The IFSO Global Registry

GLOBAL REGISTRY

4th IFSO Global Registry Report

2018

Prepared by

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Almino Ramos MD PhD
Richard Welbourn MD FRCS
John Dixon PhD FRACGP FRCP Edin
Robin Kinsman BSc PhD
Peter Walton MBA FRCP

IFSO & Dendrite Clinical Systems

The International Federation for the Surgery of Obesity and Metabolic Disorders

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The International Federation for the Surgery of Obesity and Metabolic Disorders operates the IFSO Global Registry in partnership with Dendrite Clinical Systems Limited. The Federation gratefully acknowledges the assistance of Dendrite Clinical Systems for:

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

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Preface

The year 2018 will be remembered as a landmark year for privacy protection. The Facebook™ scandal and the European GDPR legislation are just two examples of highly-publicized issues pertaining to the right of individuals to shield their private data. Unfortunately, data protection has evolved into becoming a significant obstacle in implementing what I have considered to be one of the primary tasks of the IFSO Federation, *i.e.,* the collection, interpretation and divulging of patients' data, provided they remain anonymous and untraceable to individuals.

Some, however, consider the gathering of even anonymized patient data incompatible with the privacy principle in the absence of individual *ad hoc* patient consent. Others think that national data collected in one country cannot be exported into an international Registry. I think we should avoid lapsing into a witch-hunt and look to the GDPR law, considered the most astringent in the world. It states that indeed, in principle, personal medical data may not be processed except when these medical data are completely anonymous. Only if the personal data / information can be traced back to an individual it is not considered anonymous under the GDPR. Clearly the Dendrite Registry does not breach this condition, hence the hesitation of some to participate to this beautiful piece of work, while understandable, can only be regretted.

I am of course aware that some fear that data may be *sold* to industry. Our Registry Committee as well as our Data Protection Committee were created precisely to address these concerns, and to detect, evaluate and possibly correct flaws, be they scientific or potentially commercial, of the current and future registries.

I know that some aspects of the Fourth IFSO Global Obesity Data Registry can still be improved, not least the fact that some key-countries did not include the majority of their data. I realize as well that some imperfections remain in the Registry, especially in terms of possible bias in data collection as well as absence of a universally accepted dictionary for complications and definitions such as remission of disease. Nevertheless, the truth is that this is by far the best international data registry in metabolic / bariatric surgery available so far. It gives a clear insight into the geographic and cultural differences in metabolic surgery across the globe. By doing so, and despite the aforementioned limitations, it provides an excellent working document for surgeons and other health care professionals, as well as politicians and stakeholders, and should allow for better insights into health policies, private and public alike. Hence it will eventually be of benefit to patients suffering from obesity and its related diseases. And this happens to be congruent with IFSO's mission.

Jacques Himpens,

IFSO President 2017-2018

Foreword

Resembling what happened in the 4-stages of the industrial revolution, we are now approaching a new, fourth stage in the evolution of surgery. In surgery v1.0, or open surgery, the objective was to understand anatomy and physiology, establish the fundamentals of surgical approaches, study different treatment options, and repair and remove internal organs; surgery v2.0 started with the era of minimally invasive surgery, basically the laparoscopic approach, which allowed the reduction of tissue damage, blood loss, infection and recovery time; robotic assistance inaugurated surgery v3.0, allowing surgeons a very natural and intuitive movement in a very ergonomic way, with reduction of tremor, provision of greater dexterity and 3D visualisation; the next stage, surgery v4.0, is starting now, based on infomatics, with cloud data storage, machine learning and a lot of big-data analytics. The accumulation and connection of data represent the heart of this new period.

Data technology is revolutionizing our understanding and treatment of diseases. With the proper analysis of these data it should be possible to create algorithms to help assess how patients respond to treatment and so help us make more appropriate treatment choices for each patient. This tailored approach should help to optimize outcomes, significantly decrease post-operative complications and reduce the need for revisional surgery. These new tools will be a great advance in the treatment of very complex diseases such as obesity / adiposity-based chronic disease (ABCD).

ABCD is the major non-infectious epidemic disease of this century. The excessive accumulation of adipose tissue accompanied by chronic, systemic inflammation can be associated with the development of more than one hundred associated conditions (hypertension, type 2 diabetes, cardiovascular disease, dyslipidemia, sleep apnea, orthopedic conditions, some types of cancer, *etc.*). According to the last reports of the World Health Organization (WHO), more than 2.1 billion adults were estimated to be overweight or obese, of whom 1.5 billion were overweight and 640 million were obese; on this basis about 25 million people have the classical NIH criteria for bariatric surgery. The most recent IFSO Worldwide Survey (Angrisani *et al.*, Obesity Surgery 2018) reported that 634,897 bariatric operations were performed worldwide in 2016; at this rate it would take 43 years to operate on the current pool of potential patients; and this does not account for all the extra people who will become eligible if current trends in the growth of obesity continue as expected.

One of the key bottle-necks preventing the expansion of bariatric surgery provision is the lack of faith that patients and clinical colleagues have in the efficacy of the surgery; this is partly down to our inability to communicate the benefits to them. A properly-designed and well-run registry could play an important role in helping to overcome this resistance by providing real-world evidence of the good outcomes we see for our patients.

National registries can be powerful tools to help us observe the course of a disease; to understand variations in treatments and outcomes; to examine factors that influence prognosis and quality of life; to monitor safety; and to measure the quality of the treatment. They are important at a national level to monitor and set standards of care, and also at an international level to provide a descriptive analysis of similarities and differences in patient populations. From a payer's perspective, registries can provide detailed information about the effectiveness of surgical options for different populations. IFSO and its federated bariatric societies, providers, health insurance companies, public health systems and hospitals can use the data to demonstrate quality of care, and improve the clinical outcomes for patients. Our big challenge is to convince more and more surgeons and national societies to join the Global Registry project.

In this Fourth Report we present information from the largest registry on bariatric surgery worldwide, comprising 394,431 operations from 18 single centres, 19 multi-centre submissions and 14 national registries coming from 51 countries. We would like to offer our sincere gratitude to all those societies, surgeons and centres who have submitted their data, and also to those directly involved in the project: our current president Jacques Himpens, Richard Welbourn the lead clinical author, and Peter Walton and Robin Kinsman from Dendrite.

We believe that this initiative is an important part of IFSO's response to the adiposity epidemic, and we would like to encourage all our members and national societies to actively participate in the next edition.

Almino Ramos

IFSO President 2018-2019

Introduction

It is a privilege to present data on baseline obesity-related disease, operation types, operative outcomes and disease status after 394,431 bariatric operations accumulated from local and national databases and registries from 51 countries across the world. This Global Registry initiative of IFSO, the first of its kind, could help the bariatric community establish essential benchmark knowledge about the patients we are operating upon, their age and gender distributions, body mass index (BMI) and burden of obesity-related disease, as well as track trends in surgery over time. The data are presented not as the standard abstract, introduction, methods, results, discussion and conclusions format of a peer-reviewed publication. Rather, using a small and necessarily far from comprehensive dataset, we present the data as simple tables and graphs using usually 2 variables, one for each axis, plus a dedicated commentary for each. Even though this is a very basic presentation of data, many of the results demonstrate clear and important differences in bariatric practice between countries.

This fourth iteration of the report again follows the comprehensive Founding Charter that was set up regarding the use and ownership of the accumulated and merged data. Contributors can continue to be reassured that we have steered well clear of attempting to make statistical comparisons between different units, and that their submitted data will not be misused. Similar to the previous 3 Reports, we are aware of the inherent problems of over interpretation of the data. Further aims could include agreeing and developing risk stratification models and the setting of international benchmarks for post-operative complications or mortality. The registry could help in these aims by standardizing data collection. We hope that a very large database could be useful in influencing policy internationally and increasing service provision in countries where there is currently little or no bariatric surgery. We encourage all key stakeholders in bariatric surgery (especially surgeons, providers and commissioners of care) to embrace this data collection and reporting process at individual clinics and hospitals, and onwards / upwards at both national and international levels. Thank you to all those surgeons who have committed their data for inclusion in this fourth report, your contribution is very much appreciated.

Bariatric surgery has great potential to improve health in a vast number of patients in a cost effective manner; however, it is made available to very few obese people who could benefit from it. Little is known internationally about which patients are being operated on, other than the worldwide survey of bariatric surgery undertaken by Prof. Scopinaro, Prof. Buchwald and more recently by Prof. Angrisani [1,2,3,4,5]. Although we know from their surveys which operations are being performed, we do not yet have basic demographic data on variables such as gender distribution, starting BMI, and prevalence of obesity-related disease such as type 2 diabetes, hypertension and sleep apnea. Nor do we have any data on surgical outcomes such as survival, length-of-stay or improvement in obesity-related disease between different populations. An initial step in this direction has been the peer-reviewed publication of data from the 2nd IFSO Global Registry report in Obesity Surgery [6]. Similar to the Third Report, the aims of this 4th iteration of the Global Registry project are to:

1. Establish baseline demographic characteristics for patients operated in different countries either from the respective national registries or individual units in these countries.
2. Report basic 1-year post-operative data within the limitations of the accumulated data.

The data presented are not yet a definitive global representation of bariatric surgery. However, the report is the start of a process that shows what can be achieved within the constituent countries of IFSO. The data could in future be used to estimate inequalities of provision of surgery internationally, providing benchmarks for access to surgery to those people with specific obesity-related disease such as diabetes.

Richard Welbourn

Richard Welbourn, Member of IFSO Global Registry Committee

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Fourth IFSO Global Registry Report

Executive summary

This is the fourth comprehensive, international analysis of outcomes from bariatric (obesity) and metabolic surgery, gathered under the auspices of the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) in collaboration with Dendrite Clinical Systems.

In overview

- 51 countries from 5 continents contributed a total of 394,431 operation records
- over 550 hospitals contributed data either directly or *via* their national registry submissions
- the number of records submitted ranged from 10 from a single centre to over 80,000 submitted by the national registry from Italy
- this précis reports on 165,138 Roux en Y gastric bypass operations (41.9% of all the records submitted), 128,417 sleeve gastrectomy procedures (32.6%),19,634 one anastomosis gastric bypass procedures (5.0%), and 47,858 gastric banding operations (12.1%)
- most of the database records fell in the period 2009-2018 (88.5% of the total); 220,348 operations were dated in the calendar years 2014-2018 (55.9%)

The dataset and completeness of data entry

- the simple dataset used for the previous IFSO report was extended slightly to include a total of 40 variables (28 baseline data-items; 12 in the follow-up section)
- overall, 46.2% of the baseline records were >80% complete for operations dated in the calendar years 2014-2018

Initial data on primary surgery from 2014-2018

Funding and gender inequality

- 68.0% of operations were funded by public health services; there was a great deal of variation in the rates of publicly-funded surgery across the contributor countries
- there was also a wide variation in the country-specific gender ratios, ranging from 50.9% female (in Georgia) to 100.0% female (in South Korea)

Primary operations and BMI range

- the patients' median BMI pre-surgery was 41.7 kg m^{-2} (inter-quartile range: 38.3-46.1 kg m^{-2}); there was a wide variation between different contributor countries, medians ranging from 34.2 kg m^{-2} in South Korea to 49.1 kg m^{-2} in Germany
- patients' median age was 42.0 years (inter-quartile range: 33.0-51.0 years)
- the overall proportion of female patients was 73.7% (95% CI: 73.5-73.9%)
- Mexico (81.0%), Colombia (79.2%) and Brazil (73.6%) reported the highest proportions of gastric bypass surgery; Australia (100.0%), Saudi Arabia (100.0%) and Guadeloupe (99.5%) reported the highest rates of sleeve gastrectomy operations
- 99.3% of all operations were performed laparoscopically
- 88.5% of patients who had a gastric band inserted were discharged within 1 day of their operation; after gastric bypass, 84.1% of patients were discharged within 2 days of surgery; and 84.5% of sleeve gastrectomy patients went home within 3 days of their operation

Obesity-related disease prior to surgery

- 19.8% of patients were on medication for type 2 diabetes (inter-country variation: 4.5-97.7%)
- 30.6% were treated for hypertension (inter-country variation: 10.9-92.6%)
- 12.4% of patients were on medication for depression (inter-country variation: 0.0-54.4%)
- 24.3% of patients required treatment for musculo-skeletal pain (inter-country variation: 0.0-65.1%)
- 18.6% of patients had sleep apnea (inter-country variation: 0.0-74.3%)
- 17.0% of patients had gastro-esophageal reflux disorder (inter-country variation: 0.0-54.8%)

Stratification for operative risk

- the Obesity Surgery Mortality Risk Score [1] (OSMRS) varied widely by country
- Georgia, Bulgaria and Hong Kong had the highest-risk patient populations (OSMRS groups B & C: 78.7%. 72.2% and 66.7% respectively)
- South Korea, Bolivia & Kuwait appeared to have the least risk (OSMRS groups B & C: 12.5%, 20.5% and 22.2% respectively)

Follow up data for primary surgery carried out in the calendar years 2011-2017

- there were 275,834 valid follow up records
- average recorded percentage weight loss was 28.9% one year after surgery
- one year after primary surgery 66.1% of those taking medication for type 2 diabetes beforehand were no longer on medication; the proportion of patients no longer treated for diabetes was highly dependent on weight loss achieved, with the rate of improvement increasing with higher percentage weight loss
- there were also significant reductions in the rates of treatment for depression, hypertension and musculo-skeletal pain
- rates of confirmed sleep apnea also fell one year after bariatric surgery

Implications for bariatric surgery

- a simple dataset and the willingness of many centres in different countries to contribute can lead to a large body of pooled and merged data
- this fourth report quantifies the gender inequality evident worldwide and also shows inequality of access to surgery in many countries
- on the scale of a large international collaboration, the data on improvement in diabetes demonstrate the profound treatment effect that bariatric surgery has on this disease
- therefore, this initiative continues to be useful in advancing the status and acceptability of bariatric surgery worldwide and suggests many international research projects that could be undertaken

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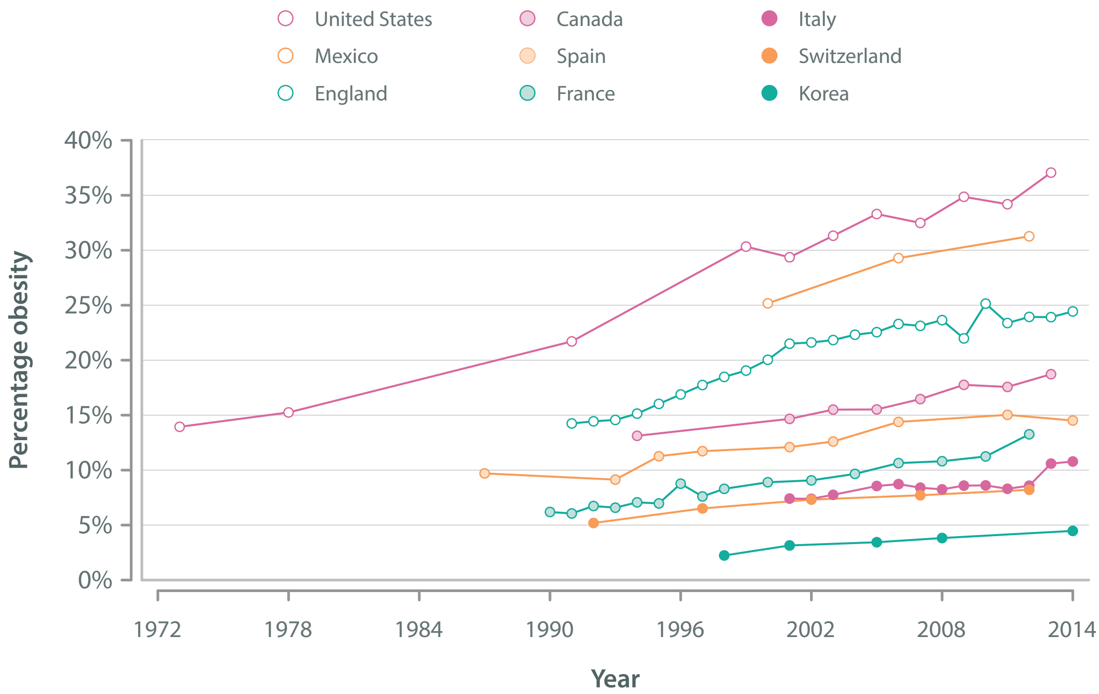
Contents

The epidemiology of obesity – a call for collective action

The inexorable increase in obesity rates among the OECD countries can clearly be seen in the chart below. These data indicate that only one of the countries in this figure reported a lower obesity rate than in the previous survey. All others have increased and the reported rate in the United States for those over 15 years of age is now well over 35% [1]. The catastrophic trend continues. Where will this end?

OECD data: Obesity rates over time



The World Health Organization (WHO) report published in February 2018, indicated that obesity rates have tripled since 1975 [2]. Most of the world's population now live in countries where being overweight causes more deaths than being underweight. There are 340 million children and adolescents (age 5-19) who are overweight or obese. The WHO stresses that obesity is preventable!

A decade ago I considered that rates in the US, Mexico, the Middle East and Pacific Islands were so high that a ceiling would be reached by now and we would have an indication of a genetically driven limit, albeit at a very high level. Clearly this is not the case and the OECD has predicted that current trends will continue in a linear fashion out to 2030.

Of course obesity prevalence tells only part of the story as a doubling of the obesity rate in a country generates a 3-fold increase in the prevalence of a BMI >35, a 5 fold increase of a BMI >40, and a 9-10 fold increase in individuals with a BMI >50 [3]. Obesity rates are generally higher in women and the exponential rise in the more severe levels of obesity has been dominated by women globally [4]. Inequality in education and economic opportunity is also greater in women [1]. The relationship between obesity, poor education and lower socioeconomic status is self-sustaining. Obese people have poorer job prospects, are less likely to be employed and have more difficulty re-entering the labour market. Obese people have more sick days, are less productive at work and earn less. The OECD stresses that addressing obesity and the negative labour market outcomes would help address the vicious cycle of social and health inequality . The impact of obesity on our communities is far greater than just the burden of type 2 diabetes, cardiovascular disease, and the cancers that obesity generates. As individuals and teams engaged in the effective management of obesity, especially those people with the greatest impairment, we are being called to action. A nation's cost of obesity extends well beyond those of health care, and includes individual and societal costs of functional impairment leading to markedly reduced productivity [5].

A survey I conducted in 2015 prior to the Diabetes Surgery Summit Consensus Conference included 22 countries representing approximately 75% of all bariatric-metabolic procedures performed in 2014 and looked at the uptake of surgery as a treatment of type 2 diabetes [6].

Modelling based on numbers of individuals operated, population prevalence, and proportion of patients eligible for surgery indicated trivial uptake. The highest uptake was in The Netherlands with 1.9% of those eligible treated annually with the lowest in China and Japan (<0.01%). Most countries had national guidelines and several had diabetes specific criteria, but it was rare to have more than 1% of those eligible operated in a year. Bariatric-metabolic surgery as therapy for type 2 diabetes had not entered the established care pathways. The conference outcome was remarkable in that all major global diabetes organizations supported the recommendation that surgery become a recommended therapy for selected patients with type 2 diabetes [7].

Managing the health burden of the obesity-diabetes epidemic will require a chronic disease model of care that provides an appropriately trained trans-disciplinary team approach, sufficient clinical capacity, and well defined clinical pathways. The care provided will need to be evidence based, collaboratively provided, and regularly evaluated. Medical, surgical, specific dietary and behavioural therapies will need to be combined to provide optimal health outcomes for individual patients. Although we have had clear evidence that combining therapies provides better outcomes, we continue to work largely in silos. Comments such as *only surgery is effective*, *I don't believe in very low calorie diets or meal replacements*, *surgery is a last resort* and *weight loss drugs are dangerous, ineffective and for short term use only* are not evidence-based and represent myopic, personal views.

Currently managing clinically severe obesity and its complications is stigmatized and neglected. Effective surgical and medical therapies beyond those of behavioural-lifestyle interventions are used by less than 1% of those eligible [6]. Put simply *things that actually work are rarely used*. This provides the most blatant example of clinical inertia (to fail to scale up of effective therapies in a timely manner). It would be unconscionable to report beyond behavioural-lifestyle intervention uptake at trivial levels for the management of hypertension, diabetes, cardiovascular disease and cancer. Weight management is extraordinarily challenging [8]. Currently we are not treading water, but drowning in a tsunami of increasing need.

We manage obesity and its related risks and complications. We need to think carefully about the language we choose to promote the quality of care that we can provide. The messaging in our area of health care appears woefully inadequate or inappropriate [9].

We need global data, and a collective will, to address this global epidemic; both prevention and treatment. It is important to pool our resources and understand the delivery of bariatric-metabolic surgery on a global basis. The IFSO international registry provides a vital component in monitoring and evaluating our response to this epidemic. I applaud the progress made with the IFSO global registry during this last year.

John Dixon, Head Clinical Obesity Research, Baker Heart and Diabetes Institute

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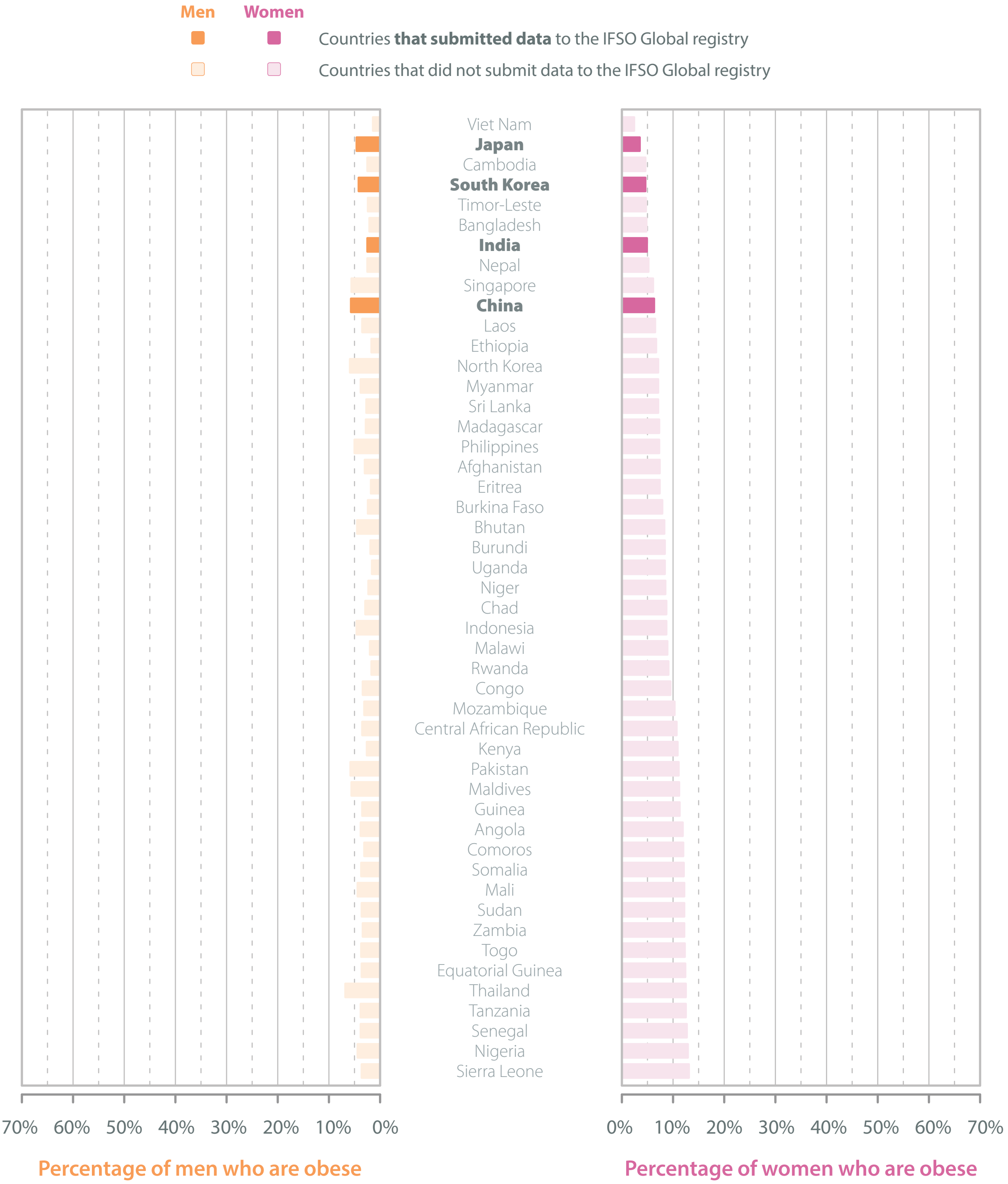
OECD & WHO data

Global prevalence of obesity

The next four graphs show the latest data available for the prevalence of obesity (defined as body mass index of ≥30 kg m^{-2}) by gender from the World Health Organisation (apps.who.int/gho/data/view.main.CTRY2450A?lang=en). Together with the graph on the previous page they illustrate the severity of the problem affecting all countries, especially the more developed. These charts are updated versions of those presented in the Third IFSO Report.

On this first page, we see the countries with the lowest prevalence of obesity. The difference in the prevalence between men and women is clear and consistent throughout these countries that currently exhibit the lowest levels of obesity, with the female populations in each country, in general, having a higher rate of obesity than the corresponding male populations; there are two exceptions: China and Japan, where this pattern is reversed.

WHO data: Gender & age standardised rates of obesity by country; countries ordered by increasing rates of obesity in the female population; people over the age of 17; data from the year 2016



Countries represented on this page are from a range of geographical regions. It is easy to recognise the European countries as it is in these countries that the prevalence of obesity in men is similar to or even exceeds that in the female population.

There are many developed countries contributing to the IFSO Global Registry in this group of countries. It is noticeable that the gender divide in obesity prevalence is greatest in the sub-Saharan African nations where obesity is much more prevalent in women. Notably, there are more contributors to the IFSO Global Registry in this group of countries, than in previous iterations of the database.

WHO data: Gender & age standardised rates of obesity by country; countries ordered by increasing rates of obesity in the female population; people over the age of 17; data from the year 2016

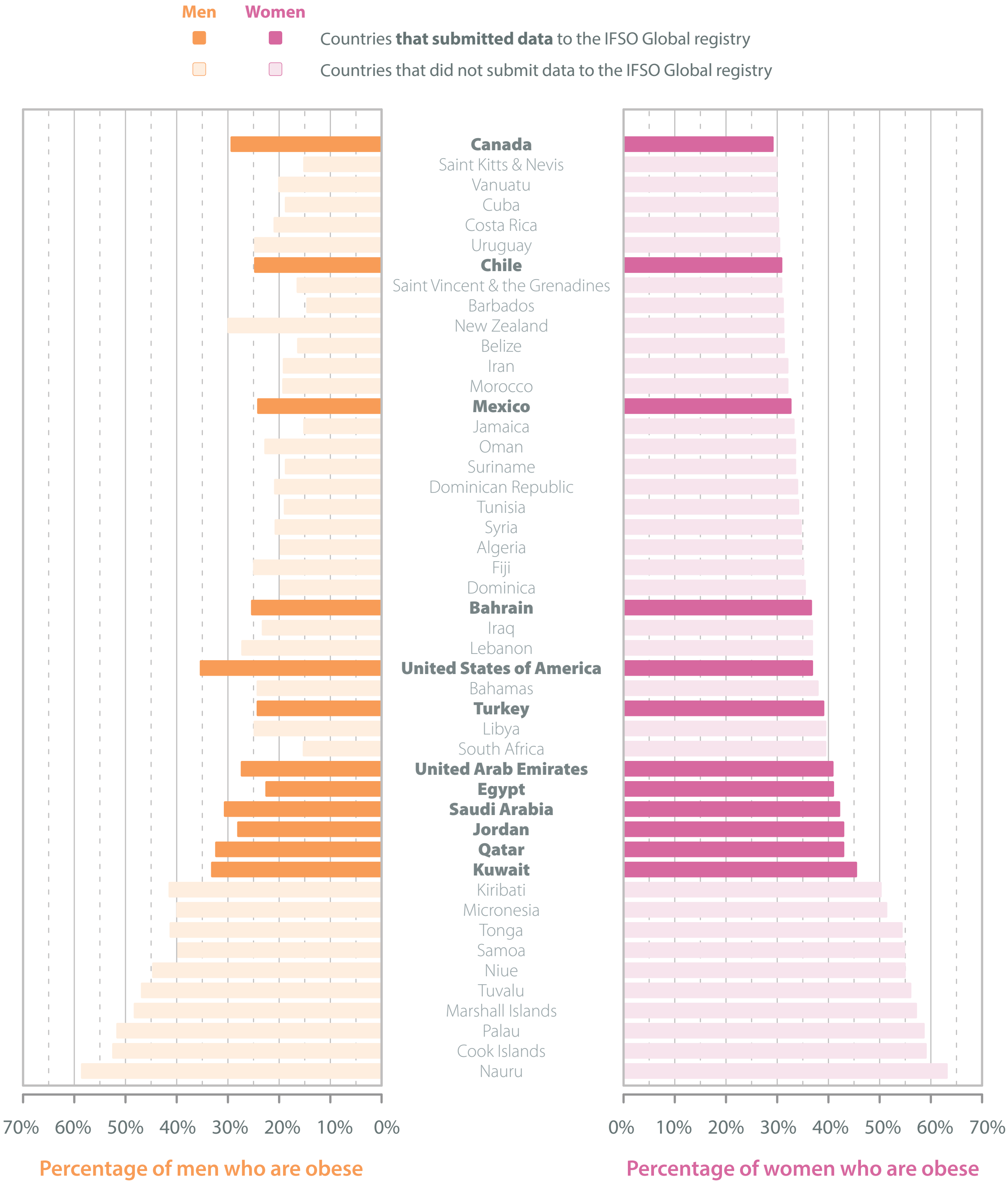
The information on these four pages might suggest to some readers that countries represented in the first chart (those with the lowest rates of female obesity), should have less to worry about than those on the last page (where in some of these countries more than half of the female population are obese). However, some simple calculations might suggest otherwise: if, as indicated by the first chart, around 3.9% of the Indian adult population and 6.2% of the Chinese adult population are obese then just these two countries, which together currently account for about 36% of the world's population, would represent a burden of disease totalling approximately **106 million** obese adults in 2016; and this number has increased by about **13 million** in just the last two years alone, which is a phenomenal increase in the burden of disease.

WHO data: Gender & age standardised rates of obesity by country; countries ordered by increasing rates of obesity in the female population; people over the age of 17; data from the year 2016

The countries represented here are those with the highest prevalence of obesity globally. Regions are very distinct and include the Pacific Islands, the Middle East, the United States & Canada, Mexico, Caribbean Islands, and parts of Central and South Americas.

