East Asian perspectives in metabolic and bariatric surgery

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Keywords
Bariatric surgery, Type 2 diabetes mellitus, Obesity

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J Diabetes Investig 2022; 13: 756–761
doi: 10.1111/jdi.13748

ABSTRACT

The prevalence of diabetes and obesity continues to rise in East Asia. As the risk of diabetes increases at a lower body mass index (BMI) in East Asians than in Europeans, the threshold of BMI values for metabolic and bariatric surgery (MBS) is lower in East Asians. MBS is considered upon reaching a BMI of 27.5 kg/m² and is recommended at a BMI of ≥ 32.5 kg/m², depending on the status of glucose homeostasis. The most commonly performed MBS in East Asia is sleeve gastrectomy, followed by Roux-en-Y gastric bypass (RYGB). Because the incidence of gastric cancer is higher in East Asia than in other regions, concerns regarding surveillance for gastric cancer might be related to a preference for sleeve gastrectomy over RYGB in this region. Even though there is a paucity of data on direct comparisons of the efficacy of MBS among different ethnic groups, the degree of weight reduction in East Asians is not inferior to other ethnic groups. Moreover, studies suggest that the diabetes remission rate in East Asians seemed to be higher than in other ethnic groups. Future studies involving multiethnic groups are necessary to identify possible ethnic differences in diabetes remission and to determine the appropriate BMI threshold for MBS according to ethnicity.

INTRODUCTION

It is estimated that the global prevalence of diabetes will continue to increase from 9.3% in 2019 to 10.9% by 2045¹. Due to rapid urbanization and nutrition transition, Asia has become an epicenter of the diabetes epidemic². South-East Asia has the third highest world age-standardized prevalence of diabetes (11.3%) after the Middle East and North Africa (12.2%), and the Western Pacific (11.4%). At a country level, China has the world’s highest number of people living with diabetes, estimated to be 166 million. The Japan National Health and Nutrition Survey (2003–2012) of individuals aged ≥ 20 years, showed that the age-standardized prevalence of diabetes was 8%⁶. Data from the Korean National Health and Nutrition Examination Survey VII (2016–2018) showed the estimated prevalence of diabetes in Korean adults (age ≥ 30 years) was 13.8%⁴.

Compared with Europeans, Asians develop type 2 diabetes at a lesser degree of obesity⁵. There are several explanations for this finding, such as a relatively higher amount of visceral fat than subcutaneous fat in Asians⁶, and an impairment in the compensatory increase of the insulin secretory function under insulin resistance⁷. A prospective observational study from the Korean Genome and Epidemiology Study demonstrated that reduced β-cell function and a lack of β-cell compensation for increased insulin resistance were observed in subjects who developed diabetes⁸. Regarding the higher risk of diabetes at the same BMI, the treatment algorithm for type 2 diabetes recommends that BMI thresholds for metabolic bariatric surgery (MBS) should be lowered by 2.5 kg/m² for Asian subjects with diabetes⁹, as elaborated below.

TREATMENT GUIDELINES FOR MBS IN EAST ASIA

The 2nd Diabetes Surgery Summit (DSS-II) was held in 2015, and the indication for metabolic surgery for individuals with type 2 diabetes was updated and released in 2016⁹. The Chinese Diabetes Society was involved in the development of the DSS-II consensus statement, and the Japan Diabetes Society endorsed the guidelines in the same year. These guidelines recommend that metabolic surgery for Asians can be considered in subjects with a BMI of ≥ 27.5 kg/m². The Asia-Pacific Metabolic and Bariatric Surgery Society endorsed the same criteria for metabolic surgery¹⁰. The Korean Society for Metabolic and Bariatric Surgery (KSMBS)¹¹ and the Korean Society for the Study of
Obesity recommend metabolic bariatric surgery when the BMI is ≥35 kg/m², or ≥30 kg/m² with comorbidities, or ≥27.5 kg/m² with uncontrolled type 2 diabetes. However, the Korean Diabetes Association did not adopt the decreased BMI cutoff by 2.5 kg/m² because of paucity of data about the long-term results of the MBS in Korean subjects with a BMI of <30 kg/m². Recently, the Japanese Society for Treatment of Obesity, the Japan Diabetes Society, and the Japan Society for the Study of Obesity developed a consensus statement recommending the MBS for subjects with a BMI of ≥35 kg/m² and subjects with BMI ≥32 kg/m² if they have diabetes or have two or more non-diabetic obesity-related health disorders. Table 1 shows the available guidelines for the indications of MBS in East Asian countries.

