures, 13,841 SGs, 4,499 gastric bands (GB), and 1,515 one anastomosis gastric bypasses (OAGB). In 2018, SG supplanted RYGB to become the commonest bariatric procedure in the United Kingdom, mirroring the global trend [2]. The declining proportion of RYGB and increasing rates of OAGB are also worth highlighting. Patients undergoing OAGB tended to be heavier and, unsurprisingly, RYGB patients were more likely to be suffering from gastro-oesophageal reflux disease (GORD) prior to surgery.

Another remarkable feature of bariatric surgery in the United Kingdom is its exceptional safety. In-hospital mortality of 0.04 % compares very favourably with internationally accepted figures [3] as does the overall complication rate of approximately 2.4 %. It remains to be seen if the apparent higher in-hospital mortality of 0.13 % seen with OAGB compared to 0.05 % seen with RYGB and 0.04 % with SG is down to a learning-curve effect or due to patient selection. At the same time, it has to be highlighted that 30-day complication data capture is poor and will need further probing to identify the underlying reasons for this apparent shortfall. It is probably worth determining whether or not there might be an electronic solution to improve data capture for these important variables. Decreasing hospital stay, where 70 % of patients are now discharged by the second post-operative day also deserves a mention.

An excess weight loss at 1 year of 73.7 % after OAGB and 71.3 % after RYGB compares favourably against 61.5% after SG and 38.8 % after GB. Once again, the lack of one-year weight loss data for the majority of patients held in the registry stands out and must encourage us to find a systematic solution to improve both data capture and the follow-up. The data also show significant improvement in a range of obesity-related diseases after surgery; most remarkable of which probably is a reduction in the prevalence of type 2 diabetes mellitus from 30% to 14% one year after surgery.

Revisional bariatric surgery is becoming more common with approximately 800 procedures *per annum*. Most of these (approximately 70.0%) were performed on patients with GB. One year excess weight loss after band to RYGB was 60.0%, which is slightly higher than that after GB to SG which at around 56.9 %. Similarly, SG to OAGB conversion yielded an EWL of 63.5 % at 1 year compared to 42.8 % with RYGB. These data confirm the additional benefits in terms of weight loss after revisional bariatric surgery in the United Kingdom.

To conclude, the sheer volume of data held by the registry now makes it one of the largest in the field of bariatric surgery in the world. It gives us a real insight into the practice of bariatric surgery in the United Kingdom and will undoubtedly help us further improve the outcomes for our patients.

References

1. Welbourn R, le Roux CW, Owen-Smith A, Wordsworth S, Blazeby JM. Why the NHS should do more bariatric surgery; how much should we do?. *British Medical Journal*. 2016; **353**: i1472.
2. Angrisani L, Santonicola A, Iovino P, et al. IFSO Worldwide Survey 2016: Primary, Endoluminal, and Revisional Procedures. *Obesity Surgery*. 2018; **28(12)**: 3783-379.
3. Chaar ME, Lundberg P, Stoltzfus J. Thirty-day outcomes of sleeve gastrectomy versus Roux-en-Y gastric bypass: first report based on Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program database. *Surgery for Obesity and Related Diseases*. 2018; **14(5)**: 545-551.

Contents

Contents

The value of registries

Over the past 3 decades, bariatric surgery has undergone an amazing transformation. From the mid 1980s until the early 2000s, bariatric surgery was being performed with dramatically greater morbidity and mortality than it is currently experiencing. There were no societal standards and the overwhelming majority of the published research to guide the surgeons was in the form of small retrospective case series. There was little true science. Surgeon training was not uniform, and even absent. Poorly trained surgeons were often performing surgical procedures that were not evidence-based and suffered from significant complications and high rates of weight regain. Mortality was unacceptably high in the range of 1-3%. Case volume rose but quality did not.

This situation resulted in a crisis of trust and confidence. In the US, the health insurance industries resisted covering cases and surgeons often could not get malpractice insurance coverage. Outside the US few cases were being performed and many patients who might have benefited from these procedures were unable to have surgery.

Fortunately, bariatric surgical leaders recognized this crisis and embarked upon an unprecedented effort to create the infrastructure to improve results and reduce untoward events through the creation of pathways to training and patient care protocols that utilized *Best Practice guidelines* and the collection and interpretation of evidence-based data.

This program then set out to include all practicing surgeons and their programs *via* the Surgical Review Corporation and the American College of Surgeons. The result of this effort was the marked improvement in results and a dramatic drop in the rate of mortality to 0.1-0.2%.

A major contributor to this success was the creation of large, all inclusive, data bases and the mandatory requirement that all participants were obliged to provide all of their data. These large databases allowed for the collection and analysis of a large amount of data, far more than what could ever have been collected in single practices or multi-center collaboration. The large volume of collected data could then be used to generate the evidence-based policies that continue to push the envelope of safety and efficacy to new heights.

Large prospective databases allow researchers to create the large randomized controlled trials that continue to add quality to the bariatric specialty. Instead of retrospective case reports that are underpowered and often of poor quality. Randomised controlled trials (RCT) are the most scientifically accurate way of answering clinical questions and furthering our understanding of the effects of bariatric surgery. However, some of the recognised problems of RCTs are the cost; difficulty in organising them; and often ideal, unreal settings that do not represent the ground reality.

Large, prospective databases can overcome many of these issues by capturing a large amount of real-life data in a cost-effective manner. Because of their sizes, they can answer some of the more difficult questions that individual surgeons can never hope to do in their practice. National and international registries that capture each procedure and their outcomes fill an important gap in our research capacity in that sense. By turning every patient episode into a research exercise that we can potentially learn from, registry databases open up possibilities that didn't hitherto exist. We can now analyse questions that need thousands of patients at ease, from real-life data.

It is with this ethos in mind that I am particularly pleased to see the third NBSR (National Bariatric Surgery Report) report of the BOMSS (British Obesity and Metabolic Surgery) of the UK (United Kingdom). With a record of over 70 thousand patients, NBSR is easily one of the largest databases in the world and allows us to evaluate important trends. For example, over the last decade, the number of bariatric and metabolic procedures has stayed relatively constant in the UK at approximately 6-7 thousand procedures *per* year. In contrast, the number of procedures worldwide has increased significantly during this period. At the same time, the trends of procedures performed in the UK seem to mirror the rest of the world. The Sleeve Gastrectomy (SG) and One Anastomosis Gastric Bypass (OAGB) are gaining popularity while the Roux-en-Y Gastric Bypass (RYGB), which was the gold standard procedure for many years, has steadily declined. Similar to many other parts of the world, in the UK in 2018, the SG has become the commonest recorded procedure displacing the RYGB to second place. It would be particularly interested to see the longer-term outcomes with the OAGB which is growing in popularity world-wide but still not an accepted procedure in the United States of America.

Low complication rates with bariatric surgery in the UK and a decreasing hospital stay of patients are other encouraging trends worth highlighting. At the same time, a large number of unspecified data in the 30-day complication section probably indicates incomplete data, and that means there is further room for improvement. Any conclusion we derive from a registry is only as good as the quality of the data we enter. I would, therefore, urge my UK colleagues to examine how they can make the registry even more robust.

I would like to conclude by congratulating surgeons in the UK and BOMSS on the production of this marvellous report. The world of registries is in its infancy globally, and in that respect, your contribution is pioneering and paramount. As time passes, registries will find more engagement from clinicians on the ground, will have some sort of data validation tools built into them, and be adequately resourced by the funders. Its data will be used to guide policy and it will considerably strengthen our research capacity. Registries will undoubtedly play a huge role in evidence building in the future, and it is therefore important that we spend some time to get them right.

Scott A Shikora MD, FACS, FASMBS

Professor of Surgery, Harvard Medical School

Director, Center for Metabolic and Bariatric Surgery, Brigham and Women's Hospital

Editor-in-Chief, Obesity Surgery Journal

President-elect, International Federation for Surgery of Obesity.

The history and the future of the NBSR

The history

The Association of Laparoscopic Surgeons (ALS) around 2006 first proposed the concept of a national register of bariatric operations. The project brought together the 3 surgical societies of ALS, AUGIS and BOMSS who tasked Richard Welbourn with delivering the first registry database. Working with Dendrite Clinical Systems, he identified the fields, created the registry database and single-handedly delivered the first version of the National Bariatric Surgery Register (NBSR) in 2008.

The initiative, drive and financial commitment at the outset came from the ALS. Laparoscopic Bariatric surgery in the United Kingdom was in its infancy and the opportunity to design a national database, capturing as many bariatric procedures as possible was necessary to ensure national data could be collected quickly and efficiently. This in turn could be used to confirm surgical safety, report outcomes and trends as well as form the basis for research questions. These data collected have now formed the backbone to this and two previous reports.

The first report, published in 2010, was already able to record the outcomes of 8710 operations with a surprisingly low in-hospital mortality rate of 0.1% and equally low complication rate of 2.6%. Follow up data was able to demonstrate major improvements in comorbid conditions such as type 2 diabetes mellitus (T2DM), sleep apnoea and reversal of mobility problems.

The second report, published in 2014, recorded outcomes for 18,283 procedures performed between 2011 and 2013. The NBSR by then had records of 32,073 cases. Compared with the first report, surgeons were now operating on heavier patients with more comorbidities and higher mortality risk scores. Despite this, surgery was performed with a lower in hospital mortality rate and equivalent complication rates.

Prof Sir Bruce Keogh, the Medical Director of the NHS in England over these years invited BOMSS to use the NBSR to produce one of the first Consultant (now Clinical) Outcome Publications (COP) in 2014. This was a remarkable achievement given the NBSR was a voluntary database collected by surgeons, independent of any NHS funding. Surgeons were prepared to allow publication of personal outcomes, hitherto unheard of. Data collection was helped in England when NHSE published the Clinical Commissioning Policy for Complex and Specialised Obesity Surgery in April 2013, mandating the use of the NBSR for all bariatric procedures carried out in the NHS. Annual COP reports, validated against HES data, have been published every year since with improvement in data collection and outcome measures, all in the public domain.

Version 2 of the NBSR was delivered in 2017. This allowed the inclusion of new operative procedures and archiving of older procedures. Paediatric / adolescent surgical fields have been added as well as QoL assessments using the EQ5D questionnaire from EuroQoL. Importantly, with the patients written consent, NHS numbers can now be recorded, which will allow linking of NBSR with other NHS databases such as HES and GP databases.

The future

Current developments include the production of individual reports for BOMSS consultants for use in their annual appraisal to demonstrate ongoing national audit activity, one of the standards set by the GMC. A similar report can be produced for NHS Trusts, which support the NBSR with data collection and running costs. This in turn can be used to confirm participation in National clinical audits.

With the inclusion of the EQ5D Quality of life measurements the NBSR can now link patient feedback to operative outcomes. In its infancy, this does require patient consent and response to messages sent at intervals. The (consented) inclusion of NHS numbers, also in its infancy, gives the NBSR an opportunity to link outcomes with other NHS records. This will lead to more in-depth measurements of outcomes through ethically approved research projects in the future.

Work is ongoing to further improve the databases. Readmissions for complications need recording, revisional surgery needs to be able to link back to the original procedure, irrespective where it was performed or by whom. Originally, data were entered against unique patient numbers known only to the primary surgeon. The NHS number inclusion will help overcome this problem.

It is vitally important to realise that clinical input to the NBSR has always been entirely voluntary. Surgeons are not paid to put data in, committee members are not paid to oversee the NBSR and administrative or development costs have only been met by voluntary contributions from NHS Trusts or small contributions from HQIP when producing COP reports. These reports would not be possible without the trust and enthusiasm of all contributing clinical teams and their host institutions.

BOMSS and the NBSR committee are also immensely grateful to Dr Peter Walton, Dr Robin Kinsman and many other team members of Dendrite Clinical Systems who have enthusiastically, patiently and expertly helped plan, revise and analyse our ever expanding data. Our thanks also go to Sarvit Wünsch and Nichola Coates who, along with the day to day running of AUGIS, help administer the NBSR within the Royal College of Surgeons of England.

Peter Small

Chairman of NBSR Committee

Obesity is a disease

A disease is defined as a disorder of structure or function of an organism, producing specific symptoms or affecting a specific location, but not directly resulting from physical injury [1].

Historically, the effects of excess weight on morbidity and mortality were recognised over 2,000 years ago when Hippocrates described obesity as a surplus of the four humours of the human body. Balance of humours was deemed vital for health, with a surplus thought to cause disease. Hippocrates was the first to recognise that obesity leads to infertility and early mortality, contrasting with earlier perceptions that excess weight indicated good health and prosperity.

We now have a greater understanding of the underlying aetio-pathophysiological contributors of obesity, mechanisms controlling eating behaviour and the genetic determinants of bodyweight. This advancement in knowledge is driving an international consensus that obesity is a serious, complex and progressive disease. Indeed, most people living with obesity and healthcare professionals treating obesity already view obesity as a disease [2]. Despite this perception, existing healthcare systems and treatment approaches in the United Kingdom do not commonly reflect this. Compliance with standards of care proposed by NICE is variable, access to weight management services is limited or absent in many regions, and people with obesity are facing unabated weight stigma in society, employment and healthcare.

In 1997, the World Health Organisation (WHO) and International Obesity Task Force described obesity as a chronic non-communicable disease that required prevention and management strategies at both individual and societal level. The WHO subsequently defined obesity as the abnormal or excess accumulation of body fat that presents a risk to health [3].This health impairment manifests in multiple comorbidities and increased mortality. Type 2 diabetes (T2D), cardiovascular disease, obstructive sleep apnoea, liver disease, gastro-oesophageal reflux, infertility, osteoarthritis, depression and anxiety disorders commonly co-exist, often compounded by impaired quality of life. The risk of developing cancer is also doubled, and life expectancy reduced.

Several national societies have since followed the WHO's lead in recognising obesity as a disease, with Japan (2002), Portugal (2004), Scotland (2010), USA (2013), Canada (2015) and Italy (2019) asking their governments to act on establishing effective prevention and management. Key regulatory bodies such as the US Food and Drug Administration and European Medicines Agency also concurred, as well as professional bodies including the European Association for the Study of Obesity (2015), World Obesity Federation (2017) and Royal College of Physicians (2019).

The biological basis of obesity

Obesity arises from a prolonged imbalance between energy intake and expenditure leading to increased visceral and peripheral lipid storage. As a result, expanding adipose tissue releases a series of pro-inflammatory cytokines and chemokines to produce a low-grade inflammatory state. When prolonged, this progresses to chronic systemic inflammation, which contributes to the aetiology of many obesity-associated comorbidities. For example, vascular inflammation promotes intimal plaque development and thus cardiovascular disease [4]. Pancreatic beta cell inflammation reduces insulin secretion which, together with peripheral insulin resistance from hepatic and muscular inflammation, leads to T2D. Inflammation of hypothalamic neurons, and subsequent insulin and leptin resistance in the arcuate nucleus, disrupt local metabolic feedback loops to promote further energy intake and weight gain [5].

Once a person develops obesity, their physiology changes to predispose to further weight gain. Signalling from the gastrointestinal tract and adipose tissue to the brain is impaired [6]. Structural changes in the brain occur, with reduced grey matter volume and density, smaller whole brain volume and decreased resting-state connectivity in motivation and reward networks [7-9]. Neural responses to food cues in homeostatic and reward regions are also enhanced, leading to further dysregulation of eating behaviour. The resulting consumption of a high-energy diet may change the gut microbiome, favouring proliferation of *Bacteroidetes* and *Firmicutes* species that further promote adipose tissue expansion [10].

Weight loss engendered by lifestyle interventions activates powerful compensatory biological pathways to encourage increased energy intake and restore bodyweight. Ghrelin increases to stimulate appetite, satiety hormone levels decrease, energy expenditure reduces, and neural responses to food cues are further enhanced. This evolutionary response means that maintenance of weight loss from lifestyle interventions is extremely challenging and often unsuccessful.

Genetic predisposition

A hallmark of many diseases is the influence of genetic make-up on susceptibility. Obesity is no different. Evidence from family, twin and adoption studies show bodyweight is up to 70% heritable [11-13]. Genetic mutations in the leptin-melanocortin pathway engender strong behavioural and biological phenotypes that lead to obesity from an early age [14]. However, genetic variants associated with body mass index, waist circumference, energy intake, satiety responsiveness, basal metabolic rate and response to exercise have also been identified. People with obesity have significantly higher numbers of these obesity-risk variants than those with normal bodyweight [15]. In fact, polygenic risk scores identify a genetic basis for nearly one-third of people with severe obesity [16].

Taken together, obesity is an impaired physiological state driven by a combination of discrete genetic, hormonal, and metabolic disorders alongside environmental triggers.

Why do we need to recognise obesity as a disease?

Recognising obesity as a complex, multi-factorial disease will provide numerous important benefits.

First, it will help to change the perception of obesity in public opinion. Weight stigma can be debilitating for those living with obesity and detrimental to the care they receive. Changing the narrative around obesity from one of personal responsibility and lifestyle choice to focus on the serious and complex health consequences, will help to reduce the stigma that people living with obesity face and ultimately improve access to evidenced based treatments.

Despite scientific advances, obesity remains incompletely understood. Formally recognising its disease status would encourage more funding for essential research to translate knowledge of the underlying mechanisms into novel, more effective treatments.

Training in obesity assessment & management for healthcare professionals is currently insufficient [17]. Recognising obesity as a disease could increase awareness of the need for more specialist obesity physicians and bariatric surgeons, whilst increasing education within the medical curriculum and postgraduate training programmes.

Some fear that declaring disease status would inundate health services owing to the vast number of people suffering with obesity. People with obesity-associated health problems are already utilising health services, costing more than £6.1 billion *per* year. However, weight management services are underfunded and, in some regions, absent. Currently less than 1% of people eligible for bariatric surgery undergo surgery. We need to switch the focus from treating the health consequences of obesity to funding effective prevention and treatment programmes. Formal recognition of obesity as a disease will help governments and NHS leaders commit to providing the necessary healthcare that people living with obesity deserve.

NBSR / BOMSS recommendation

Obesity needs to be recognised as a chronic, progressive disease by government and the broader health sector to enable the development of formal healthcare policies to improve the health of adults and children living with obesity.

Professor Rachel Batterham

Professor of Obesity, Diabetes & Endocrinology

NBSR Committee and BOMSS Council Member

Miss Roxanna Zakeri

Bariatric Surgery Research Fellow

BOMSS Trainee Research Lead

References

1. Disease| Definition of Disease by Lexico. https: //www.lexico.com / en / definition / disease. Accessed December 20, 2019.
2. Kaplan LM, Golden A, Jinnett K, et al. Perceptions of Barriers to Effective Obesity Care: Results from the National ACTION Study. *Obesity*. 2018; **26(1)**: 61-69. doi: 10.1002 / oby.22054.
3. WHO| Obesity. WHO. 2014. https: //www.who.int / topics / obesity / en/. Accessed January 1, 2019.
4. Yao L, Herlea-Pana O, Heuser-Baker J, Chen Y, Barlic-Dicen J. Roles of the chemokine system in development of obesity, insulin resistance, and cardiovascular disease. *Journal of Immunology Research*. 2014; 2014. doi: 10.1155 / 2014 / 181450.
5. Jais A, Brüning JC. Hypothalamic inflammation in obesity and metabolic disease. *The Journal of Clinical Investigation*. 2017; **127(1)**: 24-32. doi: 10.1172 / JCI88878.
6. Clemmensen C, Müller TD, Woods SC, Berthoud HR, Seeley RJ, Tschöp MH. Gut-Brain Cross-Talk in Metabolic Control. *Cell*. 2017; **168(5)**: 758-774. doi: 10.1016 / j.cell.2017.01.025.
7. Pannacciulli N, Del Parigi A, Chen K, Le DSNT, Reiman EM, Tataranni PA. Brain abnormalities in human obesity: A voxel-based morphometric study. *Neuroimage*. 2006; **31(4)**: 1419-1425. doi: 10.1016 / j.neuroimage.2006.01.047.
8. Gunstad J, Paul RH, Cohen RA, et al. Relationship Between Body Mass Index and Brain Volume in Healthy Adults. *Int Journal of Neuroscience*. 2008; **118(11)**: 1582-1593. doi: 10.1080 / 00207450701392282.
9. Doornweerd S, van Duinkerken E, de Geus EJ, Arbab-Zadeh P, Veltman DJ, IJzerman RG. Overweight is associated with lower resting state functional connectivity in females after eliminating genetic effects: A twin study. *Human Brain Mapping*. 2017; **38(10)**: 5069-5081. doi: 10.1002 / hbm.23715.
10. Bouter KE, van Raalte DH, Groen AK, Nieuwdorp M. Role of the Gut Microbiome in the Pathogenesis of Obesity and Obesity-Related Metabolic Dysfunction. *Gastroenterology*. 2017; **152(7)**: 1671-1678. doi: 10.1053 / j. gastro.2016.12.048.
11. Stunkard AJ, Harris JR, Pedersen NL, McClearn GE. The Body-Mass Index of Twins Who Have Been Reared Apart. *New England Journal of Medicine*. 1990; **322(21)**: 1483-1487. doi: 10.1056 / NEJM199005243222102.
12. Sørensen TI, Price RA, Stunkard AJ, Schulsinger F. Genetics of obesity in adult adoptees and their biological siblings. *BMJ*. 1989; **298(6666)**: 87-90. doi: 10.1136 / bmj.298.6666.87.
13. Allison DB, Kaprio J, Korkeila M, Koskenvuo M, Neale MC, Hayakawa K. The heritability of body mass index among an international sample of monozygotic twins reared apart. *International Journal of Obesity*. 1996; **20(6)**: 501-506.
14. Nunziata A, Funcke J-B, Borck G, et al. Functional and Phenotypic Characteristics of Human Leptin Receptor Mutations. *Journal of the Endocrine Society*. 2019; **3(1)**: 27-41. doi: 10.1210 / js.2018-00123.
15. Riveros-McKay F, Mistry V, Bounds R, et al. Genetic architecture of human thinness compared to severe obesity. *PLoS Genetics*. 2019; 15(1). doi: 10.1371 / journal.pgen.1007603.
16. Khera A V, Chaffin M, Wade KH, et al. Polygenic Prediction of Weight and Obesity Trajectories from Birth to Adulthood. *Cell*. 2019; **177(3)**: 587-596.e9. doi: 10.1016 / j.cell.2019.03.028.
17. Kushner RF, Horn DB, Butsch WS, et al. Development of Obesity Competencies for Medical Education: A Report from the Obesity Medicine Education Collaborative. *Obesity*. 2019; **27(7)**: 1063-1067. doi: 10.1002 / oby.22471.
18. Statistics on Obesity, Physical Activity and Diet, England, 2019 - NHS Digital. https: //digital.nhs.uk / data-and-information / publications / statistical / statistics-on-obesity-physical-activity-and-diet / statistics-on-obesity-physical-activity-and-diet-england-2019. Accessed December 20, 2019.

Volume of activity in the UK

Authors

Rachel Batterham
Roxanna Zakeri
Michael Courtney
Peter Small

Volume of activity in the United Kingdom

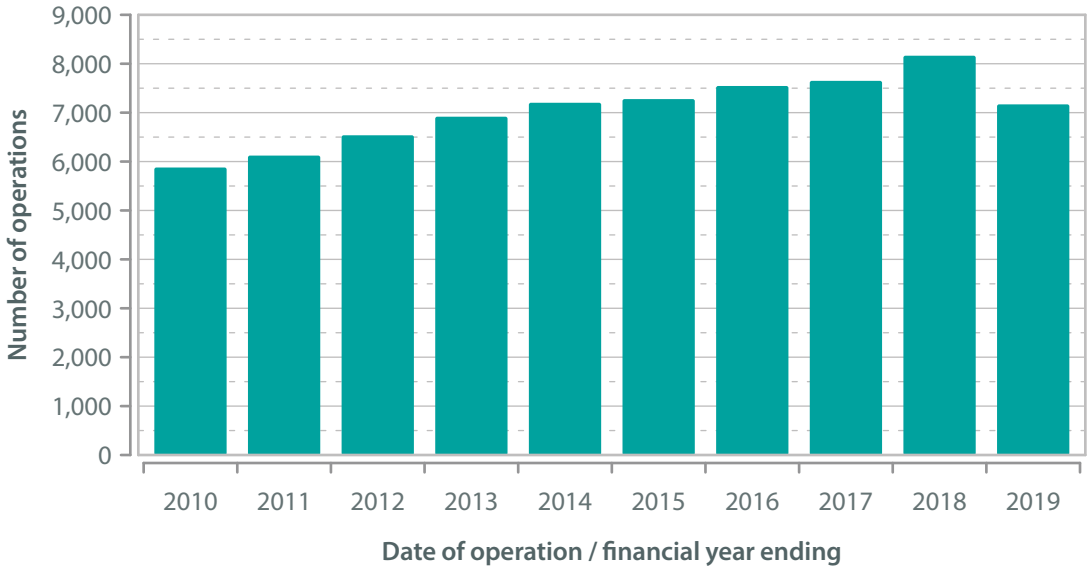
Trends through time

Number of operations

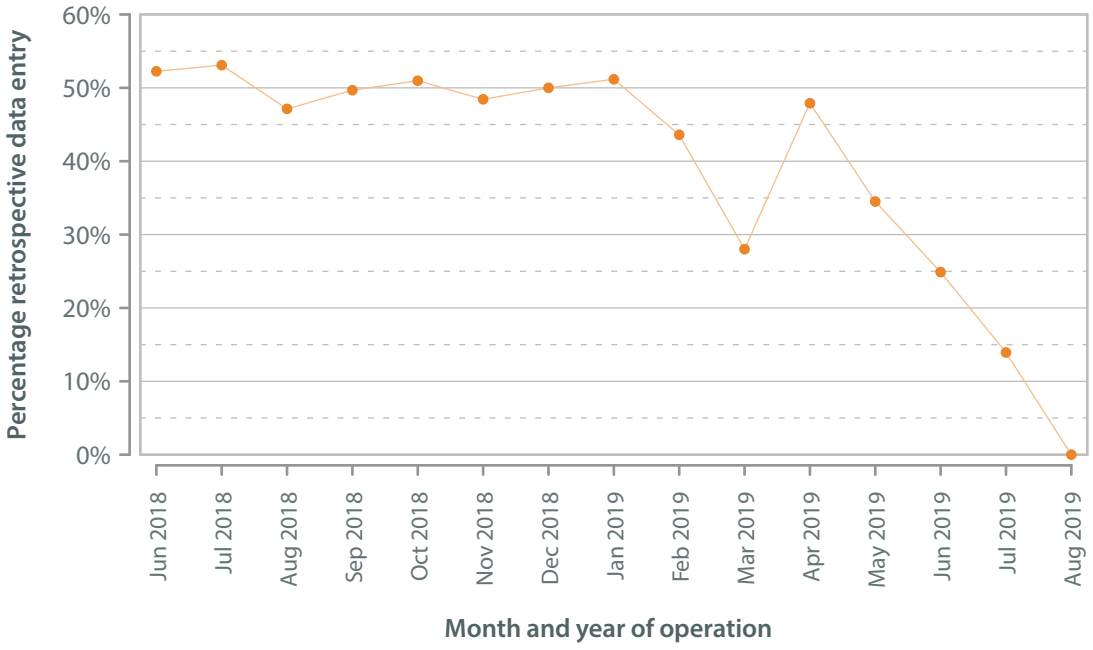
The total number of bariatric operations being performed on adults in the United Kingdom & Ireland continues to increase. Since 2010, activity has increased from nearly 6,000 operations *per* year to over 8,000 in 2018. A total of 70,461 bariatric operations are now held in the registry, with 38,388 additional cases recorded since the second NBSR report in 2014.