Despite the major concerns of Western European countries about the continued increasing levels of obesity reaching so-called *crisis* levels, there are very few European countries found in this chart, which represents those with the highest levels of obesity in the female population across the globe.

WHO data: Gender & age standardised rates of obesity by country; countries ordered by increasing rates of obesity in the female population; people over the age of 17; data from the year 2016



OECD & WHO data

Database mechanics

Dendrite Clinical Systems, as the information management provider for the IFSO Global Registry, have provided two parallel web-portals for submitting data,

- an Upload-My-Data portal for submission of electronic data files, and
- a Direct Data Entry portal for entering cases one-by-one over the Internet for those individual surgeons who do not have a local or national database system.

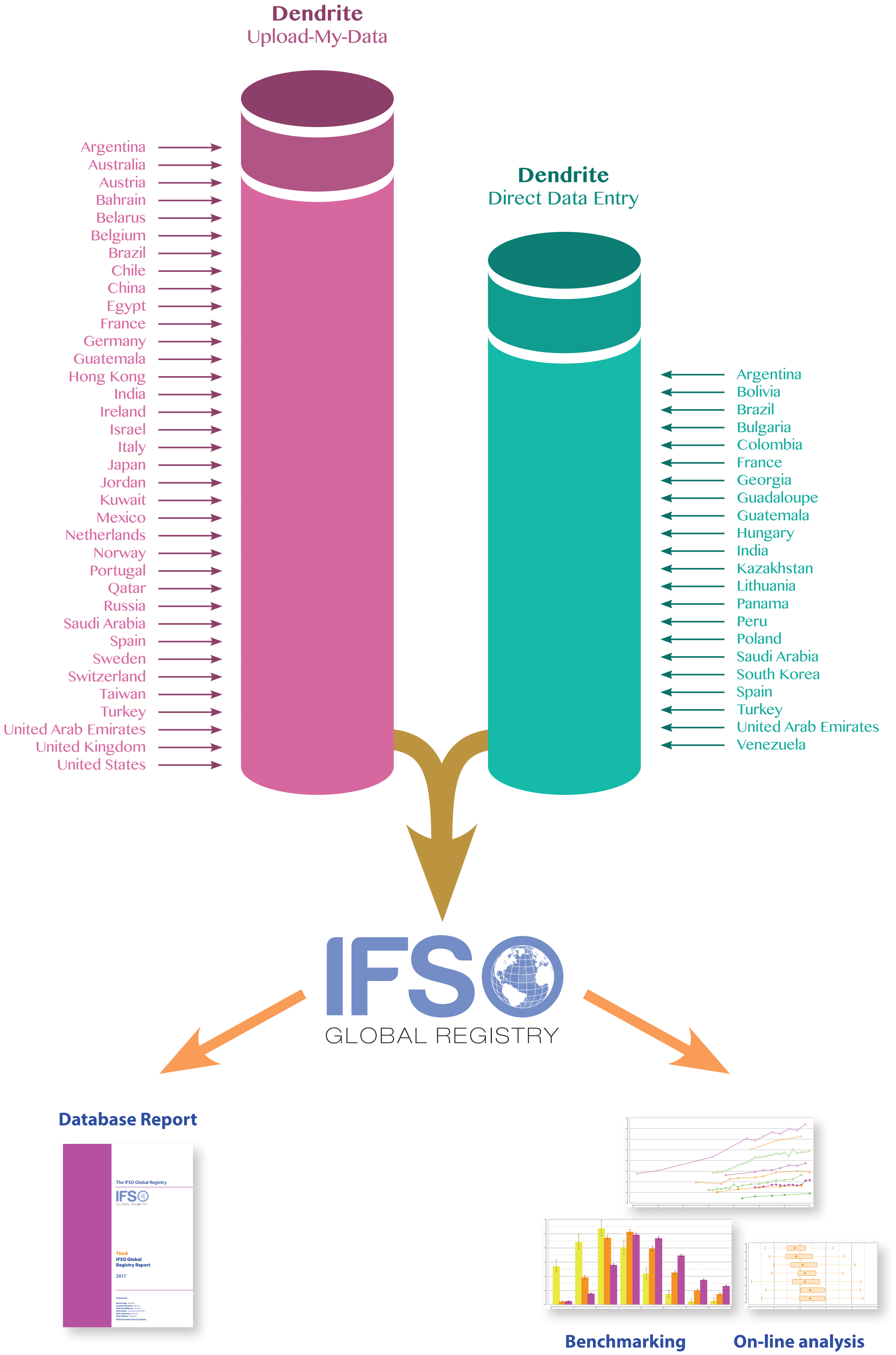
Access to these portals was arranged *via* the setup of secure ID and passwords to ensure that only authorized users could gain access to the registry. For those that had the capability to upload data electronically, each was then sent a unique contributor submit identifier code, and four key documents:

1. The Database Form: to provide a quick overview of the central database design. This is available in the Appendix in this report on pages 74-77.
2. The File Specification Document: that provides a detailed specification of the file format output required for submitting / uploading electronic data files.
3. The Data Dictionary: detailing the definitions of the database answer options.
4. The User Manual: to explain how the Upload-My-Data software works.

The diagram opposite illustrates which submissions came through which route, and shows that most countries (and all national databases) were successfully able to upload data electronically through the Upload-My-Data web portal.

By combining / merging the data from the Upload-My-Data area with the data submitted on-line case-by-case, through the Direct Data Entry module, it was then possible to run the analyses in this report on data gathered from 51 countries from around the world.

For more information on how to participate in the Dendrite / IFSO Global Registry *via* either the Upload-My-Data or Direct Data Entry route, please contact Dr Peter K H Walton, Managing Director, Dendrite Clinical Systems *via* e-mail: peter.walton@e-dendrite.com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A note on the conventions used throughout this report

There are several conventions used in this report in an attempt to ensure that the data are presented in a simple and consistent way. These conventions relate largely to the tables and the graphs, and some of these conventions are outlined below.

The specifics of the data used in any particular analysis are made clear in the accompanying text, table or chart. For example, many analyses sub-divide the data on the basis of the kind of operation performed, and the titles for both tables and charts will reflect this fact.

Conventions used in tables

On the whole, unless otherwise stated, the tables and charts in this report record the number of procedures (see the example below).

Primary surgery: age and gender; calendar years 2014-2018

Age at surgery / years	Gender: Male	Gender: Female	Gender: Unknown	Gender: All
<21	1,800	3,993	94	**5,887**
21-30	6,776	24,205	353	**31,334**
31-40	11,536	35,023	242	**46,801**
41-50	15,180	41,370	124	**56,674**
51-60	10,826	27,622	43	**38,491**
61-70	3,475	6,983	8	**10,466**
>70	176	249	2	**427**
Unspecified	27	64	6	**97**
All	**49,796**	**139,509**	**872**	**190,177**

Each table has a short title that is intended to provide information on the subset from which the data have been drawn, such as the patient's gender or particular operation sub-grouping under examination.

The numbers in each table are colour-coded so that entries with complete data for all of the components under consideration (in this example both age and gender) are shown in regular black text. If one or more of the database questions under analysis is blank, the data are reported as unspecified in orange text. The totals for both rows and columns are highlighted as emboldened text.

Some tables record percentage values; in such cases this is made clear by the use of an appropriate title within the table and a % symbol after the numeric value.

Rows and columns within tables have been ordered so that they are either in ascending order (age at procedure: <20, 20-24, 25-29, 30-34, 35-39 years, *etc.*; post-procedure stay 0, 1, 2, 3, >3 days; *etc.*) or with negative response options first (No; None) followed by positive response options (Yes; One, Two, *etc.*).

Row and column titles are as detailed as possible within the confines of the space available on the page. Where a title in either a row or a column is not as detailed as the authors would have liked, then footnotes have been added to provide clarification.

There are some charts in the report that are not accompanied by data in a tabular format. In such cases the tables are omitted for one of a number of reasons:

- insufficient space on the page to accommodate both the table and graph.
- there would be more rows and / or columns of data than could reasonably be accommodated on the page (for example, Kaplan-Meier curves).
- the tabular data had already been presented elsewhere in the report.

Conventions used in graphs

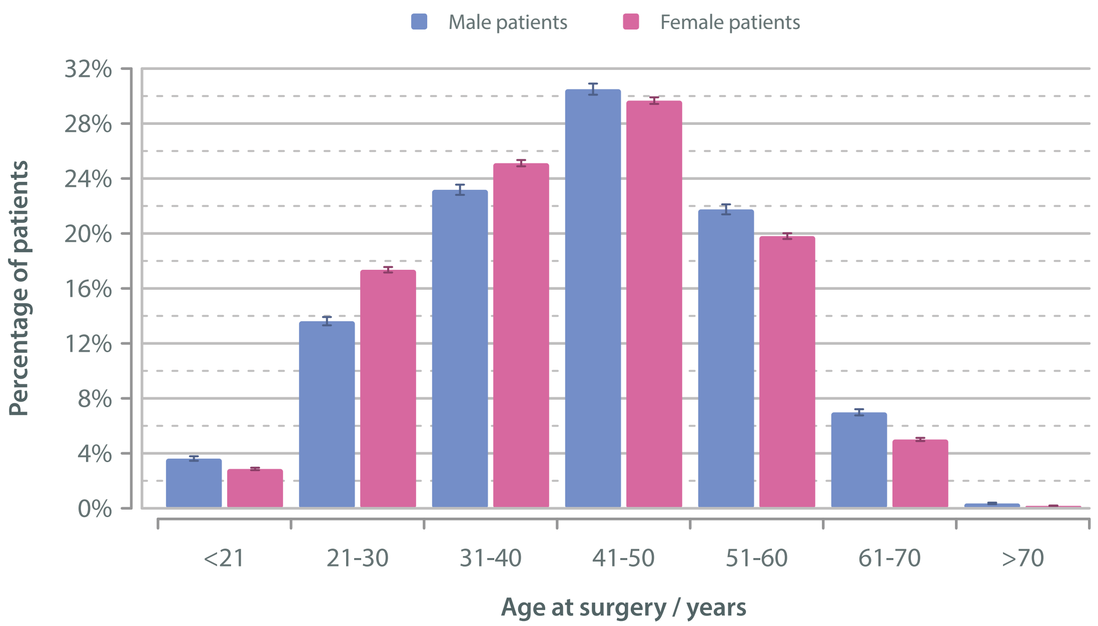
The basic principles applied when preparing graphs for this Fourth IFSO Global Registry Report were based, as far as possible, upon William S Cleveland's book *The elements of graphing data* [1]. This book details both best practice and the theoretical bases that underlie these practices, demonstrating that there are sound, scientific reasons for plotting charts in particular ways.

Counts: The counts (shown in parentheses at the end of each graph's title as n=) associated with each graph can be affected by a number of independent factors and will therefore vary from chapter to chapter and from page to page. Most obviously, many of the charts in this report are graphic representations of results for a particular group (or subset) extracted from the database, such as primary operations. This clearly restricts the total number of database-entries available for any such analysis.

In addition to this, some entries within the group under consideration have data missing in one or more of the database questions under examination (reported as unspecified in the tables); all entries with missing data are excluded from the analysis used to generate the graph because they do not add any useful information.

For example, in the graph below, only the database entries where the patient is having primary surgery in the calendar years 2014-2018, and both the patient's age and gender are known are included in the analysis; this comes to 189,214 patient-entries (1,800 + 3,993 + 6,776 + 24,205 + 11,536 + 35,023 + 15,180 + 41,370 + 10,826 + 27,622 + 3,475 + 6,983 + 176 + 249 ; the 963 entries with unspecified data are excluded from the chart).

Primary surgery: Age & gender; calendar years 2014-2018 (n=189,214)



Confidence interval: In the charts prepared for this report, most of the bars plotted around rates (percentage values) represent 95% confidence intervals [2]. The width of the confidence interval provides some idea of how certain we can be about the calculated rate of an event or occurrence. If the intervals around two rates do not overlap, then we can say, with the specified level of confidence, that these rates are different; however, if the bars do overlap, we cannot make such an assertion.

Bars around averaged values (such as patients' age, post-operative length-of-stay, *etc.*) are classical standard error bars or 95% confidence intervals; they give some idea of the spread of the data around the calculated average. In some analyses that employ these error bars there may be insufficient data to legitimately calculate the standard error around the average for each sub-group under analysis; rather than entirely exclude these low-volume sub-groups from the chart their arithmetic average would be plotted without error bars. Such averages without error bars are valid in the sense that they truly represent the data submitted; however, they should not to be taken as definitive and therefore it is recommended that such values are viewed with extra caution.

1. Cleveland WS. *The elements of graphing data*. 1985, 1994. Hobart Press, Summit, New Jersey, USA.
2. Wilson EB. Probable inference, the law of succession, and statistical inference. *Journal of American Statistical Association*. 1927; **22**: 209-212.

Analysis

The growth of the IFSO Global Registry

The info-graphics opposite show the steady growth of the IFSO Global Registry over the last four years, from its initial inception in 2015. The goal set out last year for this year was:

> *to hit a target of contributions from 50 countries and hopefully see a doubling in the total number of records that have been submitted.*

Despite this being seen by some as an ambitious target, it was achieved and is testament to the commitment of so many surgeons and their specialist surgical societies around the world to join this project; so many thanks to those people who have made this happen, in particular to the Executive Boards of the 14 National Specialist Societies who have committed their national data.

As stated in the Third IFSO Global Registry Report 2017, there has been an evolution in the maturity of each successive IFSO Registry Report. What started out as a feasibility project in 2015 has since gathered great pace and now significant momentum. Indeed, the very existence of the Global Registry has sparked interest and activity in National Specialist Societies developing their own new national registries right around the world. This Fourth Report represents a further milestone in providing global data on the practice of bariatric and metabolic surgery and provides more in-depth analyses than in previous reports.

It is important to reflect for a moment on the purpose of individual national registries *versus* the Global Registry. The function and purpose of individual national registries varies from country to country, but in essence they are all about providing a rich resource of data to drive up the quality of care, provide a benchmark of activity and outcomes, and lend transparency to the outside world about the benefits and risks of bariatric and metabolic surgery. The *outside world* here is represented by local medical and surgical communities, general practitioners, commissioners of care, governments, Departments of Health, epidemiologists, health observatories, the Press (and the list goes on!), and of course importantly includes individuals who are exploring the surgical options for treating obesity and obesity-related conditions as potential patients.

The Global Registry has never been intended to replace the role of national registries; rather, it is there to provide a global perspective on what is happening in this speciality in different countries and in different regions around the world. Indeed, it is specifically **not** the role of a global registry to reach out to individual patients to track long-term outcomes. This is the domain of national registries, which cannot be supplanted by a global registry in particular because the data that are held by IFSO centrally are fully anonymised as far as patient-identification is concerned, which is, of course, a requirement for the newer General Data Protection Regulation (GDPR) laws. Nevertheless, the Global Registry can provide a very useful additional layer of information above and beyond the capabilities of individual national registries, as it allows surgeons to get a better understanding of the context of the patient populations they are treating in comparison to practice elsewhere. This maybe particularly true where access to bariatric surgery through government funding is very open and freely available, or at the other extreme where access is very restricted.

The greatest information challenge in bariatric surgery (as it is with many other specialities) is to gather comprehensive long-term data on patient outcomes. To date some countries have submitted data to the IFSO Global Registry from systematic follow ups, whilst some other countries have provided no post-discharge data at all. Certain countries, such as Sweden, now have the ability to cross check outcomes through linkage of records from one national registry to another (*e.g.*, bariatric registry to the diabetes registry) and this probably represents a gold standard that many countries might like to emulate, but few will manage to do at least in the near future. Even so, as information technology advances at a pace, for example, with the dramatic development of wearable monitoring devices, it is probably the case that we're currently only scratching the surface of what data it is possible to collect when looking forwards only a short way into the future.

The goal for next year is to hit a target of contributions of data from 55 countries and to have over half a million procedure records under analysis.

For more information on how to participate in the Dendrite / IFSO Global Registry and / or on how to set up your own local or national database so that it is compliant with the IFSO Global Registry minimum dataset, please contact:

Dr Peter K H Walton, Managing Director, Dendrite Clinical Systems *via* e-mail: peter.walton@e-dendrite.com

2015 data merge

100,092
operations

8 single centres
7 multi-centre submissions
3 national registries

2016 data merge

142,748
operations

19 single centres
5 multi-centre submissions
7 national registries

2017 data merge

196,188
operations

21 single centres
13 multi-centre submissions
8 national registries

2018 data merge

394,431
operations

18 single centres
19 multi-centre submissions
14 national registries

Contributors

The tables on these two facing pages show which countries, from which broad geographical areas, have contributed data to the Fourth IFSO Global Registry. They show the number of procedure records sent in from each country and whether the submissions were from a national registry, multiple centres or from a single centre. It is notable that the European countries are currently the largest contributors to the registry. This is not necessarily because more bariatric surgery is performed here; rather it reflects the fact that European countries have embraced the need to set up national registries earlier than in other regions and as a result they have accumulated more historical data. Kuwait and Brazil, for example, have only just started their national registries.

This year Italy, Sweden and the United Kingdom are the top three contributors in total, but it is likely that in future other countries that perform high numbers of cases *per* head of population on an annual basis (such as France, Brazil or Saudi Arabia) might predominate in future. Some countries with well-established registries such as the USA and Australia have not yet agreed to participate in the Global Registry project, it is hoped that this situation will change in future years.

Nevertheless it is very gratifying that so many countries have embraced the Global Registry, which has truly become a significant surgical *community effort*. The simple aim is to provide a useful information benchmark that can assist individual surgeons to better understand demographic patterns, and surgical practice and outcomes on a very grand scale. There is a *caveat*; like all registries, the Dendrite / IFSO Global Registry is on a *journey* and one that is never finished, but each year as it moves forward the Registry increases in value.

Europe

Western Europe	282,698 records	
Austria	1,713	**National registry**
Belgium	12,549	**National registry**
France	4,080	Multi-centre
Germany	472	Multi-centre
Ireland	572	Multi-centre
Italy	80,364	**National registry**
Netherlands	40,765	**National registry**
Norway	3,726	**National registry**
Portugal	418	Single centre
Spain	711	Multi-centre
Sweden	63,084	**National registry**
Switzerland	7,863	Multi-centre
Turkey	3,041	**National registry**
United Kingdom	63,340	**National registry**
Eastern Europe	**6,682 records**	
Belarus	115	Single centre
Bulgaria	19	Single centre
Czech Republic	1,319	Single centre
Georgia	110	Multi-centre
Hungary	73	Single centre
Lithuania	134	Single centre
Poland	647	Multi-centre
Russia	4,265	**National registry**

Americas

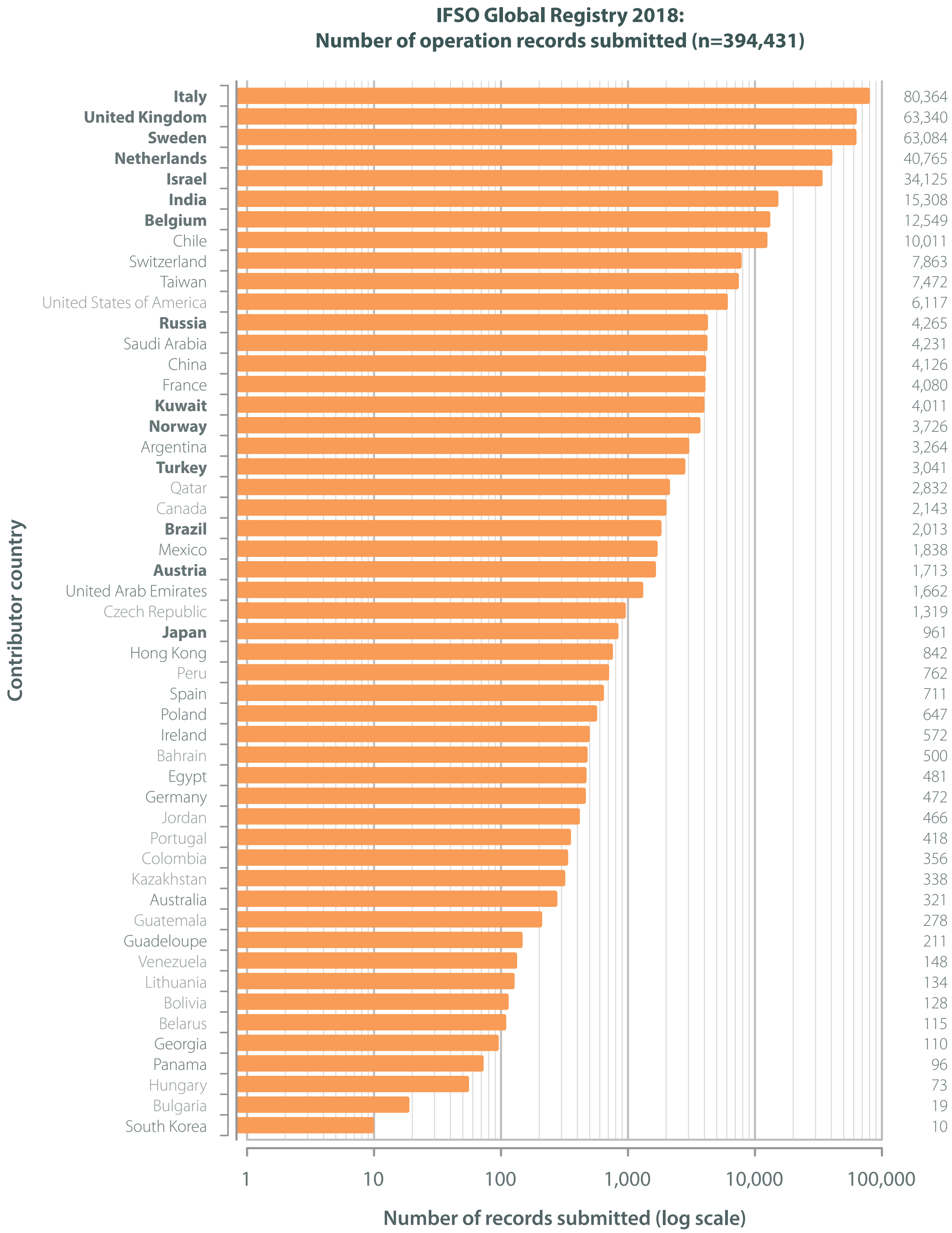
North America	10,309 records	
Canada	2,143	Single centre
Guadeloupe	211	Single centre
Mexico	1,838	Multi-centre
United States of America	6,117	Single centre
Central America	**374 records**	
Guatemala	278	Single centre
Panama	96	Multi-centre
South America	**16,682 records**	
Argentina	3,264	Multi-centre
Bolivia	128	Single centre
Brazil	2,013	Pilot **National registry**
Chile	10,011	Multi-centre
Colombia	356	Single centre
Peru	762	Single centre
Venezuela	148	Single centre

Other countries

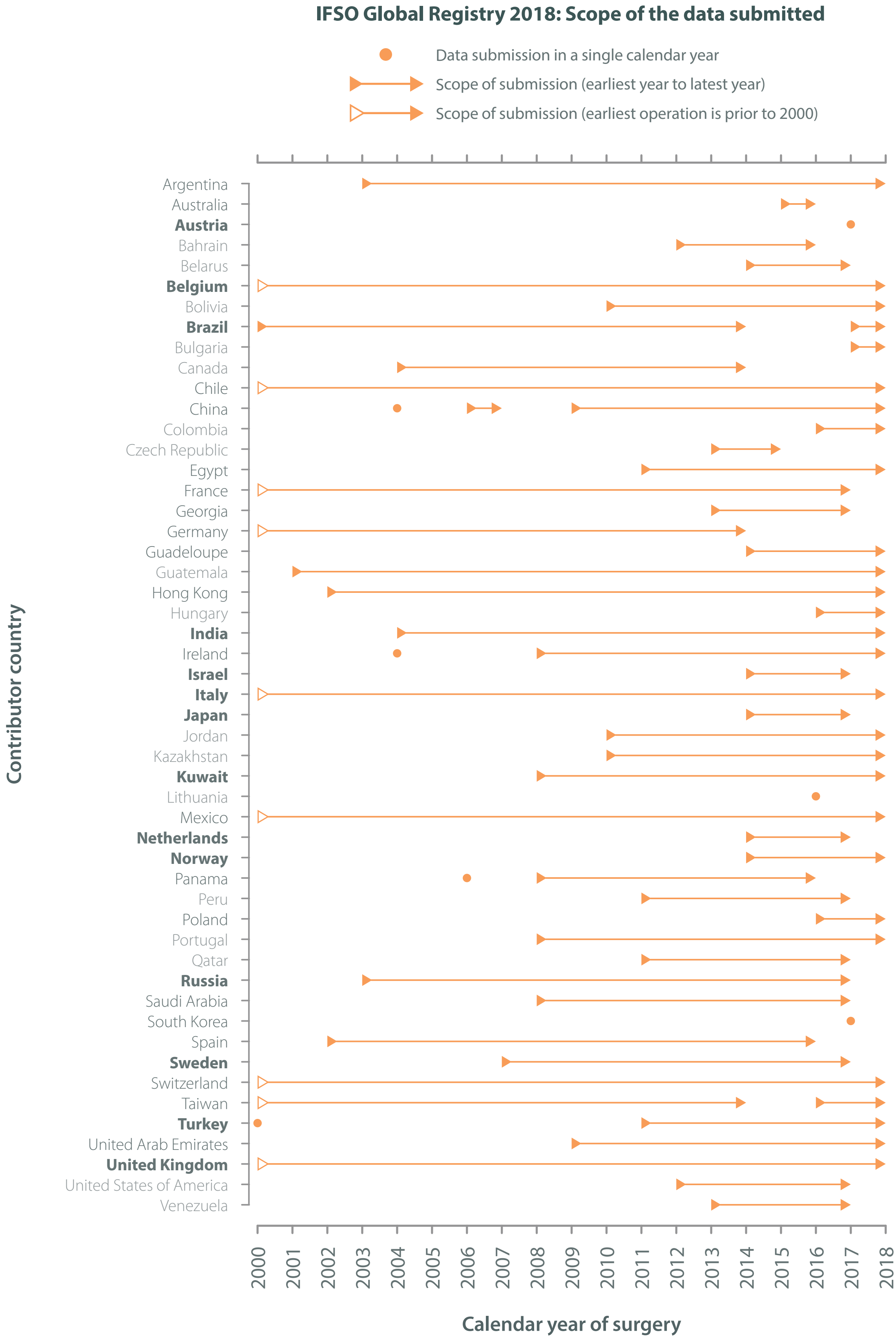
Middle East	48,308 records	
Bahrain	500	Single centre
Egypt	481	Multi-centre
Israel	34,125	**National registry**
Jordan	466	Single centre
Kuwait	4,011	**National registry**
Qatar	2,832	Single centre
Saudi Arabia	4,231	Multi-centre
United Arab Emirates	1,662	Multi-centre
Asia	**29,057 records**	
China	4,126	Multi-centre
Hong Kong	842	Multi-centre
India	15,308	**National registry**
Japan	961	**National registry**
Kazakhstan	338	Single centre
South Korea	10	Multi-centre
Taiwan	7,472	Multi-centre
Australasia	**321 records**	
Australia	321	Multi-centre

Submissions

For this Fourth IFSO Global Registry Report, data from just over **394,000** operation records were submitted from **51** countries, as shown in the chart below. The numbers represent contributions of data ranging from existing **national registries** through to data from some countries represented by a single hospital, which might not be wholly representative. The number of records submitted to the IFSO Global Registry has more than doubled since the publication of the last report in 2017. Thus, this is the continuation of an iterative process as data continue to accumulate over time, and we hope to add yet more data from even more countries in the future.



The chart below shows the calendar years for which data has been submitted for each contributor. This ranges from continuous data collection for some countries to shorter snapshots of data from others.



Analysis

Data completeness

The table below shows a précis analysis of the completeness of data submitted by each country, with a solid **green** box representing complete data collection, all the way through to an empty **pink** box for wholly missing data.