In Korea, the National Health Insurance Service has covered MBS since January 2019. Subjects with a BMI of ≥35 kg/m², or a BMI of ≥30 kg/m² with obesity-related comorbidities, can benefit from the coverage. The Japanese National Health Insurance has approved laparoscopic sleeve gastrectomy (SG) and sleeve duodenojejunal bypass (DJB) as highly advanced medical treatments since 2010 and 2018, respectively. Therefore, the costs of these two procedures are partly covered by insurance. Taiwan provides only partial coverage for bariatric surgery and China does not provide any national health insurance for bariatric surgery.

Table 1 | Indications for metabolic and bariatric surgery in East Asian countries

| Country       | Organization (Year)                                                                 | Indications                                                                 |
|---------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| South Korea   | Korean Diabetes Association (2021)                                                  | • T2D with BMI ≥35 kg/m²                                                                 |
|               | Korean Society for Metabolic and Bariatric Surgery (2018)                              | • Uncontrolled T2D with BMI ≥30 kg/m²                                                                 |
|               | Korean Society for the Study of Obesity (2020)                                       | • Bariatric surgery: BMI ≥35 kg/m² or comorbidities with BMI ≥30 kg/m² |
|               | Joint Committee in the Japanese Society for Treatment of Obesity, the Japan Diabetes Society, and the Japan Society for the Study of Obesity (2021) | • Metabolic surgery: uncontrolled T2D with BMI ≥27.5 kg/m² |
| Japan         |                                                                                      | • BMI ≥35 kg/m² or comorbidities with BMI ≥30 kg/m²                                |
|               |                                                                                      | • Uncontrolled T2D with BMI ≥27.5 kg/m²                                                                 |
| China         | Chinese Society for Metabolic & Bariatric Surgery, Chinese College of Surgeons, and Chinese Medical Doctor Association (2019) | • BMI ≥35 kg/m²                                                                 |
|               |                                                                                      | • BMI ≥32 kg/m² with diabetes or two or more non-diabetic obesity-related health disorders |
|               | Chinese Diabetes Society (2019)                                                      | • BMI ≥37.5 kg/m² (strong recommendation), BMI 32.5–37.5 kg/m² (recommendation) |
|               |                                                                                      | • Comorbidities (≥2) with BMI 27.5–32.5 kg/m²                                                                 |
|               |                                                                                      | • T2D with BMI ≥32.5 kg/m²                                                                 |
|               |                                                                                      | • T2D in the presence of other cardiovascular risk factors with BMI 27.5–32.5 kg/m² |