Between June 2018 and April 2019 approximately 50% of cases were entered retrospectively. Data from May to August 2019 suggest improved contemporaneous entry of cases (2019 data are incomplete and only go up to the month of August).

NBSR: Operations recorded in each year for adult patients (n=70,461)



**The on-line NBSR: The timing of data entry;
all data entry up to the end of August 2019 (n=7,976)**



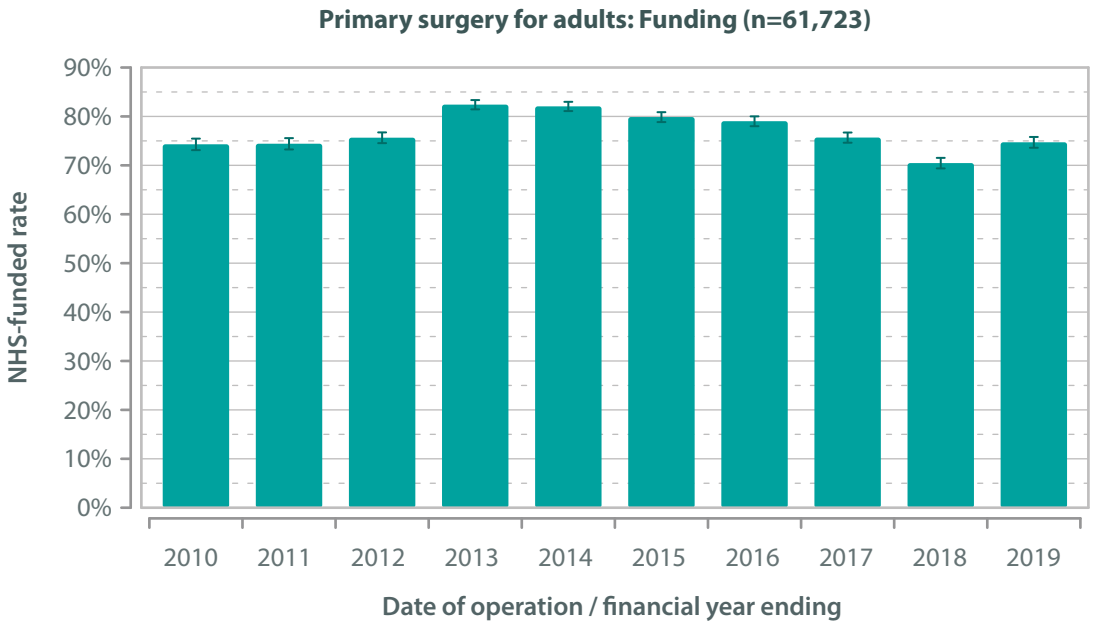
Funding

Primary bariatric surgery for adults has increased in frequency since 2010. There was a peak of 6,463 primary cases recorded in 2014, with a concomitant peak in the number of NHS-funded procedures (5,274 cases). From 2014 to 2018, there was a slight increase in the total number of primary procedures recorded (6,463 to 7,017), though the number of NHS-funded procedures declined year-on-year, falling by 6.6%. This represented an 11.6% decline in the proportion of all primary procedures performed.

Parallel to this decline has been an 79.0% increase in privately-funded primary bariatric surgery, rising from 1,153 cases in 2014 to 2,065 in 2018. These trends are likely due to serial reductions in NHS remuneration tariffs for bariatric surgery to NHS Trusts. BOMSS has played a significant role in lobbying for improved coding and financial remuneration for bariatric procedures, with promising NHS tariffs established for 2019-2020. Trends identified could also be attributed to improved recording of private patients within the NBSR. This trend is to be encouraged.

Primary surgery for adults: funding category

Financial year of operation	Funding			
	NHS	Private	Unspecified	NHS-funded rate
2010	4,002	1,384	85	74.3%
2011	4,117	1,415	84	74.4%
2012	4,512	1,452	65	75.7%
2013	5,165	1,102	60	82.4%
2014	5,274	1,153	36	82.1%
2015	4,902	1,235	40	79.9%
2016	5,045	1,339	56	79.0%
2017	4,995	1,605	30	75.7%
2018	4,926	2,065	26	70.5%
2019	4,509	1,526	50	74.7%
All	**47,447**	**14,276**	**532**	**76.9%**



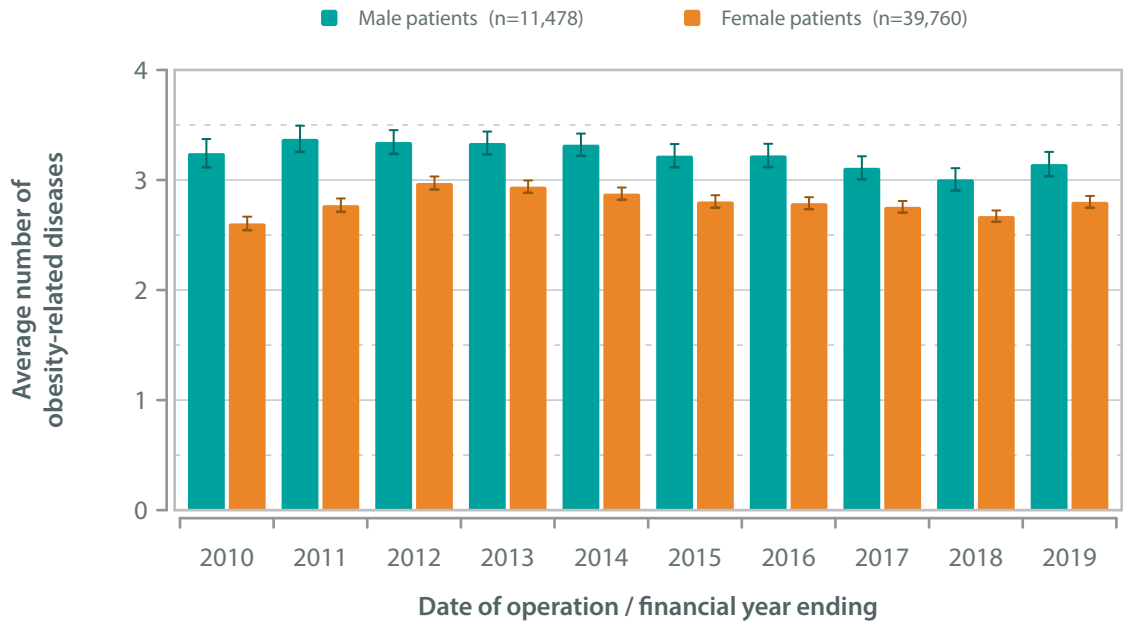
Disease profile

Number of comorbidities

Data for obesity-related comorbidities were obtained for 51,238 patients undergoing primary bariatric surgery, with females representing 77.6% (39,760 cases) and 22.4% males (11,478 cases). Throughout the 10-year period male patients had a higher average number of obesity-related comorbidities reported than did female patients.

Overall, the average number of obesity- associated diseases marginally reduced over time, particularly since 2014. If a real trend, this may be due to multiple factors including earlier presentation at a younger age.

Primary surgery for adults: Average number of obesity-related diseases; database entries with no missing obesity-related disease data



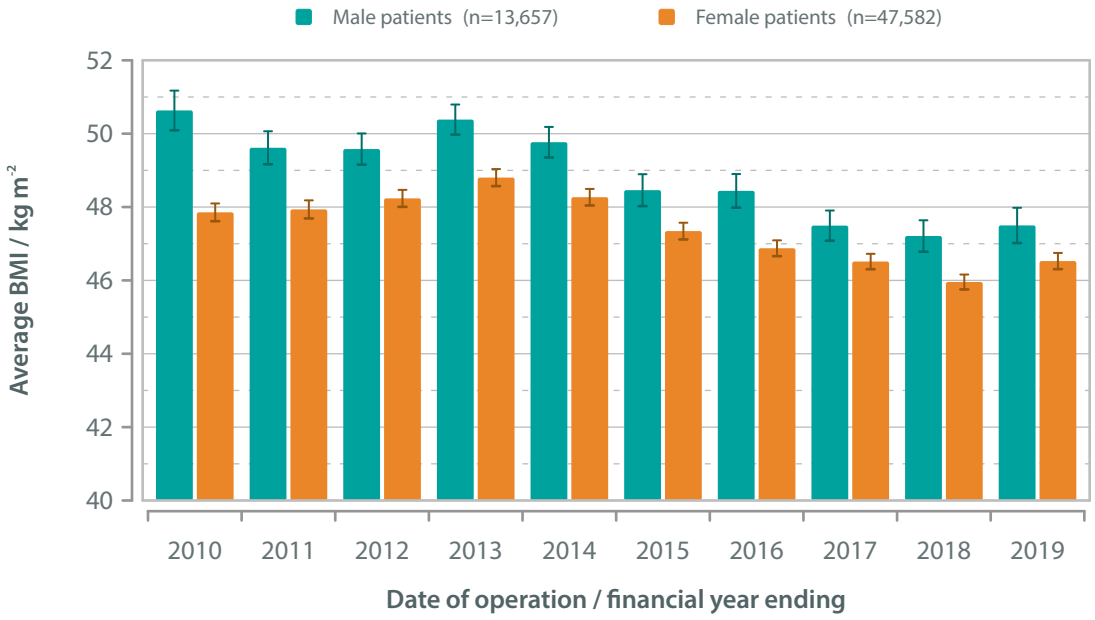
Body mass index

Average BMI

Overall, BMI for patients entering bariatric weight-loss programs was recorded for 61,239 patients, of whom 47,582 (77.7%) were female and 13,657 (22.3%) were male. Since the last report, the average BMI of male patients on entry has fallen from 49.8 kg m^{-2} in 2014 to 47.1 kg m^{-2} in 2018, and female patients from 48.2 kg m^{-2} to 45.9 kg m^{-2}. This may reflect the impact of the 2014 NICE clinical guidelines, encouraging earlier consideration of bariatric surgery for people with severe obesity.

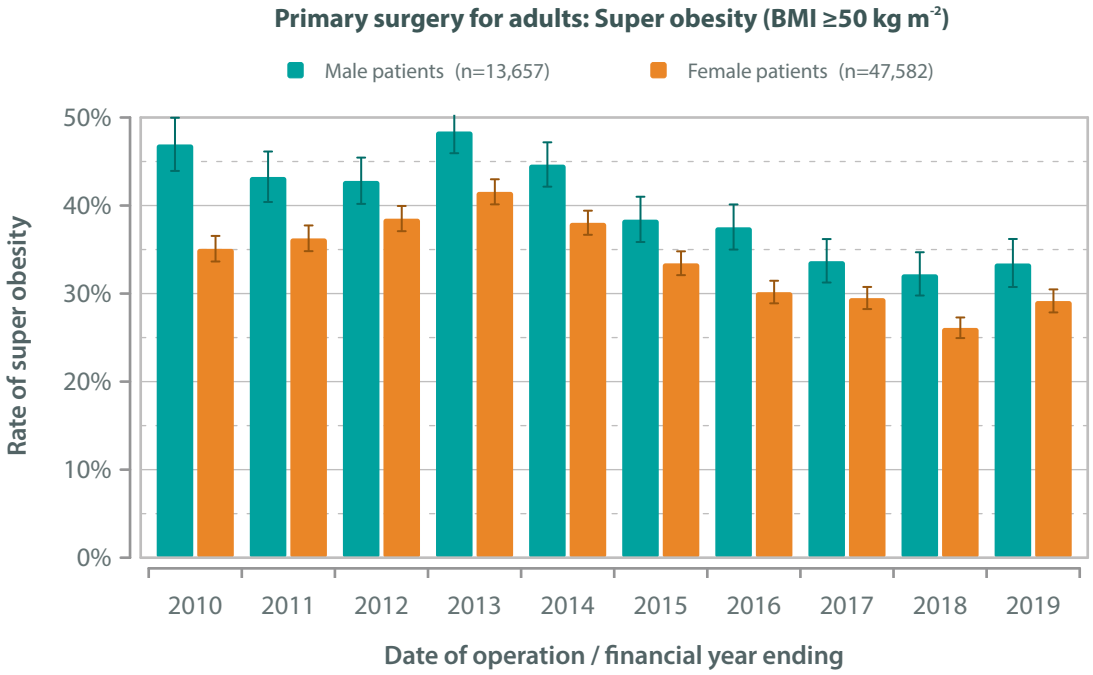
The average BMI at referral remains higher for male than female patients, with no notable change in the difference over time. With the number of female patients undergoing surgery far outnumbering male patients, this BMI difference reflects the often-delayed presentation of men to weight management services.

Primary surgery for adults: Average BMI on entry to the weight-loss program



Super obesity

There has been a marked reduction in the proportion of patients undergoing primary bariatric surgery with BMI ≥50 kg m^{-2} since 2013. In male patients, this reduced from 48% of all cases in 2013 to 32% in 2018. In female patients, the decrease was from 41% to 26%. This likely reflects the increasing acceptance of bariatric surgery as a treatment strategy for severe obesity and not as a last resort.



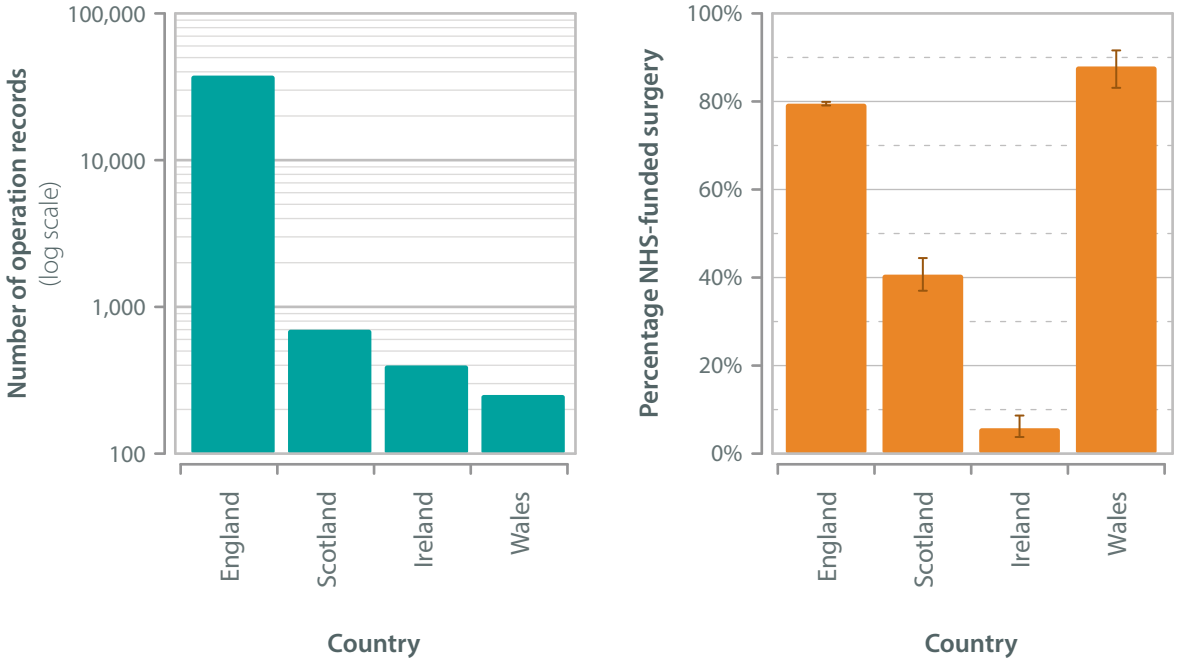
Analysis by country

Number of operations and funding

Bariatric surgery is performed in all four countries of the United Kingdom. During the financial years 2013 to 2018 there were 37,705 primary bariatric operations recorded in the NBSR in England, 699 in Scotland, 399 in Ireland and 251 in Wales. The prevalence of obesity and morbid obesity is similar in all four countries and so the ratio of number of procedures performed in each country should reflect their relative populations. Two factors that may contribute are the different countries' commissioning criteria for bariatric surgery and the number (and location of) bariatric centres. Currently the criteria for access to bariatric surgery in Scotland and Wales is more exclusive than England; in Scotland an obesity-related comorbidity is required, and in Wales a BMI greater than forty. Regarding bariatric centres, there are presently over 150 NHS and private units in England compared to ten in Scotland, three in Ireland and three in Wales (see pages 31-33). The small number of units in Scotland, Ireland and Wales is likely to have implications for both access to surgery and availability of resources and so impact on the number of procedures performed. Scottish units are not required by the Scottish Health Service to register cases in the NBSR.

The proportion of procedures in each country that were publicly-funded was variable; approximately 80% in England, 40% in Scotland, 6% in Ireland and 88% in Wales. Again, this may be reflective of variation of access to NHS-funded surgery in the different countries. The low number in Ireland is probably reflective of the lack of a dedicated NHS bariatric centre there.

Primary surgery for adults: The number of operations and the proportion of publicly-funded surgery in each country; operations in financial years 2013-2018



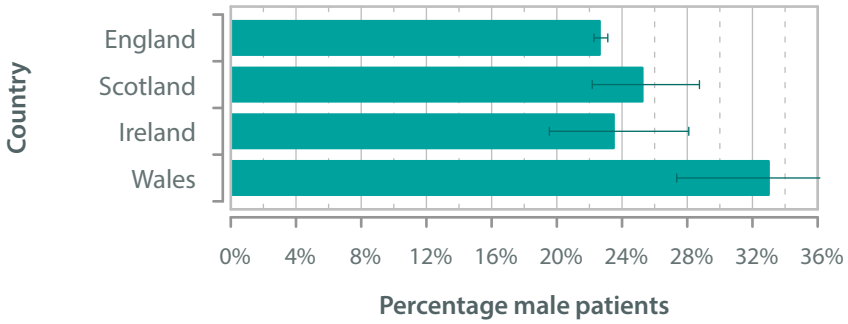
Gender

The ratio of female : male undergoing surgery is approximately 3 : 1 in England, Scotland and Ireland, and 2 : 1 in Wales; this is in spite of equal prevalence of obesity amongst men and women in all four countries. The difference between Wales and the other three countries is significant ($p < 0.05$).

Primary surgery for adults: gender in each country; operations in financial years 2013-2018

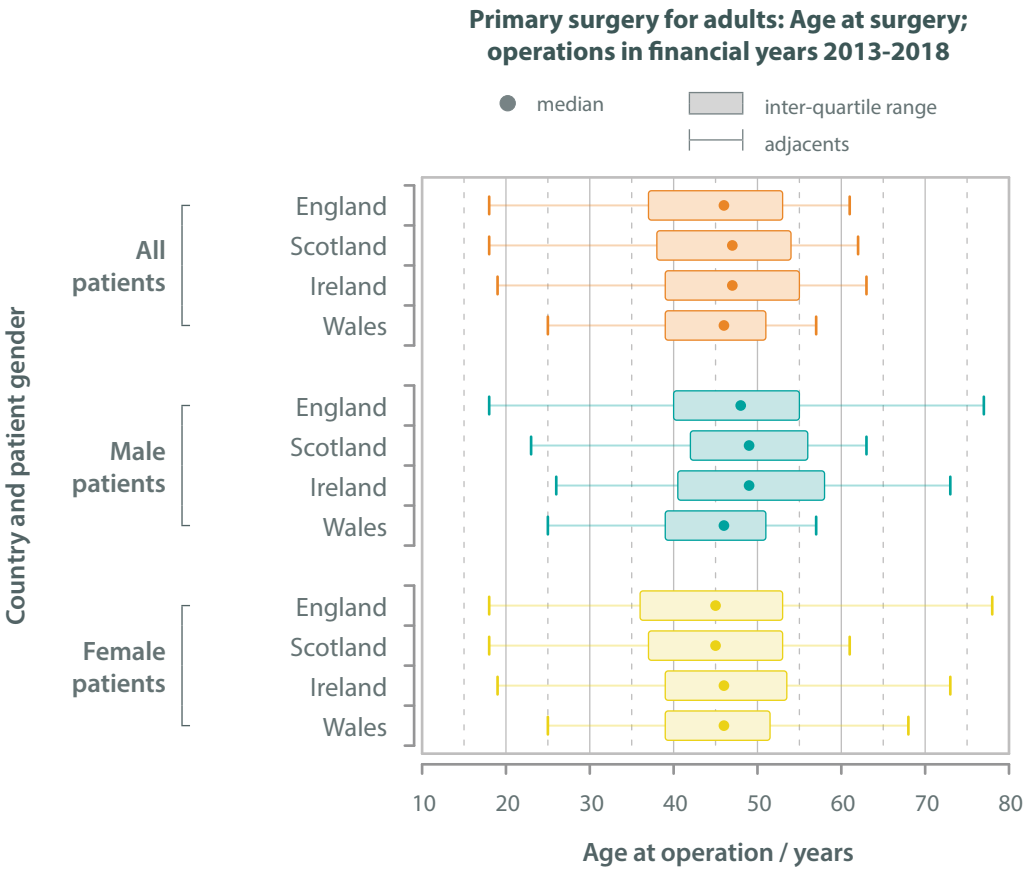
		Gender			
		Male	Female	All	Percentage male
Country	England	8,559	29,146	37,705	22.7%
	Scotland	177	522	699	25.3%
	Ireland	94	305	399	23.6%
	Wales	83	168	251	33.1%
	All	**8,913**	**30,141**	**39,054**	**22.8%**

Primary surgery for adults: Gender; operations in financial years 2013-2018



Age at surgery

The median age and inter-quartile range for patients undergoing surgery is similar across all four countries (approximately 46 years). The median age for male patients is consistently one to two years greater than for female patients. The reported median age at the time of surgery in the United Kingdom is the second highest worldwide, according to analysis of data from the countries contributing the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) 5th Registry Report (2019), and greater than the European average (43 years).



Kind of operations performed

Overall Roux-en-Y gastric bypass (RYGB) is still the most commonly-performed bariatric operation throughout the United Kingdom (49%), followed by sleeve gastrectomy (35%). In England and Ireland RYGB is performed more often than sleeve gastrectomy, whilst the opposite is true in Scotland and Wales. Due to the relatively small number of cases being performed in Scotland and Wales the predominance of sleeve may reflect individual bariatric units' preference towards this operation.

It is notable that gastric banding is now almost exclusively performed in England. In the 2014 NBSR report it was demonstrated that gastric banding in the private sector was performed relatively more commonly than other procedures (when compared to the numbers of operations that were NHS funded) and so it may be that the large number currently performed are disproportionately privately funded. Another factor is likely to be the influence of the By-Band-Sleeve study which was conducted during the years covered by this report; directly with the allocation of patients to gastric banding, and indirectly by continuing usage of an operation in the trial units, thereby maintaining awareness and popularity of the procedure that may have fallen out of favour elsewhere.