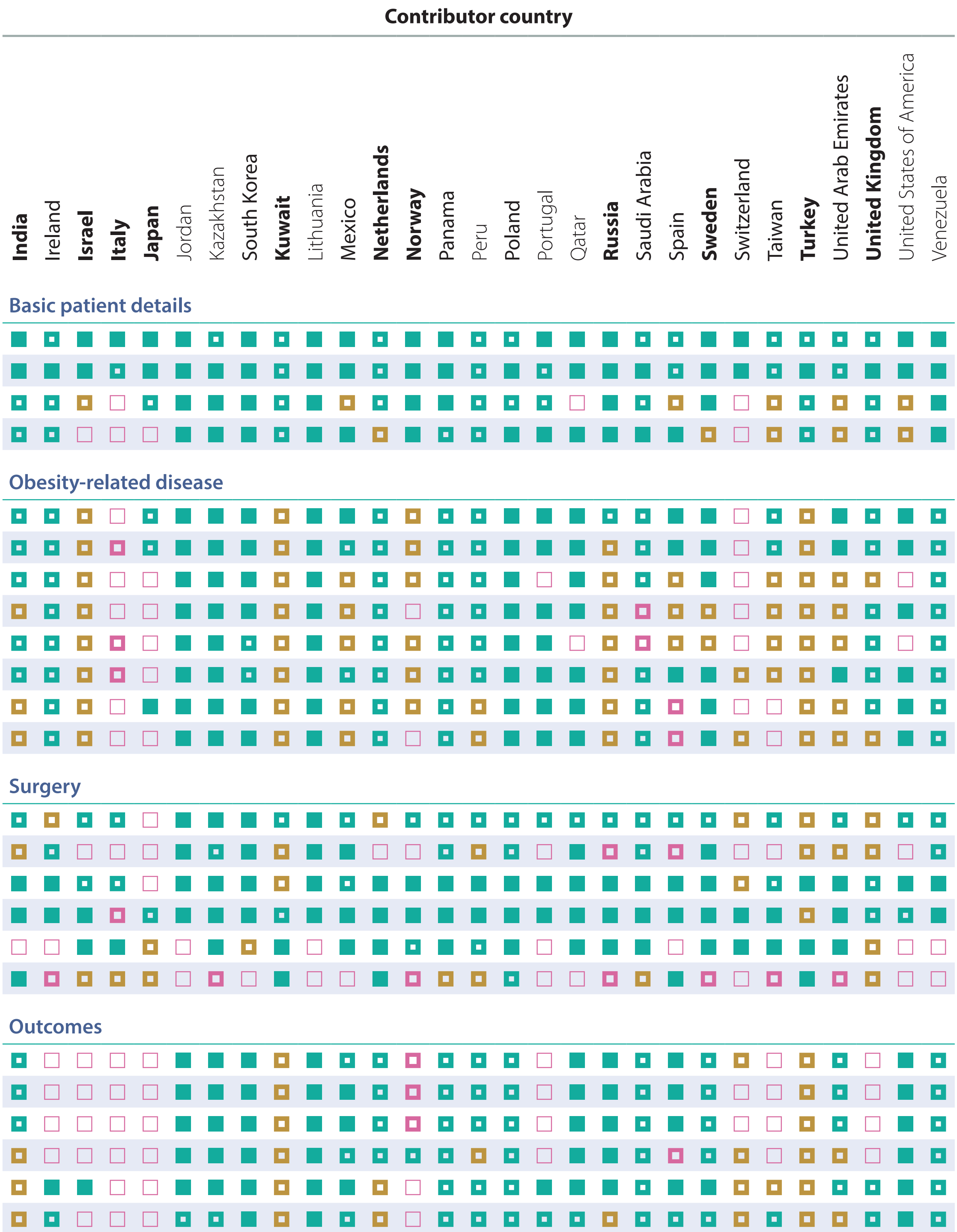
Data completeness for selected fields in the merged IFSO Global Registry

	Contributor country																					
	Argentina	Australia	**Austria**	Bahrain	Belarus	**Belgium**	Bolivia	**Brazil**	Bulgaria	Canada	**Chile**	**China**	Colombia	Czech Republic	**Egypt**	**France**	**Georgia**	**Germany**	Guadeloupe	Guatemala	**Hong Kong**	Hungary
Basic patient details																						
Age	100%	100%	90.0-99.9%	100%	100%	90.0-99.9%	90.0-99.9%	90.0-99.9%	100%	100%	100%	90.0-99.9%	100%	100%	90.0-99.9%	100%	100%	90.0-99.9%	90.0-99.9%	100%	100%	100%
Gender	100%	100%	90.0-99.9%	100%	100%	100%	100%	100%	100%	100%	10.0-89.9%	90.0-99.9%	100%	100%	100%	100%	100%	90.0-99.9%	90.0-99.9%	100%	100%	100%
Initial weight	90.0-99.9%	100%	90.0-99.9%	100%	90.0-99.9%	90.0-99.9%	100%	90.0-99.9%	100%	0%	10.0-89.9%	10.0-89.9%	90.0-99.9%	0%	100%	10.0-89.9%	100%	90.0-99.9%	100%	10.0-89.9%	100%	100%
Funding	0.1-10.0%	0%	0%	100%	100%	10.0-89.9%	100%	10.0-89.9%	100%	0%	10.0-89.9%	10.0-89.9%	90.0-99.9%	100%	90.0-99.9%	10.0-89.9%	100%	10.0-89.9%	100%	10.0-89.9%	100%	100%
Obesity-related disease																						
Diabetes	0.1-10.0%	100%	100%	100%	100%	10.0-89.9%	100%	10.0-89.9%	100%	10.0-89.9%	90.0-99.9%	10.0-89.9%	90.0-99.9%	0%	90.0-99.9%	90.0-99.9%	100%	100%	100%	0%	90.0-99.9%	100%
Hypertension	0.1-10.0%	0%	100%	100%	100%	10.0-89.9%	100%	10.0-89.9%	100%	10.0-89.9%	90.0-99.9%	10.0-89.9%	90.0-99.9%	0%	90.0-99.9%	90.0-99.9%	100%	100%	100%	0%	90.0-99.9%	100%
Depression	0.1-10.0%	0%	100%	0%	0%	10.0-89.9%	100%	10.0-89.9%	100%	10.0-89.9%	10.0-89.9%	10.0-89.9%	90.0-99.9%	0%	90.0-99.9%	10.0-89.9%	100%	100%	100%	0%	10.0-89.9%	100%
DVT risk	0.1-10.0%	0%	100%	0%	100%	10.0-89.9%	100%	10.0-89.9%	100%	0%	10.0-89.9%	10.0-89.9%	90.0-99.9%	0%	90.0-99.9%	10.0-89.9%	100%	100%	100%	0%	10.0-89.9%	100%
Musculo-skeletal pain	0.1-10.0%	0%	100%	0%	0%	10.0-89.9%	100%	0.1-10.0%	100%	0%	10.0-89.9%	10.0-89.9%	90.0-99.9%	0%	10.0-89.9%	0.1-10.0%	100%	100%	100%	0%	90.0-99.9%	100%
Sleep apnea	0.1-10.0%	0%	100%	100%	0%	10.0-89.9%	100%	10.0-89.9%	100%	0%	90.0-99.9%	10.0-89.9%	90.0-99.9%	0%	90.0-99.9%	10.0-89.9%	100%	100%	100%	0%	100%	100%
Dyslipidemia	0.1-10.0%	0%	100%	100%	100%	10.0-89.9%	100%	10.0-89.9%	100%	0%	10.0-89.9%	10.0-89.9%	90.0-99.9%	0%	90.0-99.9%	10.0-89.9%	100%	0%	100%	0%	90.0-99.9%	100%
GERD	0.1-10.0%	0%	100%	100%	100%	10.0-89.9%	100%	10.0-89.9%	100%	0%	10.0-89.9%	10.0-89.9%	90.0-99.9%	0%	90.0-99.9%	10.0-89.9%	100%	0%	100%	0%	90.0-99.9%	100%
Surgery																						
Weight at operation	90.0-99.9%	90.0-99.9%	90.0-99.9%	100%	90.0-99.9%	10.0-89.9%	100%	90.0-99.9%	100%	100%	10.0-89.9%	10.0-89.9%	90.0-99.9%	0%	90.0-99.9%	90.0-99.9%	100%	90.0-99.9%	100%	90.0-99.9%	100%	100%
Previous balloon	0.1-10.0%	100%	100%	100%	100%	10.0-89.9%	90.0-99.9%	10.0-89.9%	100%	0%	0%	10.0-89.9%	90.0-99.9%	0%	90.0-99.9%	10.0-89.9%	90.0-99.9%	0%	90.0-99.9%	10.0-89.9%	100%	90.0-99.9%
Prior bariatric surgery	0.1-10.0%	100%	100%	100%	100%	100%	100%	90.0-99.9%	100%	0%	10.0-89.9%	10.0-89.9%	100%	0%	100%	10.0-89.9%	100%	100%	100%	100%	100%	100%
Approach	100%	100%	100%	100%	100%	10.0-89.9%	100%	90.0-99.9%	100%	100%	10.0-89.9%	90.0-99.9%	100%	100%	90.0-99.9%	10.0-89.9%	100%	100%	100%	100%	100%	100%
Other operation	0%	100%	0%	100%	0%	100%	10.0-89.9%	100%	100%	10.0-89.9%	0%	0%	0.1-10.0%	0.1-10.0%	0%	100%	100%	100%	100%	0%	100%	100%
Banded procedure	10.0-89.9%	0.1-10.0%	0%	100%	0%	100%	100%	100%	100%	10.0-89.9%	0.1-10.0%	0%	10.0-89.9%	10.0-89.9%	10.0-89.9%	100%	0%	0.1-10.0%	10.0-89.9%	10.0-89.9%	0%	0%
Outcomes																						
Leak	0.1-10.0%	0%	100%	100%	100%	10.0-89.9%	100%	10.0-89.9%	100%	0%	10.0-89.9%	10.0-89.9%	90.0-99.9%	0%	10.0-89.9%	0.1-10.0%	100%	100%	100%	100%	100%	100%
Bleed	0.1-10.0%	0%	100%	100%	100%	10.0-89.9%	100%	10.0-89.9%	100%	0%	10.0-89.9%	10.0-89.9%	90.0-99.9%	0%	10.0-89.9%	0.1-10.0%	100%	100%	100%	100%	100%	100%
Obstruction	0.1-10.0%	0%	100%	100%	100%	10.0-89.9%	100%	10.0-89.9%	100%	0%	10.0-89.9%	10.0-89.9%	90.0-99.9%	0%	10.0-89.9%	0.1-10.0%	100%	100%	100%	100%	100%	100%
Reoperation	0.1-10.0%	0%	100%	100%	100%	10.0-89.9%	100%	10.0-89.9%	100%	0%	0%	10.0-89.9%	90.0-99.9%	0%	10.0-89.9%	0%	100%	0%	100%	100%	100%	100%
Status at discharge	0.1-10.0%	0%	90.0-99.9%	100%	100%	10.0-89.9%	100%	10.0-89.9%	100%	0.1-10.0%	10.0-89.9%	10.0-89.9%	90.0-99.9%	0%	90.0-99.9%	10.0-89.9%	100%	10.0-89.9%	100%	10.0-89.9%	90.0-99.9%	100%
Date of discharge	0.1-10.0%	0%	90.0-99.9%	90.0-99.9%	100%	0.1-10.0%	90.0-99.9%	10.0-89.9%	100%	0%	10.0-89.9%	10.0-89.9%	0%	0%	90.0-99.9%	0.1-10.0%	100%	0%	100%	90.0-99.9%	90.0-99.9%	100%

Completeness key 100% 90.0-99.9% 10.0-89.9% 0.1-10.0% 0% complete

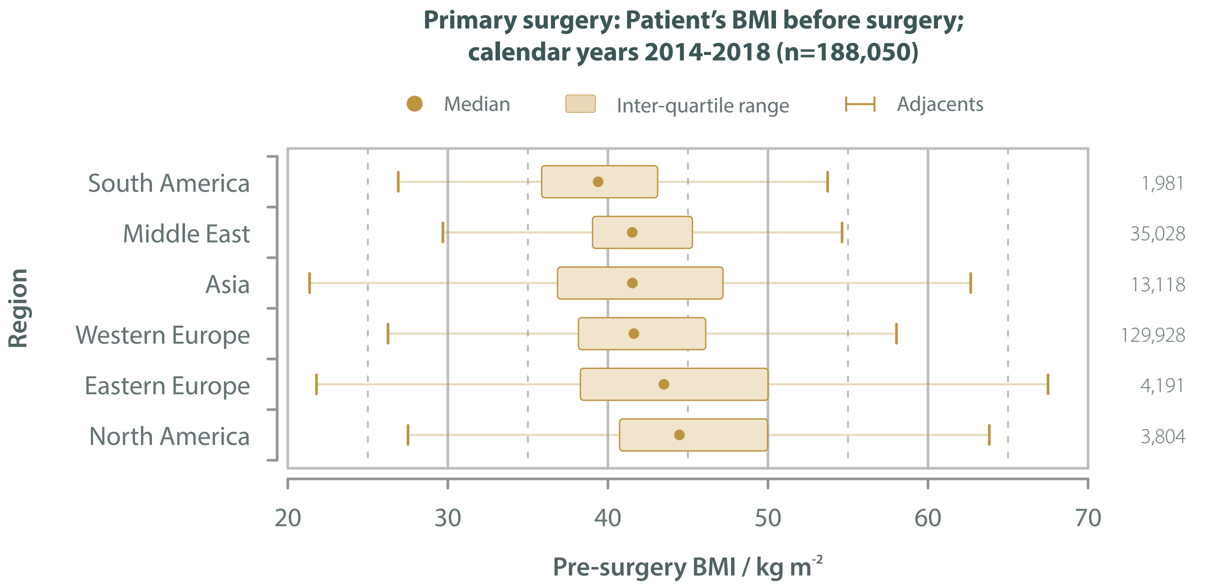
It is naturally easier for those centres submitting *via* direct data entry on-line to provide more complete data than for those well-established National Registries where the existing local dataset has been in place for a long period of time and data are being uploaded.

Data completeness for selected fields in the merged IFSO Global Registry

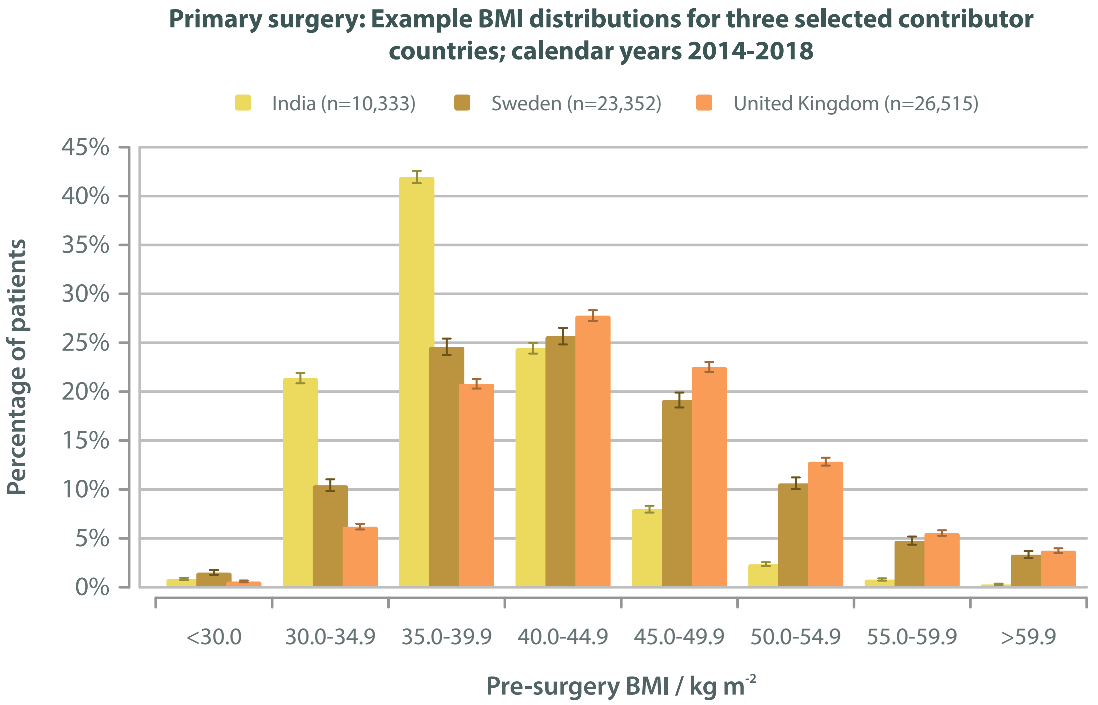


Body Mass Index prior to surgery

The chart below shows the range of patients' body mass index (BMI) prior to primary surgery by geographical region. The median ranges from 39.4 kg m^{-2} in South America to 44.5 kg m^{-2} in North America.

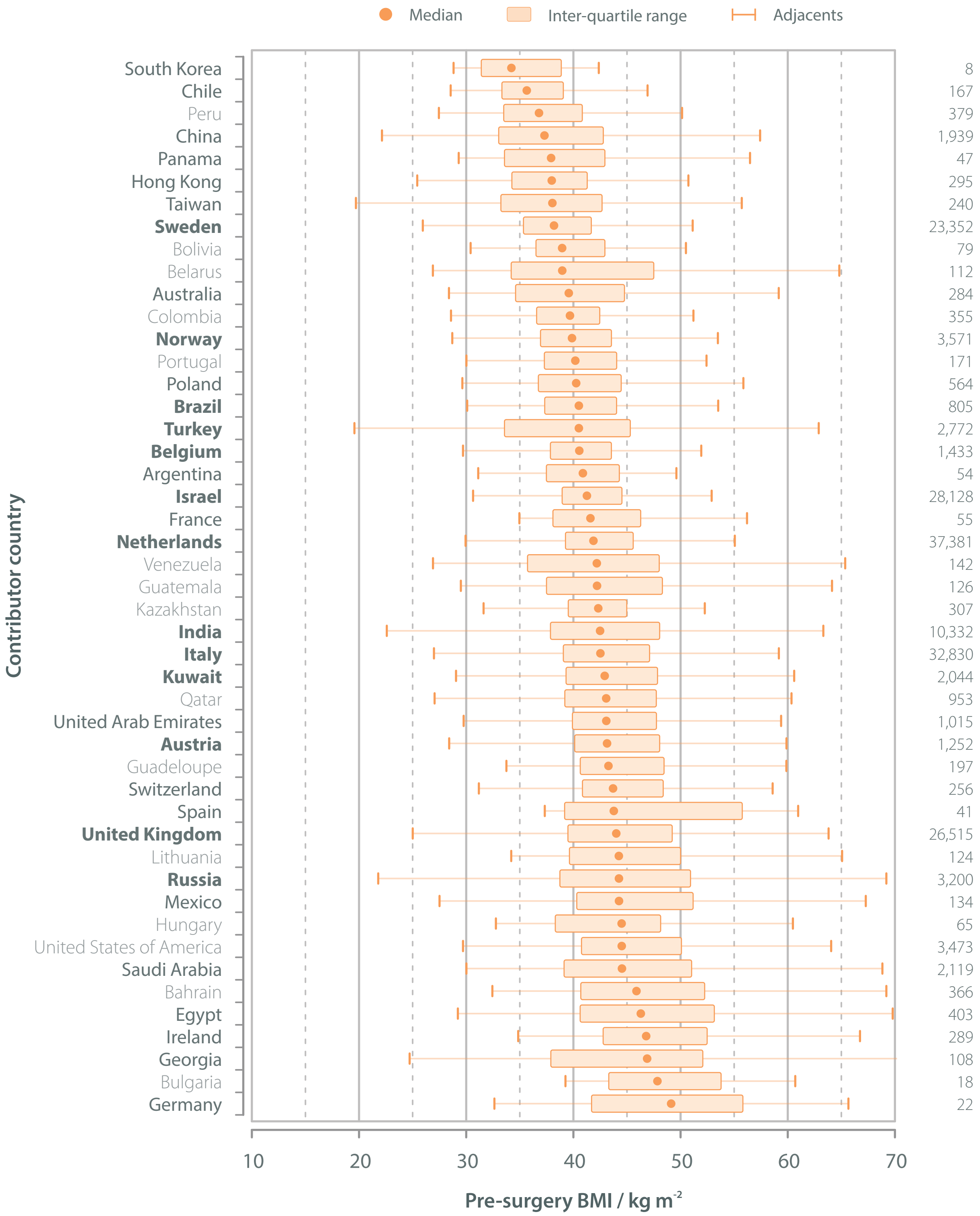


The next chart shows the distribution of BMIs for three selected contributor countries. It clearly shows the variation in populations being operated upon in different geo-political environments. As more data accumulate it will become clearer if the data from India are representative of patients operated in that country.



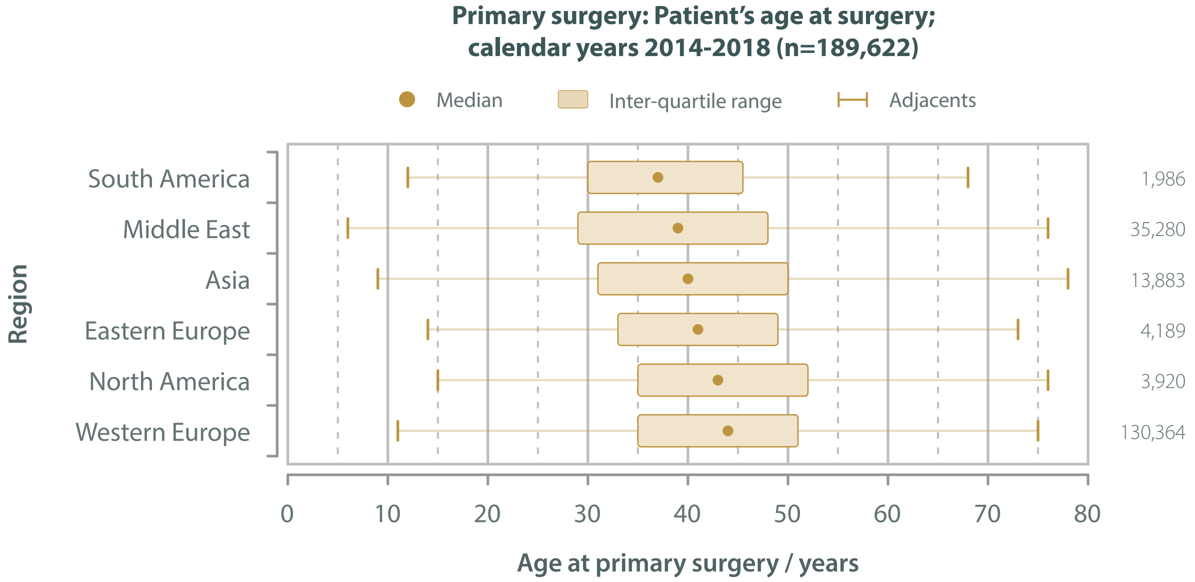
The graph below shows that there is a wide variation in the distribution of pre-surgery BMI for patients from different countries, ranked in order of increasing median BMI . Germany, Bulgaria and Georgia have the highest reported BMIs. As increasing BMI is generally associated with a greater risk of operative complications and mortality, the graph clearly implies that there needs to be caution applied when comparing complication rates across series of patients from different countries. We do not attempt to make these analyses in this report.

Primary surgery: Patient's BMI before surgery; calendar years 2014-2018 (n=188,522)

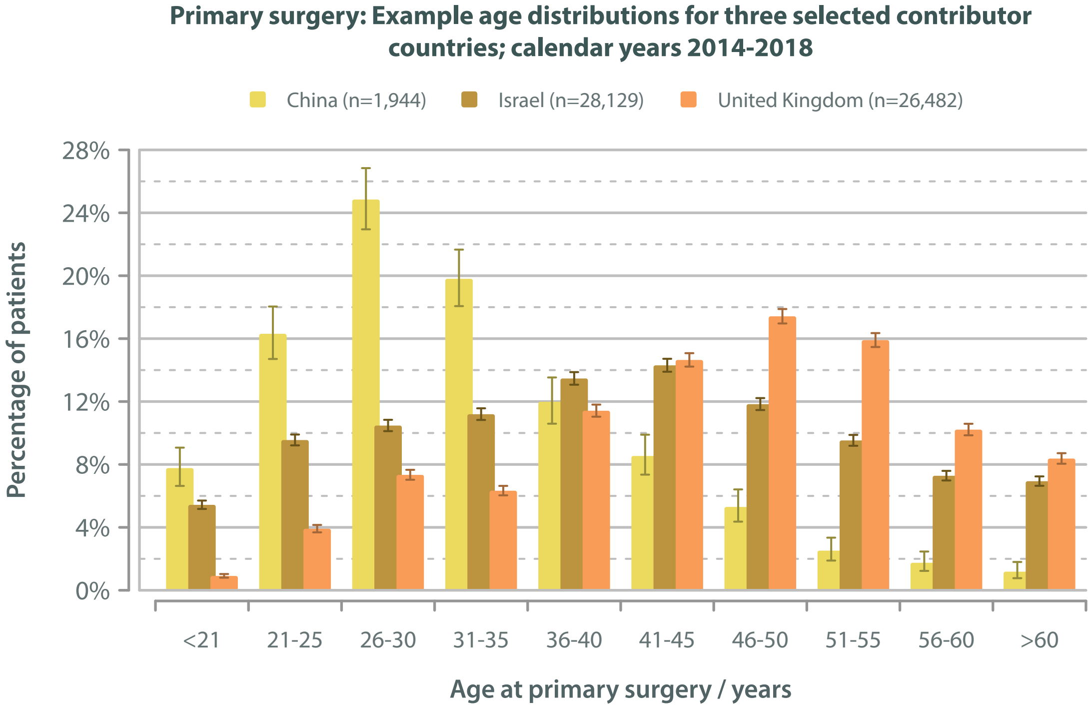


Age at surgery

The graphs below show the distribution of ages at which patients have bariatric surgery. Although there are wide ranges in the ages of patients at the time of surgery in each country, there is a notable difference of 7 years between the median age of patients in South America compared to Western Europe. In the country-specific graph on the next page there is at least 15 years difference in the median age of patients between countries at the extremes.

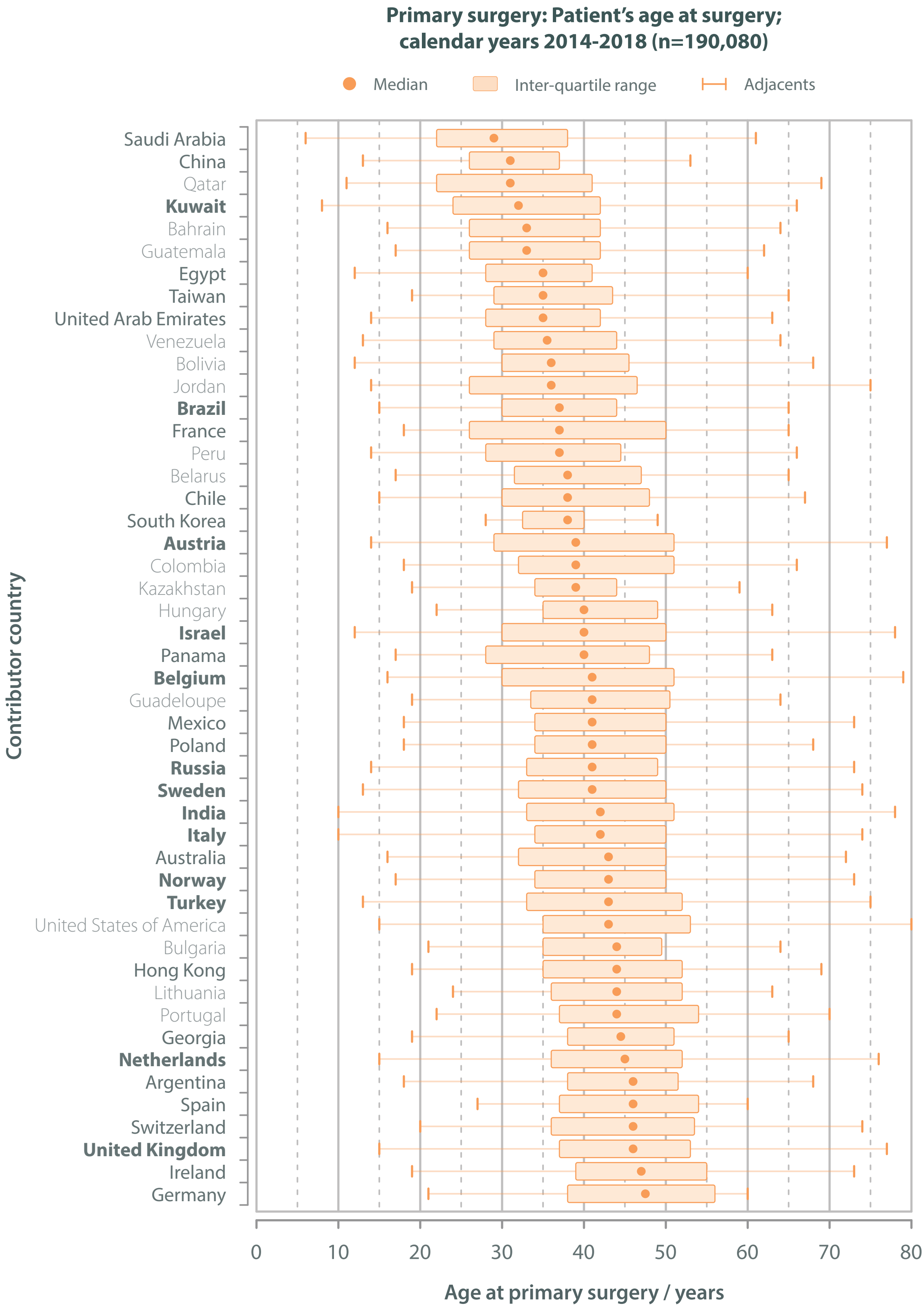


This comparison graph shows dramatic differences in age distributions of patients being operated on in three different healthcare systems: China, Israel and the United Kingdom.

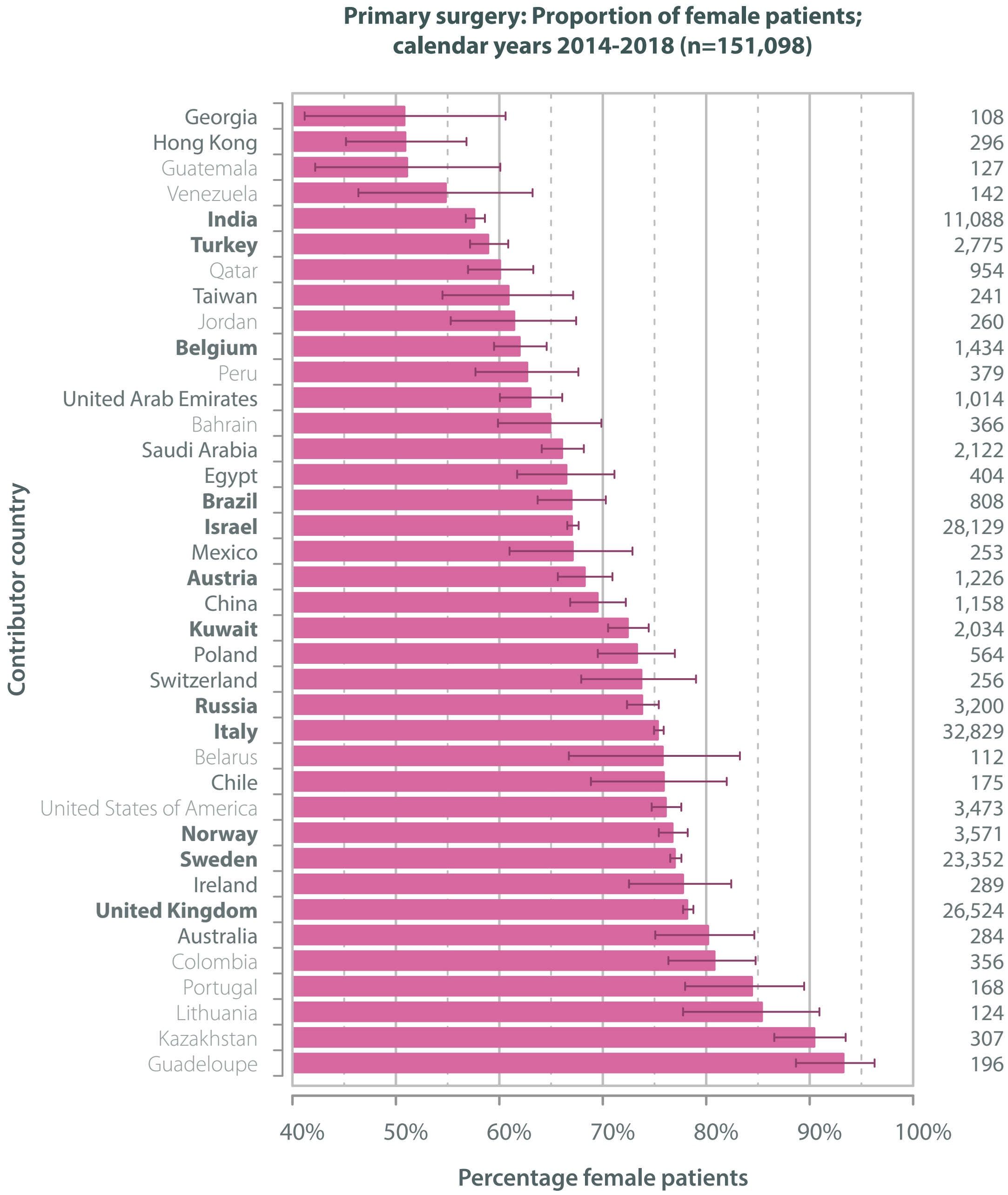


The graph below shows the median age of patients at baseline for each of the contributing countries. The patients from Saudi Arabia have the lowest median age at surgery, but the centre that submitted most of these data specialises in child & adolescent surgery, so the age distribution data are unlikely be representative for this country.