BMI, body mass index; DJB, duodenojejunal bypass; SG, sleeve gastrectomy; T2D, type 2 diabetes.
treatment, regardless of whether the baseline BMI is above or below 35 kg/m². This analysis included randomized controlled trials (RCTs) that were conducted in subjects with type 2 diabetes. Therefore, there is little doubt that individuals with a BMI of < 35 kg/m² derive substantial benefit from MBS. However, RCTs including subjects with a lesser degree of obesity (BMI < 30 kg/m²) are relatively scant. Ji et al.²⁴ reported the results of a meta-analysis to determine the effect of MBS on Asian subjects with type 2 diabetes with a BMI of < 30 kg/m². This meta-analysis included single-arm studies and, given the nature of the study design, the quality of the study was not high. Despite this limitation, the study delivered important clinical insights for MBS in Asian populations with lower BMI. The decrease of HbA1c was 2.38% at 1 year and 1.58% at 2 years, which is comparable to a previous meta-analysis⁹, including only one Asian study²⁵ out of 15 studies. This non-Asian-dominant meta-analysis showed a median HbA1c reduction of 2.0% with an observational duration of 6–60 months. Therefore, MBS conducted in subjects with a lower BMI (<30 kg/m²) might be as effective as that in subjects with a higher BMI in terms of HbA1c reduction. However, a higher baseline BMI is a well-known predictor for higher rates of remission of diabetes²⁶. Moreover, the effect of a higher baseline BMI on the higher propensity for diabetes remission was more prominent in a meta-analysis that included Asian studies²⁷. Taken together, these data suggest that we need more clinical information regarding the effect of MBS on East Asian populations with a BMI of < 30 kg/m². Several studies have evaluated the effect of MBS in subjects even with a normal BMI. Heo et al.²⁸ reported that six out of nine Korean subjects (mean BMI, 23.1 kg/m²) with type 2 diabetes showed remission or improvement of diabetes after 1 year. Cui et al.²⁹ also showed that 48 out of 58 Chinese subjects (mean BMI, 23.9 kg/m²) with type 2 diabetes discontinued antidiabetic medications and achieved a complete remission after 1 year. Despite these findings, there is still insufficient evidence to recommend a low BMI cutoff point.

**TYPES OF THE MBS PERFORMED IN EAST ASIA**

Standard procedures of MBS are the Roux-en-Y gastric bypass (RYGB), sleeve gastrectomy (SG), adjustable gastric banding (AGB), and biliopancreatic diversion (Figure 1)³⁰. According to a survey by the International Federation for the Surgery of Obesity and Metabolic Disorders, sleeve gastrectomy (53.6% of total MBS in 2016) and RYGB (30.1%) were the most commonly performed procedures worldwide³⁰. In the Asia-Pacific region, SG accounted for 69% of MBS procedures and RYGB only 10%. The most commonly performed MBS was also SG (74.4% in 2019 and 71.9% in 2020) in the registry of the KSMBs, and the number of RYGB was much less than that of SG (15.2% in 2019 and 13.2% in 2020). The main reason why RYGB has been performed less frequently is probably because endoscopic gastric cancer screening is difficult after this procedure. However, SG seems to be less effective in diabetes remission compared with RYGB³¹; therefore, a bypass procedure is also necessary for Asian subjects who need more sustainable metabolic benefits. Resectional RYGB, a procedure that combines RYGB and stomach removal, can be applied, but this procedure is recommended only in very limited situations ³². In fact, the occurrence of gastric cancer in the remnant stomach after RYGB is reported to be rare.³³ However, the overall disease-related mortality rate is high, as much as 33.3% in 17 cases. Therefore, the development of an effective screening tool for gastric cancer is necessary to ensure the safety of RYGB in Asians.

To overcome the limitation of gastric cancer screening and the relatively lower efficacy of simple restriction surgery, sleeve duodenojejunal bypass has been introduced and frequently performed in Taiwan and Japan¹⁵. Lee et al.³⁴ reported that sleeve DJB was superior to sleeve gastrectomy in subjects with type 2 diabetes in terms of excessive weight loss (EWL) (87.2 ± 14.9%
in sleeve DJB vs. 67.5 ± 27.0% in SG, \( P = 0.023 \), and the decrease of HbA1c (2.8% vs. 2.1%, \( P = 0.045 \)) at 1 year after surgery. However, the operation time and hospital stay were longer in sleeve DJB than in SG. Complications were also numerically higher in sleeve DJB compared with SG. Single-longer in sleeve DJB than in SG. Complications were also numerically higher in sleeve DJB compared with SG. Single-anastomosis DJB-SG (SADJB-SG) is a simplified technique of sleeve DJB and has the advantage of reducing operation time compared with sleeve DJB with dual anastomoses. Another variation of metabolic surgery is the mini gastric bypass (one anastomosis gastric bypass). Among various procedures of metabolic surgery, one anastomosis gastric bypass exhibited significantly higher efficacy in the total body weight loss and type 2 diabetes remission at 1 year after surgery compared with other procedures (RYGB, SG, sleeve DJB, and SADJB-SG) among 1,016 patients who underwent MBS from Taiwan, Japan, and Hong Kong. In this study, any type of bypass procedure was associated with better outcomes compared with SG. Therefore, application of a bypass procedure in addition to sleeve gastrectomy can be considered in selected subjects, although a large-scale study is necessary to confirm its benefit relative to risk and to reveal any long-term effects.