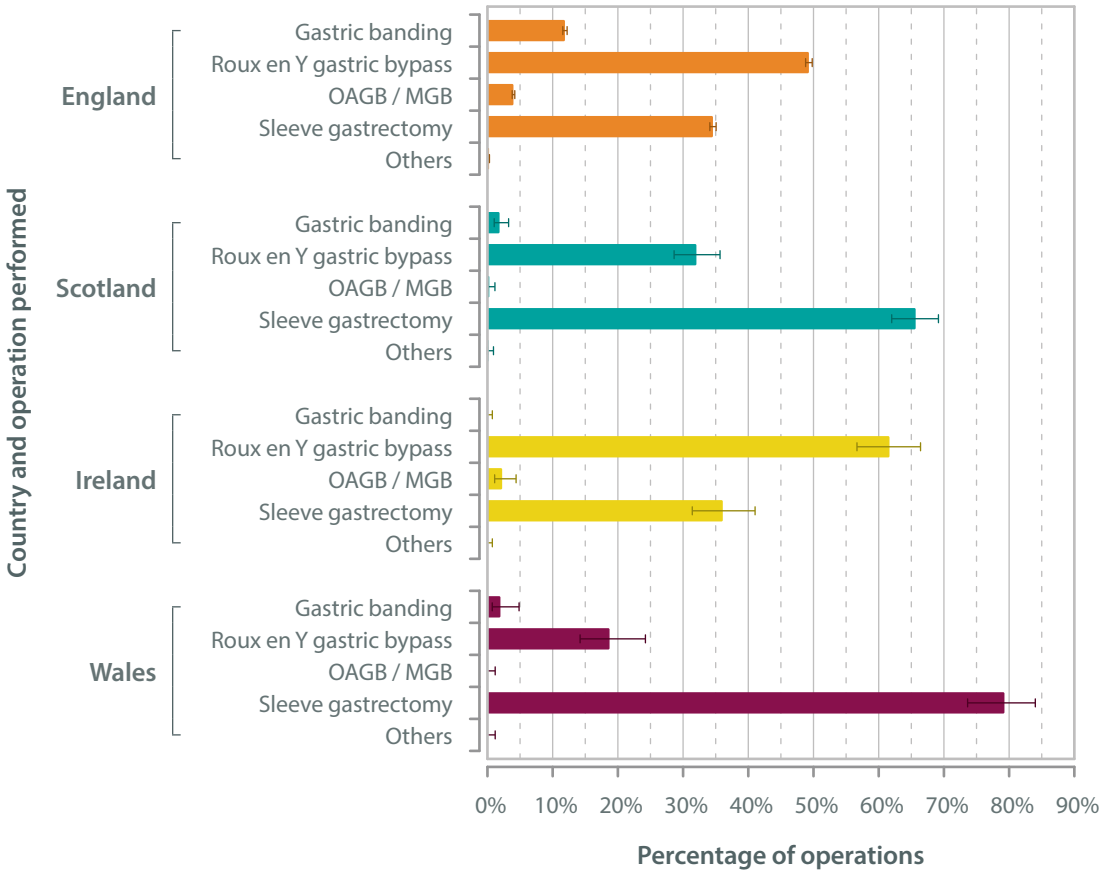
Compared to the analyses presented in the Second NBSR Report (2014) there are now more OAGB / MGB procedures performed, although the proportion (4%) remains low. The uptake of this procedure is mainly in England, with a few procedures also being performed in Scotland (2) and Ireland (9). This discrepancy is likely to be explained by the fact that the hospitals that introduced the procedure to the United Kingdom were in England.

Primary surgery for adults: operation performed; operations in financial years 2013-2018

		Country				
		England	**Scotland**	**Ireland**	**Wales**	**All**
Operation	Gastric band	4,481	13	0	5	**4,499**
	Roux en Y gastric bypass	18,587	224	246	47	**19,104**
	OAGB / MGB	1,504	2	9	0	**1,515**
	Sleeve gastrectomy	13,039	459	144	199	**13,841**
	Others	94	1	0	0	**95**
	All	**37,705**	**699**	**399**	**251**	**39,054**

Analysis by region

Primary surgery for adults: Operation performed; operations in financial years 2013-2018



Analysis by region in England

The following is a list of units in each region that contributed to the NBSR. Note the few units in Scotland, Ireland and Wales relative to their population and geographical area.

NBSR contributing hospitals grouped by region

Scotland

- Aberdeen Royal Infirmary
- BMI Albyn Hospital, Aberdeen
- Lanarkshire University Hospital
- Ninewells Hospital, Dundee
- Nuffield Health Glasgow Hospital
- Queen Elizabeth University Hospital, Glasgow
- Royal Infirmary of Edinburgh
- Spire Murrayfield Hospital, Edinburgh
- Stobbhill Hospital, Glasgow
- University Hospital, Ayr

Ireland

- 352 Kingsbridge Hospital, Belfast
- Bon Secours Hospital, Cork
- St Vincent's University Hospital, Dublin

Wales

- Morriston Hospital, Swansea
- Spire Cardiff Hospital
- Spire Yale Hospital, Wrexham

North West

- BMI The Alexandra Hospital, Manchester
- BMI The South Cheshire Private Hospital, Leighton
- Manchester Royal Infirmary
- Nuffield Health The Grosvenor Hospital, Chester
- Salford Royal Hospital
- Spire Cheshire Hospital
- Spire Fylde Coast Hospital, Blackpool
- Spire Manchester Hospital
- Spire Murrayfield Hospital Wirral
- Spire Regency Hospital, Macclesfield
- University Hospital Aintree

NE & Yorkshire

- BMI Thornbury Hospital, Sheffield
- Bradford Royal Infirmary
- Castle Hill Hospital, Cottingham
- Claremont Hospital, Sheffield
- Darlington Memorial Hospital
- Dewsbury & District Hospital, West Yorkshire
- Doncaster Royal Infirmary
- Hexham General Hospital
- Huddersfield Royal Infirmary
- Leeds General Infirmary
- North Tyneside General Hospital, North Shields
- Northern General Hospital, Sheffield
- Nuffield Health Leeds Hospital
- Nuffield Health Newcastle-upon-Tyne Hospital
- Nuffield Hospital York
- Park Hill Hospital, Doncaster
- Sheffield Children's Hospital
- South Tees University Hospitals, Middlesbrough
- Spire Elland Hospital, West Yorkshire
- Spire Hull & East Riding Hospital, Anlaby
- Spire Leeds Hospital
- Spire Washington Hospital, Tyne & Wear
- St James's University Hospital, Leeds
- Sunderland Royal Hospital
- The James Cook University Hospital, Middlesbrough
- The Yorkshire Clinic, Bingley
- University Hospital of North Tees, Stockton-on-Tees
- Wansbeck Hospital
- York Hospital
- Yorkshire Surgicentre, Rotherham

Midlands

- BMI The Droitwich Spa Hospital
- BMI The Meridien Hospital, Coventry
- BMI The Park Hospital, Nottingham
- BMI The Priory Hospital, Birmingham
- Countess of Chester Hospital
- Dolan Park Hospital, Birmingham
- Heartlands Hospital, Birmingham
- Leicester General Hospital
- Nuffield Health Derby Hospital
- Nuffield Health Leicester Hospital
- Nuffield Health North Staffordshire Hospital
- Nuffield Health Shrewsbury Hospital
- Nuffield Health Warwickshire Hospital
- Nuffield Hospital, Wolverhampton
- Princess Royal Hospital, Telford
- Royal Derby Hospital
- Royal Shrewsbury Hospital
- Spire Leicester Hospital
- Spire Little Aston Hospital, Sutton Coldfield
- Spire Parkway Hospital, Solihull
- Spire South Bank Hospital, Worcester
- University Hospital Coventry
- University Hospital of North Staffordshire
- Walsall Manor Hospital
- Worcestershire Royal Hospital

East of England

- Holly House Hospital, Essex
- Luton & Dunstable University Hospital
- Norfolk & Norwich University Hospital
- Nuffield Health Brentwood Hospital
- Rivers Hospital, Sawbridgeworth
- Spingfield Hospital, Chelmsford
- Spire Harpenden Hospital
- Spire Hartswood Hospital, Brentwood, Essex
- Spire Norwich Hospital
- Spire Wellesley Hospital, Southend-on-Sea

South East

- Berkshire Independent Hospital, Reading
- BMI Mount Alvernia Hospital, Guildford
- BMI Sarum Road Hospital, Winchester
- BMI The Hampshire Clinic, Basingstoke
- BMI The Princess Margaret Hospital, Windsor
- BMI The Runnymede Hospital, Chertsey
- BMI The Shelburne Hospital, High Wycombe
- Churchill Hospital, Oxford
- Kent Institute of Medicine & Surgery,Maidstone
- Maidstone Hospital, Kent
- McIndoe Surgical Centre, East Grinstead
- Nuffield Health Guildford Hospital
- Nuffield Heath The Manor Hospital, Oxford
- One Ashford Hospital, Ashford
- Princess Elizabeth Hospital, Guernsey
- Queen Alexandra Hospital, Portsmouth
- Royal Berkshire Hospital, Reading
- Southampton University Hospitals NHS Trust
- Spire Clare Park Hospital, Farnham
- Spire Dunedin Hospital, Reading
- Spire Gatwick Park Hospital, Horley
- Spire Montefiore, Hove
- Spire Portsmouth Hospital
- Spire Southampton Hospital
- Spire Thames Valley Hospital, Slough
- St Peter's Hospital, Chertsey
- St Richard's Hospital, Chichester

South West

- BMI Bath Clinic
- BMI The Harbour Hospital, Dorset
- BMI The Ridgeway Hospital, Swindon
- Cheltenham General Hospital
- Circle Bath Hospital
- Derriford Hospital, Plymouth
- Duchy Hospital, Truro
- Gloucestershire Royal Hospital, Gloucester
- Musgrove Park Hospital, Taunton
- North Bristol NHS Trust
- Nuffield Health Bournemouth Hospital
- Nuffield Health Bristol Hospital
- Nuffield Health Cheltenham Hospital
- Nuffield Health Plymouth Hospital
- Nuffield Health Taunton Hospital
- Poole Hospital, Dorset
- Ramsay Mount Stuart Hospital, Torquay
- Ramsey Winfield Hospital, Gloucestershire
- Royal Bournemouth General Hospital
- Royal Cornwall Hospital, Truro
- Salisbury District Hospital
- Southmead Hospital, Bristol (North Bristol NHS Trust)
- Spire Bristol Hospital

London

- Ashford Hospital, Middlesex
- Ashtead Hospital
- BMI Chelsfield Park Hospital, Orpington
- BMI The Blackheath Hospital, London
- BMI The Clementine Churchill Hospital, Harrow
- BMI The London Independent Hospital
- Chelsea & Westminster Hospital, London
- Cromwell Hospital, London
- Homerton University Hospital, London
- Hospital of St John and St Elizabeth, London
- King Edward VII's Hospital, London
- King's College Hospital, London
- London Bridge Hospital, London
- Orpington Treatment Centre
- Parkside Hospital, London
- Princess Royal University Hospital, Orpington
- Queen's Hospital Romford
- Spire Bushey Hospital, Watford
- Spire Roding Hospital, Redbridge
- St Anthony's Hospital, London
- St George's Hospital, London
- St Mary's Hospital, London
- St Thomas's Hospital, London
- The London Clinic
- The Princess Grace Hospital, London
- University College Hospital London
- University Hospital, Lewisham
- Wellington Hospital, London
- Whittington Hospital, London

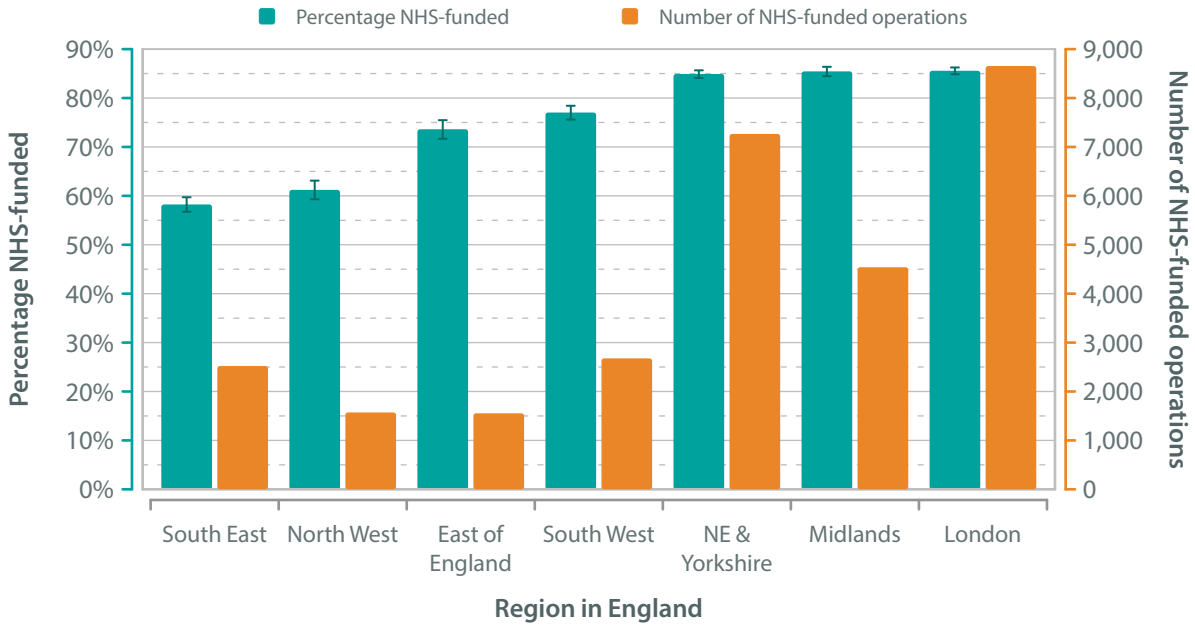
NHS funding in each of the regions of England

The greatest number of NHS funded procedures were in the North East and Yorkshire, and in London (approximately 7,000 & 8,500 respectively), and the fewest were in the North West and East of England (approximately 1,500 procedures each). There was wide geographical variation in the percentage of cases that were NHS funded with the London, Midlands and North East & Yorkshire being over 80%, the East of England and South West at around 75% and North West and South East around 60%; taking into account the number of NHS-funded cases performed this indicates that the highest volume of private practice was in the South East, followed by London and the North East and Yorkshire.

Overall the most procedures were performed in the North East and Yorkshire and London (7,266 & 8,654 respectively from 2013 to 2018) and the fewest in the North West (approximately 1,500 over the same time period).

These numbers do assume on the accurate and reliable recording of data in both NHS and private bariatric units.

Primary surgery for adults: NHS-funding in each of the regions of England; operations in financial years 2013-2018



Kind of operation performed

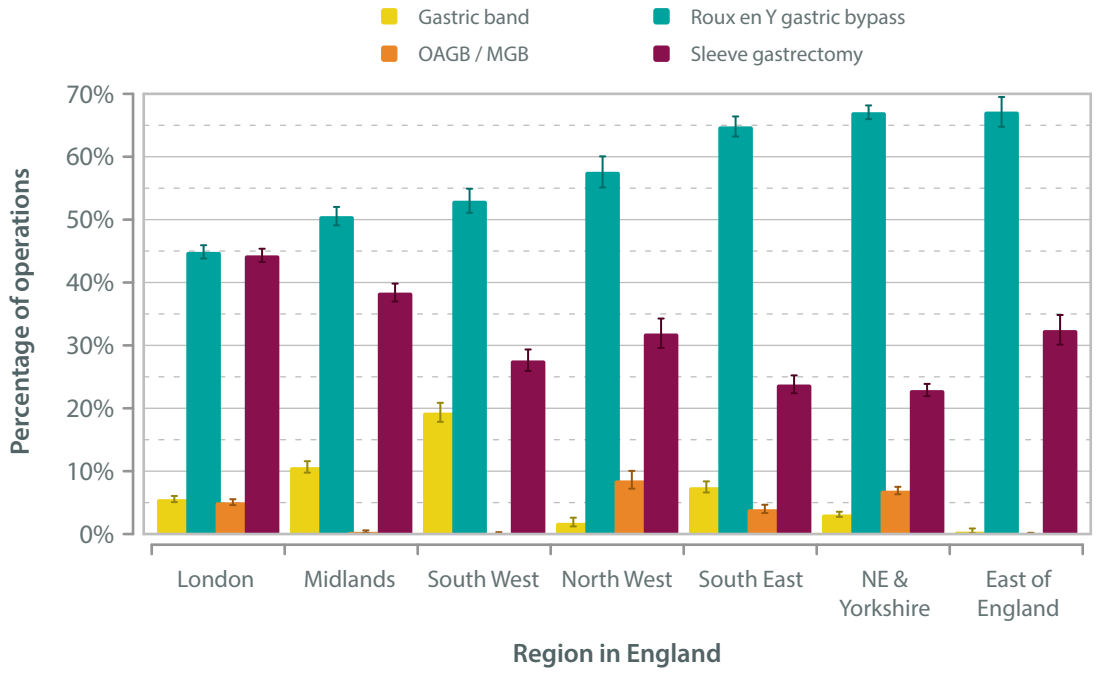
RYGB is the most frequently-performed NHS-funded procedure in each English region, followed by sleeve gastrectomy.

OAGB / MGB is performed most frequently in the North West, South East, North East and Yorkshire and London. Given the number of NHS-funded cases performed in each of these regions, this means that most OAGB / MGB procedures were performed in the North East and Yorkshire, and London. It is likely that this reflects the high-volume bariatric units that were the earliest adopters of OAGB / MGB in England.

Gastric banding is most frequently performed in the South West; potentially this is influenced by the By-Band-Sleeve study lead unit being in that region. This is followed by relatively high rates for this procedure in the Midlands and London.

It is likely that these numbers are strongly influenced by the practices and experience of the units and surgeons located in each region.

NHS-funded primary surgery for adults: Kinds of operations performed in each of the regions; operations in financial years 2013-2018

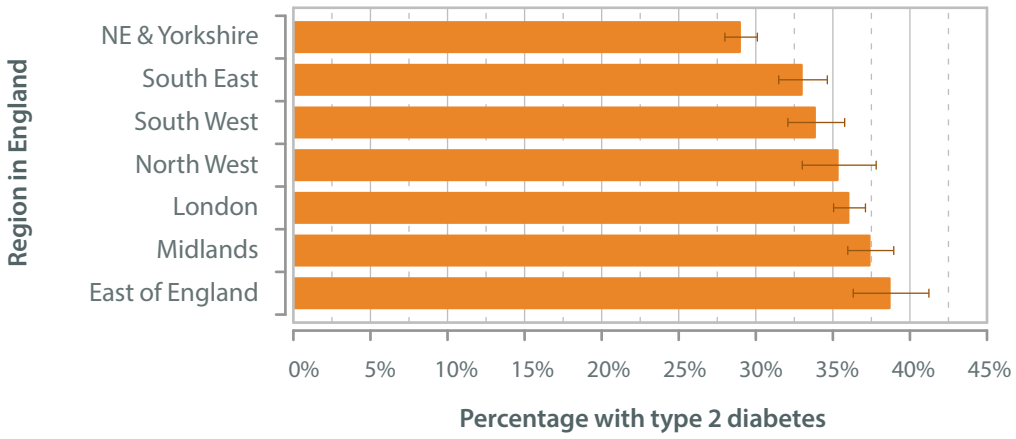


Type 2 diabetes and obesity-related diseases

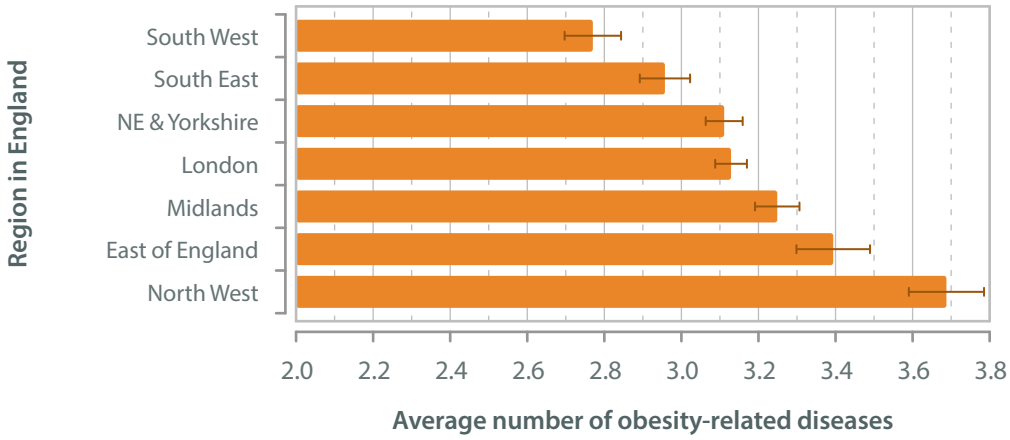
The two charts below indicate that there is clear variation across England regarding the prevalence of type 2 diabetes and the average number of obesity-related diseases in patients undergoing NHS-funded surgery. On average, it seems that most patients have approximately three obesity-related diseases and a third have type 2 diabetes. The prevalence of type 2 diabetes in patients undergoing NHS-funded surgery is higher than those undergoing privately-funded surgery (34.1% *versus* 12.1%; n=28,917 *versus* n=7,594).

Although there is likely to be some difference in the prevalence of type 2 diabetes and obesity-related disease across England, an alternative explanation for the variation in regional rates recorded in the NBSR may be the consequence of different Clinical Commissioning Group (CCG) policies on the provision of bariatric surgery throughout England. This assertion is corroborated by data from a study performed by BOMSS and the Royal College of Surgeons (2016), which found that several CCGs have their own policies that do not follow national guidelines.

NHS-funded primary surgery for adults: Type 2 diabetes in each region; operations in financial years 2013-2018



NHS-funded primary surgery for adults: Average number of obesity-related disease in each region; operations in financial years 2013-2018

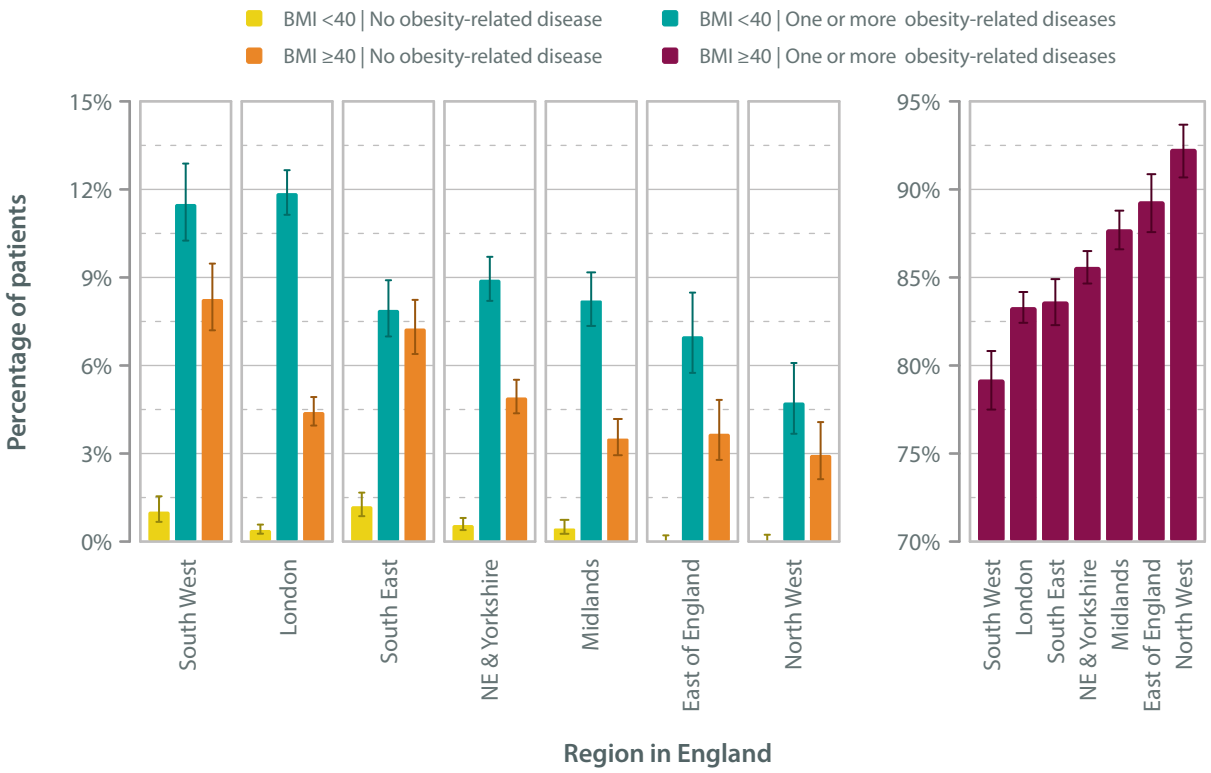


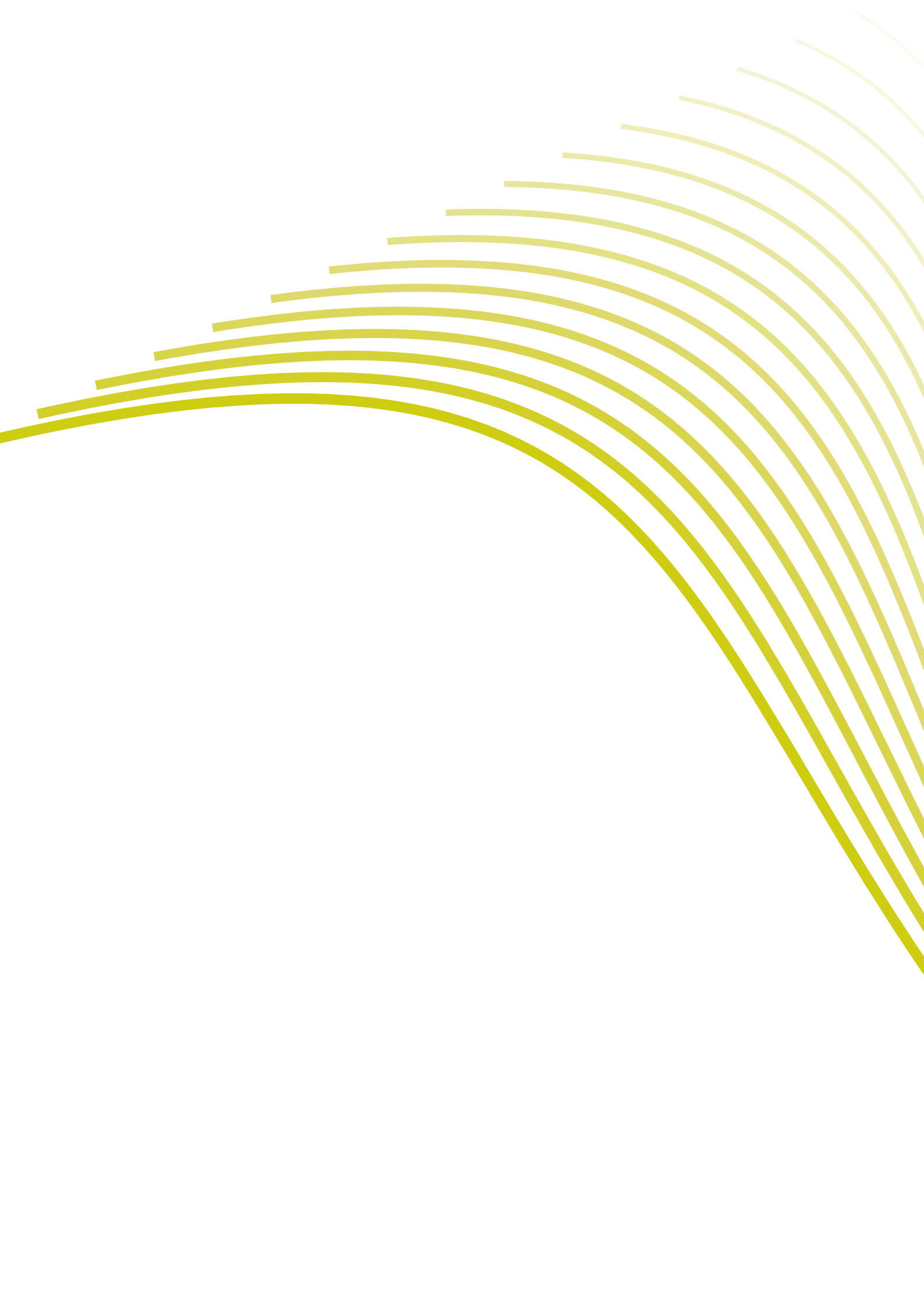
BMI and obesity-related disease

The vast majority of patients undergoing NHS-funded surgery in every region had a BMI >40 kg m^{-2} and one or more obesity-related diseases. Interestingly in every region the percentage of patients with a BMI <40 kg m^{-2} and an obesity-related disease was higher than those with a BMI >40 kg m^{-2} without any obesity-related disease. Whilst this may simply be a reflection of the likelihood of developing a obesity-related disease with increasing BMI, more concerning an explanation would be that patients and / or primary-healthcare providers are waiting for the development of an associated condition before considering bariatric surgery. Whether this is through choice or more exclusive CCG criteria is unknown.