The extremes of age are notable as we see surgery performed in both the first and the eighth decades of life. It will be important to evaluate this trend and provide evidence based guidance for operating in these age groups.



For the first time in this Fourth IFSO Global Report, we present data on the male : female gender distribution for all contributor countries. Data from the national registries of India and Turkey suggest the male to female ratio is around 40 : 60 (three-fifths female patients) in these countries, whereas in the United Kingdom, Sweden and Norway the ratio is around 25 : 75 (three-quarters female patients). The wide range of rates shown in the chart below almost demands further, systematic investigation.



Note: from this point forwards, only countries with over 100 qualifying database entries are plotted in distribution charts, so as to make the data presented less affected by the *small-numbers* effect. We can see this effect in the chart plotting BMI *per* country: the countries at both extremes of the rank-ordered distribution have low numbers under analysis.

The following table provides statistics on age at surgery for patients in each of the regions, according to gender. It demonstrates that European and American patients tend to be older than their South American, Asian & Middle Eastern counterparts. Notably, in each region the average age of male patients is systematically higher than that of the female patients, with the exception of patients in Asia.

With further iterations of the database, as more and more data accumulate, the certainty around patterns like this should become firmer.

Primary surgery: statistics on patients' age; calendar years 2014-2018

Gender and region			Count	Average (95% CI)	Median (IQR)
	All regions	All patients	190,080	**42.0** (41.9-42.1)	**42** (33-51)
		Female patients	139,445	**41.7** (41.6-41.7)	**42** (33-50)
		Male patients	49,769	**43.1** (43.0-43.2)	**44** (34-52)
	Female patients	W Europe	100,255	**42.5** (42.4-42.6)	**43** (34-51)
		E Europe	3,080	**41.1** (40.7-41.4)	**40** (33-49)
		N America	2,996	**42.8** (42.3-43.2)	**42** (34-52)
		S America	1,371	**37.9** (37.3-38.5)	**37** (30-45)
		Middle East	23,632	**38.6** (38.5-38.8)	**38** (28-48)
		Asia	7,785	**41.1** (40.8-41.4)	**40** (31-50)
	Male patients	W Europe	30,043	**44.8** (44.6-44.9)	**46** (37-53)
		E Europe	1,109	**42.1** (41.4-42.7)	**42** (35-49)
		N America	923	**46.0** (45.2-46.7)	**46** (38-54)
		S America	615	**39.1** (38.2-39.9)	**38** (32-46)
		Middle East	11,635	**39.7** (39.5-40.0)	**40** (29-49)
		Asia	5,312	**41.0** (40.7-41.4)	**41** (32-50)

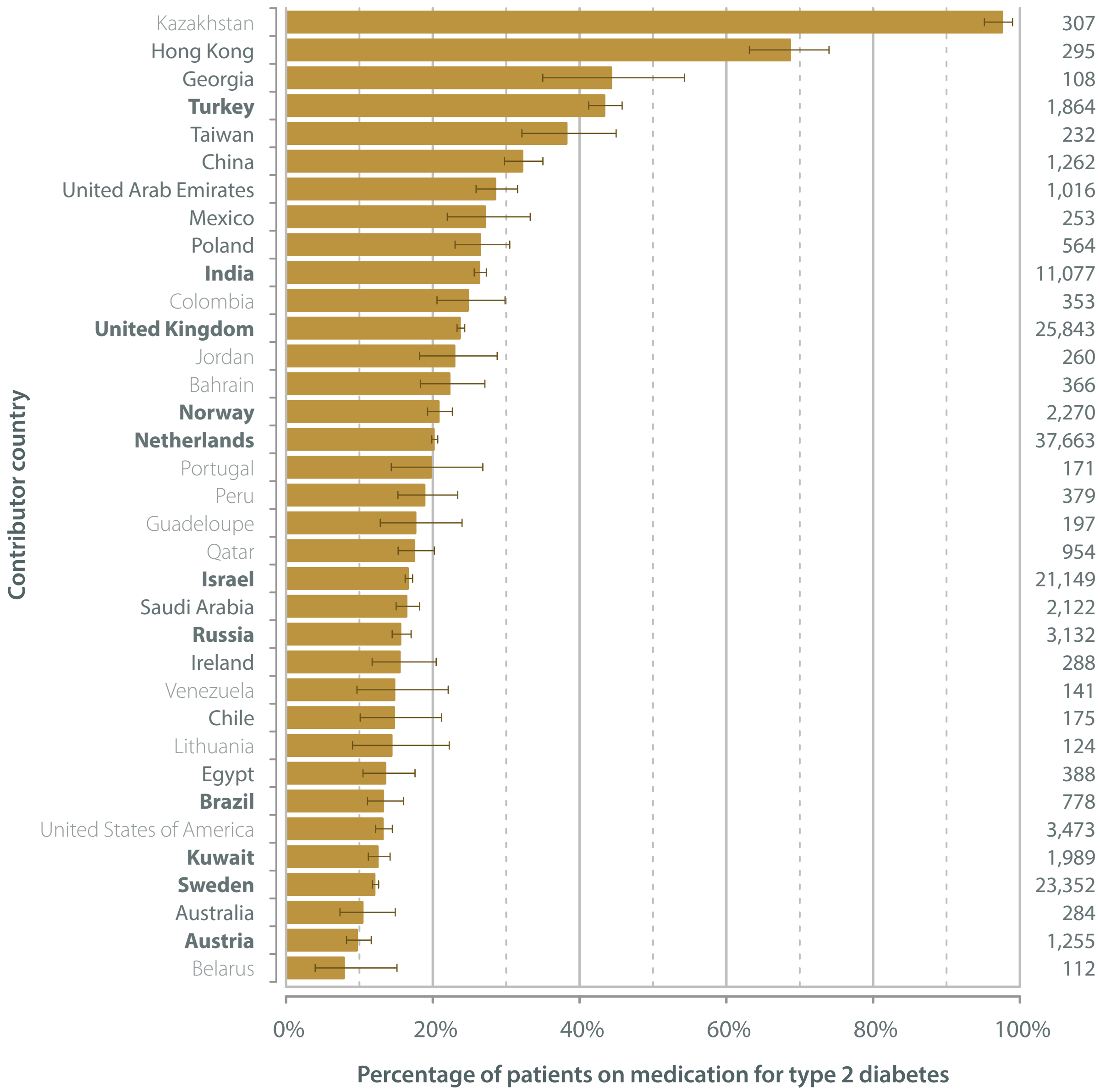
Obesity-related disease

Type 2 diabetes

Type 2 diabetes mellitus is the obesity-related disease that has attracted most attention in bariatric surgery due to the demonstrable improvement in diabetes control after surgery, and also because there are data suggesting that surgery is cost-effective. In publicly-funded healthcare systems, it may be that more patients are being referred for surgery for these reasons, hence forming a substantial proportion of operated patients. This information constitutes basic demographic data as the bariatric community seeks to increase the provision of surgery for the increasing population with this obesity-related disease. The data are reported in order of prevalence by country on these pages and by broader geographical regions on following pages.

In some healthcare systems, metabolic surgery predominates over treatment for obesity *per* se.

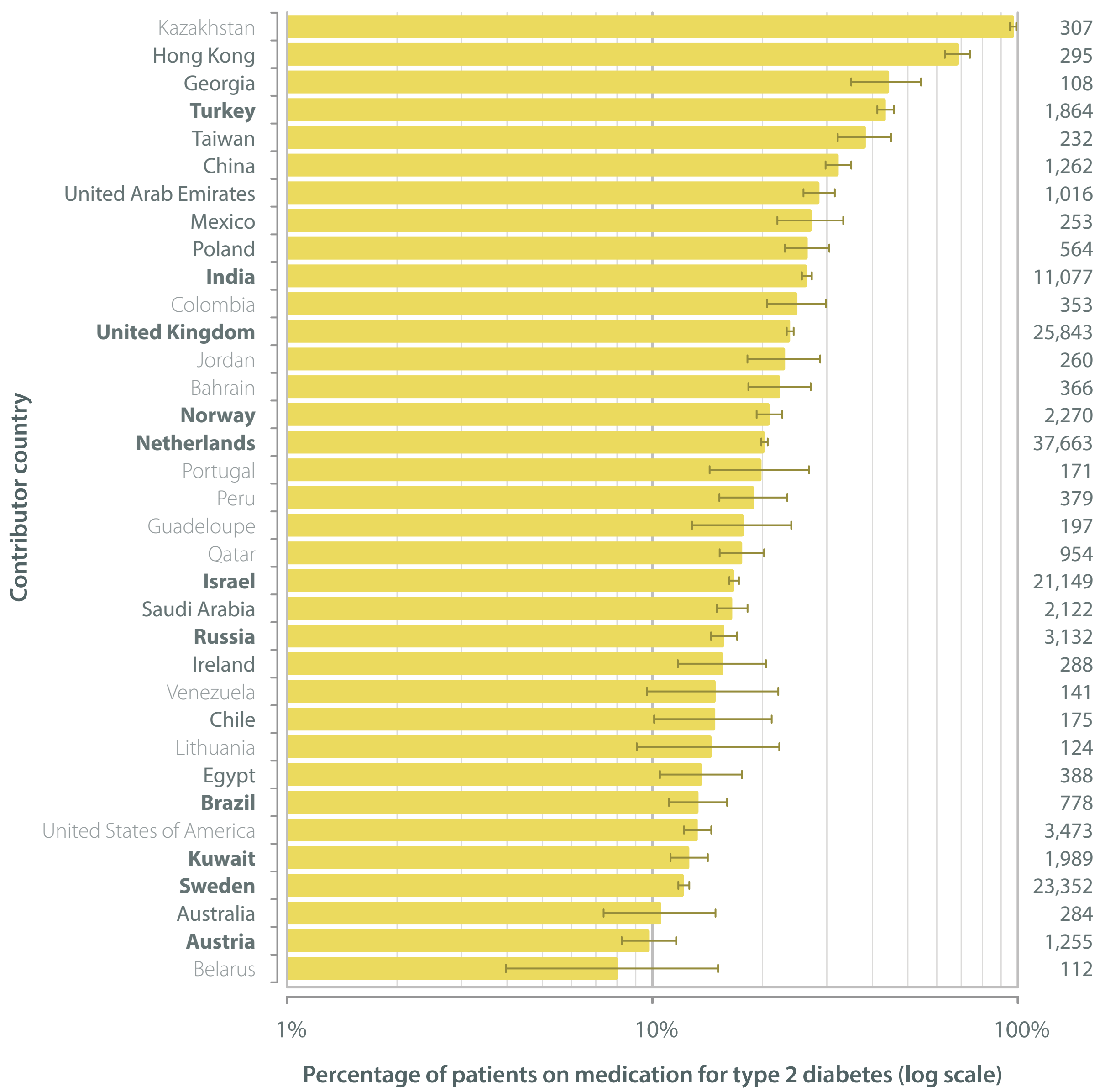
Primary surgery: Patients on medication for type 2 diabetes prior to surgery; calendar years 2014-2018 (n=144,196)



Kazakhstan, Hong Kong, Georgia & Turkey have some of the largest proportions of diabetic patients, possibly relating to the greater susceptibility of the Asian demographic to developing diabetes at lower BMI levels. The data also need to be interpreted in the context of diabetes risk with ethnicity. It may also be that the diabetes story has been taken up as a driver for surgery in these countries, contrasting with some other countries where the proportion of patients with diabetes having surgery is much lower. This area of inequality of access to bariatric and metabolic surgery is ripe for research.

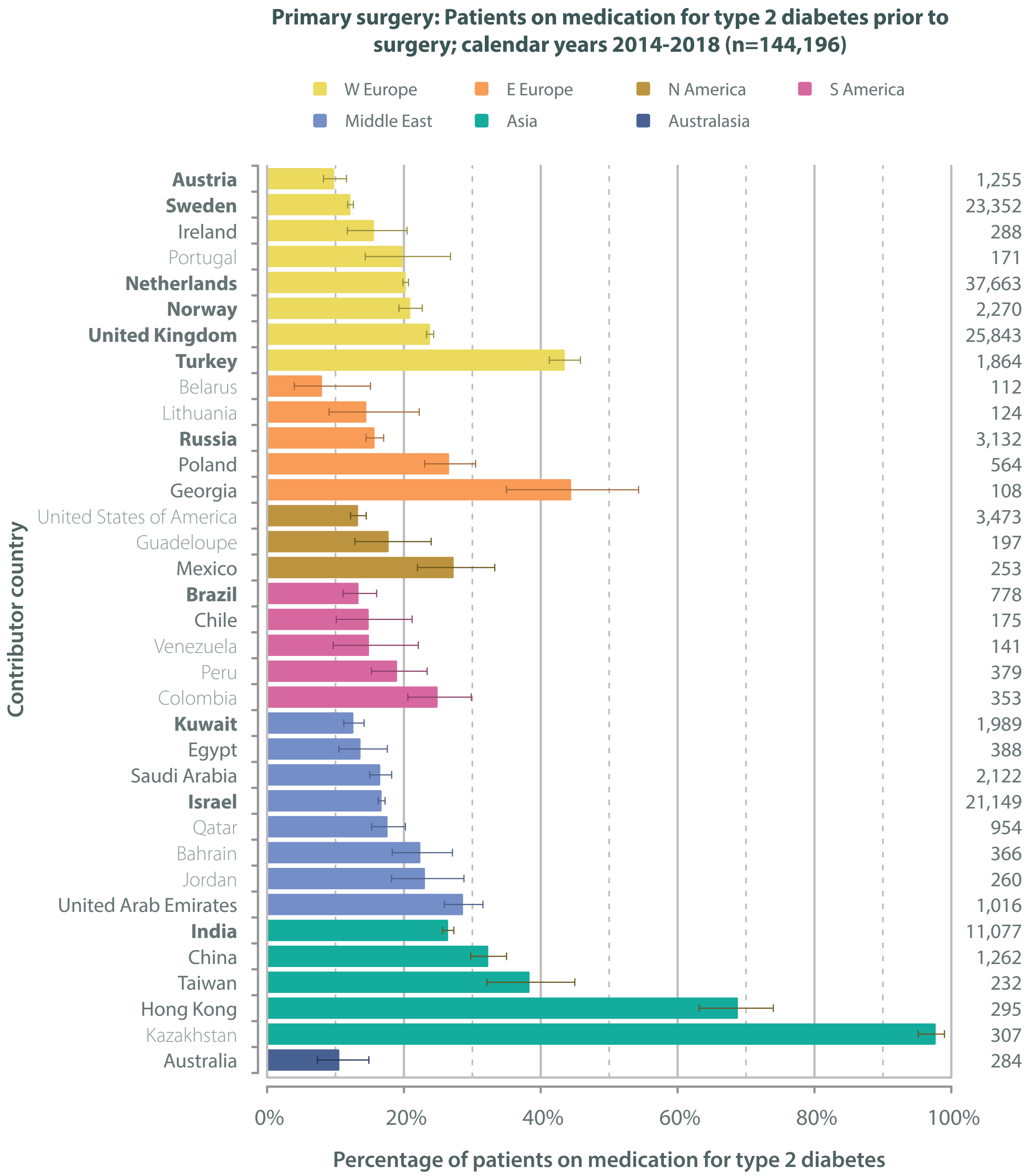
New international guidelines state that bariatric surgery should be a recommended treatment for type 2 diabetes in patients with BMI of 40 kg m^{-2} or more.

Primary surgery: Patients on medication for type 2 diabetes prior to surgery; calendar years 2014-2018 (n=144,196)



The graph below shows the rate of type 2 diabetes *per* country grouped according to geographical region and increasing prevalence within each region. There are obvious large differences in the proportion of patients with diabetes being operated upon, with a higher preponderance of patients on medication for type 2 diabetes in a number of Asian countries.

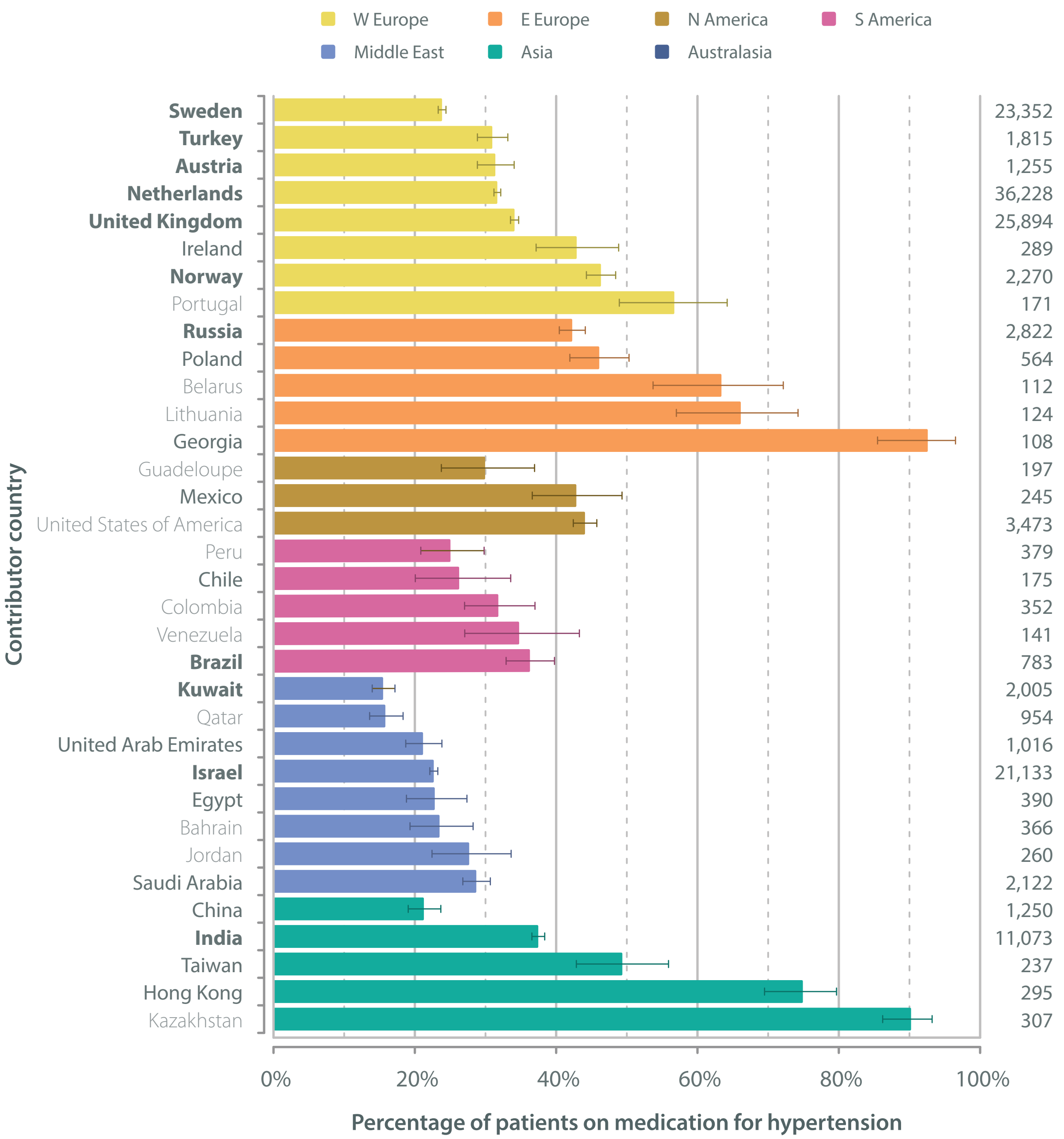
In some countries it may be that access to public funding for treatment of obese patients with type 2 diabetes is restricted. Again, we hope that as more data accumulate in future years, analysis will be able to demonstrate whether or not these patterns are *real* and sustained, which will then trigger more detailed investigations to determine the underlying reasons for these differences.



Hypertension

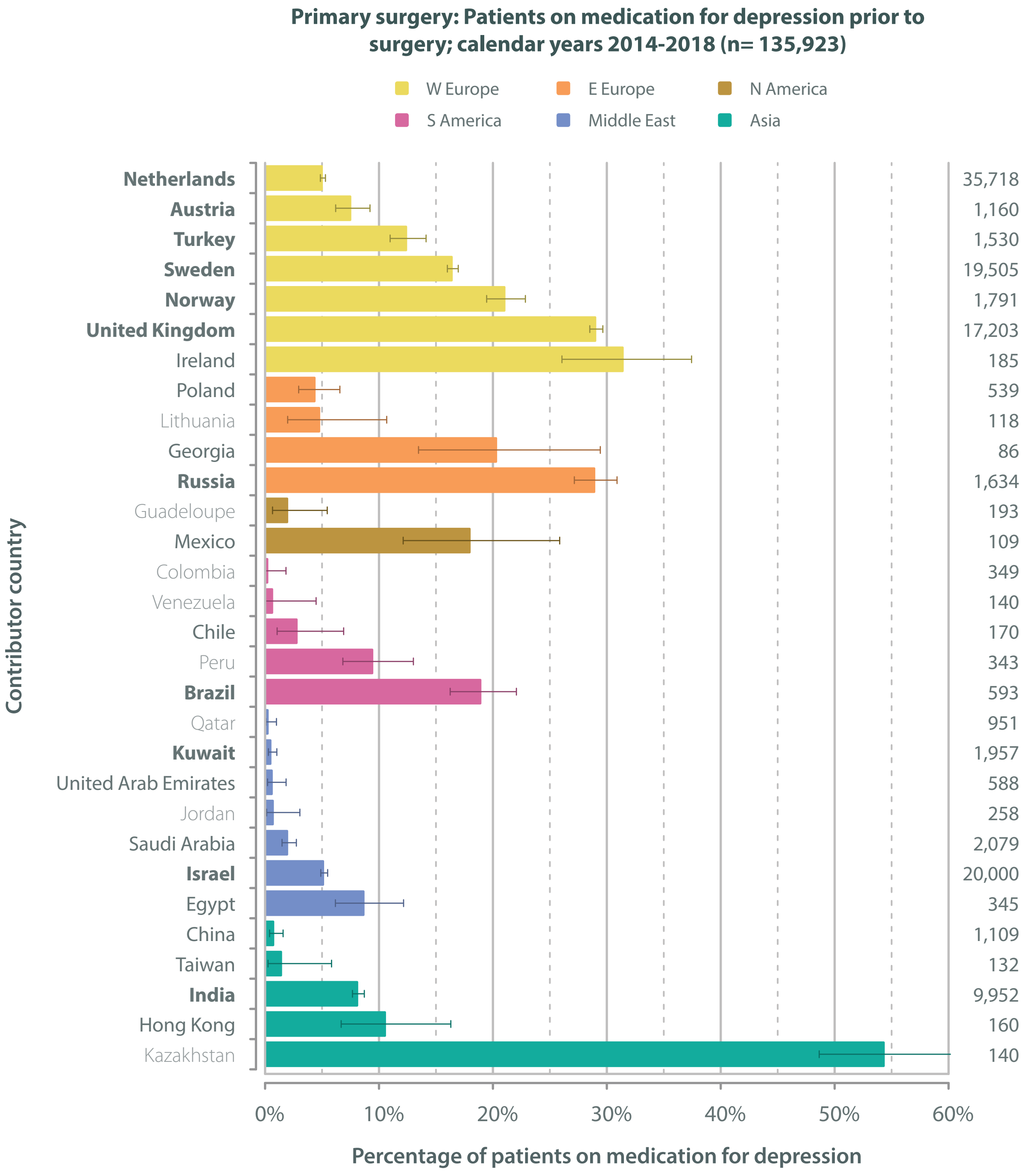
The graph below shows the rate of hypertension *per* country grouped according to region and increasing prevalence in each region. Again, there is widespread geographical variation in the prevalence of hypertension in bariatric surgery patients. In some countries hypertension is associated with diabetes as part of the *metabolic syndrome*. However, there is also strong ethnic propensity to one or the other condition. As hypertension is associated with central obesity, it would also be expected that this is a predictor of operative risk (more difficult laparoscopic surgery), and thus it is one of the factors included in the Obesity Surgery Mortality Risk Score (OSMRS) shown in a following section. Recording of the presence of hypertension is therefore needed as a prerequisite for comparing mortality between different series. The wide variation in the reported rates of hypertension between countries might indicate a need for standardization in the recording of blood pressure between different countries and surgical centres.

Primary surgery: Patients on medication for hypertension prior to surgery; calendar years 2014-2018 (n=142,157)



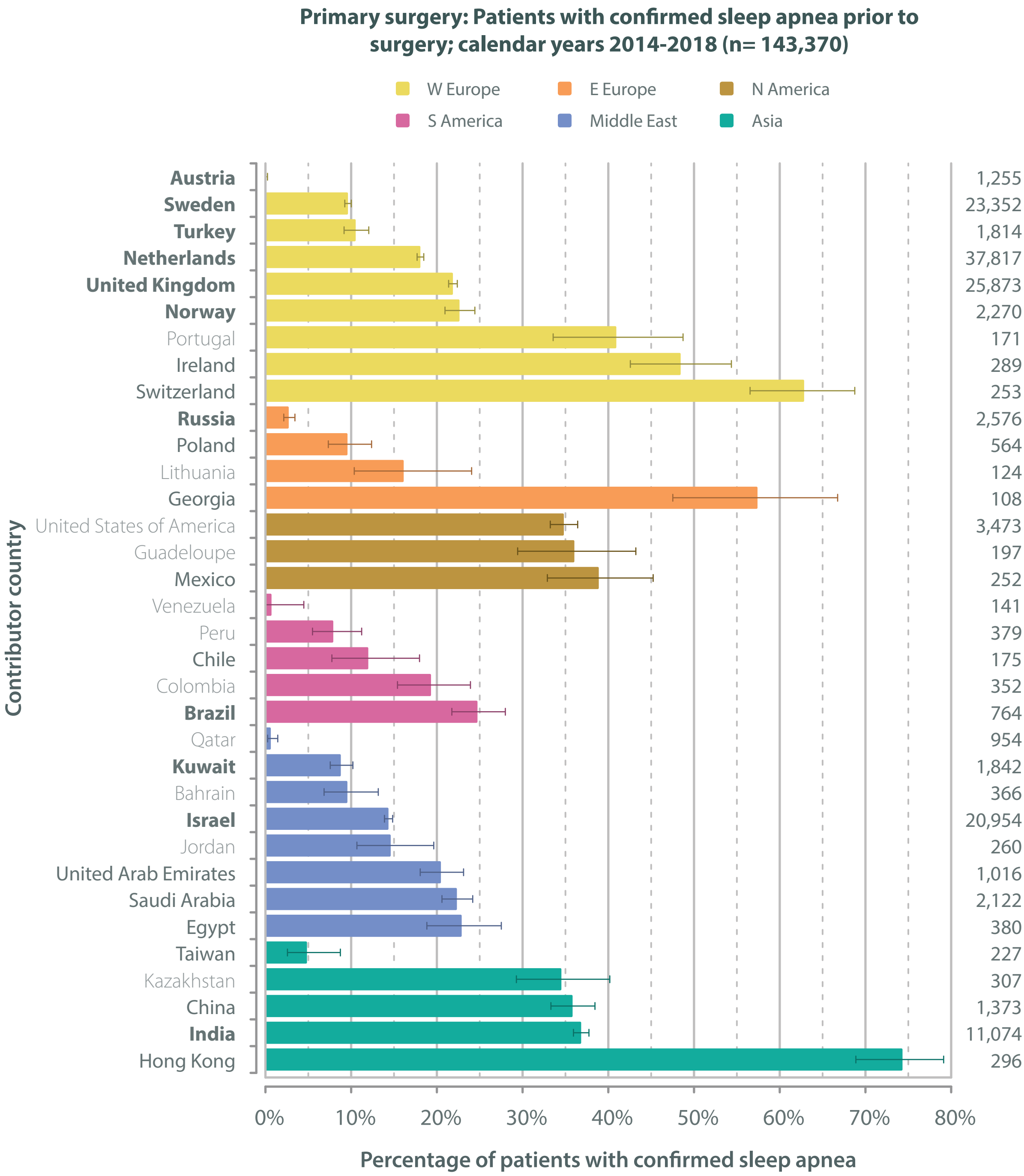
Depression

The graph below shows the rate of depression *per* country grouped according to geographical region and increasing prevalence in each region. Just looking at the data from countries submitting large numbers (those with national registries) there are significant differences. The most striking feature is the relatively high reported rates of depression in Western European counties. In contrast the rates of medication for depression recorded across most of the Middle East are only a few percent, and we do not know the reasons for this. Possibly selection of patients is a factor; however, countries with higher prevalence may need to put infrastructure in place to address the large amount of psychological disease that their patients are likely to have.