**LONG-TERM OUTCOME OF THE MBS IN EAST ASIA**

In a multicenter retrospective cohort study from Korea, 261 subjects with obesity were included between January 2008 and February 2011. From this cohort, 137 subjects were followed up for more than 5 years. The total weight loss was 24.9% in the surgical group and 2.8% in the conventional treatment group. A larger study including East Asian patients (\( n = 463 \)) from 5 Chinese, 9 Korean, and 10 Japanese institutes, showed 25.1 ± 11.0% of total weight loss at 3 years after surgery, and 23.7 ± 10.7% at 5 years after surgery. Excessive weight loss was 85.3 ± 116.5% and 91.9 ± 231.2% at 3 years and 5 years after surgery, respectively. The surgical procedures performed in this retrospective study were SG, RYGB, and sleeve DJB. A multi-institutional survey from Japan reported 26% and 32% weight loss after SG and sleeve DJB, respectively at 5 years. Another 5-year study from a multiethnic Asian population, including 41.5% Chinese, showed 47.3% and 47.7% of EWAL after SG and RYGB, respectively. Therefore, although the follow-up rate and individual outcome varied across these studies, the long-term outcome for weight loss looks promising.

In terms of diabetes remission, Asian-dominant studies showed a better outcome than non-Asian populations. For example, Kim et al. reported a difference in the effects of bariatric surgery between Asian and non-Asian populations including 37 RCTs through April 2019. This meta-analysis showed a higher diabetes remission rate at 2 years in Asian populations compared with non-Asian populations (67.2% vs. 56.3%). In the aforementioned East Asian study, 463 subjects showed 25.1 ± 11.0% of total weight loss at 3 years after surgery, and 23.7 ± 10.7% at 5 years after surgery. Excessive weight loss was 85.3 ± 116.5% and 91.9 ± 231.2% at 3 years and 5 years after surgery, respectively. The surgical procedures performed in this retrospective study were SG, RYGB, and sleeve DJB. A multi-institutional survey from Japan reported 26% and 32% weight loss after SG and sleeve DJB, respectively at 5 years. Another 5-year study from a multiethnic Asian population, including 41.5% Chinese, showed 47.3% and 47.7% of EWAL after SG and RYGB, respectively. Therefore, although the follow-up rate and individual outcome varied across these studies, the long-term outcome for weight loss looks promising.

To observe mortality data after MBS, more than 10 years of observation is needed. The Swedish Obese Subjects study is a good example that demonstrates the association between MBS and reduction in overall mortality. Among East Asian countries, the Taiwan Diabesity Study (TDS) is the largest study planned to evaluate mortality and end organ damage in overweight and/or obese patients with type 2 diabetes receiving metabolic surgery compared with conventional medical treatment. The Taiwan Diabesity Study enrolled 126 subjects who received MBS and 890 subjects who have been under medical treatment since March 2014. The long-term outcome from this study will provide more concrete evidence about the influence of MBS on mortality.