Interestingly there are a small number of patients who underwent surgery with a BMI <40 kg m^{-2} and no obesity-related disease (*i.e.,* not meeting the national recommendations for the provision of surgery). The reason for this is unclear, but may be due to surgery in ethnic minority patient groups or errors and omissions in the recording of these data in the NBSR database records.

NHS-funded primary surgery for adults: BMI and obesity-related disease in each of the regions; operations in financial years 2013-2018





Analysis by procedure

Authors

Christina Lo
Omar Khan

Analysis by procedure

Kinds of operations

As shown, there were 39,054 bariatric operations recorded in the NBSR between 2013-2018. Over 95% of all operations recorded were either Roux en Y gastric bypass (RYGB), sleeve gastrectomy or gastric band.

During this period, RYGB remained the most commonly performed bariatric operation accounting for 48.9% of all bariatric procedure.

Sleeve gastrectomy was the second most performed bariatric procedure comprising of 35.4% of operations over the period of 2013-2018. This compares to 20.9% of operations performed in 2011-2013, and only 8.3% in 2009-2010. There has been a year-on-year increase in the number of sleeve gastrectomy performed since 2008. This coincided with the reducing number of RYGB since 2014. Sleeve gastrectomy overtook RYGB to become the most commonly performed bariatric procedure in 2017 and 2018.

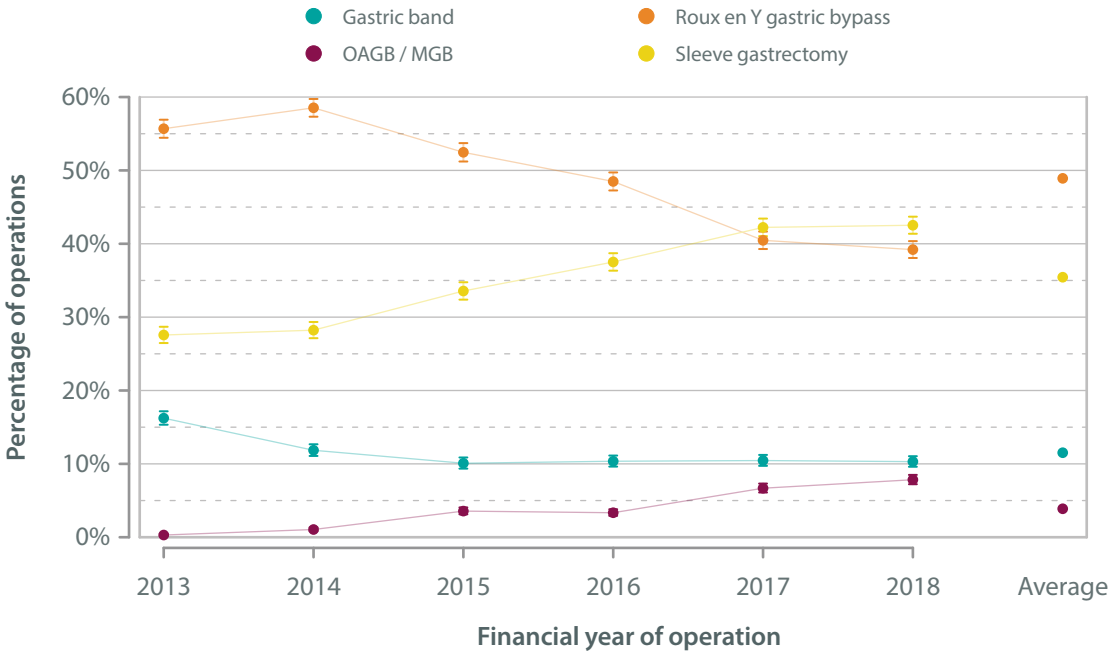
There has been a sustained move away from gastric band since 2006. This decrease has since reached a plateau at around 10-12% of the total operations over the last 5 years.

There is a new emerging trend of OAGB / MGB which comprised 3.9%. of all operations in 2013-2018.

Primary surgery for adults: operation performed;operations in financial years ending 2013-2018

Operation	Count	Percentage
Gastric band	4,499	11.5%
Roux en Y gastric bypass	19,104	48.9%
OAGB / MGB	1,515	3.9%
Sleeve gastrectomy	13,841	35.4%
Bilio-pancreatic diversion	1	0.0%
Duodenal switch (with sleeve)	9	0.0%
SADI (sleeve status unknown)	2	0.0%
Gastric plication	63	0.2%
Other	20	0.1%
All	**39,054**	

Primary surgery for adults: Changes in the proportion of each kind of operation performed over time; operations in financial years 2013-2018 (n=39,054)



Demographics and risk factors

Age at surgery

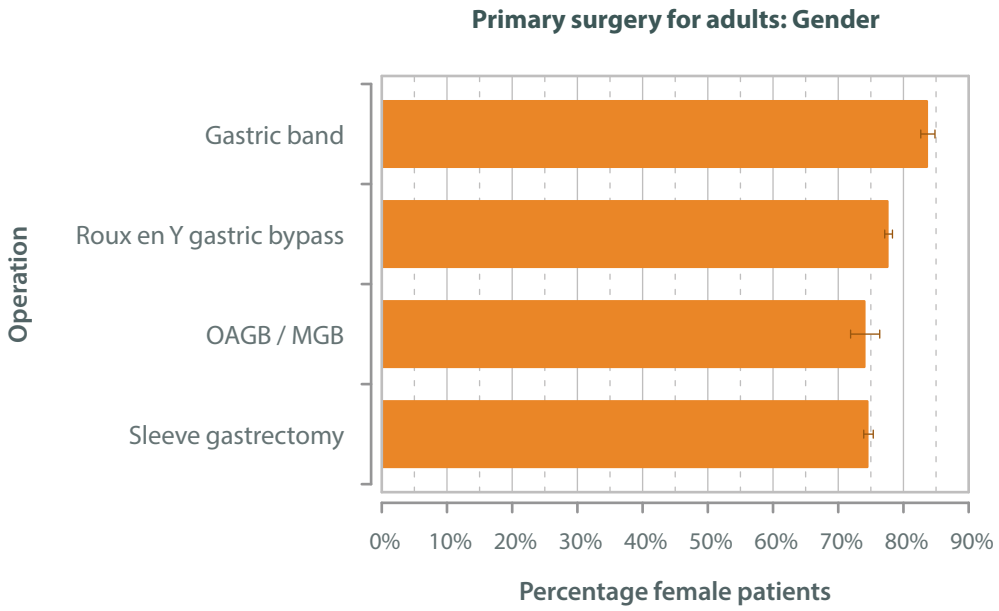
The average age of the bariatric surgery patients who had one of the four most common bariatric operations (RYGB, Sleeve gastrectomy, gastric band, and OAGB / MGB) over the period of 2013-2018 was 45.3 years. There was no obvious difference in the age of patients undergoing different types of bariatric operations.

Primary surgery for adults: age at operation; operations in financial years 2013-2018

		Age at operation / years		
		Count	**Average**	**Median**
Operation	Gastric band	4,499	**44.0** (95% CI: 43.7-44.4)	**45.0** (IQR: 35.0-53.0)
	Roux en Y gastric bypass	19,104	**45.5** (95% CI: 45.3-45.6)	**46.0** (IQR: 38.0-53.0)
	OAGB / MGB	1,515	**45.9** (95% CI: 45.4-46.5)	**47.0** (IQR: 38.0-54.0)
	Sleeve gastrectomy	13,841	**45.4** (95% CI: 45.2-45.6)	**46.0** (IQR: 37.0-53.0)

Gender

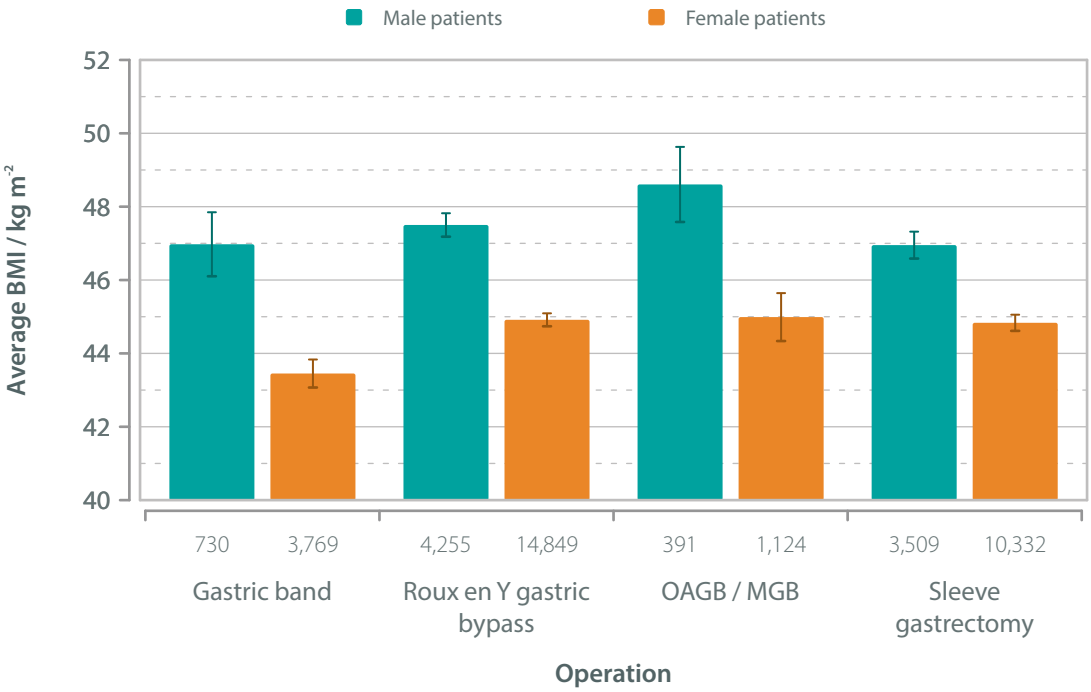
Women account for over 80% of all gastric band insertion; and over 70% of RYGB, sleeve gastrectomy, and OAGB / MGB. The female gender bias in surgery does not reflect the gender-specific obesity rate in the United Kingdom. The predominance of women undergoing bariatric surgery has been reported worldwide.



Body mass index

Overall, male patients have a higher BMI on entry to the weight-loss program comparing to female patients irrespective of the type of bariatric operation.

Primary surgery for adults: Average BMI on entry to the weight-loss program

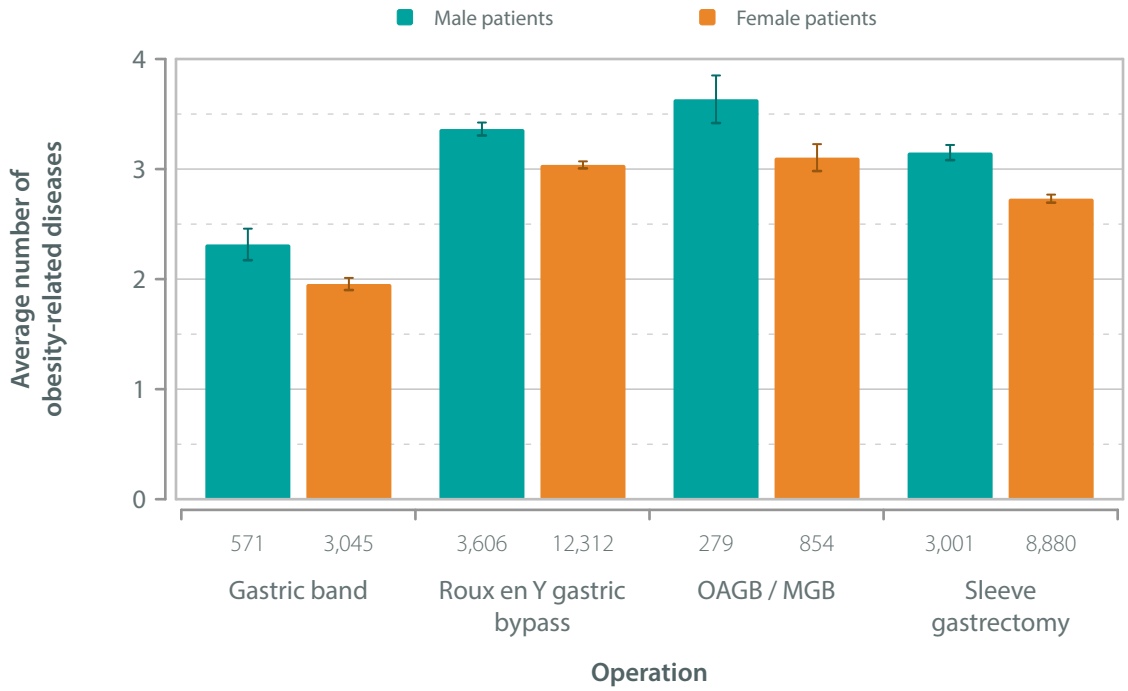


Number of obesity-related diseases

Most patients undergoing RYGB had 2 or more obesity-related comorbidities. Gastric band patients tended to have fewer comorbidities at presentation as compared to other bariatric surgical procedures.

Male patients have more obesity-related diseases comparing to female patients. This may reflect their higher BMI on entry to the weight-loss program.

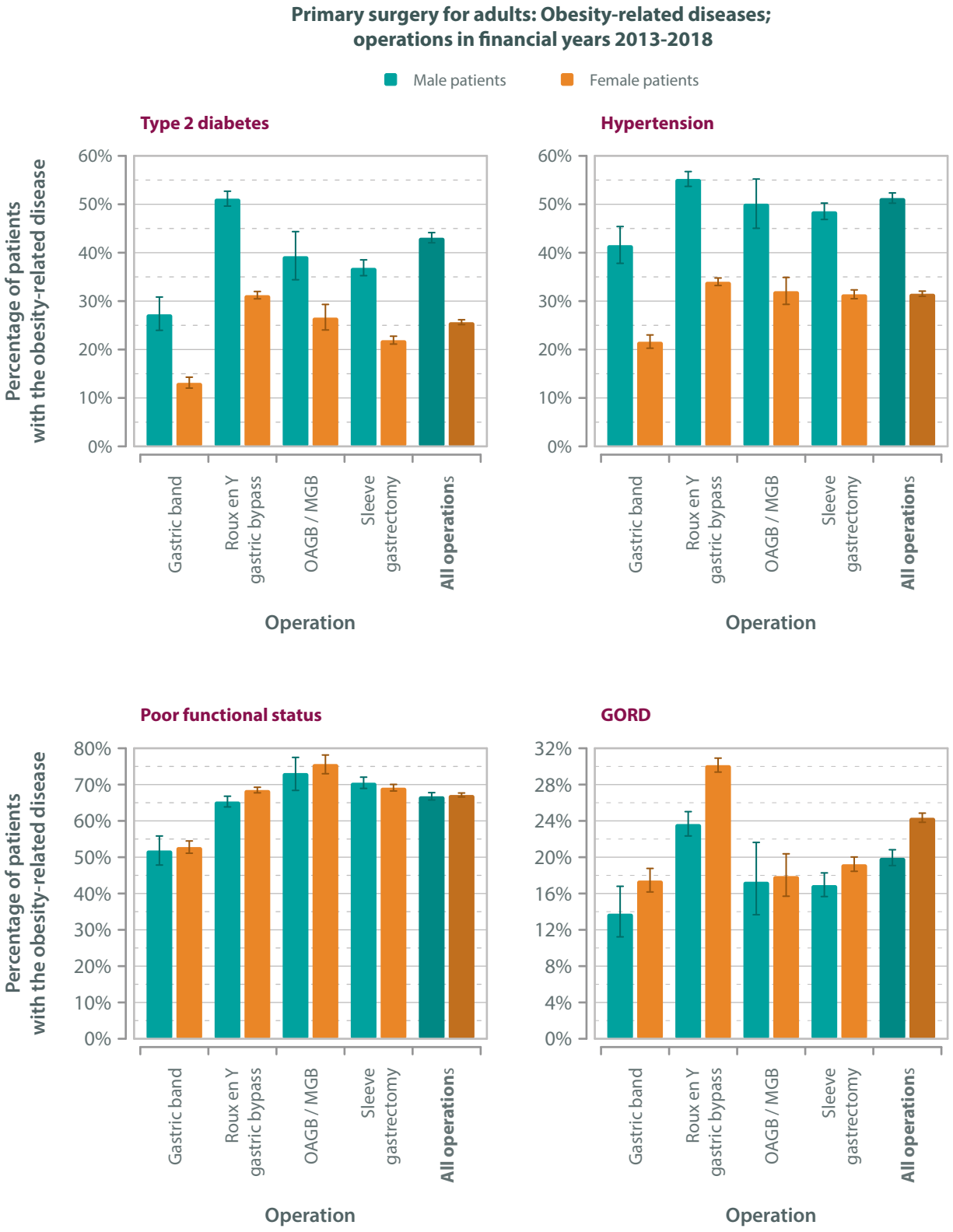
Primary surgery for adults: Obesity-related diseases; database entries with no missing obesity-related disease data; operations in financial years 2013-2018



Details for each obesity-related disease

Metabolic comorbidities of type 2 diabetes and hypertension were seen more commonly in patients undergoing RYGB. Obesity-related diseases were less common in gastric band patients.

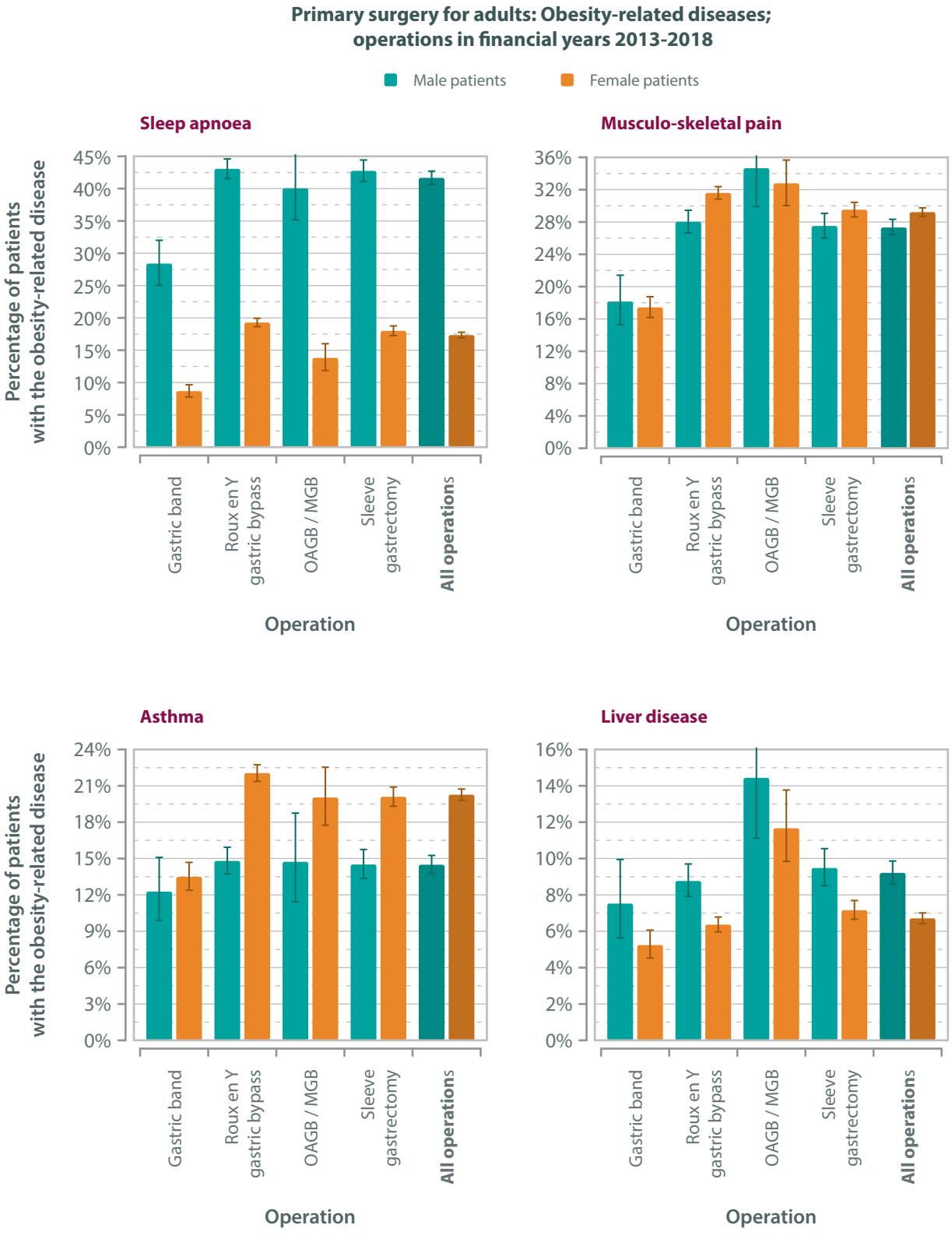
In terms of functional status, approximately 65% of bariatric surgery patients has significantly impaired functional status (unable to climb 3 flights of stairs without resting) and over 20% had GORD.



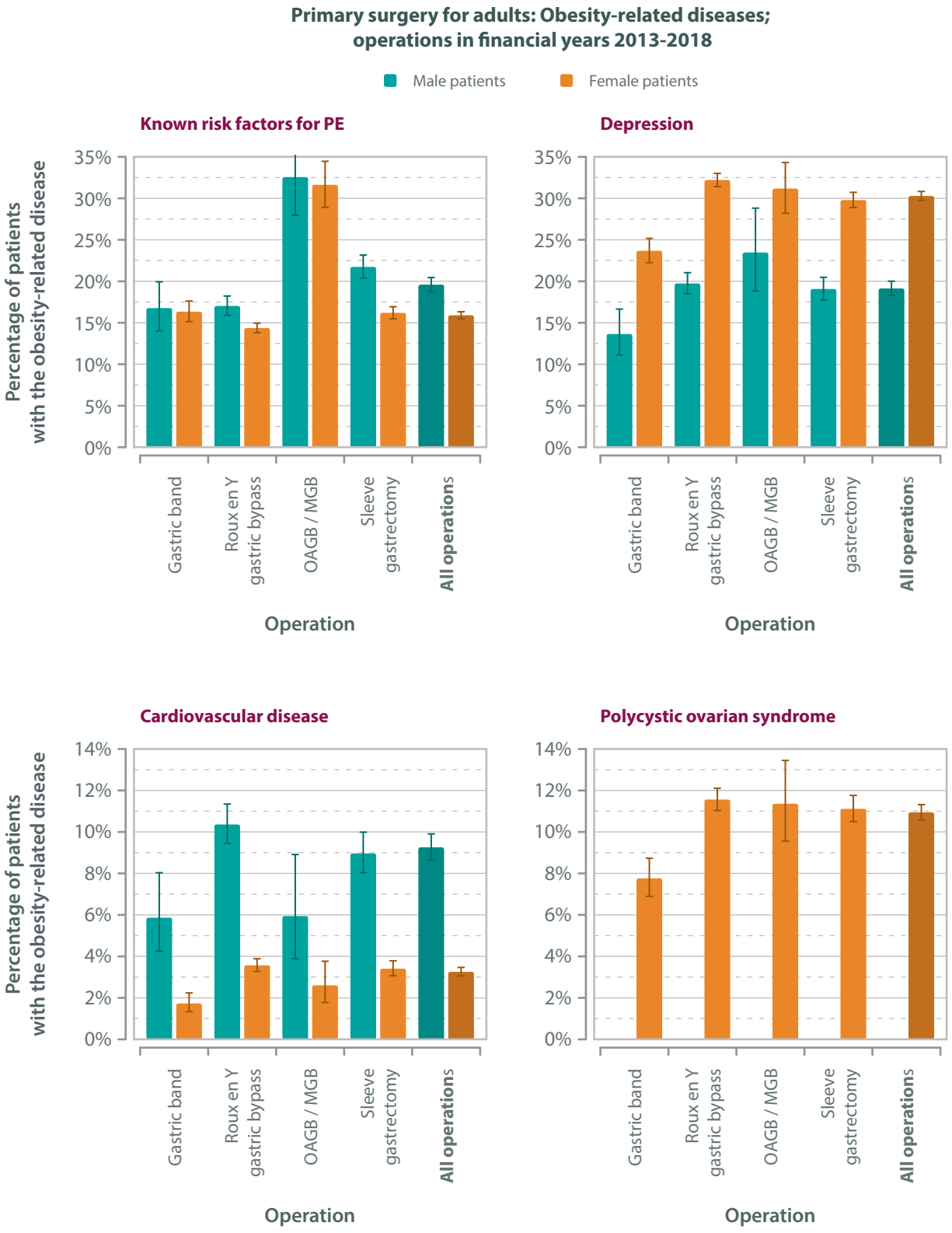
Sleep apnoea was predominantly seen in male patients, affecting approximately 40%.