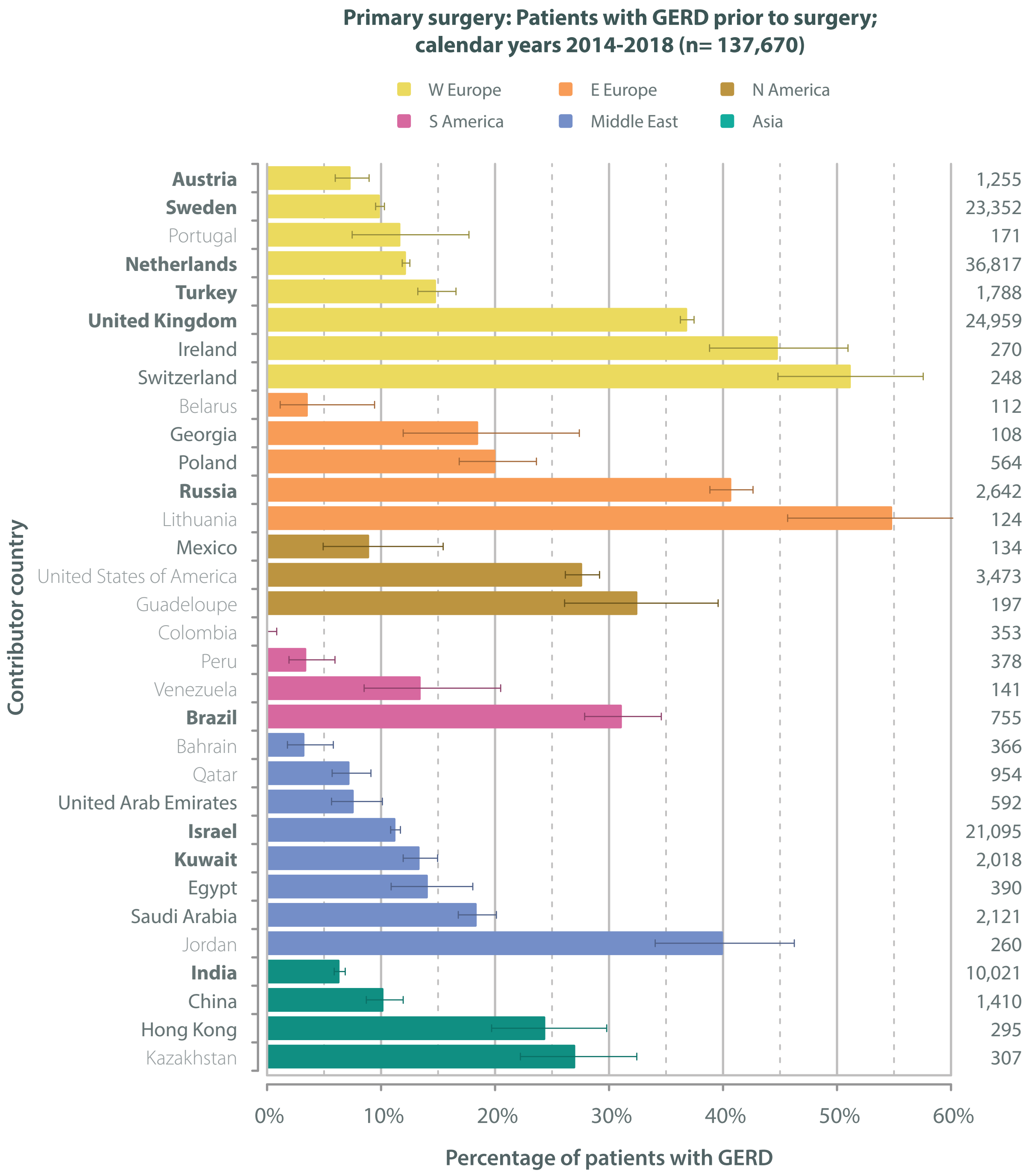
Sleep apnea

The graph below shows the rate of sleep apnea *per* country grouped according to region and increasing prevalence in each region. Sleep apnea is a major risk factor for post-operative complications after gastric bypass surgery. In future reports it may be possible to describe optimum pre-operative preparation of patients so that risk from sleep apnea is minimised, or even correlate prevalence of sleep apnea with complication rates after different operations.



Gastro-esophageal reflux disease

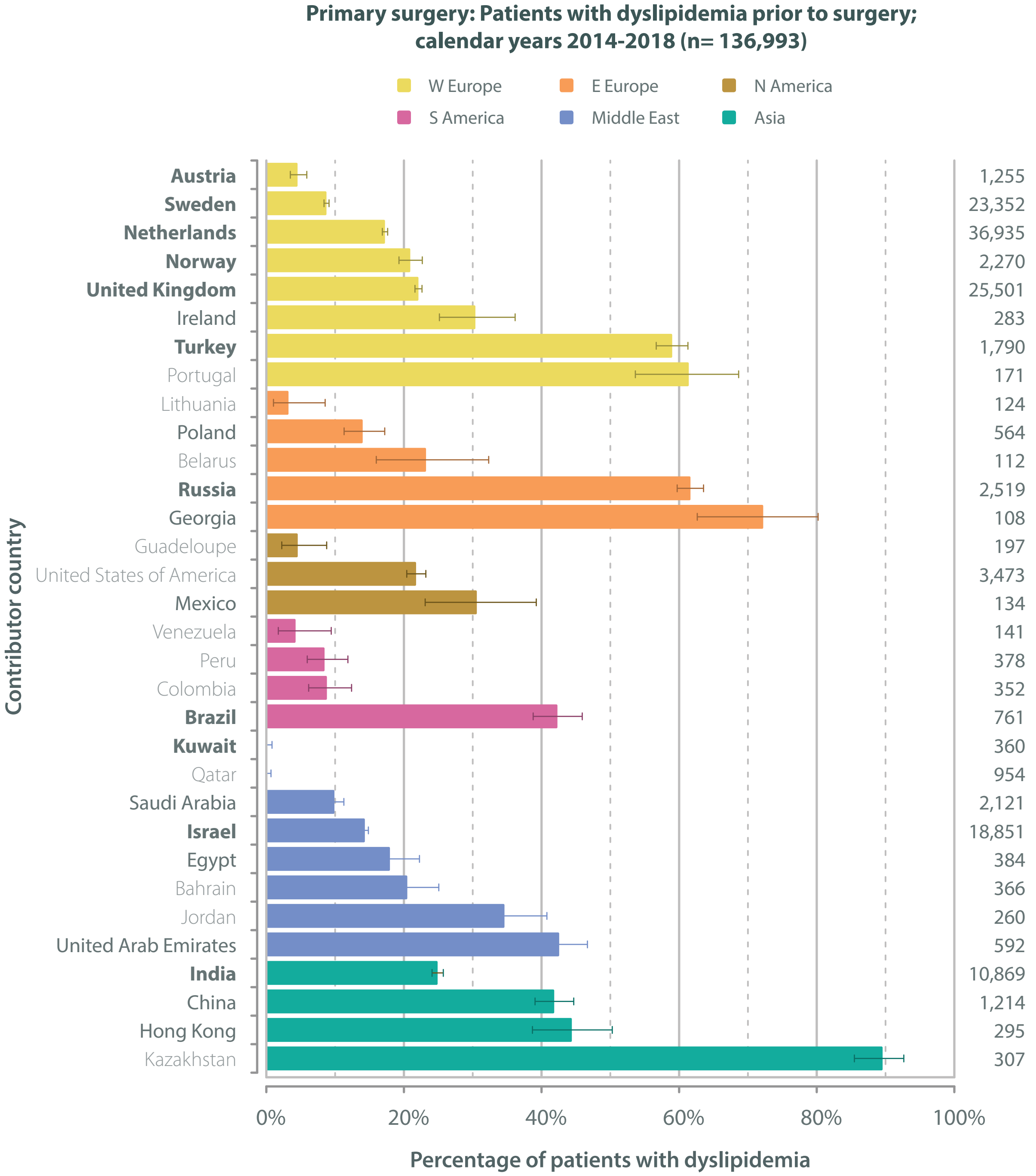
The graph below shows the rate of gastro-esophageal reflux disease (GERD) *per* country grouped according to geographical region and rising prevalence in each region. There is wide variation in reported rates of GERD across the contributor countries shown here. The rising popularity of sleeve gastrectomy year-on-year is interesting to note given the significant prevalence of GERD at presentation for surgery. Currently the long-term effects of having a sleeve gastrectomy in patients with pre-existing GERD are not known, and it is not known whether screening for Barrett's esophagus should be undertaken routinely for these patients before surgery.



Dyslipidemia

The graph below shows the rate of dyslipidemia *per* country grouped according to geographical region and increasing prevalence in each region. No distinction has been made between possible different definitions of dyslipidemia thus far in the Global Registry.

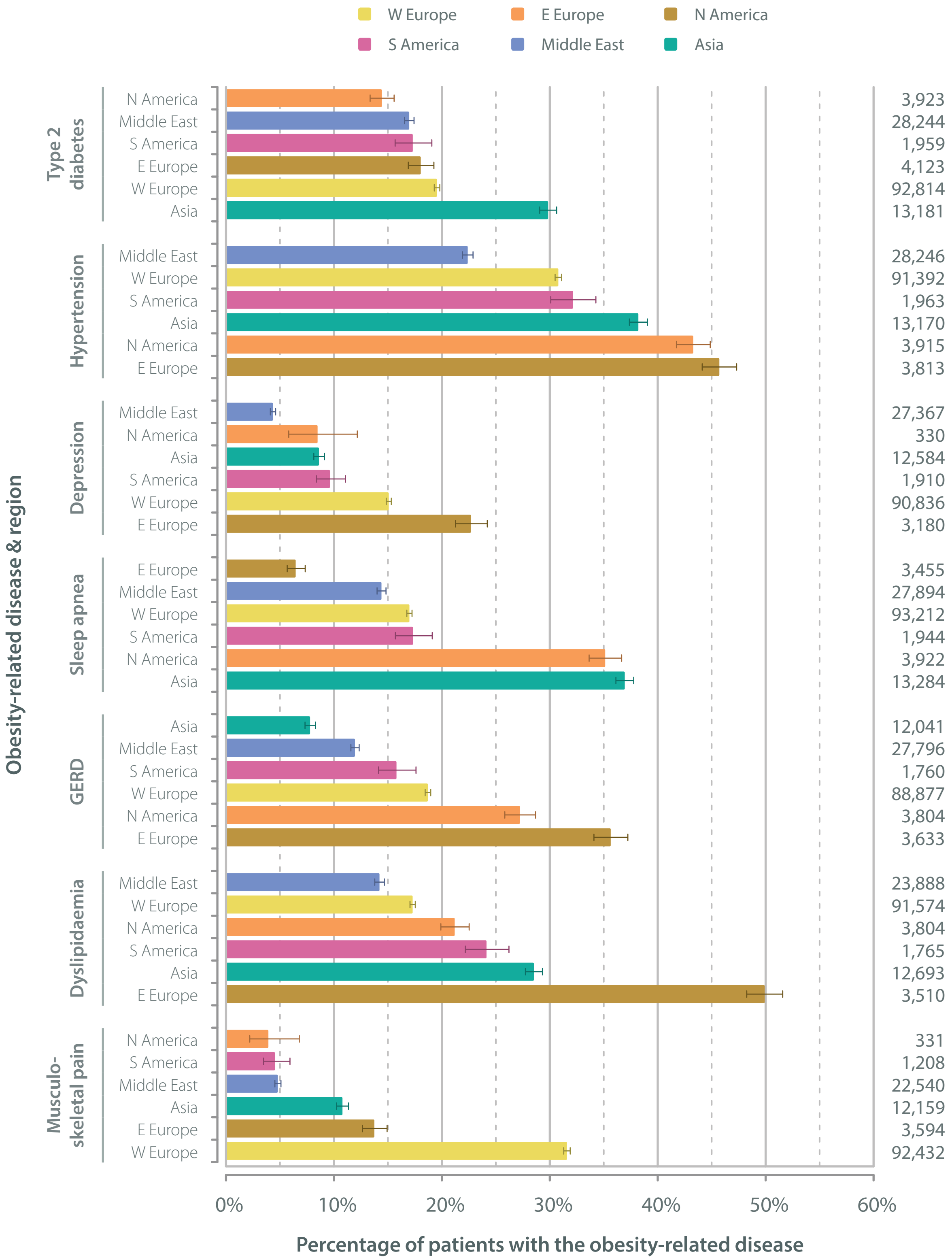
It is difficult to put any meaningful interpretation onto these variations in the reported rates of dyslipidemia, although, of course, there may be a genetic predisposition to acquisition of this condition in some patient populations.



Inter-region comparisons of obesity-related disease

Here we display the levels of the various obesity-related diseases recorded in the database, comparing rates in each geographic region. As more and more data accumulate over time, we will eventually achieve a clearer picture of differences and similarities in the rates of baseline obesity-related disease in patients having bariatric-metabolic surgery around the globe.

Primary surgery: Distributions of various obesity-related diseases by region; calendar years 2014-2018



Primary surgery: pre-operative obesity-related disease rates for high-volume contributors; calendar years 2014-2018

Region and obesity-related disease		Pre-operative obesity-related disease status				
		Absent	Present	Unspecified	Disease rate	Missing rate
W Europe	Diabetes	74,677	18,147	37,604	19.5%	28.8%
	Hypertension	63,251	28,141	39,036	30.8%	29.9%
	Depression	77,138	13,698	39,592	15.1%	30.4%
	Sleep apnea	77,373	15,839	37,216	17.0%	28.5%
	GERD	72,251	16,626	41,551	18.7%	31.9%
	Dyslipidemia	75,739	15,835	38,854	17.3%	29.8%
	Musculo-skeletal pain	63,232	29,200	37,996	31.6%	29.1%
E Europe	Diabetes	3,379	744	68	18.0%	1.6%
	Hypertension	2,070	1,743	378	45.7%	9.0%
	Depression	2,458	722	1,011	22.7%	24.1%
	Sleep apnea	3,232	223	736	6.5%	17.6%
	GERD	2,338	1,295	558	35.6%	13.3%
	Dyslipidemia	1,758	1,752	681	49.9%	16.2%
	Musculo-skeletal pain	3,100	494	597	13.7%	14.2%
N America	Diabetes	3,357	566	0	14.4%	0.0%
	Hypertension	2,220	1,695	8	43.3%	0.2%
	Depression	302	28	3,593	8.5%	91.6%
	Sleep apnea	2,544	1,378	1	35.1%	0.0%
	GERD	2,768	1,036	119	27.2%	3.0%
	Dyslipidemia	2,998	806	119	21.2%	3.0%
	Musculo-skeletal pain	318	13	3,592	3.9%	91.6%
S America	Diabetes	1,620	339	34	17.3%	1.7%
	Hypertension	1,332	631	30	32.1%	1.5%
	Depression	1,726	184	83	9.6%	4.2%
	Sleep apnea	1,607	337	49	17.3%	2.5%
	GERD	1,482	278	233	15.8%	11.7%
	Dyslipidemia	1,339	426	228	24.1%	11.4%
	Musculo-skeletal pain	1,153	55	785	4.6%	39.4%
Middle East	Diabetes	23,449	4,795	7,052	17.0%	20.0%
	Hypertension	21,920	6,326	7,050	22.4%	20.0%
	Depression	26,178	1,189	7,929	4.3%	22.5%
	Sleep apnea	23,876	4,018	7,402	14.4%	21.0%
	GERD	24,475	3,321	7,500	11.9%	21.2%
	Dyslipidemia	20,491	3,397	11,408	14.2%	32.3%
	Musculo-skeletal pain	21,458	1,082	12,756	4.8%	36.1%
Asia	Diabetes	9,247	3,934	707	29.8%	5.1%
	Hypertension	8,138	5,032	718	38.2%	5.2%
	Depression	11,500	1,084	1,304	8.6%	9.4%
	Sleep apnea	8,376	4,908	604	36.9%	4.3%
	GERD	11,103	938	1,847	7.8%	13.3%
	Dyslipidemia	9,072	3,621	1,195	28.5%	8.6%
	Musculo-skeletal pain	10,847	1,312	1,729	10.8%	12.4%

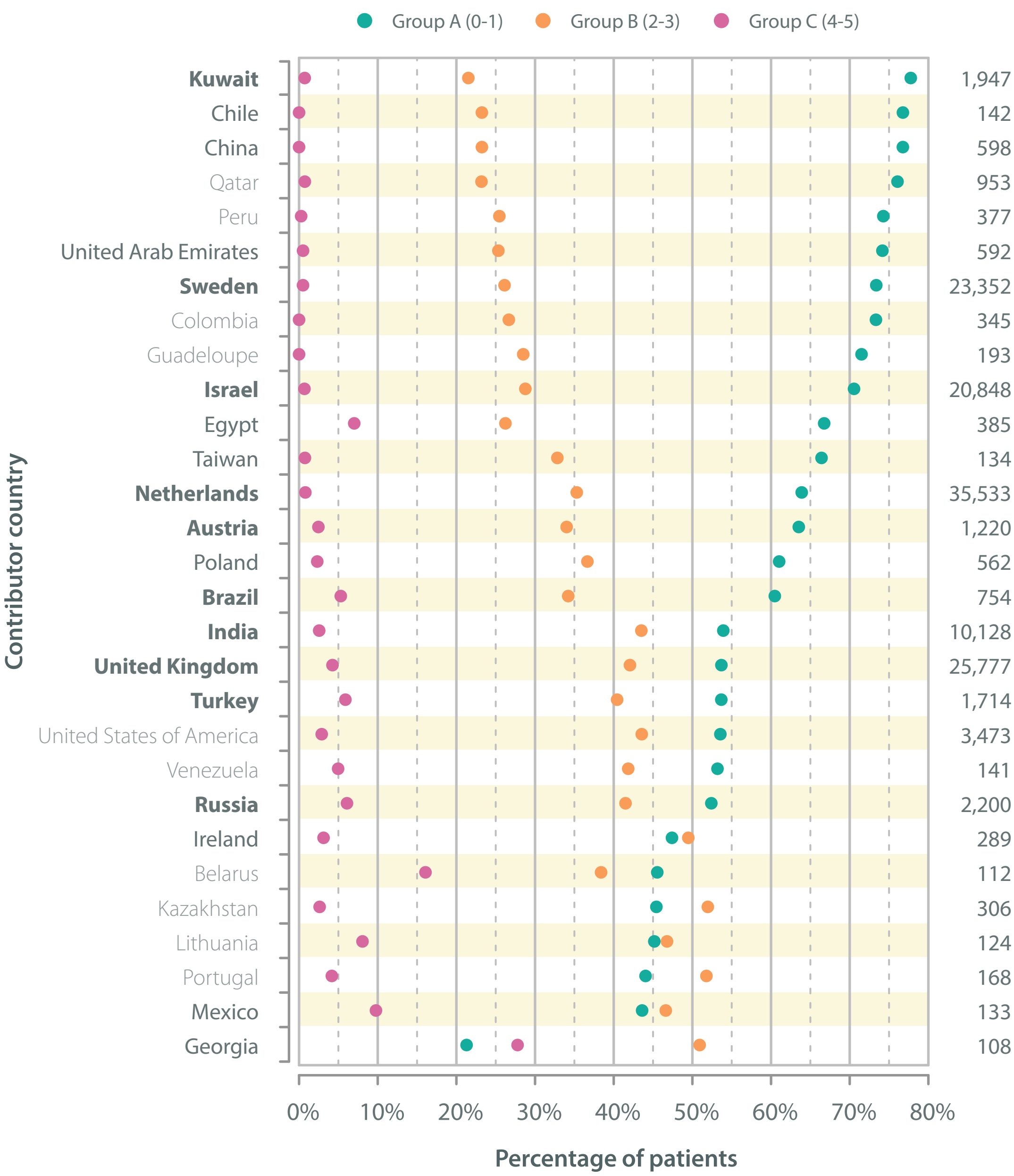
Obesity Surgery Mortality Risk Score

The Obesity Surgery Mortality Risk Score (OSMRS) stratifies patients undergoing bariatric surgery into three categories depending on how many of the following risk factors they possess (each risk factor scores one point): male gender; age ≥45 years at the time of surgery; BMI >50 kg m^{-2}; hypertension; risk factors for deep vein thrombosis / pulmonary embolus. The total score in points is then used to allocate patients into three groups: Group A (0-1 points); Group B (2-3 points); and Group C (4-5 points). These groups are considered low, medium and high risk respectively.

The utility of OSMRS risk scoring needs further assessment in the context of the practice of modern day laparoscopic bariatric-metabolic surgery, especially given the very low in-hospital mortality rates following these procedures. It may be that the score is useful to predict other composite outcomes, rather than mortality *per* se, and it is certainly useful to quickly stratify different patient populations into broad risk groups.

The chart shows the countries ordered according to decreasing rates of Group A patients.

Primary surgery: OSMRS group; calendar years 2014-2018



Primary surgery: Obesity Surgery Mortality Risk Score; calendar years 2014-2018

Contributor country	OSMRS group				
	A (0-1)	**B** (2-3)	**C** (4-5)	**Unspecified**	**All**
Argentina	26	28	0	0	**54**
Australia	0	0	0	284	**284**
Austria	775	415	30	35	**1,255**
Bahrain	0	0	0	366	**366**
Belarus	51	43	18	0	**112**
Belgium	0	0	0	1,434	**1,434**
Bolivia	62	15	1	1	**79**
Brazil	456	258	40	54	**808**
Bulgaria	5	10	3	0	**18**
Chile	109	33	0	33	**175**
China	459	139	0	1,350	**1,948**
Colombia	253	92	0	11	**356**
Egypt	257	101	27	19	**404**
France	0	0	0	55	**55**
Georgia	23	55	30	0	**108**
Germany	15	6	1	0	**22**
Guadeloupe	138	55	0	4	**197**
Guatamala	0	0	0	127	**127**
Hong Kong	32	64	0	200	**296**
Hungary	40	23	2	0	**65**
India	5,462	4,407	259	960	**11,088**
Ireland	137	143	9	0	**289**
Israel	14,708	5,997	143	7,281	**28,129**
Italy	0	0	0	32,864	**32,864**
Jordan	0	0	0	260	**260**
Kazakhstan	139	159	8	1	**307**
Kuwait	1,514	419	14	98	**2,045**
Lithuania	56	58	10	0	**124**
Mexico	58	62	13	120	**253**
Netherlands	22,705	12,543	285	2,286	**37,819**
Norway	0	0	0	3,571	**3,571**
Panama	34	12	0	1	**47**
Peru	280	96	1	2	**379**
Poland	343	206	13	2	**564**
Portugal	74	87	7	3	**171**
Qatar	725	221	7	1	**954**
Russia	1,153	913	134	1,000	**3,200**
Saudi Arabia	27	9	0	2,086	**2,122**
South Korea	7	1	0	0	**8**
Spain	19	14	5	3	**41**
Sweden	17,135	6,100	117	0	**23,352**
Switzerland	0	0	0	256	**256**
Taiwan	89	44	1	107	**241**
Turkey	920	693	101	1,061	**2,775**
United Arab Emirates	439	150	3	424	**1,016**
United Kingdom	13,839	10,843	1,095	747	**26,524**
United States of America	1,860	1,513	100	0	**3,473**
Venezuela	75	59	7	1	**142**
All	**84,499**	**46,086**	**2,484**	**57,108**	**190,177**

Surgery

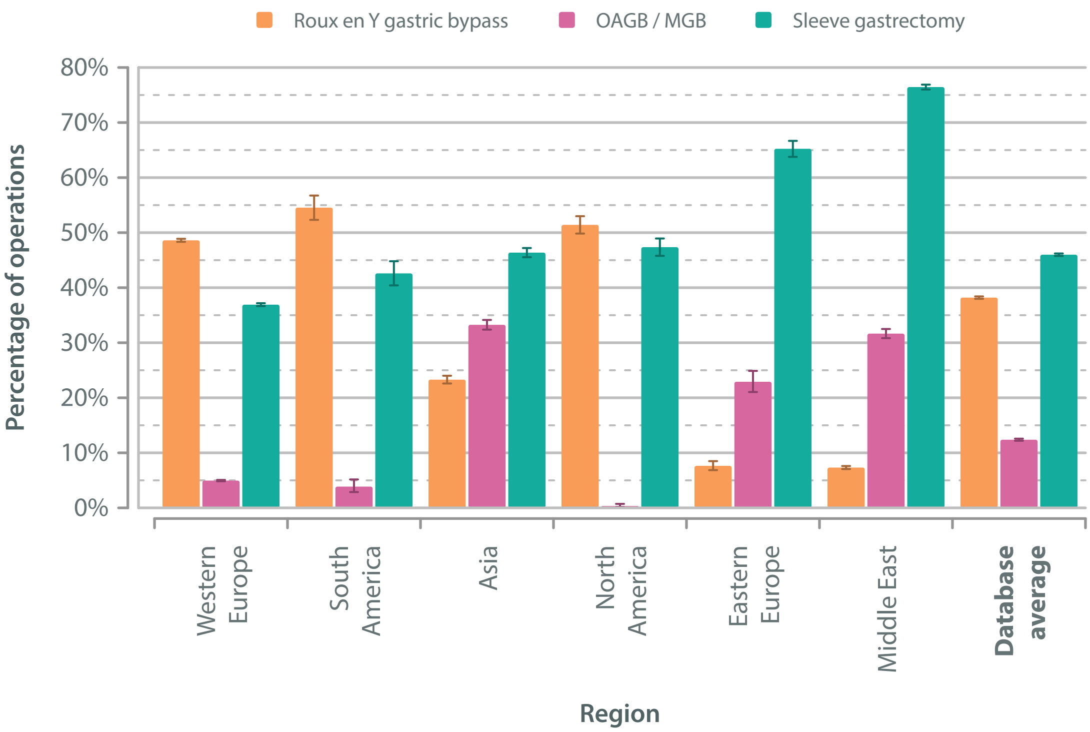
Type of surgery

The following section describes the pattern of current surgical practice as recorded in the IFSO Global Registry. Roux en Y gastric bypass and sleeve gastrectomy are the most commonly-recorded procedures. For the first time, one anastomosis gastric bypass / mini gastric bypass (OAGB / MGB) procedures have been included in the classification of operations, so we now have better feel for the frequency with which these operations are carried out. Despite the small numbers recorded, OAGB / MGB has become the second most common procedure in Asia, Eastern Europe & the Middle East after sleeve gastrectomy in each case. Roux en Y gastric bypass still predominates in other regions.

Primary surgery: operations performed; calendar years 2014-2018

Operation	Count	Percentage
Gastric band	9,534	5.0%
Roux en Y gastric bypass	72,639	38.3%
OAGB / MGB	14,516	7.7%
Gastric bypass (NOS)[1]	1,701	0.9%
Sleeve gastrectomy	87,015	45.9%
Bilio-pancreatic diversion	267	0.1%
Duodenal switch	61	0.0%
Duodenal switch with sleeve	319	0.2%
Other	3,667	1.9%
All	**189,719**	

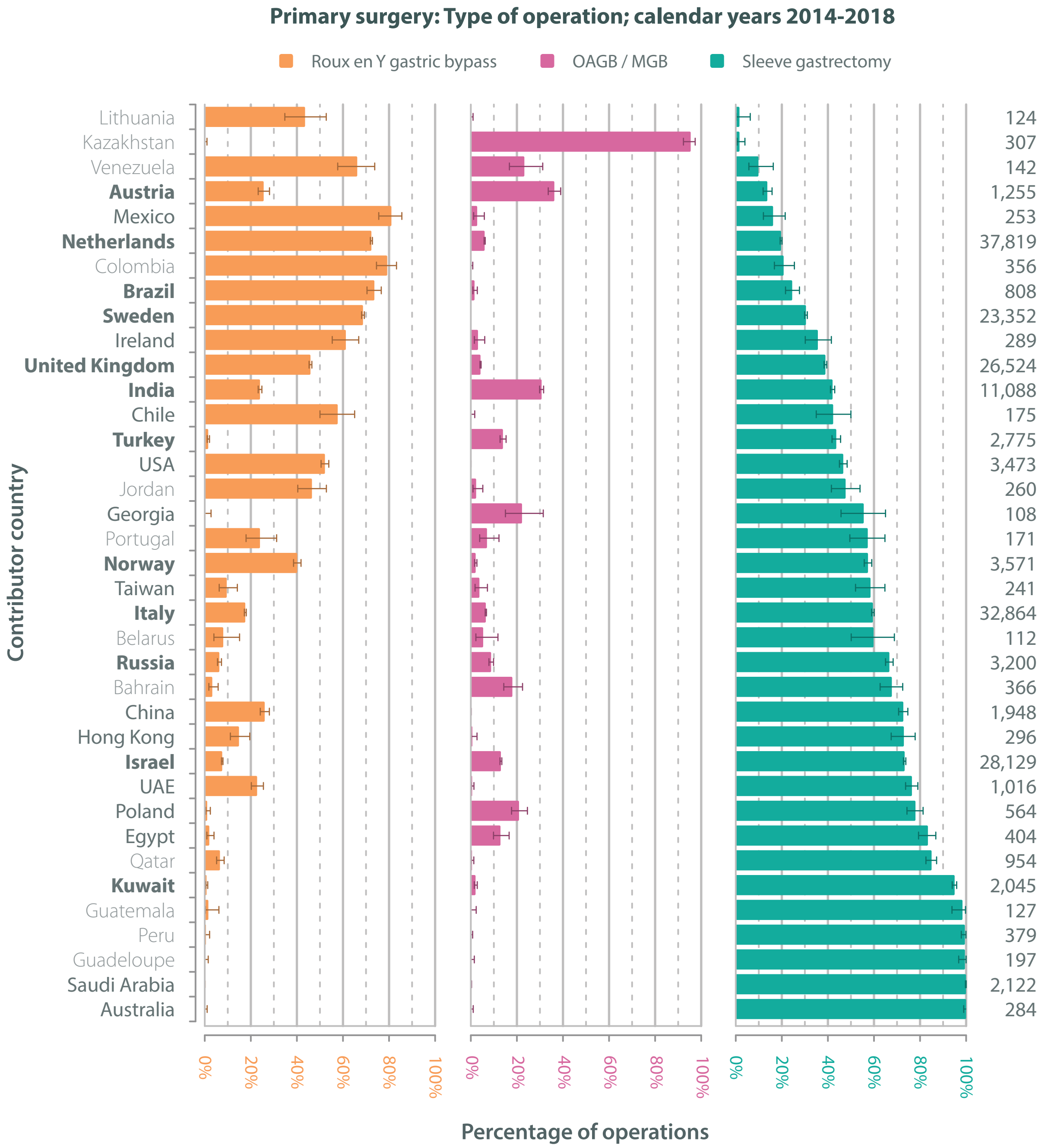
Primary surgery: Type of operation; calendar years 2014-2018 (n=190,177)



1. Not otherwise specified: no data available to determine whether the operation was a Roux en Y procedure or a mini-gastric bypass.

Here we show a comparison of the rates of the three most common bariatric operations on a country-by-country basis (ordered by increasing reported rates of sleeve gastrectomy). The nature of the visual display very clearly shows that there is wide variation in the rates of each kind of operation, which may reflect traditional practice. Caution must be used in interpreting data where the numbers *per* country are low and therefore may not be representative of whole-country practice.

We should not over analyse the information shown in the chart below, as they are only a snapshot of *current* practice, and, as we show on the following pages, the patterns of practice of bariatric surgery are changing rapidly over time: sleeve gastrectomy is becoming the operation of choice in many countries, coupled with an upsurge in OAGB / MGB procedures, which together seem to be supplanting the previous dominance of Roux en Y gastric bypass. The rates of gastric banding have been in significant and consistent decline for a number of years.

