BMJ Open  Examining spousal and family support as predictors of long-term weight loss and remission of type 2 diabetes following bariatric surgery in Singapore: a retrospective cohort study

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ABSTRACT

Objectives Postoperative outcomes vary considerably across bariatric patients and may be related to psychosocial factors. In this study, we examined whether a patient’s family support predicts postsurgical weight loss and the remission of type 2 diabetes mellitus (T2DM).

Design Retrospective cohort study in Singapore.

Setting Participants were recruited from a public hospital in Singapore.

Participants Between 2008 and 2018, 359 patients completed a presurgical questionnaire before undergoing gastric bypass or sleeve gastrectomy.

Outcome measures As part of the questionnaire, patients described their family support in terms of structure (marital status, number of family members in the household) and function (marriage satisfaction, family emotional support, family practical support). Linear mixed-effects and Cox proportional-hazard models were used to examine whether these family support variables predicted percent total weight loss or T2DM remission up to 5 years postsurgery. T2DM remission was defined as glycated haemoglobin (HbA1c) <6.0% without medications.

Results Participants had a mean preoperative body mass index of 42.6±7.7 kg/m2 and HbA1c (%) of 6.8±1.67. Marital satisfaction was found to be a significant predictor of postsurgical weight trajectories. Namely, patients who reported higher marital satisfaction were more likely to sustain weight loss than patients who reported lower marital satisfaction (β=0.92, SE=0.37, p=0.02). Family support did not significantly predict T2DM remission.

Conclusions Given the link between marital support and long-term weight outcomes, providers could consider asking patients about their spousal relationships during presurgical counselling.

Trial registration number NCT04303611.

INTRODUCTION

Although bariatric surgery produces marked weight loss and decreased obesity-related comorbidities,1 postsurgical outcomes vary across individuals. Body mass index (BMI) decreases by an average of 13 kg/m2 in the first year,1 but weight trajectories differ: whereas some patients maintain the initial weight loss or persist in further weight loss, others regain the weight over time.2 Similarly, individuals differ in whether they experience remission of diabetes mellitus, hypertension and dyslipidaemia, and whether these changes are sustained.2 Given these individual differences, there is a need to identify factors that can predict postoperative outcomes, allowing patient selection and follow-up care to be optimised.

One potential predictor may be a patient’s family support. Within the hospital setting, family support has been linked to a wide range of patient outcomes, including: duration of stay in intensive care units,3 management of chronic illnesses,4 and quality of life for paediatric patients after open-heart surgery.5 Similarly, family support has been found to increase adherence to diabetes self-management, improving patients’ glycaemic control.6 Although less is known about how family support may influence clinical outcomes after bariatric surgery,7 the postsurgical period requires a regimen of lifestyle...
changes, medication adherence and follow-up appointments that family support may improve.

Family support can be defined either by its structure or by the function it serves. Structural support refers to the availability of family members, based—for example, on marital status or the number of family members living within the household. Using this definition, several studies have described how married patients experience less weight loss than single patients 12–24 months following surgery; however, other studies either did not find this association, or reported the inverse relationship. Beyond these mixed findings, little is known about the longer-term impact of marital status, the impact of having non-spousal family members or the impact of family structure on the remission of obesity-related comorbidities.

Aside from structure, family support can also be described by function—the extent to which patients receive emotional or practical support from family members. When interviewed, patients who succeed in weight maintenance typically recount how family members encouraged or assisted them with everyday tasks, conversely, those who experienced weight regain reported feeling lonely. Despite these accounts, we are aware of only five studies that have quantified the impact of functional support on weight-related outcomes. Two studies reported increased weight loss among patients who received dietary and lifestyle support, or who reported better family functioning (including better emotional support). However, a third study did not find any significant benefits of family attendance at medical appointments on either weight loss or weight control practices. Specific to spouses, two studies reported that marriage satisfaction—a proxy marker for the quality of spousal support received—predicted weight status at 6 and 12 months postsurgery.

To summarise, a limited number of quantitative studies have examined whether family support predicts long-term outcomes after bariatric surgery. Preliminary findings suggest that the nature and quality of family support (functional support) may be better predictors than the number of family members available (structural support). However, this hypothesis has not been tested directly. Further, prior research has almost exclusively focused on weight loss as the outcome measure, and has examined brief postoperative time windows (6–36 months). Correspondingly, little is known about the remission of comorbidities, or the longer-term impact of family support on weight trajectories.

To address these gaps, we characterised preoperative structural and functional family support in a cohort of patients undergoing bariatric surgery. As our primary goal, we sought to identify which aspect of family support would predict weight loss and complete remission of type 2 diabetes mellitus (T2DM) up to 5 years following surgery.