**PREDICTION OF DIABETES REMISSION AFTER MBS**

The most remarkable benefit of the MBS is a profound improvement in glycemic control, which often comes as a remission of diabetes. Therefore, a good prediction model for diabetes remission would be very helpful to select surgical candidates. Currently various diabetes remission prediction models have been developed. Among them, ABCD and DiaRem have been widely validated. The ABCD scoring system includes age, BMI, C-peptide, and diabetes duration (therefore, the acronym ABCD was adopted) and was originally developed based on the data of Taiwanese and subsequently validated mainly by Asian studies. The meta-analysis with regard to the ABCD score showed a good predictive power with an area under the receiver operating characteristic curve of 0.79 and 0.80 at 1 year and more longer-term follow up, respectively.

**CONCLUSIONS**

Metabolic bariatric surgery is a good option for the management of diabetes and obesity in East Asians. Previous studies reported that the efficacy of MBS in Asians is not inferior and sometimes even superior to that in non-Asians. However, data on which type of surgery is more appropriate in this population in terms of both efficacy and safety remain scarce. Given that a lower BMI at baseline might be associated with less effective outcomes after MBS, analysis of data on the performance of MBS in subjects with a lesser degree of obesity (BMI < 27.5 kg/m²) is necessary. Furthermore, considering the early deterioration of β-cell function in East Asians with diabetes, the early application of MBS might be beneficial for this group. Further large-scale long-term follow-up studies should be performed to answer this question.

**DISCLOSURE**

The authors declare no conflict of interest.