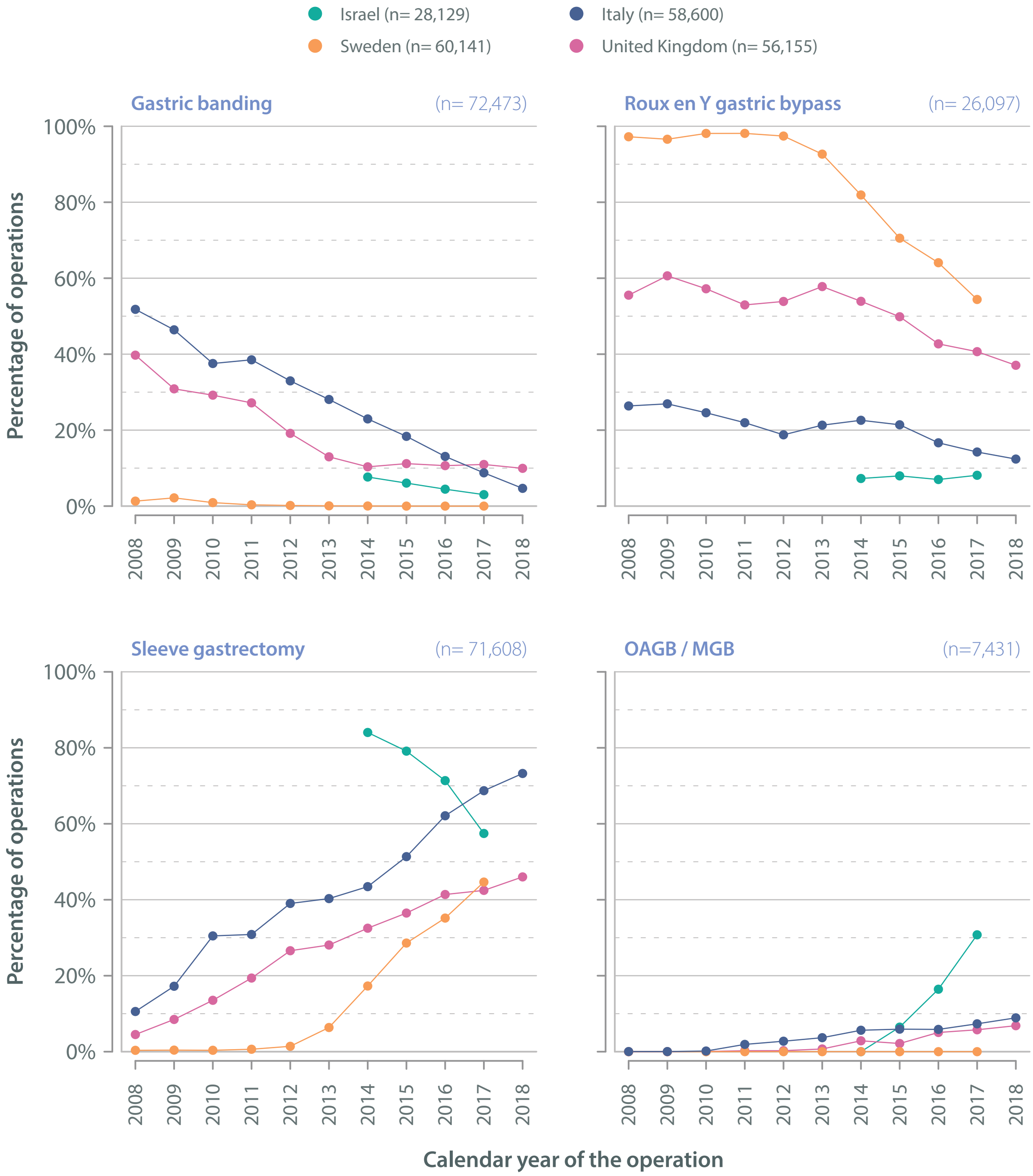


The data here from four selected national registries clearly show evolving trends in the kinds of operations being performed over time. The general trend is for a reduction in the rates of gastric banding and Roux en Y gastric bypass procedures being performed over the last 11 years.

Amongst this group of four, it is notable that in Israel alone there seems to be a change in preference from sleeve gastrectomy towards the use of OAGB / MGB.

The practice of bariatric surgery is clearly in flux, and it will be very interesting to see how these trends progress over the next few years.

Primary surgery: Changes in the kinds of operations over time within selected contributor countries; calendar years 2014-2018



Operative approach

The rapid expansion of bariatric surgery over the last 25 years has mirrored the development of laparoscopic techniques. The following table shows the prevalence of the laparoscopic approach for the different operations.

Over 99% of all operations were performed laparoscopically, an achievement that could not have been forecast even 20-25 years ago, when obesity was generally considered a contra-indication to laparoscopic surgery. To some extent it is surprising that any open operations are being performed in this current era.

Primary surgery: operative approach; calendar years 2014-2018

Operation	Approach: Laparoscopic	Laparoscopic converted to open	Endoscopic	Open	Unspecified
Counts					
Gastric band	4,949	4	4	2	4,575
Roux en Y gastric bypass	66,551	92	4	183	5,815
OAGB / MGB	12,206	3	4	24	2,279
Sleeve gastrectomy	67,471	69	21	177	19,729
All	**153,981**	**184**	**116**	**773**	**35,123**
Percentages					
Gastric band	99.80%	0.08%	0.08%	0.04%	
Roux en Y gastric bypass	99.58%	0.14%	0.01%	0.27%	
OAGB / MGB	99.75%	0.02%	0.03%	0.20%	
Sleeve gastrectomy	99.61%	0.10%	0.03%	0.26%	
All	**99.31%**	**0.12%**	**0.07%**	**0.50%**	

Analysis

Outcomes

Post-operative stay

The table and graph below are the fourth international comparison of post-operative length-of-stay between the 3 most common kinds of operation recorded in the registry: Roux en Y gastric bypass, one anastomosis gastric bypass (OAGB / MGB) and sleeve gastrectomy.

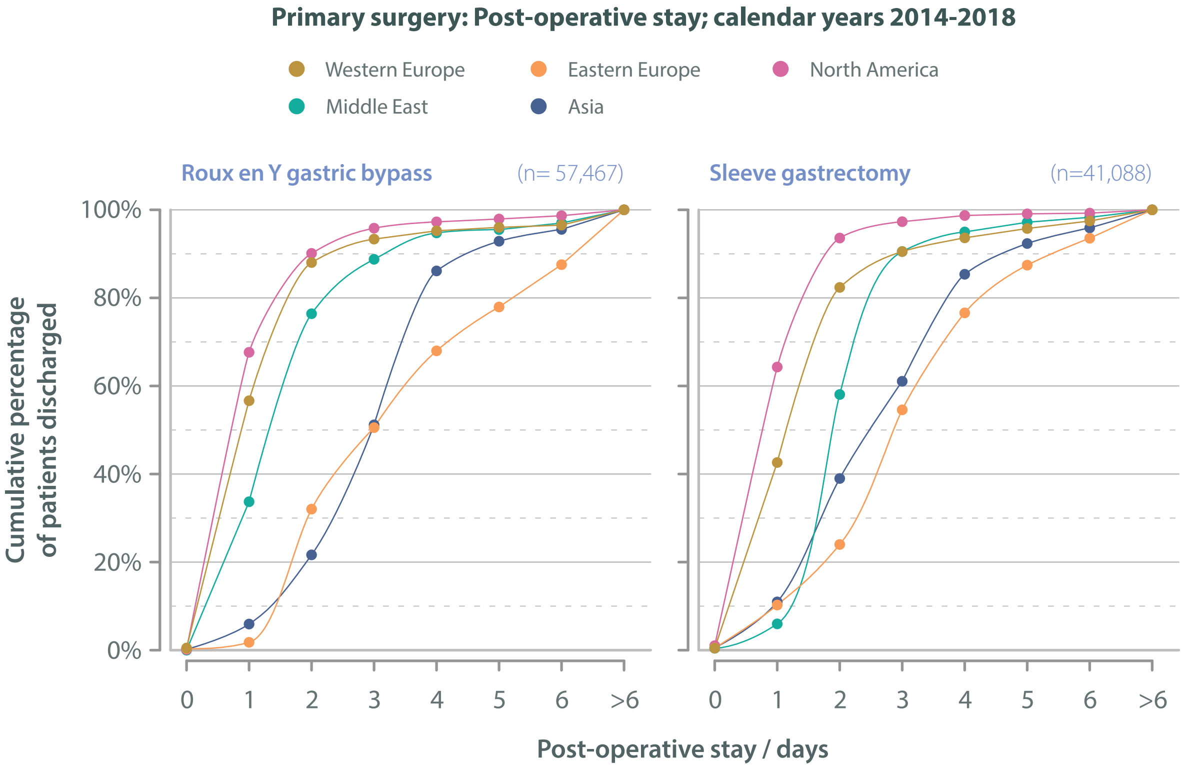
Primary surgery: post-operative stay for the most frequently performed operations; calendar years 2014-2018

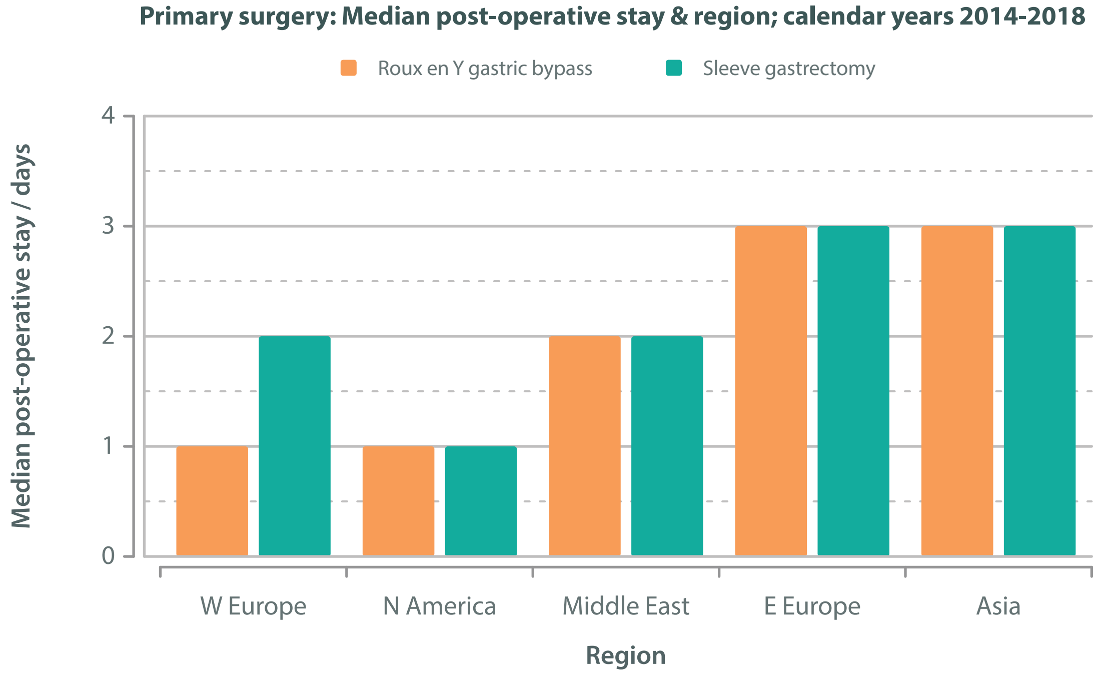
Operation and region		Post-operative stay					
		0 days	1 day	2 days	3 days	>3 days	Unspecified
Roux en Y gastric bypass	Western Europe	249	28,642	16,006	2,713	3,393	12,392
	Eastern Europe	1	4	85	52	139	39
	North America	3	1,358	452	115	84	5
	South America	8	102	528	71	25	353
	Middle East	0	90	114	33	30	2,318
	Asia	6	182	498	936	1,548	65
	Database total	**267**	**30,378**	**17,686**	**3,922**	**5,220**	**15,172**
OAGB / MGB	Western Europe	44	1,881	748	425	680	2,690
	Eastern Europe	1	99	27	63	229	14
	South America	0	8	34	2	1	1
	Middle East	3	18	75	35	23	3,697
	Asia	6	287	993	793	1,614	18
	Database total	**54**	**2,293**	**1,884**	**1,318**	**2,547**	**6,420**
Sleeve gastrectomy	Western Europe	113	10,342	9,753	1,999	2,325	23,619
	Eastern Europe	12	231	326	725	1,077	363
	North America	19	1,175	544	69	50	1
	South America	2	363	236	59	29	160
	Middle East	24	312	2,931	1,827	533	21,356
	Asia	34	625	1,685	1,327	2,341	428
	Database total	**212**	**13,054**	**15,591**	**6,008**	**6,384**	**46,218**

After Roux en Y gastric bypass, 50% of patients are discharged by around one day after surgery in Western Europe and North America, whereas it is about one-and-a-half days before half of the Middle Eastern patients have been discharged; it is around three days in both Eastern Europe and Asia before half the patients have been sent home.

The general patterns around the timing of discharge after sleeve gastrectomy are very similar, with half of North American and Western European patients staying only one day post-operatively, half of the patients in the Middle East being released from hospital by the second post-operative day; in Eastern Europe and Asia bariatric surgery patients have the longest post-operative, in-hospital recovery period, with half discharged at around three days after surgery.

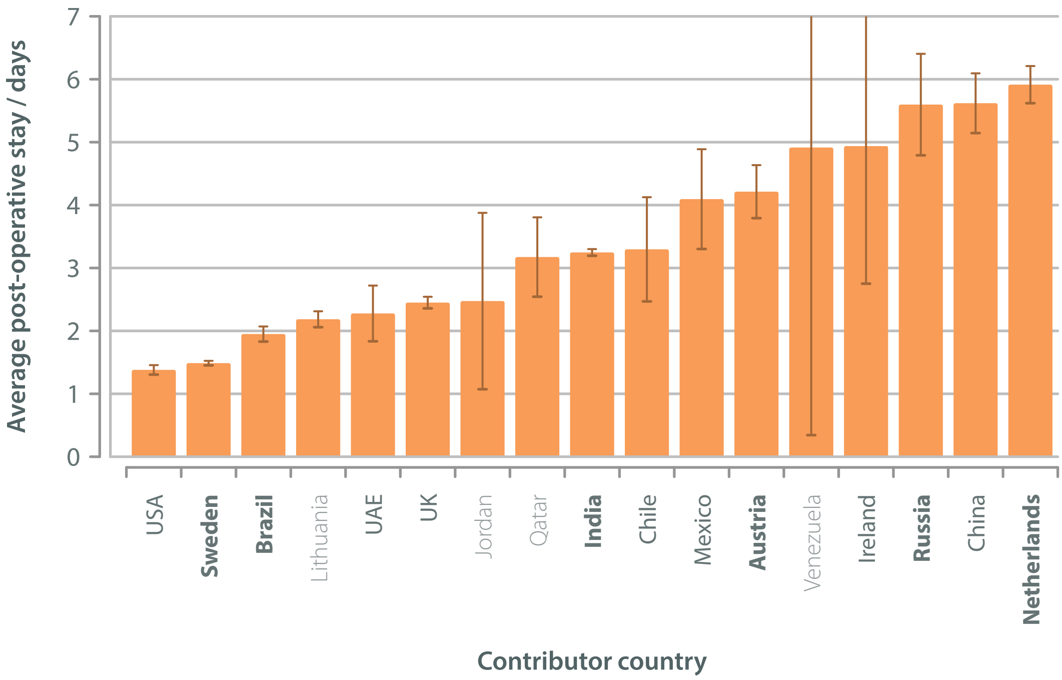
Data presented here show cumulative discharge rate after surgery for the two most common operations: Roux en Y gastric bypass and sleeve gastrectomy.



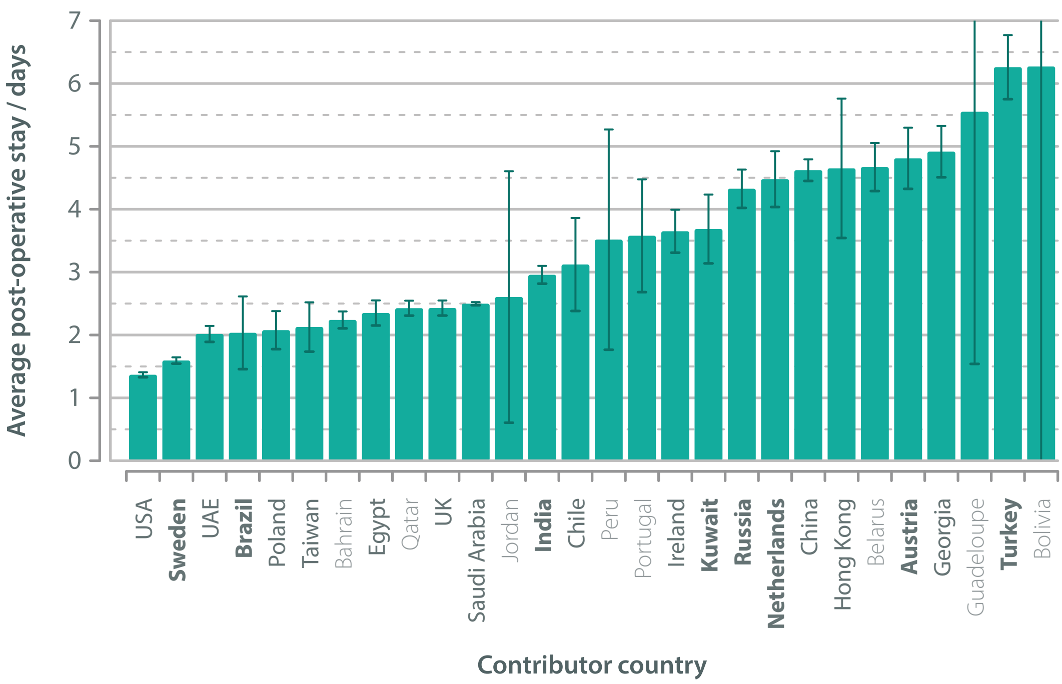


The charts below shows the **average** post-operative length-of-stay for the two most commonly recorded operations *per* country, arranged in ascending order of average stay. There are clear differences between countries; at the extremes, there are huge differences. This is presumably, at least in part, due to variations in local practice.

Primary Roux en Y gastric bypass surgery: Average post-operative stay with 95% confidence interval; calendar years 2014-2018



Primary sleeve gastrectomy surgery: Average post-operative stay with 95% confidence interval; calendar years 2014-2018



Primary Roux en Y gastric bypass: Post operative stay statistics; calendar years 2014-2018

Country	Count	Average / days (95% CI)	Median / days (IQR)
		Post operative stay statistics	
Austria	281	4.21 (3.79-4.63)	3.0 (4.0-4.0)
Brazil	524	1.95 (1.83-2.07)	2.0 (2.0-2.0)
Chile	101	3.30 (2.47-4.13)	2.0 (3.0-3.0)
China	460	5.62 (5.14-6.09)	3.0 (5.0-6.0)
India	2,642	3.25 (3.19-3.30)	2.5 (3.0-4.0)
Ireland	176	4.94 (2.75-7.12)	3.0 (3.0-4.0)
Jordan	118	2.47 (1.07-3.88)	1.0 (1.0-2.0)
Lithuania	54	2.19 (2.06-2.31)	2.0 (2.0-2.0)
Mexico	200	4.10 (3.30-4.89)	2.0 (3.0-4.0)
Netherlands	23,069	5.91 (5.62-6.21)	1.0 (1.0-2.0)
Qatar	63	3.17 (2.54-3.81)	2.0 (3.0-3.0)
Russia	164	5.60 (4.79-6.40)	3.0 (4.0-6.0)
Sweden	16,037	1.49 (1.45-1.52)	1.0 (1.0-2.0)
United Arab Emirates	54	2.28 (1.83-2.72)	2.0 (2.0-2.0)
United Kingdom	11,344	2.45 (2.36-2.54)	2.0 (2.0-2.0)
United States of America	1,812	1.38 (1.31-1.46)	1.0 (1.0-2.0)
Venezuela	94	4.91 (0.34-9.49)	2.0 (2.0-2.0)

Primary sleeve gastrectomy: Post operative stay statistics; calendar years 2014-2018

Country	Count	Average / days (95% CI)	Median / days (IQR)
		Post operative stay statistics	
Austria	169	4.81 (4.32-5.30)	4.0 (4.0-5.0)
Bahrain	246	2.24 (2.10-2.37)	2.0 (2.0-2.0)
Belarus	67	4.67 (4.29-5.05)	4.0 (4.0-5.0)
Bolivia	70	6.27 (-3.71-16.25)	1.0 (1.0-1.0)
Brazil	114	2.04 (1.46-2.61)	1.0 (2.0-2.0)
Chile	74	3.12 (2.38-3.86)	2.0 (3.0-3.0)
China	1,213	4.62 (4.45-4.79)	3.0 (4.0-6.0)
Egypt	308	2.35 (2.15-2.55)	1.0 (2.0-3.0)
Georgia	60	4.92 (4.51-5.33)	4.0 (5.0-6.0)
Guadaloupe	196	5.55 (1.54-9.56)	2.0 (2.0-2.0)
Hong Kong	215	4.65 (3.54-5.76)	3.0 (4.0-5.0)
India	4,437	2.96 (2.82-3.10)	2.0 (3.0-4.0)
Ireland	103	3.65 (3.31-3.99)	3.0 (3.0-4.0)
Jordan	119	2.61 (0.60-4.61)	1.0 (1.0-2.0)
Kuwait	1,500	3.69 (3.14-4.23)	2.0 (3.0-4.0)
Netherlands	6,609	4.48 (4.04-4.92)	1.0 (1.0-2.0)
Peru	377	3.52 (1.77-5.27)	1.0 (1.0-2.0)
Poland	440	2.08 (1.77-2.38)	1.0 (1.0-2.0)
Portugal	95	3.58 (2.68-4.48)	2.0 (3.0-3.0)
Qatar	806	2.43 (2.31-2.55)	2.0 (2.0-3.0)
Russia	1,771	4.33 (4.02-4.63)	3.0 (4.0-5.0)
Saudi Arabia	2,121	2.50 (2.47-2.52)	2.0 (2.0-3.0)
Sweden	7,116	1.59 (1.54-1.65)	1.0 (1.0-2.0)
Taiwan	141	2.13 (1.74-2.52)	1.0 (2.0-2.0)
Turkey	956	6.26 (5.75-6.77)	4.0 (5.0-6.0)
United Arab Emirates	527	2.02 (1.89-2.14)	2.0 (2.0-2.0)
United Kingdom	9,472	2.43 (2.31-2.55)	2.0 (2.0-2.0)
United States of America	1,621	1.37 (1.33-1.41)	1.0 (1.0-2.0)

Analysis

Availability of follow up data

The table below shows the availability of one-year follow up for percentage weight loss (the upper half of the table) and treatment for type 2 diabetes (the lower half of the table). This is intended to provide some idea of the breadth and depth of data in follow up that are available for analysis.

The calendar years in the table rows are the years in which the primary surgery took place. At the time this report was assembled, not surprisingly none of the patients treated in 2018 had one-year follow up data simply because not enough time had elapsed after the operation for this to be possible. Likewise, very few of the patients who had their operation in 2017 had one-year follow up data because the data were submitted before these follow up data-items could be collected.

All of the patients treated prior to 2017 were eligible for one-year follow up, but not every patient had these data recorded.

It is interesting that just over half of all patients who had a Roux en Y gastric bypass procedure had one-year follow up recorded, whereas around just under one-third of sleeve gastrectomy patients had follow up data at this time-point.

All of the following analyses based on follow up data should be viewed with this in mind.

Primary surgery in the calendar years 2012-2018; availability of one-year follow up data for two parameters

Operation and availability of percentage weight loss at one year

Calendar year	Roux en Y gastric bypass			Sleeve gastrectomy			All		
	Known	Not known	Percent known	Known	Not known	Percent known	Known	Not known	Percent known
2012	7,491	5,484	57.7%	2,328	4,585	33.7%	11,592	13,266	46.6%
2013	7,458	6,241	54.4%	2,595	6,334	29.1%	11,654	16,200	41.8%
2014	10,142	6,943	59.4%	4,147	13,241	23.8%	15,972	24,525	39.4%
2015	10,750	7,520	58.8%	5,738	14,115	28.9%	18,048	26,299	40.7%
2016	10,071	7,940	55.9%	7,132	14,478	33.0%	18,927	28,388	40.0%
2017	931	16,795	5.3%	1,465	23,088	6.0%	2,686	48,786	5.2%
2018	0	1,553	0.0%	0	4,063	0.0%	0	6,546	0.0%
All	**46,843**	**52,476**	**47.2%**	**23,405**	**79,904**	**22.7%**	**78,879**	**164,010**	**32.5%**

Operation and availability of type 2 diabetes at one year

Calendar year	Roux en Y gastric bypass			Sleeve gastrectomy			All		
	Known	Not known	Percent known	Known	Not known	Percent known	Known	Not known	Percent known
2012	6,484	6,491	50.0%	959	5,954	13.9%	7,924	16,934	31.9%
2013	6,492	7,207	47.4%	1,040	7,889	11.6%	7,899	19,955	28.4%
2014	9,005	8,080	52.7%	2,404	14,984	13.8%	12,028	28,469	29.7%
2015	9,282	8,988	50.8%	3,228	16,625	16.3%	13,162	31,185	29.7%
2016	9,082	8,929	50.4%	4,025	17,585	18.6%	13,941	33,374	29.5%
2017	726	17,000	4.1%	660	23,893	2.7%	1,543	49,929	3.0%
2018	0	1,553	0.0%	0	4,063	0.0%	0	6,546	0.0%
All	**41,071**	**58,248**	**41.4%**	**12,316**	**90,993**	**11.9%**	**56,497**	**186,392**	**23.3%**

One-year weight loss

We present weight loss data here as percentage weight loss. Percentage weight loss (%PWL) has been defined as:

$$\text{Percentage weight loss} = \frac{\text{initial weight (kg) - current weight (kg)}}{\text{initial weight (kg)}} \times 100\%$$

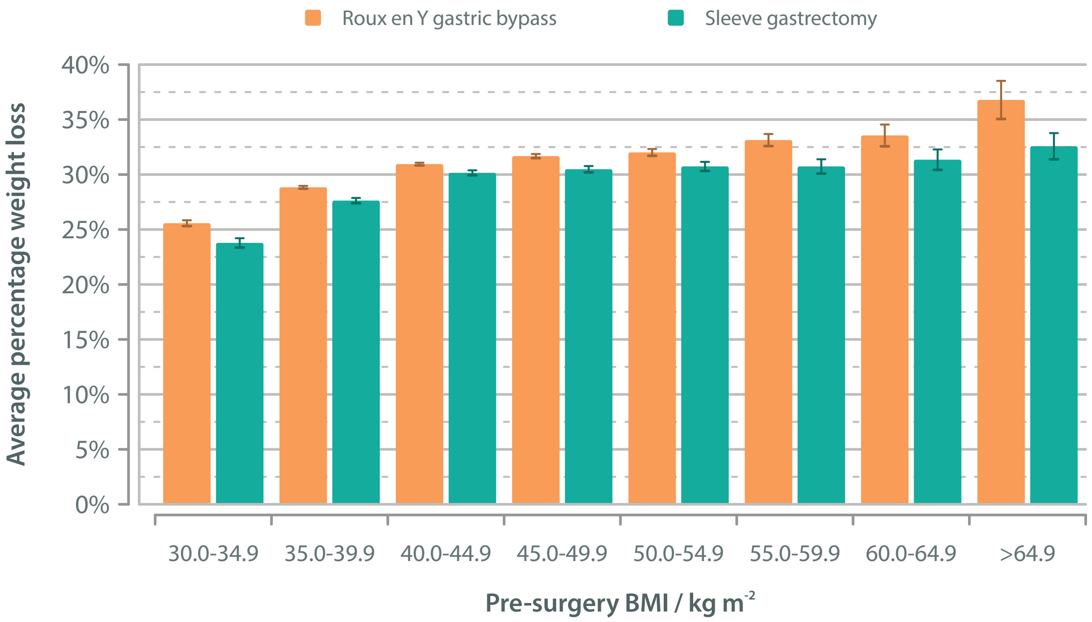
The table and graph below show aggregate analysis of percentage weight loss one year after surgery for all patients undergoing primary gastric bypass and sleeve gastrectomy operations according to the patient's initial body mass index.

The presented data indicate in large numbers of patients that the percentage weight loss at one year for gastric bypass patients is greater than for sleeve gastrectomy patients, with the obvious limitation that the follow up data are incomplete, and therefore subject to selection bias.

Primary surgery: average weight loss one year after surgery according to pre-surgery BMI for the most frequently performed operations; surgery in calendar years 2012-2017

	Average percentage weight loss one year after surgery (with count and 95% confidence interval)		
Pre-surgery BMI / kg m^{-2}	**Roux en Y**	**OAGB / MGB**	**Sleeve gastrectomy**
30.0-34.9	**25.6%** (3,961; 25.3-25.8%)	**20.0%** (62; 17.3-22.7%)	**23.8%** (1,717; 23.4-24.2%)
35.0-39.9	**28.8%** (14,915; 28.7-29.0%)	**30.7%** (418; 29.9-31.5%)	**27.6%** (5,958; 27.4-27.9%)
40.0-44.9	**31.0%** (15,645; 30.8-31.1%)	**33.0%** (721; 32.4-33.6%)	**30.2%** (7,188; 29.9-30.4%)
45.0-49.9	**31.7%** (7,510; 31.5-31.9%)	**34.0%** (543; 33.3-34.8%)	**30.5%** (4,294; 30.2-30.8%)
50.0-54.9	**32.0%** (2,976; 31.7-32.3%)	**35.3%** (321; 34.4-36.2%)	**30.7%** (2,230; 30.3-31.2%)
55.0-59.9	**33.1%** (981; 32.6-33.7%)	**33.8%** (117; 31.9-35.7%)	**30.7%** (1,036; 30.1-31.4%)
60.0-64.9	**33.6%** (349; 32.6-34.5%)	**35.7%** (42; 32.9-38.6%)	**31.4%** (479; 30.4-32.3%)
>64.9	**36.8%** (171; 35.1-38.5%)	**42.3%** (24; 38.2-46.3%)	**32.6%** (334; 31.4-33.8%)

Primary surgery: Percentage weight loss at one year by pre-surgery BMI; operations in calendar years 2012-2017



Effect of surgery on obesity-related disease

General results one-year after surgery

The data presented here show the prevalence of obesity-related disease before surgery and at 12 months after surgery in patient-groups for which this information was recorded both in the baseline (operation) record and at one year after surgery in the follow up section of the database.

There were a total of 97,766 baseline records in this period for Roux en Y gastric bypass, and a further 99,246 operation records relating to sleeve gastrectomy procedures.