METHODS

Study design and population

We conducted a chart review of patients who had undergone laparoscopic sleeve gastrectomy (LSG), one anastomosis gastric bypass (OAGB) or Roux-en-Y gastric bypass (RYGB) at a Singapore-based tertiary centre from 2008 to 2018. All patients met local criteria for surgery (BMI≥37.5 kg/m² or BMI≥32.5 kg/m² with comorbidities), and were included if they had completed an intake questionnaire on their medical and social history (routinely administered to patients during their first preoperative visit). Data were retrieved from electronic medical records managed using the Research Electronic Data Capture platform.

Patient and public involvement

This work uses data that has been provided by patients and collected as part of their care and support. No patients and or public were involved in the design and conduct of this research.

Outcome measures

Weight loss outcomes

Weight in kilograms was measured presurgery (on the day of surgery), and at follow-up clinical appointments 1, 2, 3, 4 and 5 years postsurgery. This was expressed as total percentage weight loss (%TWL), defined as the difference between patients’ postsurgical weight (at the follow-up appointment) and presurgical weight, divided by presurgical weight and expressed as a percentage.

Complete T2DM remission

Similarly, percentage of glycated haemoglobin (HbA1c) was measured presurgery and at clinical appointments 1, 2, 3, 4 and 5 years postsurgery. Complete T2DM remission was defined as HbA1c<6.0% without the use of anti-diabetic medication.

Covariates

Spousal support: marital status and marital satisfaction

Spousal support was first defined structurally, based on patients’ self-reported marital status on the intake questionnaire (married, not married: single/separated/divorced/widowed). As a marker for functional support, patients also rated their marital satisfaction using a 4-point scale ranging from ‘Dissatisfied’ (1) to ‘Very Satisfied’ (4); which has been found to correlate highly (0.86) with longer validated scales. (The variable was left empty for patients who were not married.)

Family support: family structure and functional support

Within the intake questionnaire, patients also listed the name, age and relationship of every person living in their household. Structural family support was then derived by summing up the total number of family members listed (≤2 or >2).

Two further questions assessed functional support. For each family member listed, participants rated whether the person supported their weight loss efforts (1: yes, 0: not
involved, −1: no). Scores were then summed to provide a measure of emotional support, with total scores recategorised as: ‘unsupportive’ (−3 to −1), ‘neutral’ (0) or ‘supportive’ (1 to 3).

As an assay of practical support, patients indicated the primary person within the household who: (a) planned meals, (b) cooked and/or (c) visited the supermarket or wet market for groceries. Based on their responses, patients were then classified as ‘having practical support’ (if at least one family member either planned meals, cooked or purchased groceries), or ‘having no practical support’ (if no family member performed these roles). (Online supplemental appendix 1 provides a full list of all family-support questions included.)

Figure 1 Changes in: (A) per cent total weight loss (%TWL) and (B) glycated haemoglobin (HbA1c) up to 5 years following bariatric surgery.
Table 2  Linear mixed-effects models to predict per cent total weight loss (%TWL) in the 5-year window following bariatric surgery