Approval of the research protocol: N/A

Informed Consent: N/A

Approval date of Registry and the Registration No. of the study/trial: N/A

Animal Studies: N/A
REFERENCES

1. Saeedi P, Petersohn I, Salpea P, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: results from the International Diabetes Federation Diabetes Atlas, 9(th) edition. Diabetes Res Clin Pract 2019; 157; 107843.
2. Hu FB. Globalization of diabetes: the role of diet, lifestyle, and genes. Diabetes Care 2011; 34: 1249–1257.
3. Ikeda N, Nishi N, Noda H, et al. Trends in prevalence and management of diabetes and related vascular risks in Japanese adults: Japan National Health and Nutrition Surveys 2003–2012. Diabetes Res Clin Pract 2017; 127: 115–122.
4. Jung CH, Son JW, Kang S, et al. Diabetes fact sheets in Korea, 2020: an appraisal of current status. Diabetes Metab J 2021; 45: 1–10.
5. Yoon KH, Lee JH, Kim JW, et al. Epidemic obesity and type 2 diabetes in Asia. Lancet 2006; 368: 1681–1688.
6. Williams R, Periasamy M. Genetic and environmental factors contributing to visceral adiposity in Asian populations. Endocrinol Metab (Seoul) 2020; 35: 681–695.
7. Cho YM. Characteristics of the pathophysiology of type 2 diabetes in Asians. Ann Laparosc Endosc Surg 2017; 2: 14.
8. Ohn JH, Kwak SH, Cho YM, et al. 10-year trajectory of beta-cell function and insulin sensitivity in the development of type 2 diabetes: a community-based prospective cohort study. Lancet Diabetes Endocrinol 2016; 4: 27–34.
9. Rubino F, Nathan DM, Eckel RH, et al. Metabolic surgery in the treatment algorithm for type 2 diabetes: a joint statement by international diabetes organizations. Diabetes Care 2016; 39: 861–877.
10. Rubino F, Nathan DM, Eckel RH, et al. Metabolic surgery in the treatment algorithm for Type 2 diabetes: a joint statement by international diabetes organizations. Obes Surg 2017; 27: 2–21.
11. Guideline Committee for Metabolic and Bariatric Surgery. 2018 Korean society for metabolic and bariatric surgery Guidelines. J Metab Bariatr Surg 2018; 7: 22.
12. Kim BY, Kang SM, Kang JH, et al. 2020 Korean Society for the Study of Obesity guidelines for the management of obesity in Korea. J Obes Metab Syndr 2021; 30: 81–92.
13. Hur KY, Moon MK, Park JS, et al. Clinical practice guidelines for diabetes mellitus of the Korean Diabetes Association. Diabetes Metab J 2021; 45: 461–481.
14. Oshiro T, Kasama K, Nabekura T, et al. Current status and issues associated with bariatric and metabolic surgeries in Japan. Obes Surg 2021; 31: 343–349.
15. Ohta M, Seki Y, Wong SK, et al. Bariatric/metabolic surgery in the Asia-Pacific region: APMBSS 2018 survey. Obes Surg 2019; 29: 534–541.
16. Cho YM. A gut feeling to cure diabetes: potential mechanisms of diabetes remission after bariatric surgery. Diabetes Metab J 2014; 38: 406–415.
17. Cho YM, Merchant CE, Kieffer TJ. Targeting the glucagon receptor family for diabetes and obesity therapy. Pharmacol Ther 2012; 135: 247–278.
18. Rubino F, Forgione A, Cummings DE, et al. The mechanism of diabetes control after gastrointestinal bypass surgery reveals a role of the proximal small intestine in the pathophysiology of type 2 diabetes. Ann Surg 2006; 244: 741–749.
19. Speck M, Cho YM, Asadi A, et al. Duodenal-jejunal bypass protects GK rats from (beta)-cell loss and aggravation of hyperglycemia and increases enteroendocrine cells coexpressing GIP and GLP-1. Am J Physiol Endocrinol Metab 2011; 300: E923–932.
20. Ahn CH, Chae S, Oh TJ, et al. Dynamic adaptive changes of the ileum transposed to the proximal small intestine in rats. Obes Surg 2019; 29: 2399–2408.
21. Seeley RJ, Chambers AP, Sandovall DA. The role of gut adaptation in the potent effects of multiple bariatric surgeries on obesity and diabetes. Cell Metab 2015; 21: 369–378.
22. Ahn CH, Choi EH, Oh TJ, et al. Ileal transposition increases pancreatic beta cell mass and decreases beta cell senescence in diet-induced obese rats. Obes Surg 2020; 30: 1849–1858.
23. Yasuda K. Bariatric and metabolic surgery in Asia: where are we, and where are we going? J Diabetes Investig 2018; 9: 987–990.
24. Ji G, Li P, Li W, et al. The effect of bariatric surgery on Asian patients with type 2 diabetes mellitus and body mass index <30 kg/m²: a systematic review and meta-analysis. Obes Surg 2019; 29: 2492–2502.
25. Liang Z, Wu Q, Chen B, et al. Effect of laparoscopic Roux-en-Y gastric bypass surgery on type 2 diabetes mellitus with hypertension: a randomized controlled trial. Diabetes Res Clin Pract 2013; 101: 50–56.
26. Lee WJ, Hur KY, Lakadawala M, et al. Predicting success of metabolic surgery: age, body mass index, C-peptide, and duration score. Surg Obes Relat Dis 2013; 9: 379–384.
27. Wang GF, Yan YX, Xu N, et al. Predictive factors of type 2 diabetes mellitus remission following bariatric surgery: a meta-analysis. Obes Surg 2015; 25: 199–208.
28. Heo Y, Ahn JH, Shin SH, et al. The effect of duodenoejunal bypass for type 2 diabetes mellitus patients below body mass index 25 kg/m²: one year follow-up. J Korean Surg Soc 2013; 85: 109–115.
29. Cui JF, Chen T, Shi L, et al. Gastric bypass surgery in non-obese patients with type 2 diabetes mellitus: a 1-year follow-up of 58 cases in Chinese. Int J Clin Exp Med 2015; 8: 4393–4398.
30. Angrissani L, Santonico A, Iovino P, et al. Bariatric surgery and endoluminal procedures: ISPO Worldwide Survey 2014. Obes Surg 2017; 27: 2279–2289.
31. Hofso D, Fatima F, Borgeraas H, et al. Gastric bypass versus sleeve gastrectomy in patients with type 2 diabetes.
(Oseberg): a single-centre, triple-blind, randomised controlled trial. *Lancet Diabetes Endocrinol* 2019; 7: 912–924.