Around 25% of patients had musculo-skeletal pain.

Liver disease was noted in approximately 8%, but this may be an underestimation as patients would not typically have liver biopsy performed pre-operatively.



The percentage of patients with known risk factors of PE were similar between male and female gender across the common bariatric operations. Up to a third of OAGB / MGB patients had known risk factors for PE, which was significantly higher than patients undergoing other bariatric operations. Depression was much more prevalent amongst female patients affecting over 30% comparing to 18% of male patients. Cardiovascular disease was three times more common in male patients comparing to female. In summary, male patients were heavier, had more co-morbidities and worse functional status. This in combination with the lower incidence of bariatric surgery in men needs further investigations.



Outcomes

Post-operative complications

There were only 16 deaths recorded in the registry over 2013-2018, giving a post-operative in-hospital mortality rate of 0.04% following bariatric surgery for this period. This figure correlates with the HES data which reflects the safety of bariatric surgery in the United Kingdom.

When operation-specific data are considered, there was no in-hospital mortality recorded for gastric banding. The in-hospital mortality was highest among OAGB / MGB patients at 0.13%, but this is likely a statistical error given only 2 deaths were recorded. Attention to this finding will be made in future reports. This compares to 0.05% in RYGB and 0.04% in sleeve gastrectomy respectively. This may reflect the higher BMI and higher number of obesity-related comorbidities in OAGB / MGB patients. It is clear that gastric banding had the lowest mortality rate compared to the other bariatric operations, although this difference was not statistically significant.

Out of 36,575 operations, a total of 74 cardio-vascular complications were reported over the period of 2013-2018. This gave an overall cardio-vascular complication rate of 0.20% in primary bariatric surgery. This compares to the corresponding figure of 0.3% in 2011-2013 and 0.6% in 2009-2010.

The cardio-vascular complication rates were similar between RYGB (0.24%) and sleeve gastrectomy (0.21%). Only 3 case of cardio-vascular complications were reported in total in gastric band and OAGB / MGB. The rate of cardio-vascular complications after gastric band procedures was significantly lower than that reported for either gastric bypass or sleeve gastrectomy (p=0.0113; p=0.0294; Fisher's exact test). There was no statistical difference in the complication rates and mortality rates between sleeve gastrectomy and RYGB, although the small numbers limited the conclusion that could be drawn.

The overall rate of all complications was ≤2.38%. This figure is well below the quoted complication for bariatric surgery from HES. This may reflect the fact that patients were often readmitted to other hospitals and their details not added to the NBSR. This feature is being remediated by including NHS numbers in version 2 of the database and should allow a more accurate representation of the actual complication rates.

Primary surgery for adults: post-operative complications; operations in financial years 2013-2018

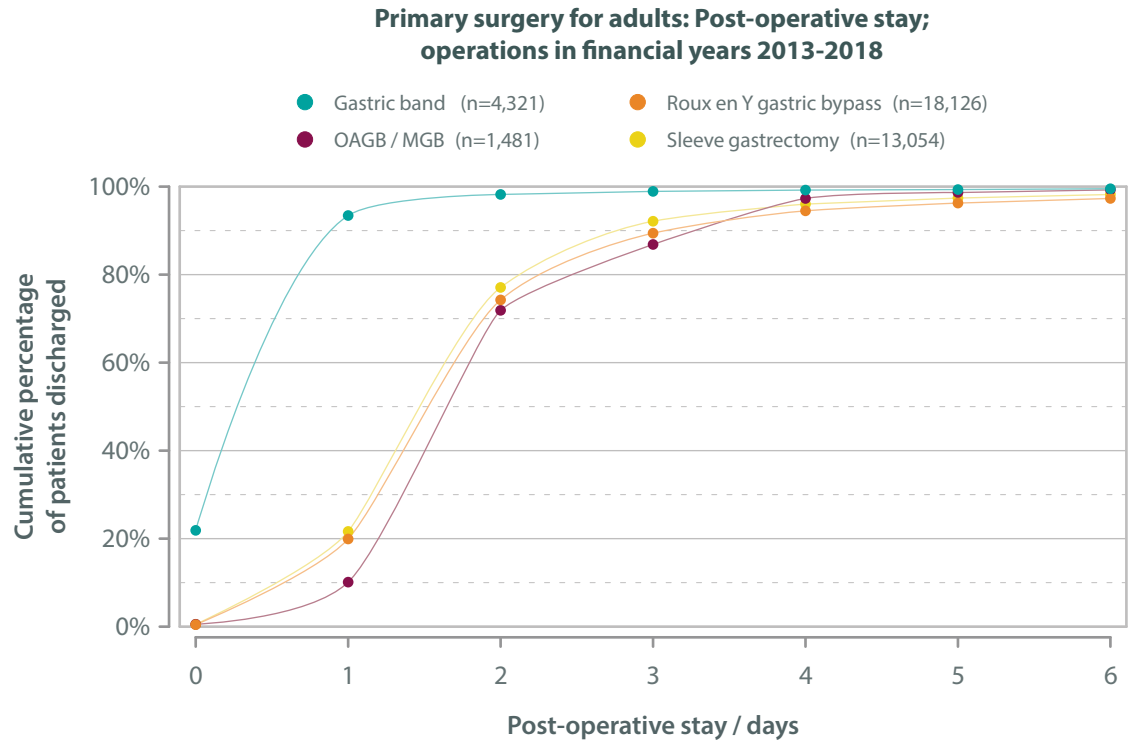
Operation and kind of post-operative complication		Complication reported				
			No	Yes	Unspecified	Rate
Cardio-vascular complications		Gastric band	4,075	2	422	0.05%
		Roux en Y gastric bypass	17,930	43	1,131	0.24%
		OAGB / MGB	1,484	1	30	0.07%
		Sleeve gastrectomy	13,086	28	727	0.21%
		All	**36,575**	**74**	**2,310**	**0.20%**
Other complications		Gastric band	4,034	30	435	0.74%
		Roux en Y gastric bypass	17,509	448	1,147	2.49%
		OAGB / MGB	1,470	18	27	1.21%
		Sleeve gastrectomy	12,774	303	764	2.32%
		All	**35,787**	**799**	**2,373**	**2.18%**
In-hospital mortality		Gastric band	4,497	0	2	0.00%
		Roux en Y gastric bypass	19,061	9	34	0.05%
		OAGB / MGB	1,510	2	3	0.13%
		Sleeve gastrectomy	13,817	5	19	0.04%
		All	**38,885**	**16**	**58**	**0.04%**

Post-operative stay

The overall length-of-stay of patients underwent primary bariatric surgery remains low. Over 90% of patients stayed 1 day or less in hospital after a gastric band procedure, and 20% left hospital on the same day as their operation, *i.e.,* these procedures are being performed as day-case surgery. Patients' stay in hospital after RYGB, sleeve gastrectomy, and OAGB / MGB were very similar: over 70% were discharged by the second day after surgery, and over 80% left after the third day. There has been a decrease in the average length-of-stay since 2007 (from just over 4 days to under 3 days).

Primary surgery for adults: post-operative stay; operations in financial years 2013-2018

		Post-operative stay / days		
		Count	**Average**	**Median**
Operation	Gastric band	4,321	**1.1** (95% CI: .9-1.2)	**1.0** (IQR: 1.0-1.0)
	Roux en Y gastric bypass	18,126	**2.6** (95% CI: 2.5-2.7)	**2.0** (IQR: 2.0-3.0)
	OAGB / MGB	1,481	**2.7** (95% CI: 2.3-3.2)	**2.0** (IQR: 2.0-3.0)
	Sleeve gastrectomy	13,054	**2.5** (95% CI: 2.4-2.6)	**2.0** (IQR: 2.0-2.0)



30-day outcomes

The most common 30-day complication of primary bariatric surgery reported in the NBSR was bleeding.

Primary surgery for adults: 30-day complications; operation in financial years 2013-2018

			30-day complication			
			No	Yes	Unspecified	Rate
30-day outcomes	Bleed	Roux en Y gastric bypass	704	164	18,236	18.9%
		OAGB / MGB	54	0	1,461	0.0%
		Sleeve gastrectomy	508	76	13,257	13.0%
	Obstruction	Roux en Y gastric bypass	800	76	18,228	8.7%
		OAGB / MGB	55	0	1,460	0.0%
		Sleeve gastrectomy	417	0	13,424	0.0%
	Leak	Roux en Y gastric bypass	808	57	18,239	6.6%
		OAGB / MGB	54	0	1,461	0.0%
		Sleeve gastrectomy	540	43	13,258	7.4%
	Re-operation	Gastric band	89	2	4,408	2.2%
		Roux en Y gastric bypass	522	7	18,575	1.3%
		OAGB / MGB	55	0	1,460	0.0%
		Sleeve gastrectomy	479	1	13,361	0.2%

One-year weight loss

The aim of bariatric surgery is to improve the overall health of patients by ameliorating, curing or preventing the development of obesity-related diseases. In this regard, weight loss is not a primary aim of surgery. However, weight loss is a convenient and important proxy measure of the effectiveness of surgery. In order to allow comparisons of the degree of weight loss achieved between patients with differing pre-operative weights, it is common to express weight lost as the percentage of excess weight loss (%EWL). Absolute weight loss (kg) and percentage total body weight loss (%) have also been included in this current report.

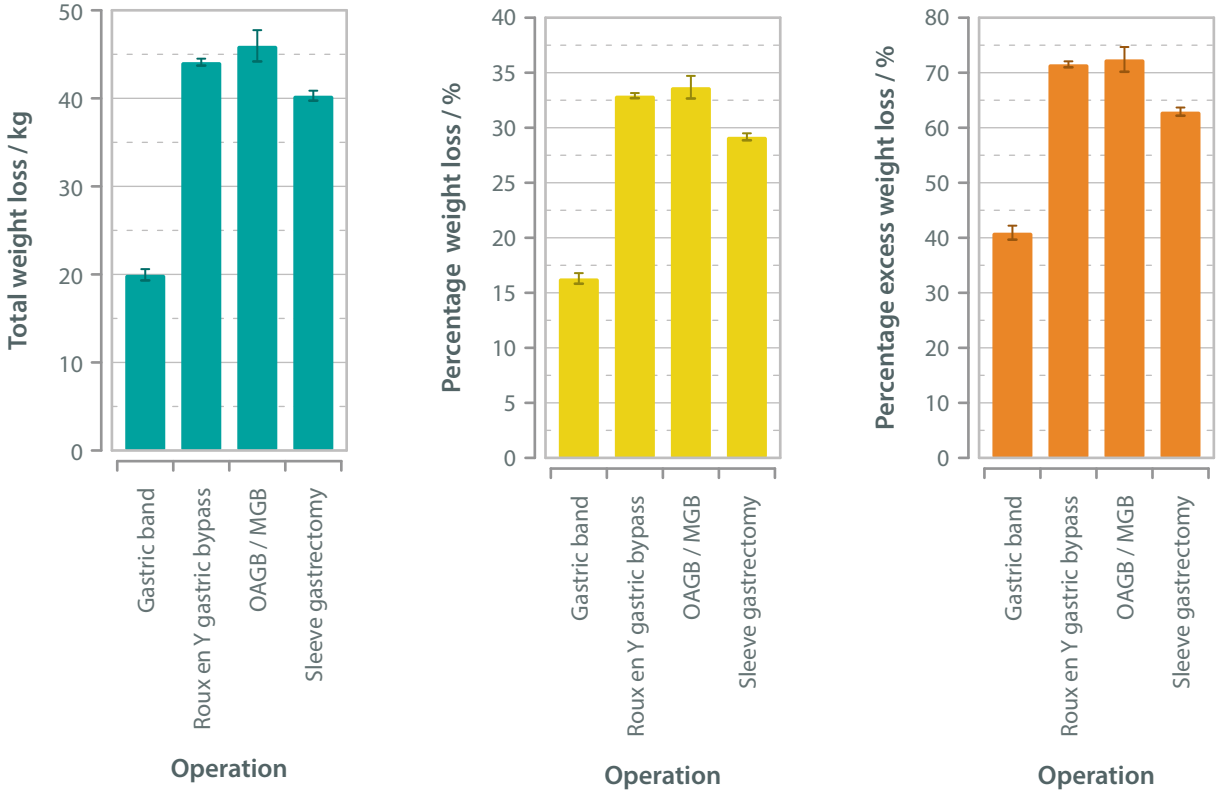
Comparing the four common primary bariatric operations between the period of 2013-2018, the percentage of excess weight loss (%EWL) was greatest after OAGB / MGB (73.7%), followed by RYGB (71.3%), sleeve gastrectomy (61.5%), and gastric band (38.8%). The one-year weight loss using all three weight-loss parameters is comparable between RYGB and OAGB / MGB. RYGB and OAGB / MGB appeared to be superior in weight loss comparing to sleeve gastrectomy. Gastric band appeared to offer significantly less weight-loss as compared to the other three bariatric procedures.

Of note, however, is the relatively small number of patients who attended at 1 year follow up. The use of the NHS number in version 2 should allow more comprehensive long-term weight data.

Primary surgery for adults: one-year weight-loss metrics; operations in financial years 2013-2018

Weight loss metric			Count	Average (95% CI)	Median (IQR)
	Total / kg	Gastric band	1,407	20.0 (19.3-20.6)	18.7 (11.9-26.4)
		Roux en Y gastric bypass	6,848	44.1 (43.7-44.5)	43.1 (34.0-53.0)
		OAGB / MGB	462	46.0 (44.2-47.7)	44.5 (34.1-56.8)
		Sleeve gastrectomy	3,644	40.3 (39.7-40.9)	38.1 (28.6-49.8)
	Excess / %	Gastric band	1,403	40.9 (39.7-42.2)	38.8 (24.0-54.8)
		Roux en Y gastric bypass	6,820	71.5 (71.0-72.1)	71.3 (58.8-85.4)
		OAGB / MGB	455	72.4 (70.2-74.7)	73.7 (57.9-88.6)
		Sleeve gastrectomy	3,633	62.9 (62.2-63.7)	61.5 (47.5-77.0)
	Percentage / %	Gastric band	1,407	16.3 (15.8-16.8)	15.7 (10.2-22.0)
		Roux en Y gastric bypass	6,848	32.9 (32.7-33.2)	33.5 (27.5-39.0)
		OAGB / MGB	462	33.7 (32.7-34.7)	34.3 (27.5-41.0)
		Sleeve gastrectomy	3,644	29.2 (28.9-29.5)	29.0 (22.8-35.6)

Primary surgery for adults: One-year weight-loss metrics; operations in financial years 2013-2018



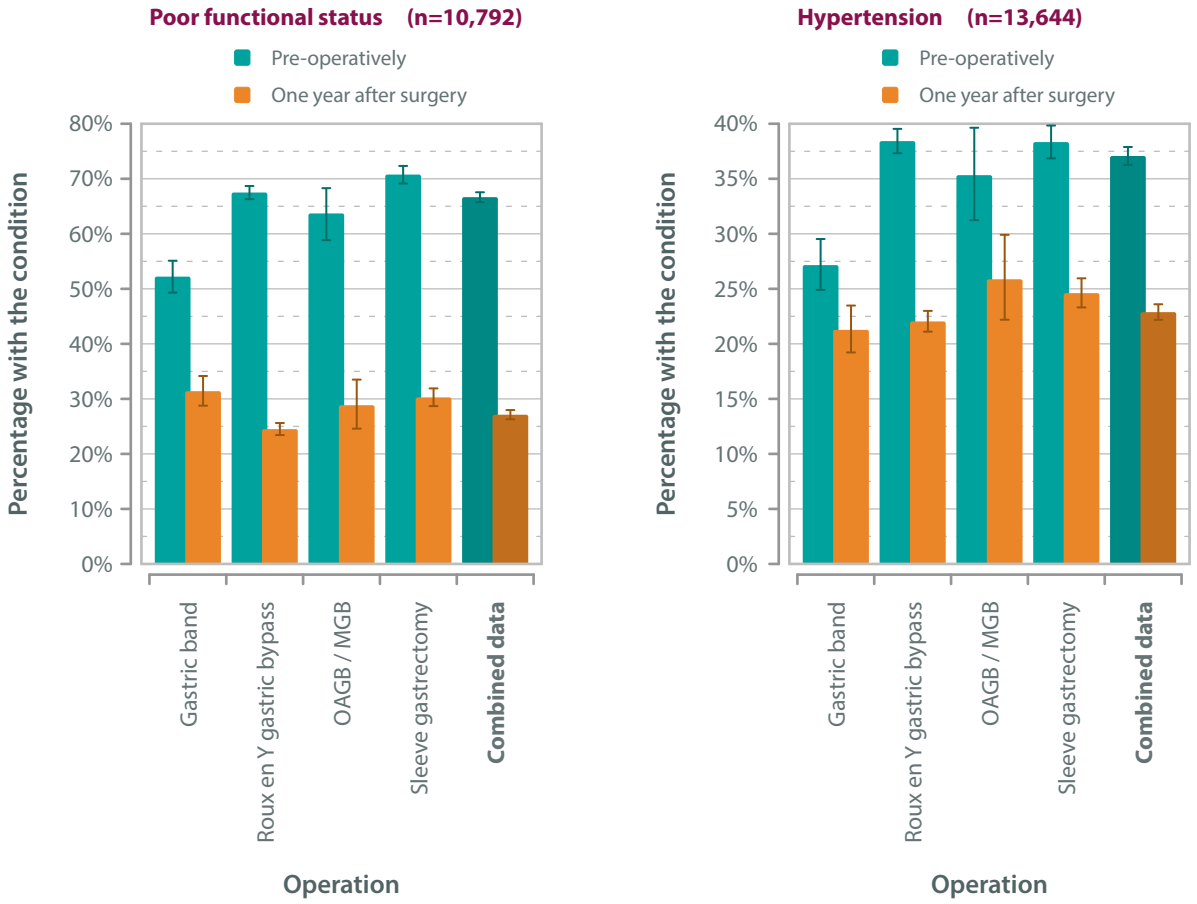
Obesity-related disease

Pre-operative and one-year post-operative obesity-related disease

As shown, there was a significant improvement in functional status with those who could not climb 3 flights of stairs without resting reduced from over 65% to just over 25% one year after bariatric surgery.

There was also considerable reduction of hypertension in all four groups of bariatric surgery patients one year post-operation. The overall prevalence of hypertension dropped from approximately 37% to 23%.

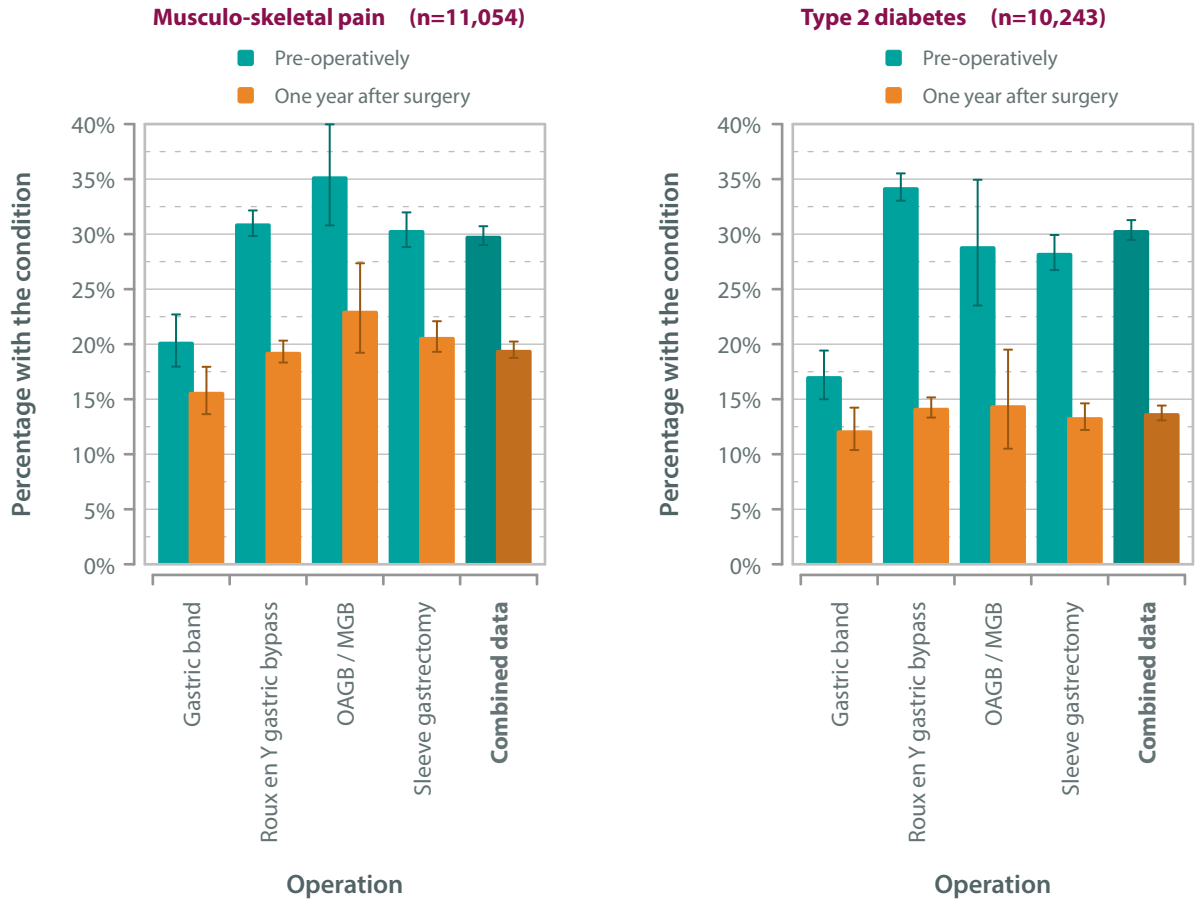
Primary surgery for adults: Obesity-related disease rates pre-operatively and one year post-operatively; operations in financial years 2013-2018



The incidence of type 2 diabetes reduced from 30% to 14% one year post-operation. The highest reduction was observed in the RYGB, from 34% down to 14%. These figures do not account for any improvement in diabetic control (e.g. conversion of an insulin-dependent type 2 diabetic to a patient only requiring oral medications).

Musculo-skeletal pain dropped from 30% to 19% one year post-operation with substantially reduction associated with all four groups of bariatric procedures.

Primary surgery for adults: Obesity-related disease rates pre-operatively and one year post-operatively; operations in financial years 2013-2018



The overall incidence of GORD was unchanged post-surgery. However, RYGB and gastric band were associated with a **reduction** in GORD; with SG and OAGB / MGB associated with an **increase** in incidence. All four procedures were associated with a reduction in sleep apnoea, though the effect was less marked in gastric band.