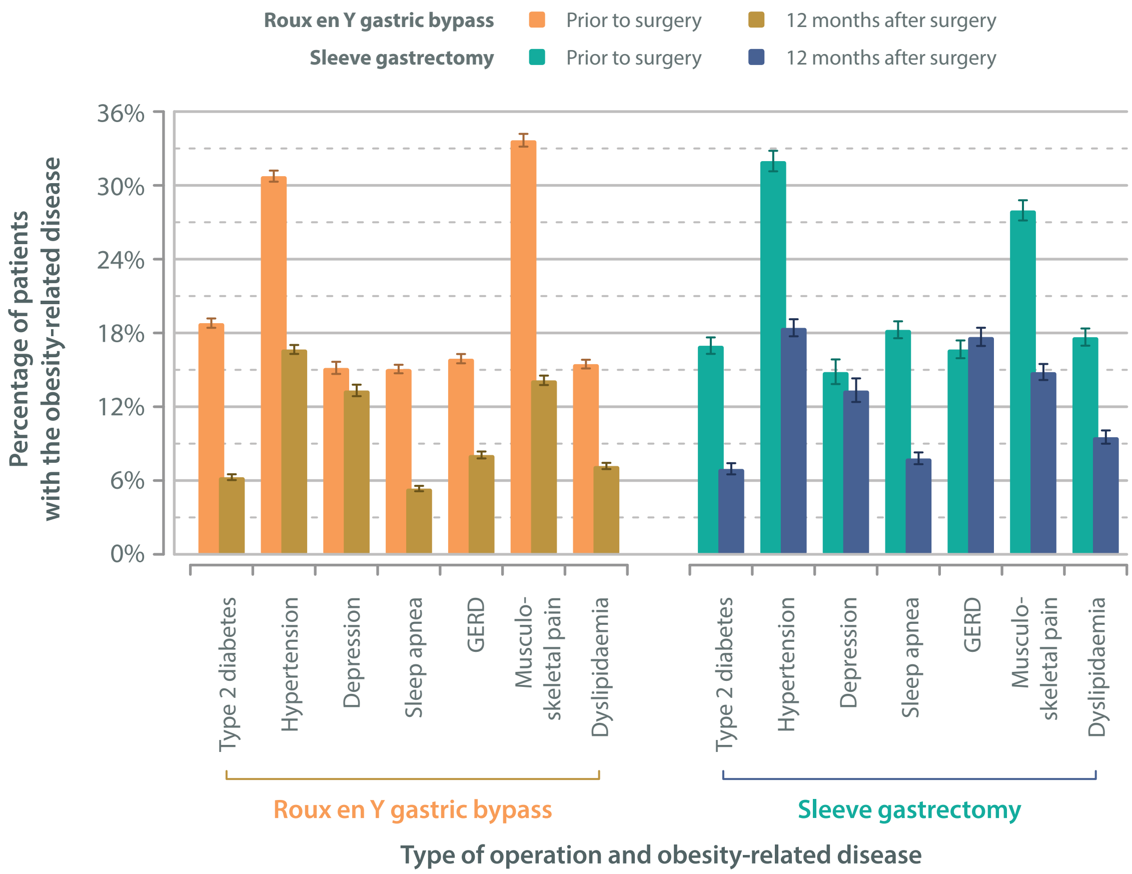
Primary surgery: obesity-related disease before and 12 months after surgery; records with complete data at both time-points; surgery in calendar years 2012-2017

Type of operation and obesity-related disease		Prior to surgery			12 months after surgery		
		No	Yes	Rate	No	Yes	Rate
Roux en Y gastric bypass	Type 2 diabetes	33,224	7,690	18.8%	38,349	2,565	6.3%
	Hypertension	28,038	12,449	30.7%	33,744	6,743	16.7%
	Depression	17,395	3,107	15.2%	17,771	2,731	13.3%
	Sleep apnea	35,156	6,235	15.1%	39,179	2,212	5.3%
	GERD	30,671	5,801	15.9%	33,527	2,945	8.1%
	Musculo-skeletal pain	21,234	10,777	33.7%	27,483	4,528	14.1%
	Dyslipidaemia	34,225	6,261	15.5%	37,579	2,907	7.2%
Sleeve gastrectomy	Type 2 diabetes	10,156	2,074	17.0%	11,381	849	6.9%
	Hypertension	8,247	3,876	32.0%	9,891	2,232	18.4%
	Depression	4,202	731	14.8%	4,276	657	13.3%
	Sleep apnea	10,017	2,236	18.2%	11,298	955	7.8%
	GERD	8,622	1,723	16.7%	8,517	1,828	17.7%
	Musculo-skeletal pain	8,345	3,239	28.0%	9,868	1,716	14.8%
	Dyslipidaemia	9,539	2,045	17.7%	10,481	1,103	9.5%

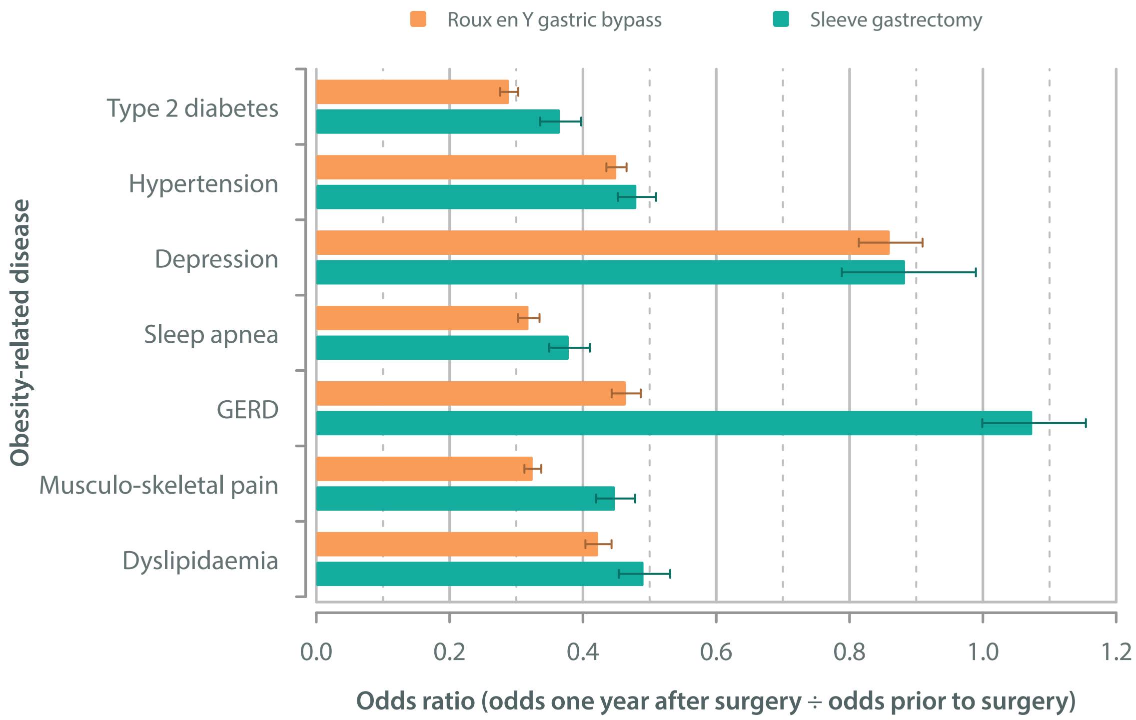
The proportion of patients who were medicated for type 2 diabetes before surgery but no longer treated for the condition one year later was 68.1% for Roux en Y gastric bypass and 61.1% for sleeve gastrectomy. As these procedure-based data are not directly comparable on a formal scientific basis, we do not attempt to assess any differences in outcome between the two operations on a statistical basis.

However, it is notable that GERD does not appear to improve after sleeve gastrectomy, indeed there is some indication that the reported rate has increased one year post-operatively.

Primary surgery: Obesity-related disease before and 12 months after surgery; patients with complete data at both time-points; calendar years 2012-2017



Primary surgery: Odds on the change in obesity-related disease rates 12 months after surgery; operations in calendar years 2014-2017

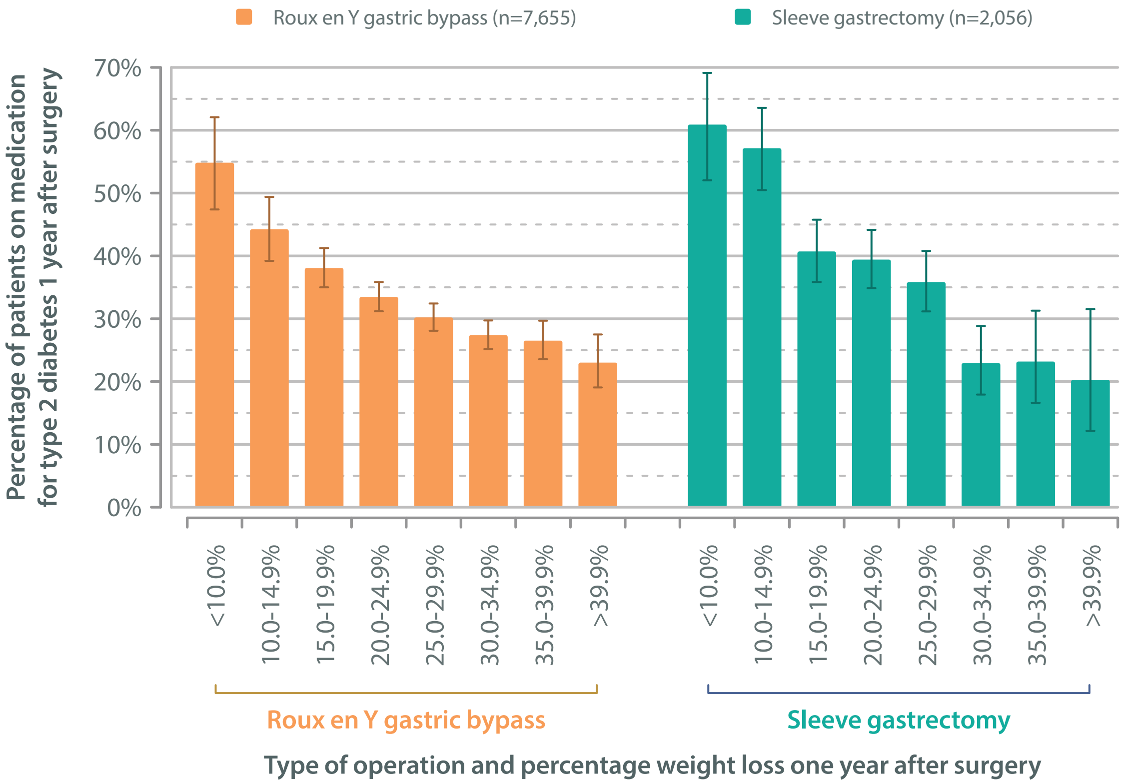


Focus on type 2 diabetes one year after surgery

The following graph pulls out information for patients who were on treatment for diabetes prior to surgery, and shows the recorded rates of type 2 diabetes 12 months after surgery according to the extent of the patients' weight loss at that time. The data are sub-divided according to two main kinds of procedure: Roux en Y gastric bypass and sleeve gastrectomy. The graph suggests that increased weight loss is associated with greater rates of recovery from type 2 diabetes, irrespective of the kind of surgery performed.

Note that the 95% confidence intervals (the error bars) around the rates for the two procedures do not overlap at every point of weight loss, but since the data presented are subject to selection bias in follow up we do not look to over interpret this result.

Primary surgery for patients with type 2 diabetes pre-operatively: Medication for type 2 diabetes one year after surgery; operations in 2012-2017

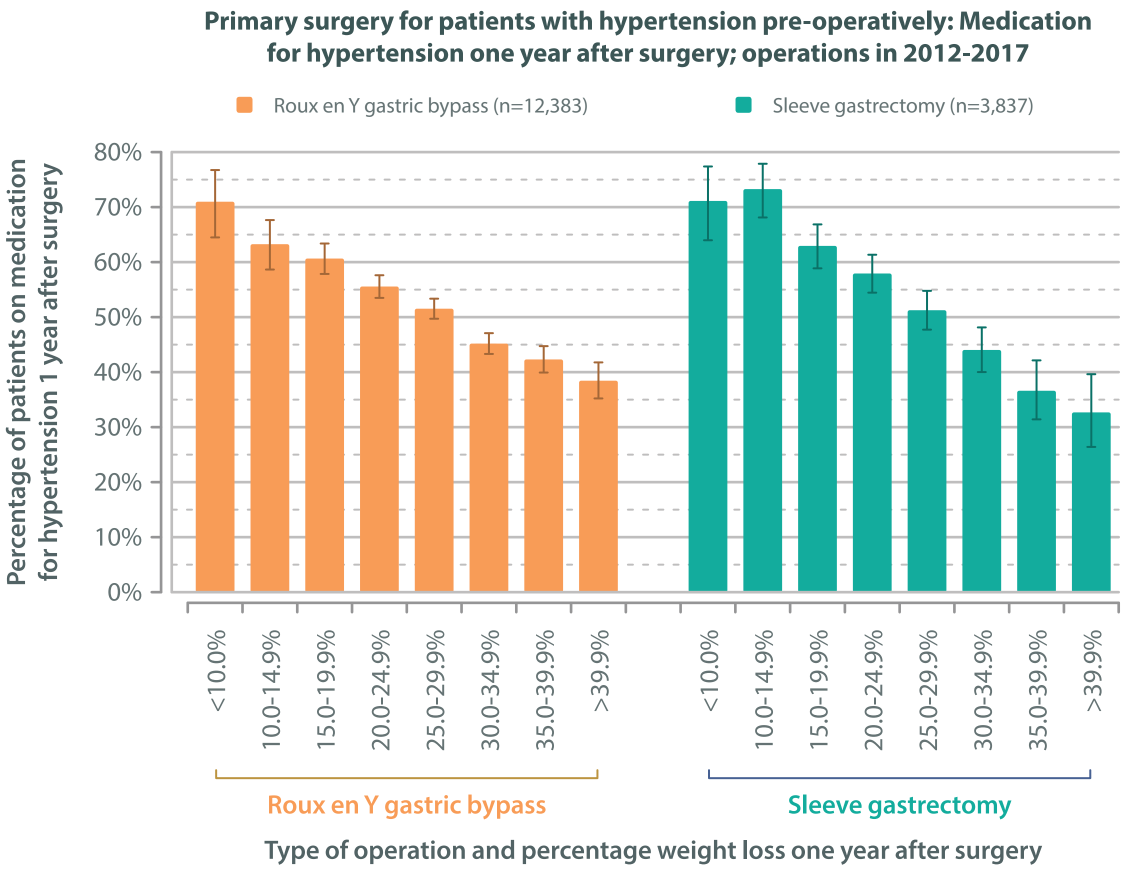


Focus on hypertension one year after surgery

The graph below focuses on the data for patients who were treated for hypertension prior to surgery, and shows the corresponding post-operative effect of reduction in treatment rates for hypertension according to extent of weight loss post-surgery, again for the two main types of operation.

Again, there is the same general relationship of a greater reduction in treatment rates (for hypertension) with increased percentage weight loss.

This might be useful information to impart to patients alongside the *informed consent* process before surgery.

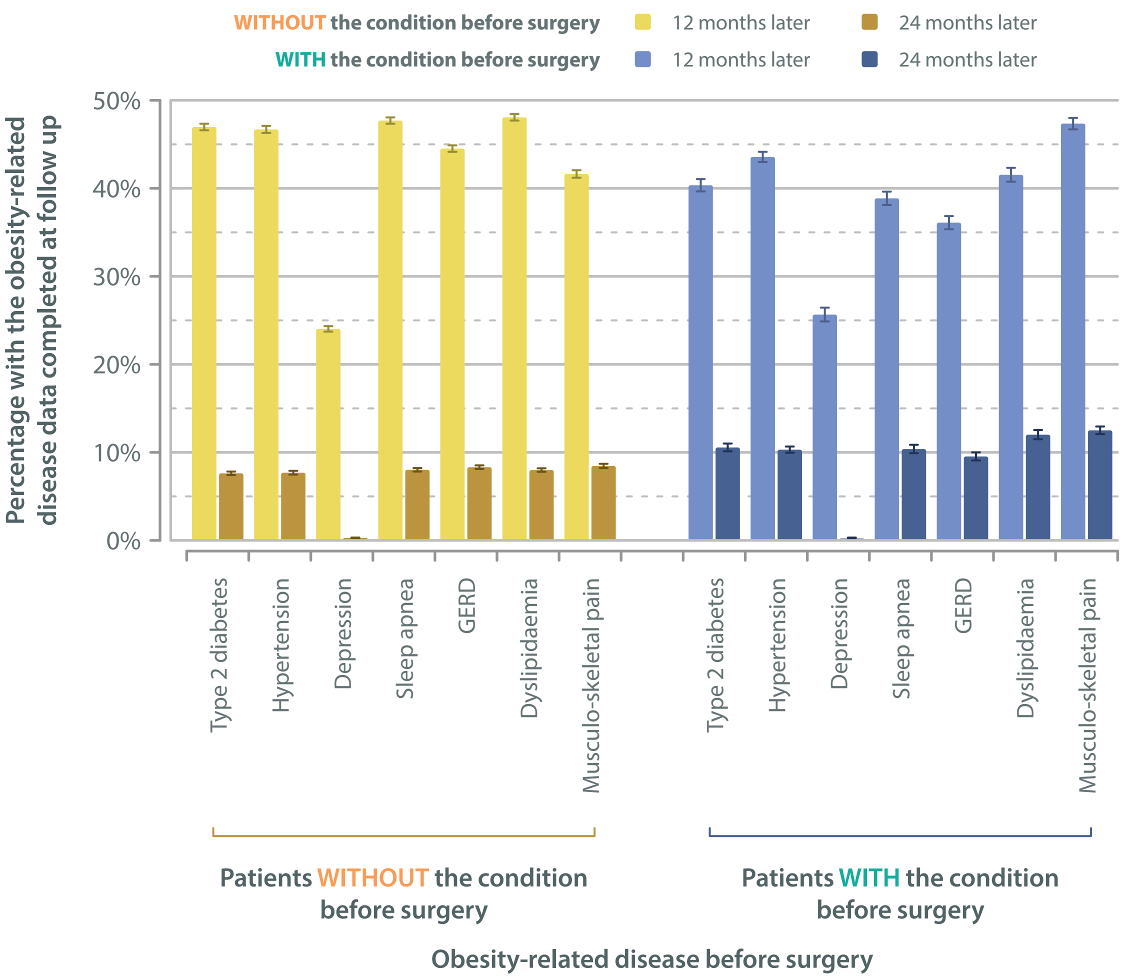


General results two years after surgery

The graph below shows the extent of obesity-related disease data in follow up 12 and 24 months post-surgery. It illustrates the enormity of the challenge facing bariatric surgeons worldwide if we are to improve data collection outside of funded studies, as, at most, only 1 in 5 patients have follow up data recorded at 12 months and even fewer, less than 1 in 10, have follow up data recorded at 24 months.

Collecting data after surgery is expensive, time consuming and subject to patients being contactable or attending follow up. However, if we can clearly demonstrate the medium-term to long-term benefits that our patients get after their surgery then more healthcare systems might be prepared to fund bariatric surgery.

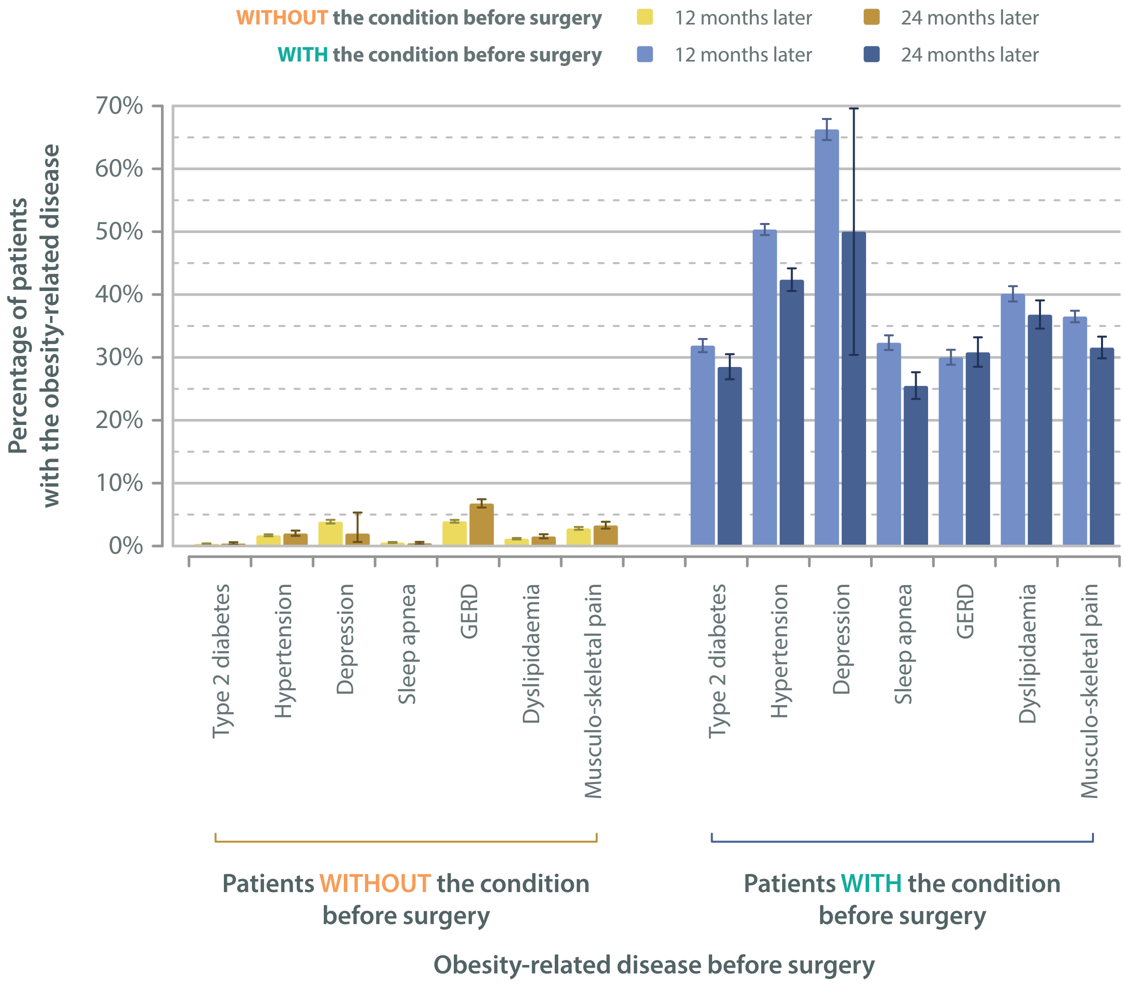
Primary Roux en Y gastric bypass: Data completeness for obesity-related disease data 12 and 24 months after surgery; operations in calendar years 2012-2017



The graph below shows data following on from primary Roux en Y gastric bypass procedures. In general, the greater part of recovery from obesity-related disease seems to occur within 12 months after surgery. For patients with hypertension, the positive effects of surgery appear to further increase (significantly) in the second year after the operation for this obesity-related disease. The same pattern is evident for the sleep apnea and medication for musculo-skeletal pain.

It is noteworthy that a few patients seem to develop incident diabetes after their operation (diabetes is recorded present at 24 months in those who were not diabetic before surgery). An appreciable proportion of patients, up to 5%, who did not have GERD pre-operatively develop this condition at 12-24 months.

Primary Roux en Y gastric bypass: Obesity-related disease rates 12 and 24 months after surgery; operations in calendar years 2012-2017



Appendices

Contributor hospitals (ordered by country in alphabetical order)

Argentina

- Hospital Argerich, Buenos Aires
- Neuqèn Provincial Hospital, Dr Eduardo Castro Rendon, Neuquen
- Sanatori Güemes, Buenos Aires
- University Hospital Austral, Buenos Aires

Australia

- St John of God Hospital, Subiaco, Western Australia
- St John of God Hospital, Murdoch, Western Australia

Austria

Österreichische Gesellschaft für Adipositaschirurgie

- Children's Surgery University Hospital Salzburg
- Divine Messias Hospital, Vienna
- General Hospital of Vienna, University Clinics
- Hietzing Hospital, Vienna
- Hospital of the Elisabethine Order, Graz
- Klagenfurt Clinic KABEG
- Landesklinikum Hollabrunn
- Ordensklinikum Linz
- Order of the Brothers of Mercy, Salzburg
- Sisters of Mercy Hospital, Vienna
- St John's Hospital in Tyrol
- Villach Hospital KABEG
- Wels-Grieskirchen Clinic
- Wolfsberg Hospital KABEG

Bahrain

- King Hamad University Hospital, Al Sayh

Belarus

- The 9th City Hospital, Minsk

Belgium

SOMS

Belgian Society of Obesity & Metabolic Surgery

- AZ Jan Palfijn, Gent
- AZ Klina, Brasschaat
- AZ Sint-Blasius, Dendermonde
- AZ Sint-Lucas, Gent
- Centre Hospitalier Régional de la Citadelle, Liege
- Centre Hospitalier Régional Mons-Hainaut, Bergen
- Centre Hospitalier Régional Verviers, Luik
- Centre Hôspitalier de l'Ardenne, Libramont-Chevigny
- Centre Hôspitalier EpiCura, Hornu
- Centre Hôspitalier Régional de Huy
- Centre Hôspitalier Universitaire de Charleroi
- CHIREC Obesity Center, Brussels
- Clinique Saint-Pierre, Ottignies
- Clinique Sainte-Anne Saint-Remi
- Cliniques Universitaires Saint-Luc, UCL
- Hasselt Jessa Ziekenhuis, Hasselt
- Hôpital Erasme, Bruxelles
- Sint-Dimpna Ziekenhuis Geel
- Sint-Franciscus Ziekenhuis, Limburg, Flanders
- ZNA Antwerpen, Antwerpen

Bolivia

Los Olivos Clinic, Cochabamba

Brazil

Sociedade Brasileira de Cirurgia Bariátrica e Metabólica

- Hospital Alemão Oswaldo Cruz, São Paulo
- Hospital Beneficência Portuguesa de São Paulo
- Hospital Beneficência Portuguesa de São José do Rio Preto
- Hospital das Clínicas, Recife
- Hospital Esperança, Recife
- Hospital Israelita Albert Einstein, São Paulo
- Hospital Jayme da Fonte, Recife
- Hospital Marcelino Champagnat, Curitiba
- Hospital Mirante, São Paulo
- Hospital Nove de Julho
- Hospital Ophir Loyola, Belém
- Hospital Porto Dias, Belém
- Hospital SAHA, São Paulo
- Hospital Santa Cruz, Santa Cruz du Sol
- Hospital Santa Joana, São Paulo
- Hospital Santa Rita, São Paulo
- Hospital São Luiz (Jabaquara)
- Hospital São Luiz Unidade Itaim
- Hospital Sírio Libanês, São Paulo
- Hospital Unimed, Recife
- Hospital Vitória, São Paulo
- Real Hospital Português, Recife
- Santa Casa de Misericórdia de São José do Rio Preto

Bulgaria

- Alexandrovska University Hospital, Sofia

Canada

- Hospital du Scare-Coeur de Montreal

Chile

- Center for the Treatment of Obesity and Metabolic Diseases, Pontificia Universidad Catolica de Chile, Santiago
- Centro Clinico de La Obesidad, Santiago
- Hospital Dipreca, Santiago

China

- Affiliated First Hospital of Hunan Traditional Chinese Medical College
- Beijing Friendship Hospital, Capital Medical University
- Beijing Shijitan Hospital, China Capital Medical University
- Beijing Tiantan Hospital, Capital Medical University
- China-Japan Union Hospital of Jilin University
- East Hospital, Tongi University School of Medicine
- First affiliated Hospital of Nanjing Medical University
- Hospital Affiliated Xuzhou Medical University
- Jiahe Surgical Hospital, ChangChun
- Shanghai 10th People's Hospital, Tongji University School of Medicine
- Shanxi Dayi Hospital
- Tangshan Gongren Hospital, Hebei Medical University
- The Affililiated Drum Tower Hospital of Nanjing University Medical School
- The First Affiliated Hospital of Jinan University
- The Second Hospital of Hebei Medical University
- Tianjin Nankai Hospital

Colombia

- Clinica La Colina, Bogota

Czech Republic

- OB Klinika Mediczech, Prague

Egypt

- Air Force Specialised Hospital, Cairo
- Al Hayah, Qesm Hurghada
- Bedayat, Cairo
- Dr Yousry Gohar Hospital, Cairo
- Maadi Clinic, Cairo
- Mansoura University Hospital
- Royal Hospital, Cairo
- Sama Smoha, Alexandria

France

- Centre Hospitalier, Le Mans
- Elsan Pole Santé Sud, Le Mans
- Hospital Claude Huriez, Lille, France
- Polyclinique Lyon-Nord-Rillieux

Georgia

- Caraps Medline, Tbilisi
- Health House, Tbilisi
- Innova Medical Center, Tbilisi
- J.S.C.K Eristavi National Center of Experimental & Clinical Surgery, Tbilisi
- Tbilisi Central Hospital, Tbilisi

Germany

- Adipositaszentrum Nordhessen, Kassel
- Marienkrankenhaus Kassel Chirurgische Klinik

Guadeloupe

- Clinique des Eaux Claires

Guatemala

- Centro de Tratamiento Intergral del Metabolism y la Obesidad, New Life Center, Guatemala City

Hong Kong

- Prince of Wales Hospital, Shatin
- The University of Hong Kong
- United Christian Hospital, Kowloon
- Yan Chai Hospital, Kowloon

Hungary

- Duna Medical Center, Budapest

Ireland

- Bon Secours Hospital, Cork
- St Vincent's Hosptal, Dublin

India

OSSI

Obesity Surgery Society of India

- Apollo Hospital, Chennai
- Apollo Hospital, Indraprastha, New Delhi
- Apollo Hospital, Kakinada
- Apollo Hospital, Mumbai
- Apollo Spectra Hospitals, Mumbai
- Asian Bariatrics, Ahmedabad
- Asian Bariatrics, Hyderabad
- Asian Institute of Gastroenterology, Hyderabad
- Aster CMI Hospial, Bangalore
- A V Da'Costa Hospital, Goa
- Baroda Laparoscopy Hospital, Vadodara
- Bellevue Clinic, Kolkata
- Care Institute of Medical Sciences, Ahmedabad
- Centre for Obesity & Digestive Surgery, Mumbai
- Columbia Asia Hospital, Ahmedabad
- Columbia Asia Referral Hospitals, Yeshwantpura
- Continental Hospital, Telengana
- Dhawn Hospital, Panchkula
- Digestive Health Institute, Mumbai
- Dr Todkar Hospital, Pune
- Endocare Hospital, Vijayawada
- Excel Hospital, Surat
- Fortis Flt. Lt. Rajan Dhall Hospital, Vasant Kuni
- Fortis Hospital, Shalimar Bagh
- GEM Hospitals, Coimbatore
- Gunasheela Surgical & Maternity Hospital, Bangalore
- Hindija Healthcare Speciality, Mumbai
- ILS Hospital, Kolkata
- Jammu Hospital, Jalandhar
- Jeewan Mala Hospital, New Delhi
- Kirloskar Hospital, Hyderbad
- Kokilaben Dhirubhai Hospitals, Mumbai
- Kular Hospital, Ludhiana
- Lilavati Hospital, Mumbai
- LivLife Hospitals, Hyderabad
- Max Hospital, Shalimarbagh, New Delhi
- Max Super Speciality Hospital, Saket, New Delhi
- Mohak Hitech Specialty Hospital, Indore
- National Hospital, Mumbai
- Shanthi Memorial Hospital, Cuttack
- Shree Hospital, Pune
- Surat Institute of Digestive Sciences (SIDS), Gujurat
- Sushrisha Hospital, Kolhapur
- Unique Hospital, Surat
- Wings Hospital, Surat
- Wockhardt Hospitals, Mumbai
- Zen Hospital, Mumbai

Israel

The Israel National Bariatric Surgery Registry

- Assaf Harofeh Medical Center
- Assuta Medical Center, Ashdod
- Assuta Medical Center, Beer-Sheva
- Assuta Medical Center, Tel Aviv
- Assuta Medical Center Haifa
- Assuta Medical Center Rishon Lezion
- Barzilai Medical Center
- Bnai Zion Medical Center
- Carmel Medical Center
- Elisha Medical Center
- Galilee Medical Center
- Hadassah Mt. Scopus Medical Center
- Haemek Medical Center
- Herzliya Medical Center
- Hillel Yaffe Medical Center
- Kaplan Medical Center
- Laniado Hospital, Nentanya
- Mayanei Hayeshua Medical Center, Bnei Brak
- Meir Medical Center
- Merav Medical Center
- Rabin Medical Center – Belinson & Hasharon Hospitals
- Rambam Health Care Campus
- Shaare Zedek Medical Center
- Sheba Medical Center
- Soroka Medical Center
- St. Joseph Hospital
- Tel Aviv Sourasky Medical Center
- The Baruch Padeh Medical Center, Poriya
- The Hadassah University Hospital-Ein Kerem
- The Holy Family Hospital Nazareth
- The Nazareth Hospital
- Wolfson Medical Center, Tel Aviv
- Ziv Medical Center, Safed

Italy

S.I.C.OB.