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1† Beta (SE) (95% CI)</th>
<th>Model 2‡ Beta (SE) (95% CI)</th>
<th>P value</th>
<th>Model 1† Beta (SE) (95% CI)</th>
<th>Model 2‡ Beta (SE) (95% CI)</th>
<th>P value</th>
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<td>Family support variables</td>
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<td>Marital status</td>
<td>−0.86 (1.77) (−4.89, 3.21)</td>
<td>−0.66 (1.59) (−3.81, 2.49)</td>
<td>0.63</td>
<td>0 (ref)</td>
<td>0 (ref)</td>
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<tr>
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<td>Marital status×Time</td>
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<td>0.01 (0.59) (−1.19, 1.20)</td>
<td>0.84</td>
<td>0 (ref)</td>
<td>0 (ref)</td>
<td>0 (ref)</td>
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<td>−1.55 (1.18) (−3.89, 0.78)</td>
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<td>0 (ref)</td>
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<td>0 (ref)</td>
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<td>Marital satisfaction×Time</td>
<td>0.92 (0.37) (0.18, 1.65)</td>
<td>0.79 (0.37) (0.04, 1.53)</td>
<td>0.02*</td>
<td>0 (ref)</td>
<td>0 (ref)</td>
<td>0.04*</td>
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<td>Number of family members in household ≤2</td>
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<td>0.31 (0.78) (−1.24, 1.85)</td>
<td>0.54</td>
<td>0 (ref)</td>
<td>0 (ref)</td>
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<tr>
<td>Number of family members in household×Time ≤2</td>
<td>−0.47 (0.24) (−0.95, 0.01)</td>
<td>−0.43 (0.23) (−0.88, 0.03)</td>
<td>0.06</td>
<td>−0.47 (0.24) (−0.95, 0.01)</td>
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<td>Practical family support</td>
<td>−0.12 (1.02) (−2.14, 1.91)</td>
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<td>0.91</td>
<td>−0.12 (1.02) (−2.14, 1.91)</td>
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<td>−0.02 (0.26) (−0.55, 0.51)</td>
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<td>Emotional family support</td>
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<td>4.30 (3.84) (−3.34, 11.94)</td>
<td>0.74</td>
<td>1.42 (4.28) (−7.11, 9.94)</td>
<td>4.30 (3.84) (−3.34, 11.94)</td>
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<td>−1.01 (1.71) (−4.40, 2.37)</td>
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<td>Emotional family support×Time</td>
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<td>−0.62 (0.80) (−2.27, 1.03)</td>
<td>0.94</td>
<td>0.06 (0.82) (−1.62, 1.74)</td>
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<td>0.08 (0.45) (0.86, to 0.82)</td>
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<td>−0.03 (0.08) (−0.20, 0.14)</td>
<td>0.71</td>
<td>−0.03 (0.08) (−0.20, 0.14)</td>
<td>−0.03 (0.08) (−0.20, 0.14)</td>
<td>0.71</td>
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<tr>
<td>Preoperative age×Time</td>
<td>−0.02 (0.02) (−0.07, 0.03)</td>
<td>−0.02 (0.02) (−0.07, 0.03)</td>
<td>0.49</td>
<td>−0.02 (0.02) (−0.07, 0.03)</td>
<td>−0.02 (0.02) (−0.07, 0.03)</td>
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<td>Sex</td>
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<td>−1.30 (0.86) (−3.00, 0.42)</td>
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<td>−1.30 (0.86) (−3.00, 0.42)</td>
<td>−1.30 (0.86) (−3.00, 0.42)</td>
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<td>Sex×Time</td>
<td>−0.10 (0.28) (−0.67 to 0.47)</td>
<td>−0.10 (0.28) (−0.67 to 0.47)</td>
<td>0.72</td>
<td>−0.10 (0.28) (−0.67 to 0.47)</td>
<td>−0.10 (0.28) (−0.67 to 0.47)</td>
<td>0.72</td>
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<td>Malay</td>
<td>0.98 (0.97) (−0.95, 2.90)</td>
<td>0.98 (0.97) (−0.95, 2.90)</td>
<td>0.32</td>
<td>0.98 (0.97) (−0.95, 2.90)</td>
<td>0.98 (0.97) (−0.95, 2.90)</td>
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<td>Indian</td>
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<td>1.43 (0.91) (−0.37, 3.22)</td>
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<td>1.43 (0.91) (−0.37, 3.22)</td>
<td>1.43 (0.91) (−0.37, 3.22)</td>
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Continued
Demographic and clinical variables
As additional covariates, we extracted: gender (male, female), ethnicity (Chinese, Malay, Indian, others), age at time of surgery, BMI at time of surgery and type of surgery (LSG, OAGB, RYGB).

STATISTICAL ANALYSES
Statistical analyses were conducted using SPSS V.25 (IBM Corp) and R V.3.4.0 (R Core Team, Vienna, Austria). To track changes in %TWL over time, we ran a linear mixed-effects model with parameters estimated using maximum likelihood estimation (using a first-order autoregressive covariance structure). We included as fixed effects: time (years following surgery), the five family support variables (marital status, marital satisfaction, number of family members, emotional family support and structural family support) and the interaction between time and the family support variables (model 1). Random intercepts accounted for correlated data due to the longitudinal design, and continuous variables were grand mean-centred. To assess robustness, we repeated this analysis while controlling for the set of demographic and clinical variables as additional predictors.

RESULTS
Three hundred and fifty-nine patients were included in the analyses (table 1). 62.7% of patients were women, with a mean preoperative age of 40.1±10.1 years. At baseline, patients had a mean BMI of 42.6±7.7 kg/m² and 37.3% had T2DM (mean preoperative HbA1c (%): 6.82±1.67). Three in four patients (75.2%) underwent LSG. In the 5 years after surgery, patient attrition rates were similar to those documented in previous studies (1 year: 57%; 2 years: 34%; 3 years: 27%; 4 years: 18%, 5 years: 13%; see online supplemental appendix 2 for a detailed breakdown). Using Little’s Missing Completely at Random test, we found no evidence that attrition resulted in a biased sample (online supplemental appendix 2).

As shown in figure 1, mean %TWL following surgery was: 27.4±7.9 (1-year postsurgery), 26.3±8.7 (2 years), 24.9±8.34 (3 years), 22.9±10.0 (4 years) and 22.1±9.84 (5 years). Mean postoperative HbA1c (%) was: 5.4±0.7 (1-year postsurgery), 5.90±1.2 (2 years), 6.06±1.2 (3 years), 6.2±1.2 (4 years) and 6.2±1.2 (5 years). (A detailed breakdown of clinical outcomes after each type of bariatric surgery has been described previously.)