Primary surgery for adults: Obesity-related disease rates pre-operatively and one year post-operatively; operations in financial years 2013-2018

Improvement in obesity-related diseases

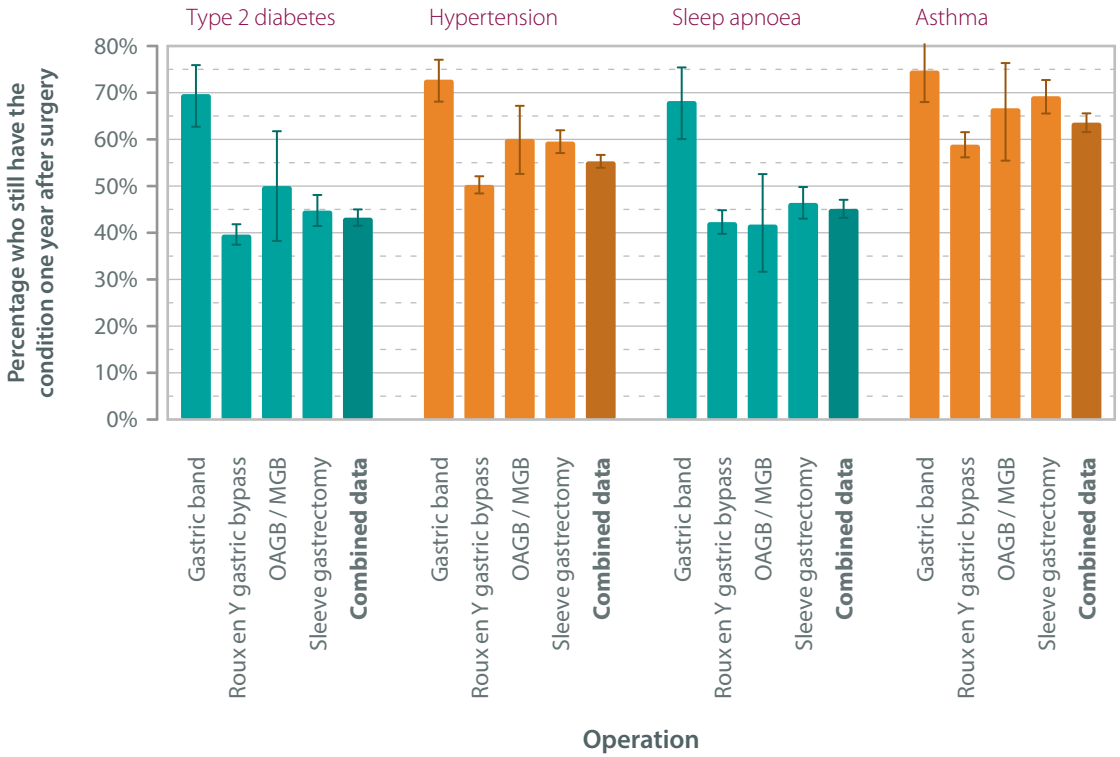
Analysis by procedure

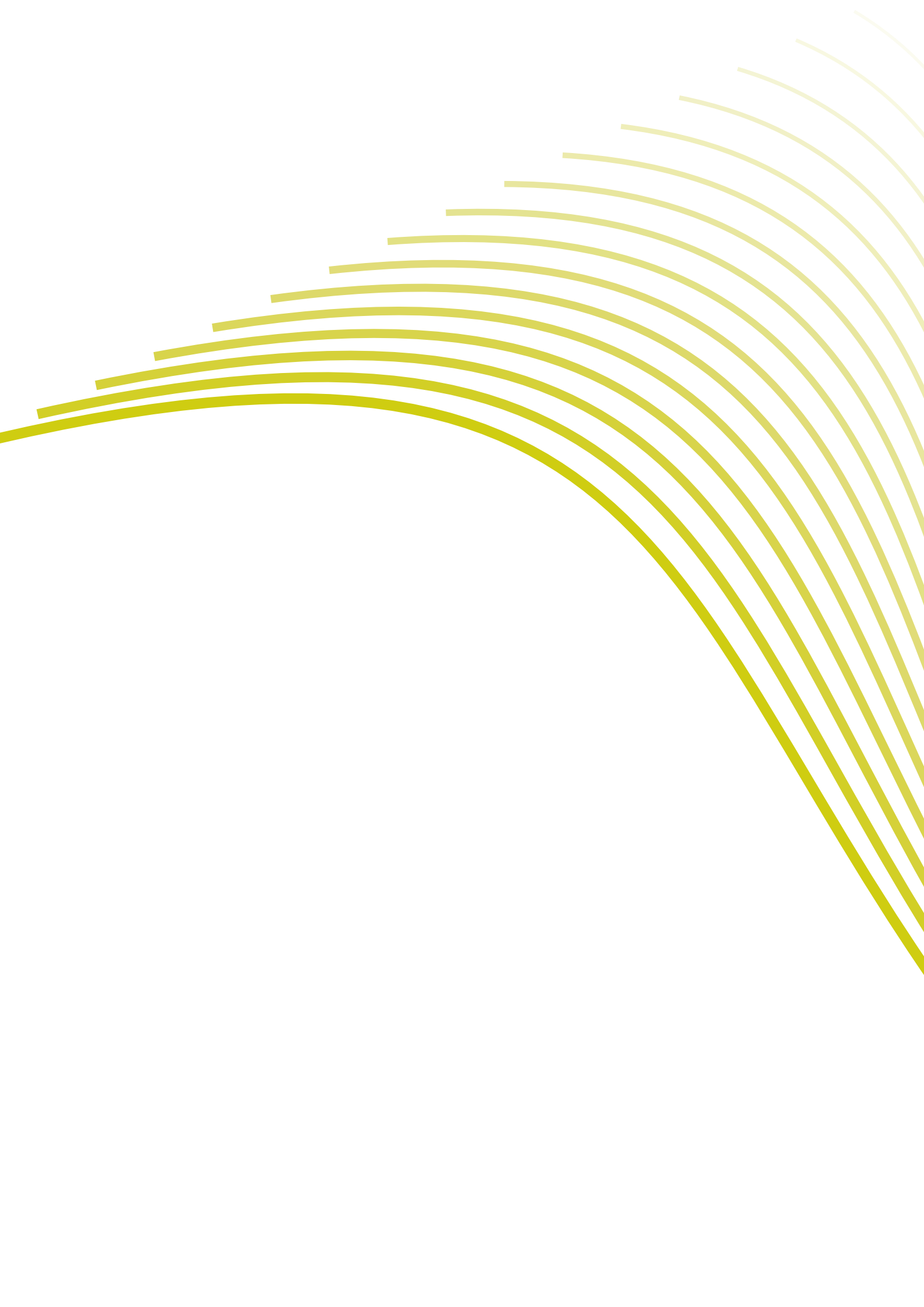
Primary surgery for adults: obesity-related disease one year after surgery for patients with that disease pre-operatively; operations in financial years 2013-2018

Operation and obesity-related disease		Obesity-related disease one year after surgery				
			No	Yes	Unspecified	Disease rate
Type 2 diabetes	Gastric band		60	138	449	69.7%
	Roux en Y gastric bypass		1,180	774	4,670	39.6%
	OAGB / MGB		37	37	374	50.0%
	Sleeve gastrectomy		489	396	2,583	44.7%
	All		**1,766**	**1,345**	**8,076**	**43.2%**
Hypertension	Gastric band		108	289	646	72.8%
	Roux en Y gastric bypass		1,437	1,452	4,307	50.3%
	OAGB / MGB		73	110	368	60.1%
	Sleeve gastrectomy		643	946	3,244	59.5%
	All		**2,261**	**2,797**	**8,565**	**55.3%**
Sleep apnoea	Gastric band		48	103	345	68.2%
	Roux en Y gastric bypass		867	635	3,056	42.3%
	OAGB / MGB		53	38	218	41.8%
	Sleeve gastrectomy		461	399	2,417	46.4%
	All		**1,429**	**1,175**	**6,036**	**45.1%**
Asthma	Gastric band		50	148	352	74.7%
	Roux en Y gastric bypass		540	773	2,463	58.9%
	OAGB / MGB		28	56	196	66.7%
	Sleeve gastrectomy		203	457	1,861	69.2%
	All		**821**	**1,434**	**4,872**	**63.6%**
Poor functional status	Gastric band		295	317	1,510	51.8%
	Roux en Y gastric bypass		2,703	1,358	8,361	33.4%
	OAGB / MGB		157	108	849	40.8%
	Sleeve gastrectomy		1,327	929	7,081	41.2%
	All		**4,482**	**2,712**	**17,801**	**37.7%**
Musculo-skeletal pain	Gastric band		87	144	483	62.3%
	Roux en Y gastric bypass		988	918	3,695	48.2%
	OAGB / MGB		77	76	338	49.7%
	Sleeve gastrectomy		440	570	2,858	56.4%
	All		**1,592**	**1,708**	**7,374**	**51.8%**
GORD	Gastric band		111	117	445	51.3%
	Roux en Y gastric bypass		1,012	706	3,375	41.1%
	OAGB / MGB		28	35	194	55.6%
	Sleeve gastrectomy		277	422	1,721	60.4%
	All		**1,428**	**1,280**	**5,735**	**47.3%**

As shown, all four operations were associated with functional and metabolic improvements amongst patients with pre-existing obesity-related diseases. These effects were less pronounced in patients undergoing gastric banding

Primary surgery for adults with each of the obesity-related diseases: Rates of the same obesity-related disease one year after surgery; operations in the financial years 2013-2018





Revision surgery

Author

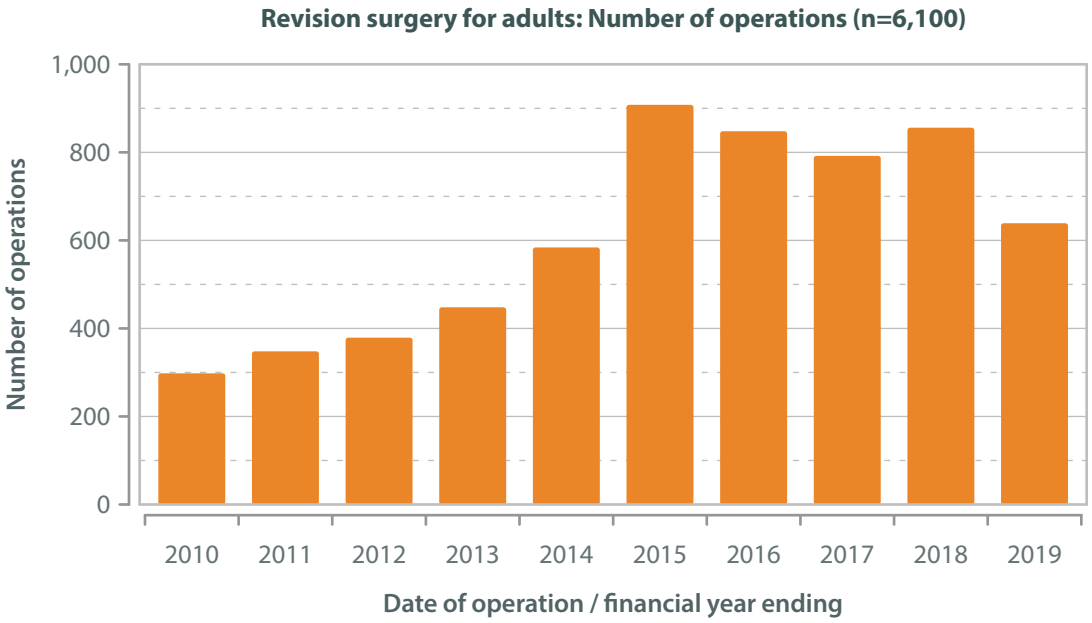
James Hopkins

Revision surgery

Operations performed

Number of operations

The number of revisional operations performed are a small percentage of the total bariatric procedures listed in the NBSR, from 2013-2018. A total of 4,436 procedures listed as revisional surgery equated to 10.2% of all procedure entered into the registry in this 6-year period. There was an exponential rise from 300 procedures recorded in 2010 to over 900 in 2015, with a steady rate of revisional operation in the years 2015–2018. This reflects the rise in primary bariatric procedures recorded in registry from 2006–2010 (326 to 5,758) with only a slow increase in primary procedures recorded since 2011 to 2018. In 2018 there were 856 revisional procedures and 7,017 primary operations (making of a total of 7,873 procedures where the operation sequence was recorded; this data-item was missing for a further 273 operation records), so revisions comprised 10.9% of the operations entered into the registry.



Kinds of operations

The commonest revisional operation involved a re-operation of a gastric band, at 38.4%, and this should largely be regarded as gastric band maintenance surgery. The first and second registry reports have shown a decline in the number of primary gastric band procedure performed from 2007–2013, but from 2011–2013 (the time frame of the second report) this was an average of 1,359 procedure *per* year, when the rate of primary band procedure was an average of 22.4 % of all primary bariatric procedures. From 2013–2018 the average number of revisional band procedure performed was 341, and accepting that the recent revisional data does include operations on older primary gastric banding surgery, the top end estimate of primary band surgery requiring revisional band surgery is 25.1%. This is in keeping with systematic review of gastric band surgery, that commented that early band surgery had a high re-operation rate, and this does reduce with time. This is in contrast to Roux en Y gastric bypass, which has remained the commonest primary procedure (52.3%) of all operations from 2011–2013 (as well as from 2013–2018), with over 3,000 operations each year. The number of revisional Roux en Y gastric bypass operation performed from 2013–2018 was 42 *per* year, or 1.3% of the annual rate of Roux en Y gastric bypass surgery.

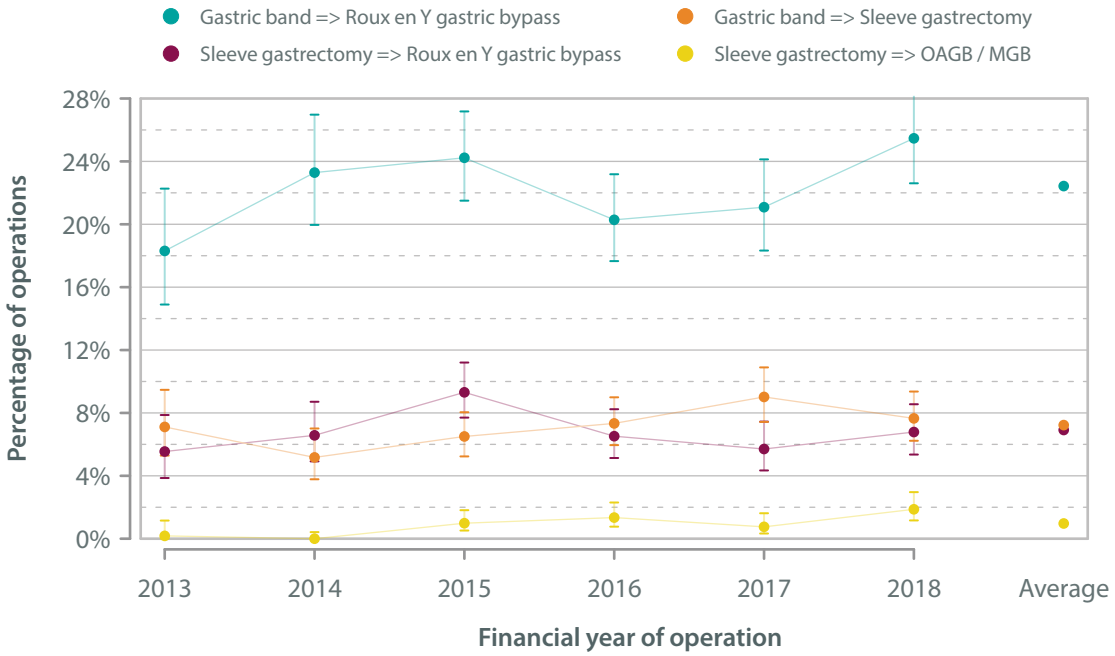
The next two commonest revisional operations reflect conversion of gastric band to another procedure, with the commonest being Roux en Y gastric bypass, 22.4%. Including gastric band conversions to OAGB (1.5%) conversion from gastric band to a bypass is 2.4 times more common than conversion to a sleeve gastrectomy (10.1%). Of all revisional surgery procedures involving a conversion to an alternative procedure, 62.8% of these are a conversion to a Roux en Y gastric bypass, making it the most common revisional operation. The rise in the number of sleeve gastrectomies performed, from <10% of all primary procedures in 2010, to over 40% in 2018, makes calculation of a sleeve revision rate much harder. An average of 85 sleeve revisions to any bypass (Roux en Y or OAGB) occurred *per* year from 2013–2018, and with 1,210 primary sleeves occurring *per* year from 2011–2013

and 2768 *per* year from 2013–2018 this gives a range of sleeve to bypass revision rates from 3.0–6.9%. The rates of sleeve conversion to any bypass is 12 times higher than a re-sleeve or a sleeve to a duodenal switch conversion.

Redo surgery for adults: surgery performed; operations in financial years 2013-2018

Prior operation => current operation	Count	Percentage
Gastric band => Gastric band	1,705	38.4%
Gastric band => Roux en Y gastric bypass	995	22.4%
Gastric band => Sleeve gastrectomy	446	10.1%
Sleeve gastrectomy => Roux en Y gastric bypass	372	8.4%
Roux en Y gastric bypass => Roux en Y gastric bypass	213	4.8%
Unspecified => Roux en Y gastric bypass	192	4.3%
Unspecified => Gastric band	135	3.0%
Gastric band => OAGB / MGB	68	1.5%
Sleeve gastrectomy => OAGB / MGB	52	1.2%
Unspecified => Sleeve gastrectomy	51	1.1%
Sleeve gastrectomy => Sleeve gastrectomy	35	0.8%
Sleeve gastrectomy => Duodenal switch (NO sleeve)	35	0.8%
Other combinations	137	3.1%
All	**4,436**	

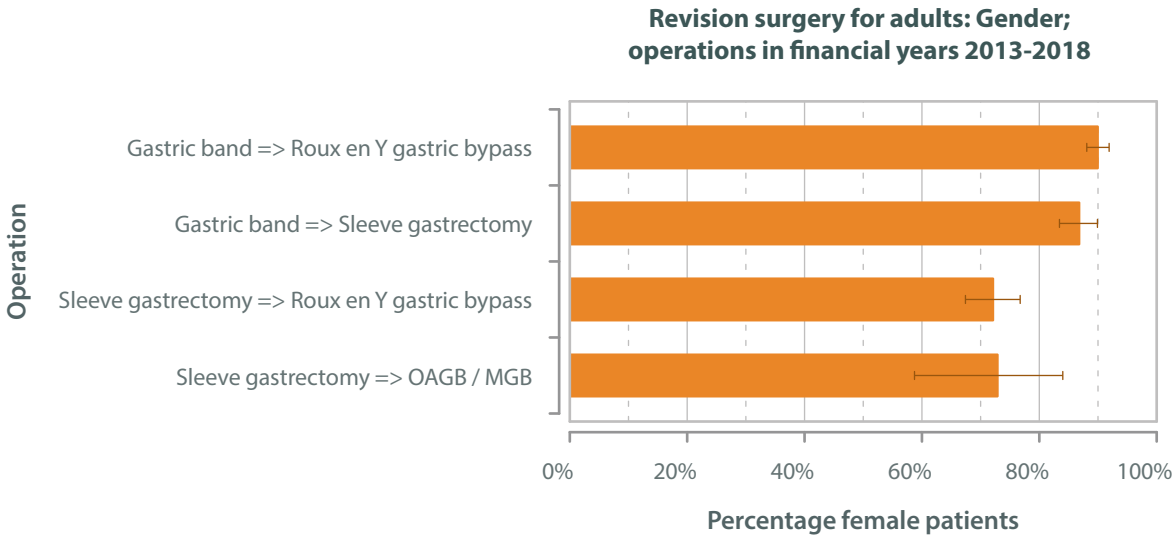
Revision surgery for adults: Changes in the relative proportions of the most common revision operations performed over time; operations in financial years 2013-2018 (n=4,436)



Demographics and obesity-related disease

Gender

The proportion of patients by gender having revisional surgery, for the commonest performed operations reflects the percentages of males and females having primary surgery. Revision from a band to a Roux en Y gastric bypass (90%) or sleeve gastrectomy (86%) reflects the higher proportion of females having gastric banding as a primary procedure (82.3% in 2011–2013, and 84% 2013–2018). The percentage of females having a sleeve revision to any bypass was 72%, closely reflecting the primary sleeve surgery rate, 71.2% in 2011–2013 and 74.8% in 2013–2018.

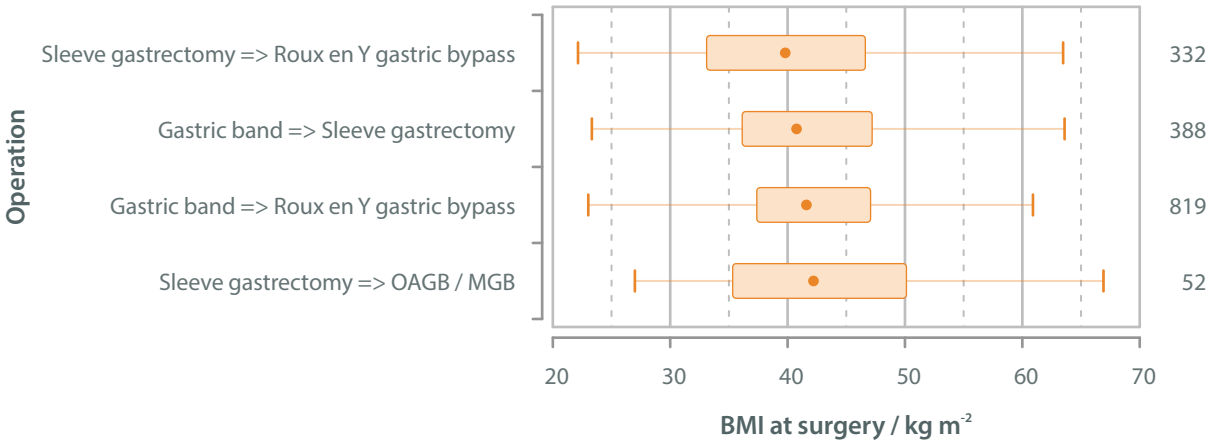


BMI at surgery

The median BMI at revisional surgery is not significantly different from that at the time of primary surgery, which for Roux en Y gastric bypass, OAGB and sleeve gastrectomy in 2013–2018 was 45 kg m^{-2}. The median BMI for a revision to a Roux en Y was 40.8 kg m^{-2}, OAGB 43.7 kg m^{-2} and sleeve 40.7 kg m^{-2}. However, what is much more noticeable is the range of BMIs undergoing revisional surgery compared to primary surgery. This is likely to reflect the reason for the revisional operation, which could include a cohort of patients with a complication of a primary surgery and perhaps a significantly lower BMI, as well as those in whom the reason is either weight regain (± comorbidity relapse) or an unsatisfactory primary weight loss or weight loss as part of a staged process in the super obese, where the BMI is likely to be higher. For Roux en Y gastric bypass, the commonest revisional operation the range was BMI 40.4–72.0 kg m^{-2}, and this includes cohorts of patients at a lower BMI having revisional surgery for complications or intolerance of the primary procedure at a lower BMI (*e.g.,* significant GORD), as well as those with weight regain following either gastric banding (± separate band removal) or a sleeve gastrectomy.

Whilst the current rates of revisional bariatric surgery are 10% of all primary weight loss operations, obesity is a life-long disease. Other large surgical registries, *e.g.,* the bone and joint registry, have shown a revisional surgery rate for joint replacement surgery due to the relapse of symptoms and life expectancy of patients out-lasting the life-span of a joint prosthesis. In the same way as bariatric surgery prolongs life expectancy, there will be some relapse of obesity and the associated obesity-related diseases, which warrant a revisional bariatric surgery.

Revision surgery for adults: BMI at surgery; operations in financial years 2013-2018

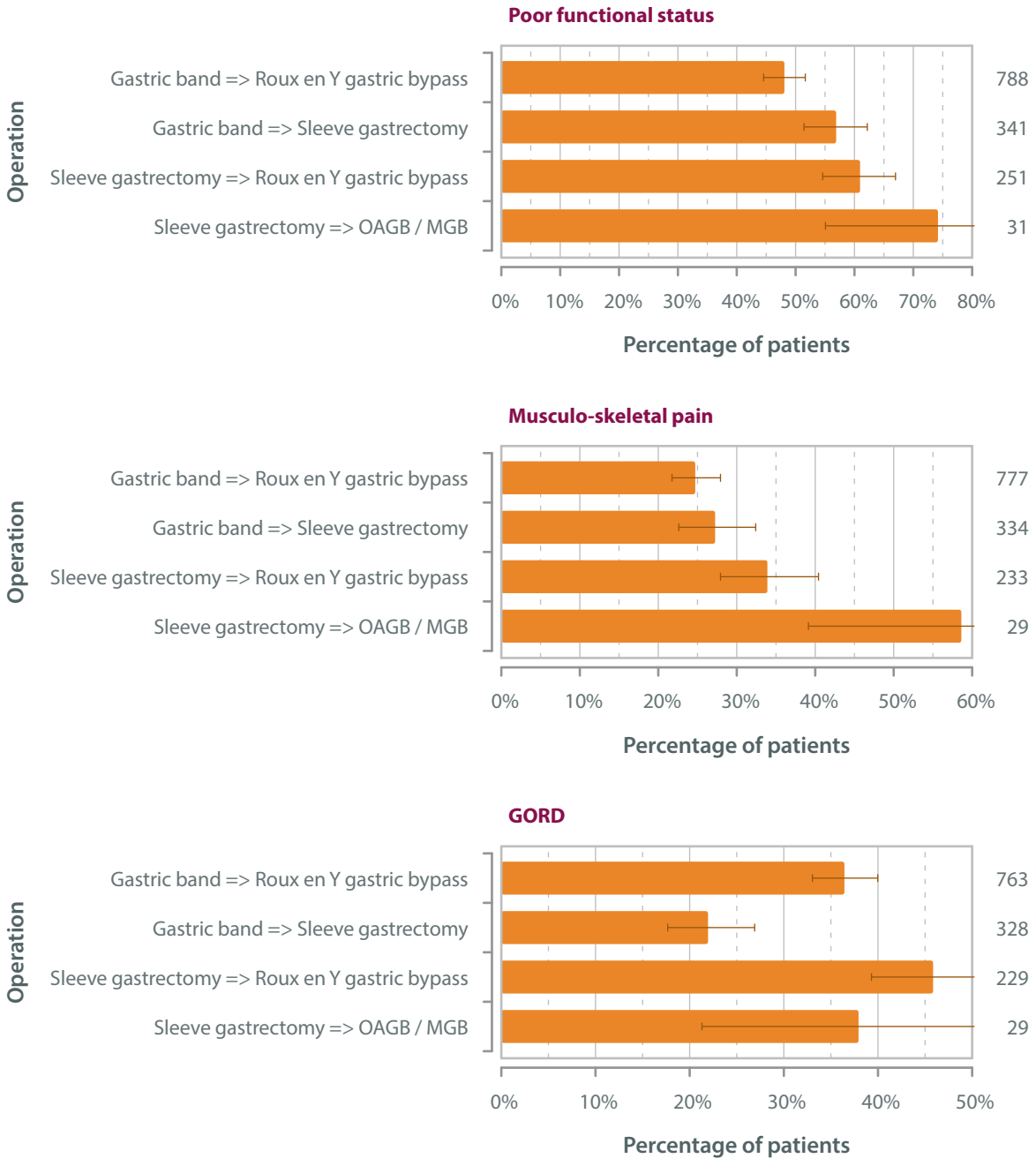


Obesity-related disease

The prevalence of obesity-related disease is closely linked to a patient's BMI, but as indicated above there was a much wider range of BMIs in patients undergoing revisional surgery, depending upon the reason for revision. However the average rates of these diseases in the revisional surgery population are very similar to those having primary surgery, as the average BMI of the populations are similar. Poor functional status or bone / joint related pains were the two commonest conditions associated with BMI in the second registry report (2011–2013) at 72% and 55% respectively. For those undergoing the commonest conversion operations 47–74% reported a poor functional status and 25–58% had musculo-skeletal pain.