Società Italiana di Chirurgia dell'Obesità e delle malattie metaboliche

- Hospital list not available at the time of going to press

Japan

Japanese Society for the Study of Obesity

- Department of Digestive and Pediatric Surgery Tokushima University Faculty of Medicine
- Department of Gastroenterological and Pediatric Surgery, Oita University Faculty of Medicine
- Department of General Surgical Science Gunma University Graduate School of Medicine
- Department of Surgery, University of Osaka
- Department of Surgery and Science, Graduate School of Medical Science, Kyushu University
- Department of Surgery Iwate Medical University School of Medicine
- Department of Surgery Jichi Medical University
- Department of Surgery Nagasaki University, Graduate School of Biomedical Science
- First Towakai Hospital
- Frontier Surgery Chiba University Graduate School of Medicine
- Kansai Medical University Hospital
- Kusatsu General Hospital
- Morioka Munincipal Hospital
- Ohama Daiichi Hospital
- Okazaki City Hospital
- Takeda General Hospital
- Tochigi Medical Center, Shimotsuga
- Tohoku University Graduate School of Medicine, Department of Surgery
- Toho University Sakura Medical Center
- Tokyo Metropolitan Tama Medical Center
- Yotsuya Medical Cube

Jordan

- Gastrointestinal Bariatric & Metabolic Center, Jordan Hospital, Amman

Kazakhstan

- Astana Medical University

Kingdom of Saudi Arabia

- King Salman Armed Forces Hospital, Tabuk
- King Saud University Hospital, Riyadh
- Tabuk New You Medical Center, Riyadh

Kuwait

- Al-Amiri Hospital, Kuwait City
- Al Salam International Hospital, Kuwait City
- Farwaniya Hospital, Kuwait City
- Jahra Hospital, Al Jahra
- Mubarak Al-Kabeer Hospital, Kuwait City
- Sabah Hospital, Kuwait City

Lithuania

- Lithuanian University of Health Sciences Hospital, Kaunas

Mexico

- ABC Medical Center, Mexico City
- Colima Medica Center
- Hospitales Angeles
- Hospitales Star Médica
- National Institute of Medical Sciences and Nutrition, Mexico City

Netherlands

DATO
DUTCH AUDIT FOR TREATMENT OF OBESITY

Dutch Audit for Treatment of Obesity

- Albert Schwitzer Ziekenhouis Dordrecht
- Bariatrisch Centrum Zuid West Nederland
- Catharina Ziekenhuis Eindhoven
- Groene Hart Hospital
- Haukeland University Hospital, Bergen
- Maasstad Ziekenhuis Rotterdam
- Maxima Medisch Centrum Eindhoven/Vedlhoven
- MC Slotervaart Amsterdam
- Medisch Centrum Leeuwarden
- Nederlandse Obesitas Kliniek (NOK) Amsterdam
- Nederlandse Obesitas Kliniek (NOK) Heerlen
- Nederlandse Obesitas Kliniek (NOK) West
- Rijnstate Ziekenhuis Arnhem
- Rode Kruis Ziekenhuis Beverwijk
- Sint Franciscus Gasthuis Rotterdam
- St Antonius Ziekenhuis Nieuwegein
- TweeSteden Ziekenhuis Tilburg
- Waterlandziekenhuis Purmerend
- Yotsuya Medical Cube
- Ziekenhuis Groep Twente (ZGT)
- ZorgSaam Ziekenhuis Zeews-Vlaanderen

Norway

SOREG

Scandinavian Obesity Surgery Registry

- Bærum Hospital, Bærum
- Førde Hospital, Førde
- Haugesund Hospital, Haugesund
- Haugesund Private Hospital, Haugesund
- Ibsen Hospital, Gjøvik
- Innlandet Hospital, Gjøvik
- Namsos Hospital, Namsos
- Nordland Hospital, Bodø
- Oslo University Hospital, Oslo
- St.Olavs Hospital, Trondheim
- Stavanger University Hospital, Stavanger
- Sørlandet Hospital, Arendal
- Vestfold Hospital, Tønsberg
- Volvat Medical Centre, Bergen, Bergen
- Volvat Medical Centre, Oslo, Oslo
- Voss Hospital, Voss
- Ålesund Hospital, Ålesund

Panama

- Cirugia General y Laparoscopica Avanzada
- Hospital Punta Pacifica, Panama City

Peru

- Clinica de dia Avendana, Lima

Poland

- Ceynowa Hospital, Wejherowo
- Department of General, Transplant and Liver Surgery, Medical University of Warsaw
- Medical University Hospital of Gdansk

Portugal

- Unidade de Tratamento Cirúrgico de Obesidade, Centro Hospitalar de Setubal, EPE

Qatar

- Hamad General Hospital, Hamad Medical Corporation, Doha

Russia

Russian National Bariatric Surgery Registry

- Clinic of Endoscopic & Minimal Invasive Surgery, Stavropol State Medical University, Stavropol
- Clinic UGMK Health, Ekaterinburg
- LLC Medical Center, Medeor, Chelyabinsk
- LLC SM Clinic, Kazan
- Moscow Clinical and Scientific Centre, Moscow
- Non-State Health Care Facility, Central Clinical Hospital No 2 JSC, Russian Railways Hospital, Moscow
- Non-State Health Care Facility, Clinical Hospital, The Station Krasnodar of JSC, Russian Railways Hospital, Krasnodar
- Non-State Health Care Facility, Clinical Hospital, The Station Mineral Water of JSC, Russian Railways Hospital
- Non-State Health Care Facility, The Station Khabarovsk-1 of JSC, Russian Railways Hospital, Khabarovsk
- Non-State Health Care Facility, The Station Voronezh-1 of JSC, Russian Railways Hospital, Voronezh
- Non-State Public Health Institution "Railway clinical hospital on station Samara" of JSC Russian Railways
- Pavlov First Saint Petersburg State Medical University, St. Petersburg
- Regional Clinical Hospital, Khanty-Mansiysk
- Regional Clinical Hospital No 2, Krasnodar
- Republic Clinical Hospital, Grozny
- Samara Regional Hospital, Samara
- State Clinical Hospital, South Regional Medical Center of Federal Medical Biological Agency, Rostov-on-Don
- State Clinical Hospital of First Aid No 2, Omsk
- State Hospital of First Aid, Ufa State Hospital No 5, Nizhny Novgorod
- State Regional Clinical Hospital, Ryazan
- The Center of Endosurgery and Lithotripsy (CELT-clinic), Moscow
- The Federal Almazov North-West Medical Research Centre, St. Petersburg
- The Federal State Budgetary Institute, The Nikiforov Russian Center of Emergency & Radiation Medicine, St. Petersburg
- Treatment & Rehabilitation Center of The Ministry of Health of the Russian Federation, Moscow
- Tver Regional Clinical Hospital, Tver

Appendices

South Korea

- Chung-Ang University Hospital, Seoul
- Korea University Anam Hospital, Seoul
- Daejeon Wellness Hospital

Spain

- San Carlos Clinical Hospital, University of Madrid
- University Hospital of Torrevieja, Alicante

Sweden

SOREG

Scandinavian Obesity Surgery Registry

- Aleris Motala
- Aleris Skane
- Axcess Medica Simrishamn
- Bariatric Center Skane
- Bariatric Center Sophiahemmet
- Blekinge Hospital
- Boras Hospital
- Capio St Goran Hospital
- Carlanderska Hospital
- Centrum for titthalskirurgi
- Danderyd Hospital
- Eksjo Hospital
- Ersta Hospital
- Falun Hospital
- Gavle Hospital
- Hudiksvall Hospital
- Kalmar Hospital
- Ljungby Hospital
- Lund University Hospital
- Lycksele Hospital
- Mora Hospital
- Norrkoping Hospital
- Norrtalje Hospital
- Nykoping Hospital
- Orebro/Lindesberg University Hospital
- Osterlenkirurgin Simrishamn
- Ostersund Hospital
- Sahlgrenska University Hospital
- Skovde Hospital
- Sodersjukhuset Hospital
- Sodertalje Hospital
- Sunderbyn Hospital
- Sundsvall Hospital
- Torsby Hospital
- Trollhattan Hospital
- Uppsala University Hospital
- Varberg Hospital
- Varnamo Hospital
- Vasteras Hospital
- Vastervik Hospital
- Vastra Frolunda Hospital
- Vaxjo Hospital

Switzerland

- Hirslandden Klinik, Bern
- Hopital Riviera-Chablais, Aigle

Taiwan

- Bariatric & Metabolic International Surgery Center E-Da Hospital, Kaohsiung City
- China Medical University Hospital, Taichung City
- Min Sheng General Hospital

ULUSAL OBEZİTE VERİTABANI

Turkey

Turkish National Obesity Database

- Acıbadem Hospital, Kocaeli
- Büyük Anadolu Hospital, Samsun
- Cerrahpasa Faculty of Medicine, Istanbul
- Doruk Yıldırım Hastanesi, Bursa
- Doruk Çekirge Hospital, Bursa
- Fatsa State Hospital, Ordu
- Fırat University Faculty of Medicine, Elazig
- İbn-i Sina Hospital, Osmaniye
- Medical Park Hospital, Samsun
- Medicorium
- Medilife Beylikdüzü Hospital, Istanbul
- Metabolic Surgery Clinic, Istanbul
- Murat Ustun Center for Obesity & Metabolism Surgery, Istanbul
- Selçuk University Faculty of Medicine, Konya
- Tekden Hospital, Denizli
- Tınaztepe Hospital, Izmir

United Arab Emirates

- Bariatric & Metabolic Institute, Abu Dhabi
- Healthpoint Hospital, Abu Dhabi
- Mediclinic Dubai Mall
- NMC Specialty, Dubai
- Seha Emirates Hospital, Abu Dhabi
- Sheikh Khalifa Medical City, Abu Dhabi

United Kingdom

The UK National Bariatric Surgery Registry

- Aberdeen Royal Infirmary
- Ashford Hospital, Middlesex
- Ashtead Hospital
- Berkshire Independent Hospital, Reading
- BMI Albyn Hospital, Aberdeen
- BMI Bath Clinic
- BMI Chelsfield Park Hospital, Orpington
- BMI Mount Alvernia Hospital, Guildford
- BMI Sarum Road Hospital, Winchester
- BMI The Alexandra Hospital, Manchester
- BMI The Blackheath Hospital, London
- BMI The Clementine Churchill Hospital, Harrow
- BMI The Droitwich Spa Hospital
- BMI The Hampshire Clinic, Basingstoke
- BMI The Harbour Hospital, Dorset
- BMI The London Independent Hospital
- BMI The Meridien Hospital, Coventry
- BMI The Park Hospital, Nottingham
- BMI The Princess Margaret Hospital, Windsor
- BMI The Priory Hospital, Birmingham
- BMI The Ridgeway Hospital, Swindon
- BMI The Runnymede Hospital, Chertsey
- BMI The Shelburne Hospital, High Wycombe
- BMI The South Cheshire Private Hospital, Leighton
- BMI Thornbury Hospital, Sheffield
- Bradford Royal Infirmary
- Castle Hill Hospital, Cottingham
- Chelsea & Westminster Hospital, London
- Cheltenham General Hospital
- Churchill Hospital, Oxford
- Circle Bath Hospital
- Claremont Hospital, Sheffield
- Countess of Chester Hospital
- Cromwelll Hospital, London
- Darlington Memorial Hospital
- Derriford Hospital, Plymouth
- Dewsbury & District Hospital, West Yorkshire
- Dolan Park Hospital, Bromsgrove
- Doncaster Royal Infirmary
- Duchy Hospital, Truro
- Gloucestershire Royal Hospital, Gloucester
- Heartlands Hospital, Birmingham
- Hexham General Hospital
- Holly House Hospital, Essex
- Homerton University Hospital, London
- Hospital of St John and St Elizabeth, London
- Huddersfield Royal Infirmary
- Kent Institute of Medicine & Surgery, Maidstone
- King Edward VII's Hospital, London
- King's College Hospital, London
- Lanarkshire University Hospital
- Leeds General Infirmary
- Leicester General Hospital
- London Bridge Hospital, London
- Luton & Dunstable University Hospital
- Maidstone Hospital, Kent
- Manchester Royal Infirmary
- McIndoe Surgical Centre, East Grinstead
- Morriston Hospital, Swansea
- Musgrove Park Hospital, Taunton
- Ninewells Hospital, Dundee
- Norfolk & Norwich University Hospital
- Northern General Hospital, Sheffield
- North Tyneside General Hospital, North Shields
- Nuffield Health Bournemouth Hospital
- Nuffield Health Brentwood Hospital
- Nuffield Health Bristol Hospital
- Nuffield Health Cheltenham Hospital
- Nuffield Health Derby Hospital
- Nuffield Health Glasgow Hospital
- Nuffield Health Guildford Hospital
- Nuffield Health Leeds Hospital
- Nuffield Health Leicester Hospital
- Nuffield Health Newcastle-upon-Tyne Hospital
- Nuffield Health North Staffordshire Hospital
- Nuffield Health Plymouth Hospital
- Nuffield Health Shrewsbury Hospital
- Nuffield Health Taunton Hospital
- Nuffield Health The Grosvenor Hospital, Chester
- Nuffield Health Warwickshire Hospital
- Nuffield Heath The Manor Hospital, Oxford
- Nuffield Hospital York
- Orpington Treatment Centre
- Park Hill Hospital, Doncaster
- Parkside Hospital, London
- Poole Hospital, Dorset
- Princess Royal Hospital, Telford
- Princess Royal University Hospital, Orpington
- Queen Alexandra Hospital, Portsmouth
- Queen Elizabeth University Hospital, Glasgow
- Queen's Hospital Romford
- Ramsay Mount Stuart Hospital, Torquay
- Ramsay Winfield Hospital, Gloucestershire
- Rivers Hospital, Sawbridgeworth
- Royal Berkshire Hospital, Reading
- Royal Bournemouth General Hospital

United Kingdom continued …

- Royal Cornwall Hospital, Truro
- Royal Derby Hospital
- Royal Infirmary of Edinburgh
- Royal Shrewsbury Hospital
- Salford Royal Hospital
- Salisbury District Hospital
- Sheffield Children's Hospital
- Southampton General Hospital
- Southmead Hospital, Bristol
- South Tees University Hospitals, Middlesbrough
- Spingfield Hospital, Chelmsford
- Spire Bristol Hospital
- Spire Bushey Hospital, Watford
- Spire Cheshire Hospital
- Spire Clare Park Hospital, Farnham
- Spire Dunedin Hospital, Reading
- Spire Elland Hospital, West Yorkshire
- Spire Fylde Coast Hospital, Blackpool
- Spire Gatwick Park Hospital, Horley
- Spire Harpenden Hospital
- Spire Hartswood Hospital, Brentwood, Essex
- Spire Hull & East Riding Hospital, Anlaby
- Spire Leeds Hospital
- Spire Leicester Hospital
- Spire Little Aston Hospital, Sutton Coldfield
- Spire Manchester Hospital
- Spire Montefiore, Hove
- Spire Murrayfield Hospital, Edinburgh
- Spire Murrayfield Hospital Wirral
- Spire Norwich Hospital
- Spire Parkway Hospital, Solihull
- Spire Portsmouth Hospital
- Spire Regency Hospital, Macclesfield
- Spire Roding Hospital, Redbridge
- Spire Southampton Hospital
- Spire South Bank Hospital, Worcester
- Spire Thames Valley Hospital, Slough
- Spire Washington Hospital, Tyne & Wear
- Spire Wellesley Hospital
- Spire Yale Hospital, Wrexham
- St Anthony's Hospital, London
- St George's Hospital, London
- St James's University Hospital, Leeds
- St Mary's Hospital, London
- Stobbhill Hospital, Glasgow
- St Peter's Hospital, Chertsey
- St Richard's Hospital, Chichester
- St Thomas's Hospital, London
- Sunderland Royal Hospital
- The James Cook University Hospital, Middlesbrough
- The London Clinic
- The Princess Grace Hospital, London
- The Yorkshire Clinic, Bingley
- University College Hospital London
- University Hospital, Ayr
- University Hospital, Lewisham
- University Hospital Aintree
- University Hospital Coventry
- University Hospital of North Staffordshire
- University Hospital of North Tees, Stockton-on-Tees
- Walsall Manor Hospital
- Wansbeck Hospital
- Wellington Hospital, London
- Whittington Hospital, London
- Worcestershire Royal Hospital
- York Hospital
- Yorkshire Surgicentre, Rotherham

United States of America

- Fresno Heart & Surgical Hospital, California

Venezuela

- Sagrada Familia Hospital Maracaibo

The IFSO Global Registry database form

The IFSO Global Registry

IFSO GLOBAL REGISTRY

Database form

Version: **4.1** document dated **10 Jan 2018**

Author: Robin Kinsman robin.kinsman@e-dendrite.com

International Federation for the Surgery of Obesity and metabolic disorders

IFSO Global Registry

Baseline section; Page 2; Version **4.1** (**10 Jan 2018**)

Basic demographic data

All baseline data refer to the condition of the patient when they were originally diagnosed. The titles of mandatory questions are highlighted in **purple**.

Unique patient identifier			
Date of birth		dd / mm / yyyy	
Gender	○ Male	○ Female	○ Unknown

Baseline data

Basic patient details

Height		cm
Weight on entry to the weight-loss program		kg
Funding category	○ Publicly funded ○ Self-pay	○ Private insurer

Comorbidities

Type 2 diabetes on medication	○ No	○ Yes
Diabetes medication type	○ Oral therapy	○ Insulin
Hypertension on medication	○ No	○ Yes
Depression on medication	○ No	○ Yes
Increased risk of DVT or PE	○ No	○ Yes
Musculo-skeletal pain on medication	○ No	○ Yes
Confirmed sleep apnoea	○ No	○ Yes
Dyslipidaemia on medication	○ No	○ Yes
GERD / GORD	○ No	○ Yes

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IFSO GLOBAL REGISTRY

Appendices

International Federation for the Surgery of Obesity and metabolic disorders
IFSO Global Registry
Baseline section; Page 3; Version **4.1** (**10 Jan 2018**)

Unique patient identifier	
Date of operation	dd / mm / yyyy

Surgery

Date of operation	dd / mm / yyyy	
Weight at surgery	kg	
Has the patient had bariatric surgery before	○ No	○ Yes
Operative approach	○ Laparoscopic ○ Lap converted to open	○ Endoscopic ○ Open
Type of operation	○ Gastric band ○ Roux en Y gastric bypass ○ OAGB / MGB ○ Sleeve gastrectomy	○ Duodenal switch ○ Duodenal switch with sleeve ○ Bilio-pancreatic diversion ○ Other
Banded procedure	○ No	○ Yes
Details of other procedure	○ Gastric plication ○ Single anastomosis duodenal-ileal surgery ○ Vertical banded gastroplasty ○ Other	

Outcomes

Leak within 30 days of surgery	○ No	○ Yes
Bleeding within 30 days of surgery	○ No	○ Yes
Obstruction within 30 days of surgery	○ No	○ Yes
Re-operation for complications within 30 days of surgery	○ No ○ Yes	
Patient status at discharge	○ Alive	○ Deceased
Date of discharge or death	dd / mm / yyyy	

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IFSO GLOBAL REGISTRY

International Federation for the Surgery of Obesity and metabolic disorders

IFSO Global Registry

Follow up section; Page 4; Version **4.1** (**10 Jan 2018**)

Unique patient identifier		
Date of follow up	dd / mm / yyyy	

Follow up

Weight at follow up	kg	
Type 2 diabetes on medication	○ No	○ Yes
Diabetes medication type	○ Oral therapy	○ Insulin
Hypertension on medication	○ No	○ Yes
Depression on medication	○ No	○ Yes
Increased risk of DVT or PE	○ No	○ Yes
Musculo-skeletal pain on medication	○ No	○ Yes
Confirmed sleep apnoea	○ No	○ Yes
Dyslipidaemia on medication	○ No	○ Yes
GERD / GORD	○ No	○ Yes
Clinical evidence of malnutrition	○ No	○ Yes
Patient status	○ Alive	○ Deceased

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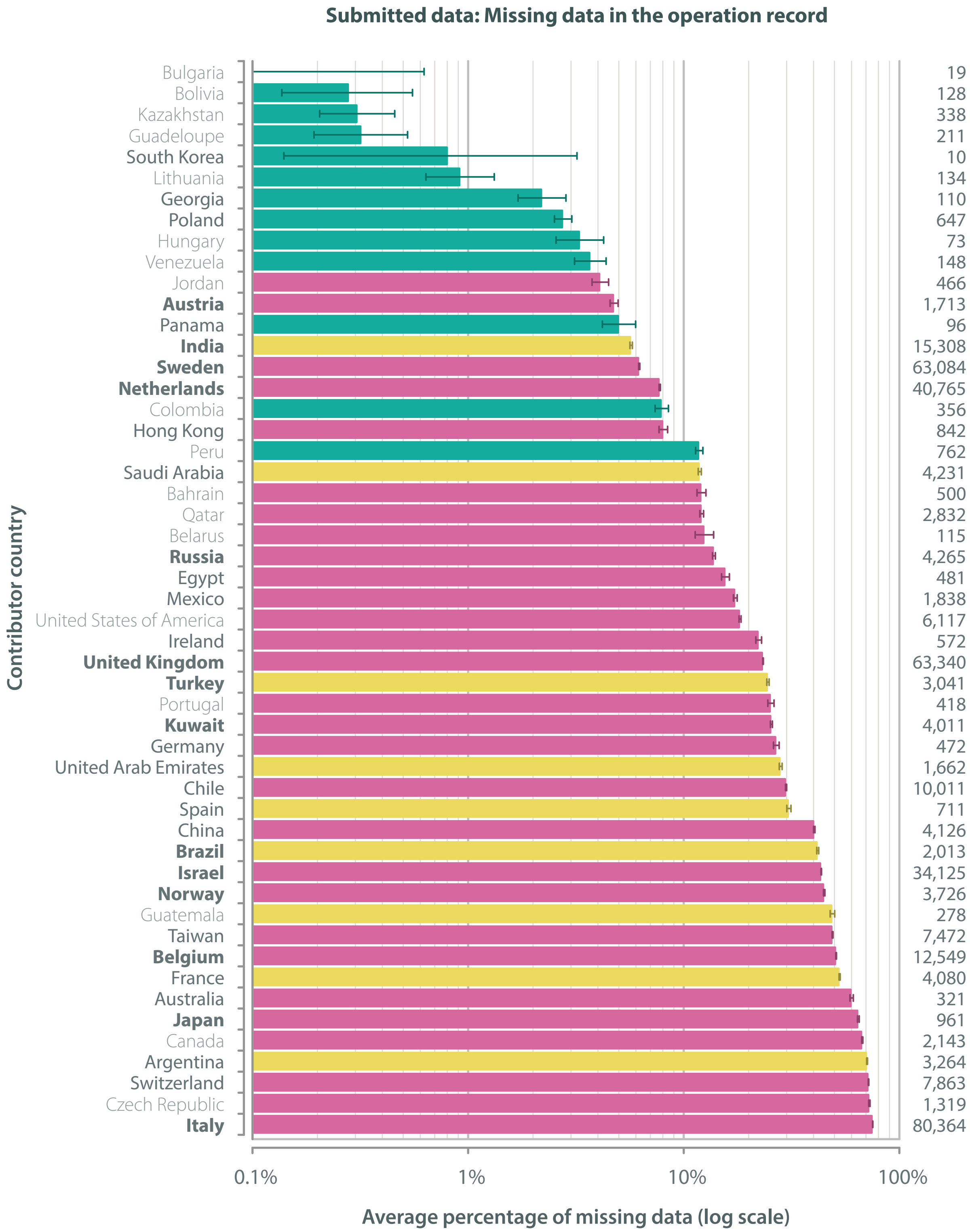
IFSO GLOBAL REGISTRY

Additional charts and tables

The chart below illustrates the data completeness of submissions from each of the contributor countries in the IFSO Global Registry. Please note that the horizontal axis is a on a **logarithmic** scale. The **green** bars represent data that has been entered, on a case-by-case basis, in the Direct Data Entry portal, and, as might be expected, missing data is minimal. **Pink** bars represent data that has been uploaded, while the **yellow** bars represent a hybrid mix of both Direct Data Entry and electronic uploads. Even though the IFSO Minimum Dataset is truly minimal, it is still a challenge for some countries to submit complete data because they are either not collecting the necessary fields or the data they hold locally does not match sufficiently to be uploaded (see also pages 26-27).



IFSO Global Registry: data completeness for the baseline (operation) record

		Data completeness information			
		Operation records	Missing data items	Data items required	Missing data rate
Contributor country	Argentina	3,264	57,826	81,620	70.8%
	Australia	321	4,842	8,058	60.1%
	Austria	1,713	2,018	42,446	4.8%
	Bahrain	500	1,507	12,470	12.1%
	Belarus	115	356	2,853	12.5%
	Belgium	12,549	155,648	305,776	50.9%
	Bolivia	128	9	3,212	0.3%
	Brazil	2,013	21,068	50,373	41.8%
	Bulgaria	19	0	478	0.0%
	Canada	2,143	36,095	53,644	67.3%
	Chile	10,011	75,187	252,057	29.8%
	China	4,126	41,973	104,151	40.3%
	Colombia	356	711	8,988	7.9%
	Czech Republic	1,319	23,742	32,694	72.6%
	Egypt	481	1,878	12,025	15.6%
	France	4,080	52,864	100,040	52.8%
	Georgia	110	61	2,766	2.2%
	Germany	472	3,128	11,638	26.9%
	Guadaloupe	211	17	5,309	0.3%
	Guatemala	278	3,370	6,886	48.9%
	Hong Kong	842	1,715	21,329	8.0%
	Hungary	73	61	1,846	3.3%
	India	15,308	21,827	382,757	5.7%
	Ireland	572	3,204	14,387	22.3%
	Israel	34,125	369,048	849,799	43.4%
	Italy	80,364	1,488,639	1,978,457	75.2%
	Japan	961	15,730	24,371	64.5%
	Jordan	466	482	11,746	4.1%
	Kazakhstan	338	26	8,466	0.3%
	Kuwait	4,011	25,594	100,374	25.5%
	Lithuania	134	31	3,366	0.9%
	Mexico	1,838	8,041	46,354	17.3%
	Netherlands	40,765	79,269	1,024,340	7.7%
	Norway	3,726	41,896	93,512	44.8%
	Panama	96	121	2,413	5.0%
	Peru	762	2,265	19,192	11.8%
	Poland	647	446	16,167	2.8%
	Portugal	418	2,652	10,451	25.4%
	Qatar	2,832	8,640	71,317	12.1%
	Russia	4,265	14,671	106,249	13.8%
	Saudi Arabia	4,231	12,645	106,538	11.9%
	South Korea	10	2	248	0.8%
	Spain	711	5,479	17,821	30.7%
	Sweden	63,084	98,507	1,584,857	6.2%
	Switzerland	7,863	139,079	193,322	71.9%
	Taiwan	7,472	91,448	186,701	49.0%
	Turkey	3,041	18,787	76,415	24.6%
	United Arab Emirates	1,662	11,825	41,985	28.2%
	United Kingdom	63,340	369,177	1,582,837	23.3%
	United States of America	6,117	28,034	153,653	18.2%
	Venezuela	148	136	3,685	3.7%

The Fourth IFSO Global Registry Report 2018

This is the fourth international analysis of outcomes from bariatric (obesity) and metabolic surgery, gathered under the auspices of IFSO (the International Federation for the Surgery of Obesity and Metabolic Disorders).

…this is by far the best international data registry in metabolic / bariatric surgery available so far. It gives a clear insight in the geographic and cultural differences in metabolic surgery across the globe. By doing so, and despite the aforementioned limitations, it provides an excellent working document for surgeons and other health care professionals, as well as politicians and stakeholders and should allow for better insights in health policies, private and public alike.

Jacques Himpens

… the report is the start of a process that shows what can be achieved within the constituent countries of IFSO. The data could in future be used to estimate inequalities of provision of surgery internationally, providing benchmarks for access to surgery to those people with specific obesity-related disease such as diabetes.

Richard Welbourn

We need global data, and a collective will, to address this global epidemic; both prevention and treatment. It is important to pool our resources and understand the delivery of bariatric-metabolic surgery on a global basis. The IFSO international registry provides a vital component in monitoring and evaluating our response to this epidemic. I applaud the progress made with the IFSO global registry during this last year.

John Dixon

IFSO GLOBAL REGISTRY

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Dendrite Clinical Systems
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Henley-on-Thames
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United Kingdom

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