32. Park YS, Ahn SH, Park DJ, *et al.* Effectiveness of sleeve gastrectomy for metabolic surgery in Korea. *J Obes Metab Syndr* 2018; 27: 131–133.

33. Tornese S, Aiolfi A, Bonitta G, *et al.* Remnant gastric cancer after Roux-en-Y gastric bypass: narrative review of the literature. *Obes Surg* 2019; 29: 2609–2613.

34. Lee WJ, Almulaifi AM, Tsou JJ, *et al.* Duodenal-jejunal bypass with sleeve gastrectomy versus the sleeve gastrectomy procedure alone: the role of duodenal exclusion. *Surg Obes Relat Dis* 2015; 11: 765–770.

35. Ser KH, Lee WJ, Chen JC, *et al.* Laparoscopic single-anastomosis duodenal-jejunal bypass with sleeve gastrectomy (SADJB-SG): surgical risk and long-term results. *Surg Obes Relat Dis* 2019; 15: 236–243.

36. Shen SC, Lee WJ, Kasama K, *et al.* Efficacy of different procedures of metabolic surgery for type 2 diabetes in Asia: a multinational and multicenter exploratory study. *Obes Surg* 2021; 31: 2153–2160.

37. Heo YS, Park JM, Kim YJ, *et al.* Bariatric surgery versus conventional therapy in obese Korean patients: a multicenter retrospective cohort study. *J Korean Surg Soc* 2012; 83: 335–342.

38. Park JY, Heo Y, Kim YJ, *et al.* Long-term effect of bariatric surgery versus conventional therapy in obese Korean patients: a multicenter retrospective cohort study. *Ann Surg Treat Res* 2019; 96: 283–289.

39. Ohta M, Seki Y, Ohyama T, *et al.* Prediction of long-term diabetes remission after metabolic surgery in obese east Asian patients: a comparison between ABCD and IMS scores. *Obes Surg* 2021; 31: 1485–1495.

40. Haruta H, Kasama K, Ohta M, *et al.* Long-term outcomes of bariatric and metabolic surgery in Japan: results of a multi-institutional survey. *Obes Surg* 2017; 27: 754–762.

41. Toh BC, Chan WH, Eng AKH, *et al.* Five-year long-term clinical outcome after bariatric metabolic surgery: a multi-ethnic Asian population in Singapore. *Diabetes Obes Metab* 2018; 20: 1762–1765.

42. Kim JH, Pyo JS, Cho WJ, *et al.* The effects of bariatric surgery on type 2 diabetes in Asian populations: a meta-analysis of randomized controlled trials. *Obes Surg* 2020; 30: 910–923.

43. Sjostrom L, Narbro K, Sjostrom CD, *et al.* Efficacy of different procedures of metabolic surgery for type 2 diabetes in Asia: a multinational and multicenter exploratory study. *Obes Surg* 2021; 31: 2153–2160.

44. Lee WJ, Chang YC, Almalki O, *et al.* Study design and recruitment for a prospective controlled study of diabesity: Taiwan Diabesity Study. *Asian J Surg* 2019; 42: 244–250.

45. Singh P, Adderley NJ, Hazlehurst J, *et al.* Prognostic models for predicting remission of diabetes following bariatric surgery: a systematic review and meta-analysis. *Diabetes Care* 2021; 44: 2626–2641.

46. Sasaki A, Yokote K, Naitoh T, *et al.* Metabolic surgery in treatment of obese Japanese patients with type 2 diabetes: a joint consensus statement from the Japanese Society for Treatment of Obesity, the Japan Diabetes Society, and the Japan Society for the Study of Obesity. *Diabetol Int* 2021; 13: 1–30.

47. Zeng Q, Li N, Pan XF, *et al.* Clinical management and treatment of obesity in China. *Lancet Diabetes Endocrinol* 2021; 9: 393–405.

48. Jia W, Weng J, Zhu D, *et al.* Standards of medical care for type 2 diabetes in China 2019. *Diabetes Metab Res Rev* 2019; 35: e3158.