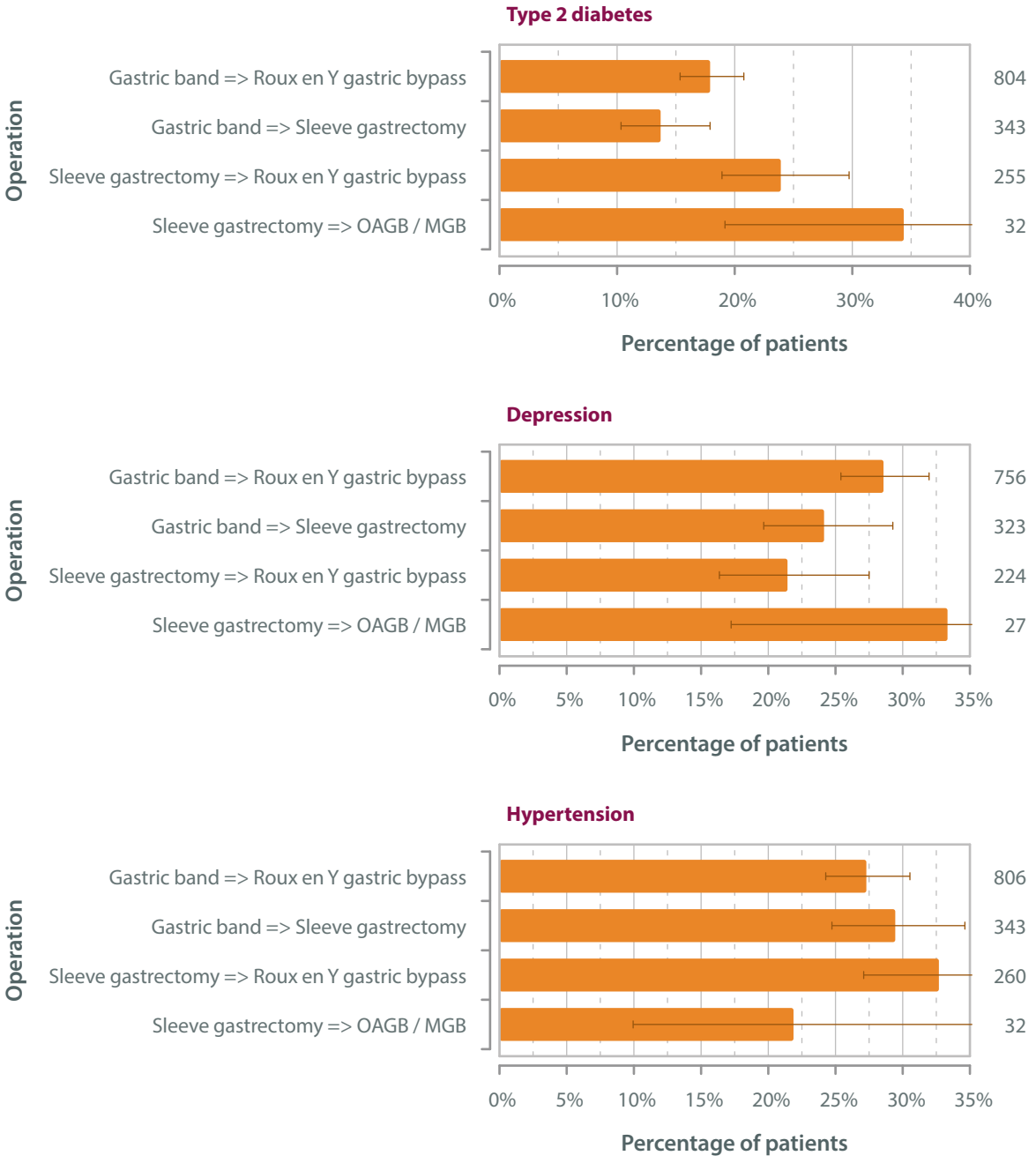
GORD, a commonly cited reason for band to bypass or sleeve to bypass revision, was present in 22–46 % of the main conversion operation types, in comparison with 32–37% rates seen in those undergoing primary bariatric surgery in the 2011–2013 cohort, and 20–24% in the 2013–2018 cohort.

Revision surgery for adults: Obesity-related disease; operations in financial years 2013-2018



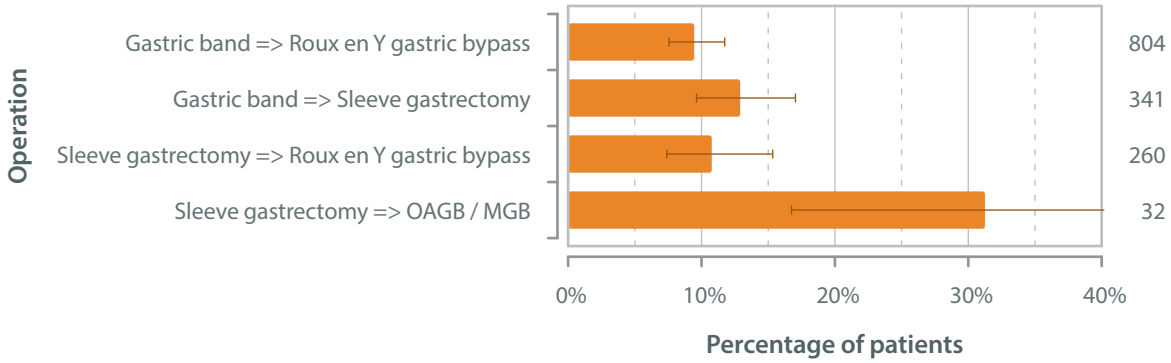
For diabetes the rates for conversion from a primary gastric band was 14–18% and from a sleeve gastrectomy was 24–34%, in comparison with 26% of all female patients and 44% of all male patients having primary surgery in both cohorts from 2011–2018. Hypertension was present in over 25 % of all revisional surgery patients, whereas in both the 2011–2013 and 2013–2018 cohorts having primary surgery it is recorded for 31–35% of female patients and 51–55% of male patients.

Revision surgery for adults: Obesity-related disease; operations in financial years 2013-2018

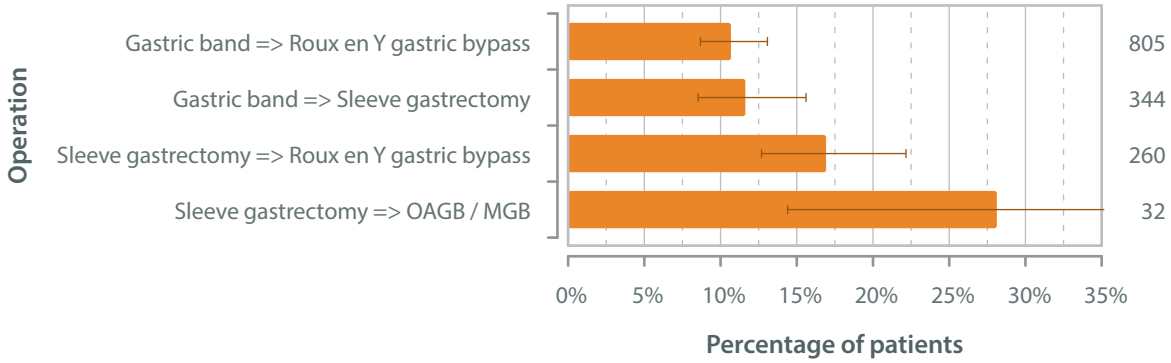


Revision surgery for adults: Obesity-related disease; operations in financial years 2013-2018

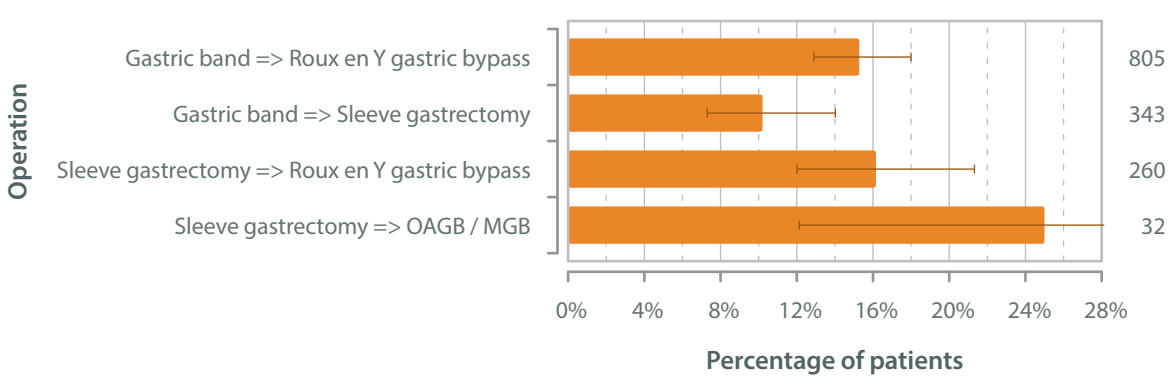
Risk factors for pulmonary embolus



Sleep apnoea

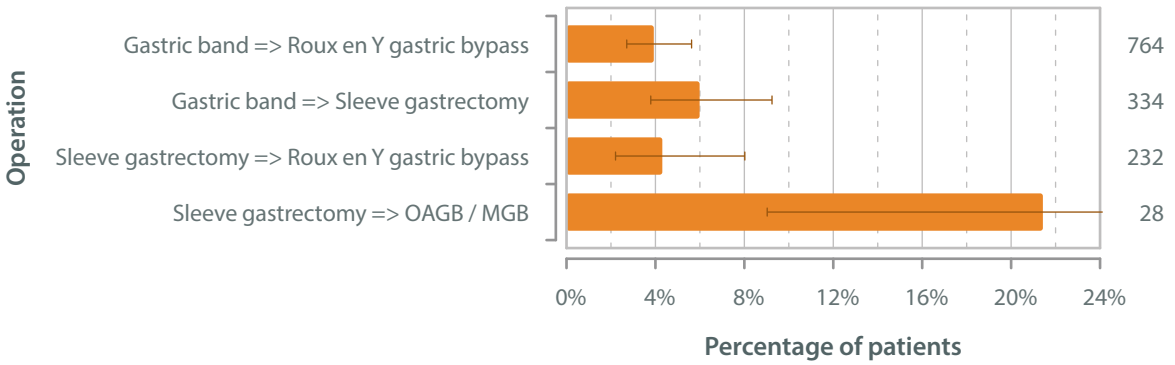


Asthma

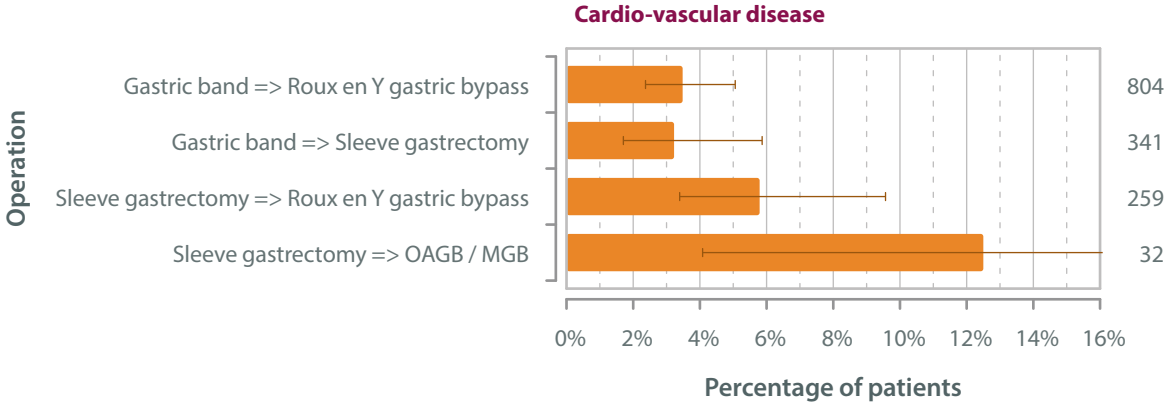


Revision surgery for adults: Obesity-related disease; operations in financial years 2013-2018

Liver disease



Cardio-vascular disease



One-year weight loss

The outcome of revisional weight loss surgery were not reported on in the first and second NBSR registry reports, where number of patients were small, and follow up data is relative incomplete.

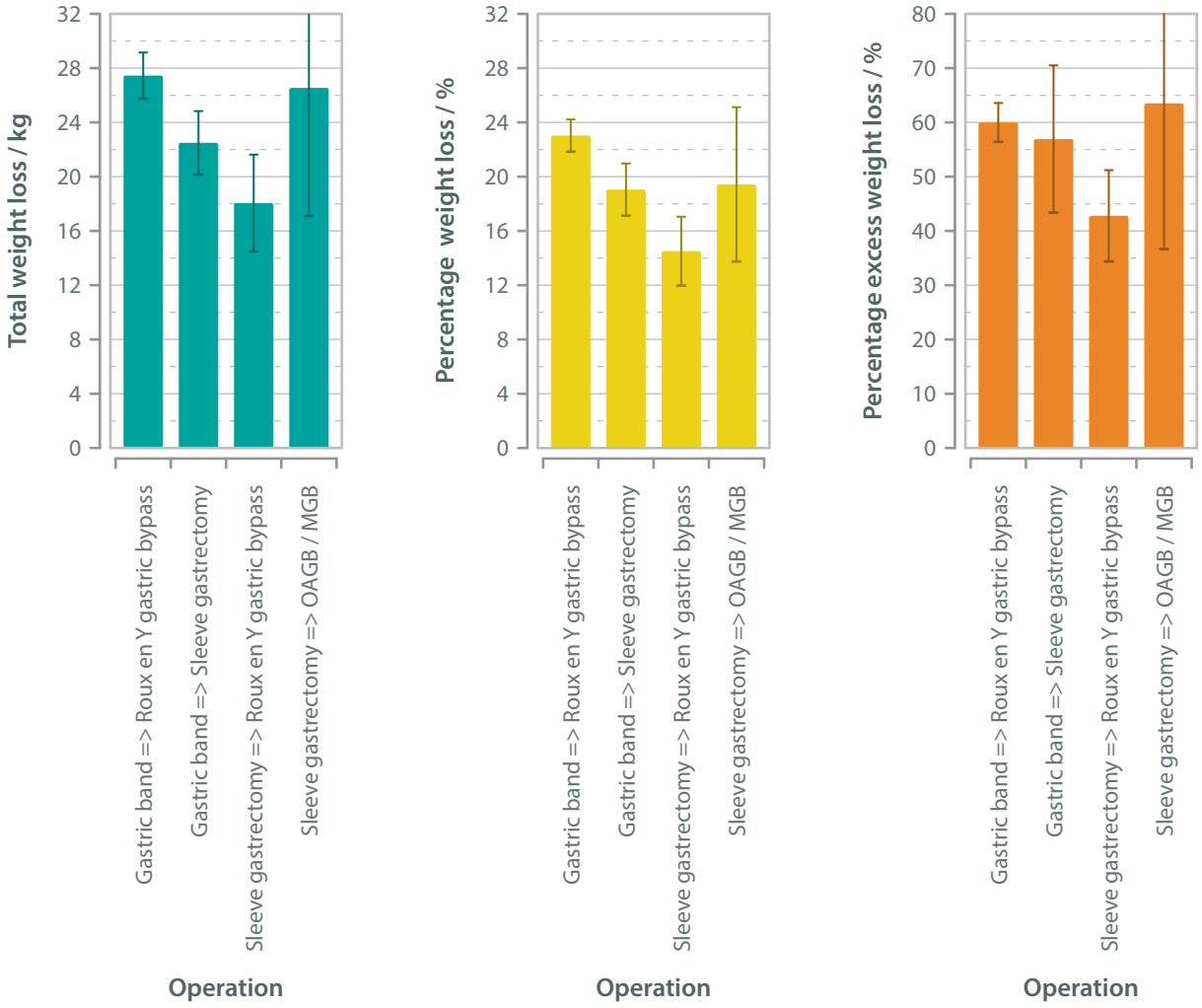
For every metric the weight loss measure at 12 months was lower for revisional surgery procedures than for the corresponding primary procedure, even though the average starting BMI was comparable. This ranged from 45% for sleeve as a revisional operation to 69% for Roux en Y gastric bypass as a revisional procedure. That being said, clinically meaningful weight loss was achieved by all revisional operation, well in excess of weight loss achieved by non-surgical means. Roux en Y gastric bypass achieved significantly better absolute and percent total weight loss after gastric banding than did sleeve gastrectomy (27.5 kg & 23% *versus* 22.5 kg & 19.0%). Compared to similar weight loss metrics after primary surgery for Roux en Y gastric bypass and OAGB, after sleeve gastrectomy the small number of patients converted to an OAGB appeared to loose more weight than those converted to a Roux en Y gastric (total 26.5 kg *versus* 18.0 kg; percentage 19.4% *versus* 14.5% respectively). However with only 18 patients will one year follow up data after revisional OAGB the margin of error was large.

Revision surgery for adults: one-year weight-loss metrics; operations in financial years 2013-2018

Prior => current operation and weight loss metric		Count	Average (95% CI)	Median (IQR)
Gastric band => Roux en Y gastric bypass	Total / kg	253	**27.5** (25.8-29.2)	**26.9** (17.8-35.1)
	Excess / %	253	**60.0** (56.4-63.6)	**57.7** (44.3-77.7)
	Percentage / %	253	**23.0** (21.8-24.2)	**23.5** (17.7-29.4)
Gastric band => Sleeve gastrectomy	Total / kg	111	**22.5** (20.2-24.8)	**23.3** (13.2-33.0)
	Excess / %	110	**56.9** (43.4-70.5)	**48.9** (29.9-70.2)
	Percentage / %	111	**19.0** (17.1-21.0)	**20.9** (12.0-26.0)
Sleeve gastrectomy => Roux en Y gastric bypass	Total / kg	95	**18.0** (14.5-21.6)	**14.1** (5.3-27.7)
	Excess / %	89	**42.8** (34.4-51.2)	**35.8** (19.3-59.2)
	Percentage / %	95	**14.5** (12.0-17.0)	**13.6** (6.2-21.3)
Sleeve gastrectomy => OAGB / MGB	Total / kg	18	**26.5** (17.1-36.0)	**20.8** (12.2-40.4)
	Excess / %	18	**63.5** (36.6-90.4)	**47.6** (32.1-86.5)
	Percentage / %	18	**19.4** (13.7-25.1)	**19.0** (10.8-27.5)

Gastric band maintenance surgery is relatively common, when a band is converted to some other procedure. Roux en Y gastric bypass is the most commonly performed revisional weight loss procedure, with good clinical effectiveness. Small number of data suggest that OAGB maybe superior to Roux en Y gastric bypass after a sleeve.

Revision surgery for adults: One-year weight-loss metrics; operations in financial years 2013-2018



References

1. Paul E. O'Brien, Annemarie Hindle, Leah Brennan, Stewart Skinner, Paul Burton, Andrew Smith, Gary Crosthwaite, and Wendy Brown. Long-Term Outcomes After Bariatric Surgery: a Systematic Review and Meta-analysis of Weight Loss at 10 or More Years for All Bariatric Procedures and a Single-Centre Review of 20-Year Outcomes After Adjustable Gastric Banding. *Obesity Surgery*. 2019; **29(1)**: 3–14.
2. Bou Daher H, Sharara Al. Gastroesophageal reflux disease, obesity and laparoscopic sleeve gastrectomy: The burning questions. *World Journal of Gastroenterology*. 2019; **25(33)**:4805-4813. doi: 10.3748/wjg.v25.i33.4805.
3. Martyn Porter, Richard Armstrong, Peter Howard, Matthew Porteous, J. Mark Wilkinson. Orthopaedic registries – the UK view (National Joint Registry): impact on practice. EFORT Open Rev 2019;4 DOI: 10.1302/2058-5241.4.180084
4. John P H Wilding, Vicki Mooney. Should obesity be recognised as a disease? British Medical Journal. 2019; **366**: l4258. doi: https://doi.org/10.1136/bmj.l4258
5. Viktoria L Gloy, Matthias Briel, Deepak L Bhatt, Sangeeta R Kashyap, Philip R Schauer, Geltrude Mingrone, Heiner C Buche, Alain J Nordman. Bariatric surgery versus non-surgical treatment for obesity: a systematic review and meta-analysis of randomised controlled trials. *British Medical Journal*. 2013; **347**: f5934 doi.org/10.1136/bmj.f5934
6. Welbourn R, Fiennes A, Kinsman R, and Walton PKH. First Registry Report to March 2010. ISBN: 1-903968-27-5. Published by Dendrite Clinical Systems Ltd; Feb 2011.
7. Welbourn R, Small P, Finlay I, Sareela A, Somers S, Mahawar K, Walton PKH, and Kinsman R. Second Registry Report. ISBN: 978-0-9568154-8-4. Published by Dendrite Clinical Systems Ltd; Nov 2014.

Appendix

The database form

Form A

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 1; Version 2.0 (20 Feb 2018)

Basic demographic data

All baseline data refer to the condition of the patient when they were originally diagnosed.

Unique patient identifier	
Date of birth	dd / mm / yyyy
Gender	○ Male ○ Female ○ Unknown
Ethnic origin	○ Caucasian ○ Asian ○ African ○ Chinese ○ Afro-Carribean ○ Other ○ Not recorded

Registry data

Basic details

Consultant	GMC number
Hospital	select from the list
Dual operating case	○ No ○ Yes
Second consultant	GMC number
Funding category	○ NHS ○ Private
Employment status	○ Full-time ○ Part-time ○ Unemployed ○ Student ○ Retired
Patient discussed at an MDT before surgery	○ No ○ Yes
Has the patient consented for PROMs follow up	○ No ○ Yes
Patient's mobile phone number	
Patient's e-mail address	

Powered by
Dendrite Clinical Systems

Form B

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 2; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Height and weight data

Date of entry to the weight loss program yyyy or yyyy-mm or yyyy-mm-dd if known

Tier 3 weight loss programme ○ No ○ Yes

Height on entry to the weight loss program cm

Weight on entry to the weight loss program kg

Powered by
Dendrite Clinical Systems

Appendix

Form E

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 3; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Comorbidity A

ASA grade
- ○ ASA I
- ○ ASA II
- ○ ASA III
- ○ ASA IV

Type 2 diabetes
- ○ No indication of type 2 diabetes
- ○ Pre-diabetes
- ○ Oral hypoglaemics
- ○ Injectable other than insulin
- ○ Insulin treatment

Number of medications for diabetes
- ○ One
- ○ Two
- ○ Three
- ○ Four

Most recent pre-operative HbA1c
- ○ 5.0% (31 mmol mol^{-1})
- ○ 6.0% (42 mmol mol^{-1})
- ○ 6.5% (48 mmol mol^{-1})
- ○ 7.0% (53 mmol mol^{-1})
- ○ 7.5% (58 mmol mol^{-1})
- ○ 8.0% (64 mmol mol^{-1})
- ○ 9.0% (75 mmol mol^{-1})
- ○ 10.0% (86 mmol mol^{-1})
- ○ 11.0% (97 mmol mol^{-1})
- ○ 12.0% (108 mmol mol^{-1})
- ○ 13.0% (119 mmol mol^{-1})
- ○ >13.0% (>119 mmol mol^{-1})

Duration of type 2 diabetes
- ○ < 1 year
- ○ 1 years
- ○ 2 years
- ○ 3 years
- ○ 4 year
- ○ 5 years
- ○ 6 years
- ○ 7 years
- ○ 8 years
- ○ 9 years
- ○ 10 years
- ○ >10 years

Hypertension
- ○ No indication of hypertension; or on no treatment
- ○ Hypertension on treatment

Cardiovascular
- ○ No indication of atherosclerosis
- ○ Diagnosed atherosclerosis

Diagnosis of sleep apnoea
- ○ No
- ○ Yes - untreated
- ○ Yes - treated

Diagnosis of asthma
- ○ No
- ○ Yes

Functional status
- ○ Can climb 3 flights of stairs without resting
- ○ Can climb 1 flight of stairs without resting
- ○ Can climb half a flight of stairs without resting
- ○ Requires wheelchair / house bound

Known risk factors for PE
- ○ No
- ○ Yes

Powered by
Dendrite Clinical Systems

Form E

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 4; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Comorbidity B

Musculo-skeletal pain on daily medication	○ No	○ Yes
Medication for GORD	○ No	○ Yes
Liver disease	○ No	○ Yes
Poly-cystic ovarian syndrome	○ No indication / diagnosis; no medication ○ Diagnosis of PCOS; no medication ○ PCOS on medication ○ Infertility	
Depression	○ No indication of depression	○ Depression on medication
Did the patient have a gastric balloon pre-surgery	○ None ○ One	○ Two ○ Three or more

Powered by
Dendrite Clinical Systems

Appendix

Form F

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 5; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

EQ5D

Mobility
- I have no problems in walking about
- I have slight problems in walking about
- I have moderate problems in walking about
- I have severe problems in walking about
- I am unable to walk about

Self care
- I have no problems washing or dressing myself
- I have slight problems washing or dressing myself
- I have moderate problems washing or dressing myself
- I have severe problems washing or dressing myself
- I am unable to wash or dress myself

Usual activities
- I have no problems doing my usual activities
- I have slight problems doing my usual activities
- I have moderate problems doing my usual activities
- I have severe problems doing my usual activities
- I am unable to do my usual activities

Pain / discomfort
- I have no pain or discomfort
- I have slight pain or discomfort
- I have moderate pain or discomfort
- I have severe pain or discomfort
- I have extreme pain or discomfort

Anxiety / depression
- I am not anxious or depressed
- I am slightly anxious or depressed
- I am moderately anxious or depressed
- I am severely anxious or depressed
- I am extremely anxious or depressed

General health VAS integer; range: 0-100

Powered by
Dendrite Clinical Systems

Form G

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 6; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Operation

Date of most recent weight dd / mm / yyyy

Weight immediately prior to operation kg

Has the patient has a prior bariatric procedure other than a balloon placement
- ○ No
- ○ Yes

Is this current operation a planned second stage
- ○ No
- ○ Yes

Operative approach
- ○ Laparoscopic
- ○ Laparoscopic converted to open
- ○ Open
- ○ Endoscopic

Operation
- ○ Gastric balloon (skip next 3 quns)
- ○ Roux en Y gastric bypass
- ○ One anastomosis gastric bypass
- ○ Gastric band
- ○ Bilio-pancreatic diversion
- ○ Duodenal switch
- ○ Sleeve gastrectomy
- ○ SADI
- ○ Gastric plication
- ○ Other

Gastric balloon placement route
- ○ Endoscopic
- ○ Swallowed

Is a sleeve being performed as part of this same operation (DS and SADI only)
- ○ No
- ○ Yes

Other operation details
- ○ Endobarrier
- ○ Pose/Rose
- ○ Stretta
- ○ Linx
- ○ Gastric artery embolisation
- ○ Gastric pacing

For revisions prior operation type
- ○ Roux en Y gastric bypass
- ○ One anastomosis gastric bypass
- ○ Gastric band
- ○ Bilio-pancreatic diversion
- ○ Duodenal switch
- ○ Sleeve gastrectomy
- ○ SADI
- ○ Gastric plication
- ○ Other

Other prior operation details
- ○ Endobarrier
- ○ Pose/Rose
- ○ Stretta
- ○ Linx
- ○ Gastric artery embolisation
- ○ Gastric pacing

Liver size
- ○ Normal
- ○ Enlarged
- ○ Severely enlarged

Liver appearance
- ○ Normal
- ○ Steatotic
- ○ Cirrhotic

Powered by
Dendrite Clinical Systems

Appendix

Form H

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 7; Version 2.0 (20 Feb 2018)

Unique patient identifier	
Date of operation	dd / mm / yyyy

Gastric balloon

Gastric balloon	○ Allergan BIB ○ Heliosphere ○ Obalon ○ Spitzer 3 ○ Elipse ○ Orbera 365 ○ Other
Details of other balloon	
Fill volume	○ 500 ml ○ 650 ml ○ 550 ml ○ 700 ml ○ 600 ml ○ Other volume
Other fill volume	ml
Balloon removed	○ No ○ Yes
Date balloon removed	dd / mm / yyyy
Any complications	○ No ○ Yes

Powered by
Dendrite Clinical Systems

Form H

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 8; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Complications for gastric balloons

Date of complication dd / mm / yyyy

Complication

- ☐ Perforation
- ☐ Bleeding
- ☐ Obstruction
- ☐ Other

Other complications

Powered by
Dendrite Clinical Systems

Appendix

Form I

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 9; Version 2.0 (20 Feb 2018)

Unique patient identifier	
Date of operation	dd / mm / yyyy

Gastric band

Gastric band	○ Allergan AP small	
	○ Allergan AP large	○ Bioring (Cousin)
	○ AMI	○ Minimizer Extra
	○ MID	○ BioEnterics LAP-BAND
	○ Heliogast	○ Other
Gastro-gastric tunneling sutures	○ No	○ Yes
Any complications	○ No	○ Yes
Band still in situ	○ No	○ Yes
Date band removed	dd / mm / yyyy	
Reason for band removal	☐ Port / tubing / technical band problem	
	☐ Band intolerance	☐ Perforation
	☐ Erosion	☐ Infection
	☐ Pouch / oesophageal dilatation	☐ Bleeding
	☐ Slippage	☐ Other
Other reason for band removal		

Powered by
Dendrite Clinical Systems

Form I

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 10; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Complications for gastric bands

Date of complication dd / mm / yyyy

Complication
- ☐ Slippage
- ☐ Infection
- ☐ Bleeding
- ☐ Perforation
- ☐ Other

Other complications

Any re-operation ○ No ○ Yes

Date of re-operation dd / mm / yyyy

Re-operation performed
- ☐ Band slippage; re-positioned
- ☐ Band removed
- ☐ Attention to port / tubing

Powered by
Dendrite Clinical Systems

Appendix

Form J

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 11; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Roux en Y gastric bypass

Banded gastric bypass ○ No ○ Yes

Type of banded bypass ○ Fobi ring ○ Minimizer ○ AMI ring

Linear stapler for gastric pouch select from the table: **STAPLE**

Type of reinforcement ○ None ☐ Seamguard ☐ Peristrips ☐ Tisseel fibrin glue ☐ Suturing ☐ Endo GIA Reinforcer Reload ☐ Other

Bougie used ○ None ○ 30 Fr ○ 32 Fr ○ 34 Fr ○ 36 Fr ○ 38 Fr ○ 40 Fr ○ Other

Other bougie size Fr

Gastrojejunostomy ○ Circular stapler ○ Linear stapler ○ Hand sewn

Stapler used (Gastrojejunostomy) select from the table: **STAPLE**

Stapler manufacturer ○ Medtronic (Covidien) ○ Ethicon

Stapler size (Medtronic) ○ 21 mm ○ 25 mm ○ 28 mm

Stapler size (Ethicon) ○ 21 mm ○ 25 mm ○ 29 mm

Bilio-pancreatic limb length cm; range: 10-250 in 5 cm increments

Roux limb length cm; range: 40-200 in 5 cm increments

Jejuno-jejunostomy ○ Triple linear stapler ○ Double linear stapler ○ Single linear stapler ○ Hand sewn

Stapler used (jejuno-jejunostomy) select from the table: **STAPLE**

RYGB route of Roux limb ○ Ante-colic / ante-gastric ○ Retro-colic / ante-gastric ○ Retro-colic / retro-gastric ○ Other

RYGB closure of hernia defects ○ None ☐ Petersen's space ☐ Jejuno-jejunostomy ☐ Mesocolon

Any complications ○ No ○ Yes

Powered by
Dendrite Clinical Systems

Form J

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 12; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Complications for Roux en Y gastric bypass

Date of complication dd / mm / yyyy

Complication
- ☐ Leak
- ☐ Bleeding
- ☐ Obstruction
- ☐ Other

Other complications

Leak location
- ○ Gastrojejunostomy
- ○ Jejunojenostomy
- ○ Gastric remnant
- ○ Other

Other leak location

Probable source of bleeding
- ☐ GI tract
- ☐ Intra-abdominal
- ☐ Other

Other source of bleeding

Treatment of bleeding
- ○ No transfusion needed
- ○ Blood transfusion

Cause of bowel obstruction
- ○ Petersen's hernia
- ○ Mesenteric anastomosis defect
- ○ Mesocolic defect
- ○ Anastomotic anatomy
- ○ Adhesions
- ○ Other

Other cause of bowel obstruction

Treatment of bowel obstruction
- ○ Settled conservatively
- ○ Endoscopic dilatation

Any re-operation
- ○ No
- ○ Yes

Date of re-operation dd / mm / yyyy

Approach for re-operation
- ○ Laparoscopic
- ○ Laparoscopic converted to open
- ○ Open

Re-operation performed
- ☐ Re-fashioning anastomosis
- ☐ Attention to bleeding area
- ☐ Hernia repair
- ☐ Drain placement
- ☐ Gastrostomy
- ☐ Enteral feeding
- ☐ Laparoscopy only
- ☐ Other

Details of other re-operation

Powered by
Dendrite Clinical Systems

Appendix

Form K

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 13; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Mini gastric bypass

Gastric pouch length in cm
○ <5 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 ○ 11 ○ 12 ○ 13 ○ 14 ○ 15 ○ 16 ○ 17 ○ 18 ○ 19 ○ 20 ○ >20

Banded gastric bypass ○ No ○ Yes

Type of banded bypass ○ Fobi ring ○ Minimizer ○ AMI ring

Linear stapler for gastric pouch select from the table: **STAPLE**

Type of reinforcement
○ None
☐ Seamguard ☐ Peristrips ☐ Tisseel fibrin glue ☐ Suturing ☐ Endo GIA Reinforcer Reload ☐ Other

Bougie used ○ None ○ 30 Fr ○ 32 Fr ○ 34 Fr ○ 36 Fr ○ 38 Fr ○ 40 Fr ○ Other

Other bougie size Fr

Gastrojejunostomy ○ Circular stapler ○ Linear stapler ○ Hand sewn

Stapler used (Gastrojejunostomy) select from the table: **STAPLE**

Stapler manufacturer ○ Medtronic (Covidien) ○ Ethicon

Stapler size (Medtronic) ○ 21 mm ○ 25 mm ○ 28 mm

Stapler size (Ethicon) ○ 21 mm ○ 25 mm ○ 29 mm

Bilio-pancreatic limb length cm; range: 10-250 in 5 cm increments

Closure of Petersen's Space ○ No ○ Yes

Any complications ○ No ○ Yes

Powered by
Dendrite Clinical Systems

Form K

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 14; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Complications for mini gastric bypass

Date of complication dd / mm / yyyy

Complication
- ☐ Leak
- ☐ Bleeding
- ☐ Obstruction
- ☐ Other

Other complications

Leak location
- ○ Gastrojejunostomy
- ○ Gastric remnant
- ○ Other

Other leak location

Probable source of bleeding
- ☐ GI tract
- ☐ Intra-abdominal
- ☐ Other

Other source of bleeding

Treatment of bleeding
- ○ No transfusion needed
- ○ Blood transfusion

Cause of bowel obstruction
- ○ Petersen's hernia
- ○ Mesenteric anastomosis defect
- ○ Anastomotic anatomy
- ○ Adhesions
- ○ Other

Other cause of bowel obstruction

Treatment of bowel obstruction
- ○ Settled conservatively
- ○ Endoscopic dilatation

Any re-operation
- ○ No
- ○ Yes

Date of re-operation dd / mm / yyyy

Approach for re-operation
- ○ Laparoscopic
- ○ Laparoscopic converted to open
- ○ Open

Re-operation performed
- ☐ Re-fashioning anastomosis
- ☐ Attention to bleeding area
- ☐ Hernia repair
- ☐ Drain placement
- ☐ Gastrostomy
- ☐ Enteral feeding
- ☐ Repair gastric staple line
- ☐ Laparoscopy only
- ☐ Other

Details of other re-operation

Powered by
Dendrite Clinical Systems

Appendix

Form L

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 15; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Sleeve gastrectomy

Make of stapler for sleeve
- ○ Ethicon
- ○ Medtronic

Number of cartridges used
- ○ <4
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10
- ○ 11
- ○ 12
- ○ >12

Type of reinforcement
- ○ None
- ☐ Seamguard
- ☐ Peristrips
- ☐ Tisseel fibrin glue
- ☐ Suturing
- ☐ Endo GIA Reinforcer Reload
- ☐ Other

Bougie used
- ○ None
- ○ 30 Fr
- ○ 32 Fr
- ○ 34 Fr
- ○ 36 Fr
- ○ 38 Fr
- ○ 40 Fr
- ○ Other

Other bougie size Fr

Distance from pylorus
- ○ 0 cm
- ○ 1 cm
- ○ 2 cm
- ○ 3 cm
- ○ 4 cm
- ○ 5 cm
- ○ 6 cm
- ○ 7 cm
- ○ 8 cm
- ○ 9 cm
- ○ 10 cm

Any complications
- ○ No
- ○ Yes

Powered by
Dendrite Clinical Systems

Form L

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 16; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Complications for sleeve gastrectomy procedures

Date of complication dd / mm / yyyy

Complication
- ☐ Staple line leak
- ☐ Bleeding
- ☐ Other

Other complications

Leak location
- ○ Gastric sleeve
- ○ Gastric remnant
- ○ Angle of His
- ○ Distal
- ○ Other

Other leak location

Treatment of staple line leak
- ☐ Attention to leaking area
- ☐ Percutaneous drain
- ☐ Enteral feeding
- ☐ Other

Other treatment of staple line leak

Probable source of bleeding
- ☐ GI tract
- ☐ Intra-abdominal
- ☐ Other

Other source of bleeding

Treatment of bleeding
- ○ No transfusion needed
- ○ Blood transfusion

Any re-operation
- ○ No
- ○ Yes

Date of re-operation dd / mm / yyyy

Approach for re-operation
- ○ Laparoscopic
- ○ Laparoscopic converted to open
- ○ Open

Re-operation performed
- ☐ Attention to bleeding area
- ☐ Hernia repair
- ☐ Drain placement
- ☐ Repair gastric staple line
- ☐ Laparoscopy only
- ☐ Other

Details of other re-operation

Powered by
Dendrite Clinical Systems

Appendix

Form M

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 17; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Duodenal switch

Duodeno-ileal anastomosis
- ○ Circular stapler
- ○ Linear stapler
- ○ Hand sewn

Stapler used (Duodeno-ileal anastomosis) select from the table: **STAPLE**

Ileo-ileal anastomosis
- ○ Single linear stapler
- ○ Double linear stapler
- ○ Triple linear stapler
- ○ Hand sewn

Stapler used (Ileo-ileal anastomosis) select from the table: **STAPLE**

Type of reinforcement
- ○ None
- ☐ Seamguard
- ☐ Peristrips
- ☐ Tisseel fibrin glue
- ☐ Suturing
- ☐ Endo GIA Reinforcer Reload
- ☐ Other

BPD / DS common channel limb length
- ○ 75 cm
- ○ 100 cm
- ○ 125 cm
- ○ Other

BPD / DS alimentary channel limb length
- ○ 100 cm
- ○ 150 cm
- ○ 200 cm
- ○ 250 cm

Closure of hernia defects
- ○ No
- ○ Yes

Any complications
- ○ No
- ○ Yes

Powered by
Dendrite Clinical Systems

Form M

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 18; Version 2.0 (20 Feb 2018)

Unique patient identifier	
Date of operation	dd / mm / yyyy

Complications for duodenal switch

Date of complication	dd / mm / yyyy
Complication	☐ Leak ☐ Obstruction ☐ Bleeding ☐ Other
Other complications	
Leak location	○ Gastro-ileal ○ Ileo-ileal ○ Other
Other leak location	
Probable source of bleeding	☐ GI tract ☐ Intra-abdominal ☐ Other
Other source of bleeding	
Treatment of bleeding	○ No transfusion needed ○ Blood transfusion
Cause of bowel obstruction	○ Petersen's hernia ○ Anastomotic anatomy ○ Mesenteric anastomosis defect ○ Adhesions ○ Mesocolic defect ○ Other
Other cause of bowel obstruction	
Treatment of bowel obstruction	○ Settled conservatively ○ Endoscopic dilatation
Any re-operation	○ No ○ Yes
Date of re-operation	dd / mm / yyyy
Approach for re-operation	○ Laparoscopic ○ Laparoscopic converted to open ○ Open
Re-operation performed	☐ Re-fashioning anastomosis ☐ Enteral feeding ☐ Attention to bleeding area ☐ Repair gastric staple line ☐ Hernia repair ☐ Laparoscopy only ☐ Drain placement ☐ Other
Details of other re-operation	

Powered by
Dendrite Clinical Systems

Appendix

Form N

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 19; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

SADI operation

Duodeno-ileal anastomosis
- ○ Circular stapler
- ○ Linear stapler
- ○ Hand sewn

Stapler used (Duodeno-ileal anastomosis) select from the table: **STAPLE**

Type of reinforcement
- ○ None
- ☐ Seamguard
- ☐ Peristrips
- ☐ Tisseel fibrin glue
- ☐ Suturing
- ☐ Endo GIA Reinforcer Reload
- ☐ Other

SADI common channel limb length
- ○ 75 cm
- ○ 100 cm
- ○ 125 cm
- ○ 200 cm
- ○ 250 cm
- ○ 300 cm

Closure of hernia defects ○ No ○ Yes

Any complications ○ No ○ Yes

Powered by
Dendrite Clinical Systems

Form N

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 20; Version 2.0 (20 Feb 2018)

Unique patient identifier	
Date of operation	dd / mm / yyyy

Complications for SADI operations

Date of complication	dd / mm / yyyy
Complication	☐ Leak ☐ Obstruction ☐ Bleeding ☐ Other
Other complications	
Leak location	○ Gastric sleeve ○ Gastro-ileal ○ Angle of His ○ Duodeno-ileal ○ Distal ○ Ileo-ileal ○ Other
Other leak location	
Probable source of bleeding	☐ GI tract ☐ Intra-abdominal ☐ Other
Other source of bleeding	
Treatment of bleeding	○ No transfusion needed ○ Blood transfusion
Cause of bowel obstruction	○ Petersen's hernia ○ Anastomotic anatomy ○ Mesenteric anastomosis defect ○ Adhesions ○ Mesocolic defect ○ Other
Other cause of bowel obstruction	
Treatment of bowel obstruction	○ Settled conservatively ○ Endoscopic dilatation
Any re-operation	○ No ○ Yes
Date of re-operation	dd / mm / yyyy
Approach for re-operation	○ Laparoscopic ○ Laparoscopic converted to open ○ Open
Re-operation performed	☐ Re-fashioning anastomosis ☐ Attention to bleeding area ☐ Enteral feeding ☐ Hernia repair ☐ Repair gastric staple line ☐ Drain placement ☐ Laparoscopy only ☐ Gastrostomy ☐ Other
Details of other re-operation	

Powered by
Dendrite Clinical Systems

Appendix

Form O

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 21; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Bilio-pancreatic diversion

Distal gastrectomy proximal linear stapler	select from the table: **STAPLE**
Type of reinforcement	○ None ☐ Seamguard ☐ Suturing ☐ Peristrips ☐ Endo GIA Reinforcer Reload ☐ Tisseel fibrin glue ☐ Other
Distal gastrectomy duodenal linear stapler	select from the table: **STAPLE**
Gastro-ileal anastomosis	○ Circular stapler ○ Linear stapler ○ Hand sewn
Ileo-ileal anastomosis	○ Single linear stapler ○ Triple linear stapler ○ Double linear stapler ○ Hand sewn
Stapler used (Ileo-ileal anastomosis)	select from the table: **STAPLE**
BPD / DS common channel limb length	○ 75 cm ○ 100 cm ○ 125 cm ○ Other
BPD / DS alimentary channel limb length	○ 100 cm ○ 150 cm ○ 200 cm ○ 250 cm
Closure of hernia defects	○ No ○ Yes
Any complications	○ No ○ Yes

Powered by
Dendrite Clinical Systems

Form O

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 22; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of operation dd / mm / yyyy

Complications for bilio-pancreatic diversion operations

Date of complication dd / mm / yyyy

Complication
- ☐ Leak
- ☐ Bleeding
- ☐ Obstruction
- ☐ Other

Other complications

Leak location
- ○ Gastro-ileal
- ○ Ileo-ileal
- ○ Other

Other leak location

Probable source of bleeding
- ☐ GI tract
- ☐ Intra-abdominal
- ☐ Other

Other source of bleeding

Treatment of bleeding
- ○ No transfusion needed
- ○ Blood transfusion

Cause of bowel obstruction
- ○ Petersen's hernia
- ○ Mesenteric anastomosis defect
- ○ Mesocolic defect
- ○ Anastomotic anatomy
- ○ Adhesions
- ○ Other

Other cause of bowel obstruction

Treatment of bowel obstruction
- ○ Settled conservatively
- ○ Endoscopic dilatation

Any re-operation
- ○ No
- ○ Yes

Date of re-operation dd / mm / yyyy

Approach for re-operation
- ○ Laparoscopic
- ○ Laparoscopic converted to open
- ○ Open

Re-operation performed
- ☐ Re-fashioning anastomosis
- ☐ Attention to bleeding area
- ☐ Hernia repair
- ☐ Drain placement
- ☐ Enteral feeding
- ☐ Repair gastric line staple
- ☐ Laparoscopy only
- ☐ Other

Details of other re-operation

Powered by
Dendrite Clinical Systems

Appendix

Form P

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 23; Version 2.0 (20 Feb 2018)

Unique patient identifier	
Date of operation	dd / mm / yyyy

Additional procedures (complete for each kind of operation)

Any additional procedures	○ No	○ Yes
Additional procedures	☐ Cholecystectomy ☐ Hernia repair	☐ Apronectomy ☐ Other
Other additional procedure		
Hernia repair	☐ Umbilical ☐ Ventral	☐ Incisional ☐ Hiatus hernia

Powered by
Dendrite Clinical Systems

Form Q

NBSR
UK National Bariatric Surgery Registry
Baseline section; Page 24; Version 2.0 (20 Feb 2018)

Unique patient identifier	
Date of operation	dd / mm / yyyy

Post-operative course

Cardio-vascular complications	○ None ☐ MI ☐ DVT ☐ PE ☐ Dysrhythmia ☐ Stroke ☐ Cardiac arrest
Other complications	○ No ○ Yes
Clavien-Dindo grade of complications	○ Grade I ○ Grade II ○ Grade IVa ○ Grade IIIa ○ Grade IVb ○ Grade IIIb ○ Grade V
Clavien-Dindo: disability at discharge	○ No ○ Yes
Patient status at discharge	○ Alive ○ Deceased
Date of discharge (or in-hospital death)	dd / mm / yyyy
Discharged to	○ Home ○ Another hospital ○ Other
Other discharge destination	
Cause of death	○ PE ○ Bleed ○ Cardiac ○ Pneumonia ○ Leak ○ Other
Details of other cause of death	

Powered by
Dendrite Clinical Systems

Appendix

Form U

NBSR
UK National Bariatric Surgery Registry
Follow up section; Page 25; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of follow up dd / mm / yyyy

Follow up

Basic follow up

Patient status	○ Alive ○ Deceased
Cause of death	
Weight on this date	kg
Patient re-admitted to hospital on this date	○ No ○ Yes
Reason for re-admission	
Patient re-operated on this date	○ No ○ Yes
Reason patient re-operated on this date	
How followed up	○ Hospital clinic ○ Other clinic ○ Other in person; phone or electronic contact ○ Did not attend follow up / uncontactable
Blood tests: patient having regular appropriate monitoring	○ No ○ Yes ○ No recommendation made
Clinical evidence of malnutrition	○ No ○ Yes
Employment status	○ Full-time ○ Part-time ○ Unemployed ○ Student ○ Retired

Powered by
Dendrite Clinical Systems

Form U

NBSR
UK National Bariatric Surgery Registry
Follow up section; Page 26; Version 2.0 (20 Feb 2018)

Unique patient identifier

Date of follow up dd / mm / yyyy

Comorbidity at follow up

Type 2 diabetes
- ○ No indication of type 2 diabetes
- ○ Pre-diabetes
- ○ Oral hypoglaemics
- ○ Injectable other than insulin
- ○ Insulin treatment

Most recent pre-operative HbA1c

○ 5.0% (31 mmol mol^{-1})	○ 9.0% (75 mmol mol^{-1})
○ 6.0% (42 mmol mol^{-1})	○ 10.0% (86 mmol mol^{-1})
○ 6.5% (48 mmol mol^{-1})	○ 11.0% (97 mmol mol^{-1})
○ 7.0% (53 mmol mol^{-1})	○ 12.0% (108 mmol mol^{-1})
○ 7.5% (58 mmol mol^{-1})	○ 13.0% (119 mmol mol^{-1})
○ 8.0% (64 mmol mol^{-1})	○ >13.0% (>119 mmol mol^{-1})

Hypertension
- ○ No indication of hypertension; or on no treatment
- ○ Hypertension on treatment

Diagnosis of sleep apnoea

○ No	
○ Yes - untreated	○ Yes - treated

Diagnosis of asthma ○ No ○ Yes

Functional status
- ○ Can climb 3 flights of stairs without resting
- ○ Can climb 1 flight of stairs without resting
- ○ Can climb half a flight of stairs without resting
- ○ Requires wheelchair / house bound

Musculo-skeletal pain on daily medication ○ No ○ Yes

Medication for GORD ○ No ○ Yes

New pregnancy ○ No ○ Yes

Estimated date of delivery dd / mm / yyyy

Powered by
Dendrite Clinical Systems

Appendix

Form V

NBSR
UK National Bariatric Surgery Registry
Follow up section; Page 27; Version 2.0 (5 Apr 2013)

Unique patient identifier

Date of follow up dd / mm / yyyy

EQ5D

Mobility
- I have no problems in walking about
- I have slight problems in walking about
- I have moderate problems in walking about
- I have severe problems in walking about
- I am unable to walk about

Self care
- I have no problems washing or dressing myself
- I have slight problems washing or dressing myself
- I have moderate problems washing or dressing myself
- I have severe problems washing or dressing myself
- I am unable to wash or dress myself

Usual activities
- I have no problems doing my usual activities
- I have slight problems doing my usual activities
- I have moderate problems doing my usual activities
- I have severe problems doing my usual activities
- I am unable to do my usual activities

Pain / discomfort
- I have no pain or discomfort
- I have slight pain or discomfort
- I have moderate pain or discomfort
- I have severe pain or discomfort
- I have extreme pain or discomfort

Anxiety / depression
- I am not anxious or depressed
- I am slightly anxious or depressed
- I am moderately anxious or depressed
- I am severely anxious or depressed
- I am extremely anxious or depressed

General health VAS integer; range: 0-100

Powered by
Dendrite Clinical Systems

The Third National Bariatric Surgery Registry Report

These are remarkably good outcomes in a high risk group of patients even in the pre-Covid era. Of particular interest is the reduction in the prevalence of type 2 diabetes mellitus from 30% to 14% one year after surgery.

The registry is a remarkable achievement ensuring that surgeons are sharing their outcomes with each other and their patients.

Neil Mortensen, President of the Royal College of Surgeons of England

This third report once again highlights the exceptional safety and efficacy of bariatric surgery in the United Kingdom. There are many firsts in this report …

David Kerrigan, President of British Obesity and Metabolic Surgery Society

The UK National Bariatric Surgery Registry
c/o Mr Peter Small
The British Obesity & Metabolic Surgery Society
at The Association of Surgeons of Great Britain & Ireland
35-43 Lincoln's Inn Fields
London WC2A 3PE
United Kingdom

Phone +44 (0) 207 304 4773
Fax +44 (0) 207 430 9235
email nbsr@asgbi.org.uk

nbsr.e-dendrite.com

Dendrite Clinical Systems
Dr Peter K H Walton
Managing Director
Fifth Floor, Reading Bridge House
George Street, Reading
Berkshire RG1 8LS
United Kingdom

Phone +44 (0) 1491 411 288
Fax +44 (0) 1491 411 377
email peter.walton@e-dendrite.com

www.e-dendrite.com