Table 2

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1†</th>
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<th>Model 2‡</th>
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<tr>
<td></td>
<td>Beta (SE)</td>
<td>(95% CI)</td>
<td>P value</td>
<td>Beta (SE)</td>
<td>(95% CI)</td>
<td>P value</td>
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<td>Ethnicity×Time</td>
<td>−0.12 (0.30)</td>
<td>(−0.72, 0.49)</td>
<td>0.70</td>
<td>−0.22 (0.28)</td>
<td>(−0.78, 0.34)</td>
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<tr>
<td>Indian</td>
<td>−0.22 (0.28)</td>
<td>(−0.78, 0.34)</td>
<td>0.43</td>
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<tr>
<td>Preoperative BMI</td>
<td>0.51 (0.11)</td>
<td>(0.30, 0.72)</td>
<td>&lt;0.001*</td>
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<td>Preoperative BMI×Time</td>
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<td>Type of surgery</td>
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<td>OAGB</td>
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<td>RYGB</td>
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<td>LSG</td>
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<td>Type of surgery×Time</td>
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<td>OAGB</td>
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<td>(−0.16, 1.07)</td>
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<td>RYGB</td>
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<td>(−0.52, 0.57)</td>
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<td>LSG</td>
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</table>

*p<0.05.
†Model 1 included time (years following surgery), family support variables and the interaction between time and family support variables as predictors.
‡Model 2 was identical to model 1, with the inclusion of demographic and clinical variables as additional predictors.
BMI, body mass index; LSG, laparoscopic sleeve gastrectomy; OAGB, one anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass.


BMJ Open. First published as 10.1136/bmjopen-2022-068810 on 2 May 2023. Downloaded from http://bmjopen.bmj.com on July 2, 2023 by guest. Protected by copyright.
57.9% of patients were married at the time of surgery, with most reporting marital satisfaction (78.3% satisfied or very satisfied; table 1). Family support 36.2% of patients had more than two family members living in the same household. Most patients (73.5%) reported having practical family support, with at least one family member assisting with meal planning, cooking or groceries. Similarly, 73.3% of patients reported having emotional support, with family members supportive of their weight loss. Where patients had unsupportive family members, these tended to be their parents (47.8%).

Predictors of postoperative %TWL
As shown in table 2, marital satisfaction significantly predicted the trajectory of %TWL over 5 years (model 1: $\beta=0.92$, SE=0.37, $p=0.02$). Namely, patients who reported higher preoperative marital satisfaction showed more prolonged maintenance of weight loss postsurgery (ie, less steep declines), compared with patients who reported lower marital satisfaction (figure 2). This effect was robust, and was observed even when demographic and clinical variables were controlled for (model 2: $\beta=0.79$, SE=0.37, $p=0.04$).

Averaged across time, preoperative BMI ($\beta=0.51$, SE=0.11, $p<0.001$) and type of surgery (RYGB: $\beta=2.18$, SE=0.92, $p=0.02$) also emerged as predictors of %TWL. No other main or interaction effect was significant (smallest $p=0.06$).

Predictors of T2DM control
For T2DM management, preoperative age (HR=0.97 (95% CI 0.95, 0.99), $p=0.01$), preoperative BMI (HR=1.03 (95% CI 1.00, 1.06), $p=0.02$) and type of surgery significantly predicted complete remission (OAGB: HR=0.68 (95% CI 0.50, 0.92), $p=0.01$; RYGB: HR=0.71 (95% CI 0.55, 0.91), $p=0.01$). No other covariate emerged as a significant predictor (table 3).

DISCUSSION
In this study, we examined whether preoperative family support predicted long-term outcomes after bariatric surgery. Prior to this research, only a handful of studies had examined this question and were limited in: (a) definitions of family support used (looking at either structural or functional support alone, and either spouses or the family unit), (b) outcomes measured (focusing only on weight loss) and (c) time period studied (examining only the short-term window after surgery). Correspondingly, our study was designed to address these gaps.

When we included multiple metrics of family support, marital satisfaction emerged as the primary predictor of weight trajectory. This finding is notable for several reasons. First, two previous studies had observed that marital satisfaction predicted weight loss 6 and 12 months following surgery.18 19 Extending these studies, our research underscores how satisfaction continues to predict outcomes in the longer term—up to 5 years postsurgery. While the mechanisms explaining the effect of marital satisfaction on sustained weight loss trajectory remain presently unclear, prior studies suggest that appropriate spousal support can facilitate patients' adherence to postoperative dietary recommendations, thereby improving outcomes.27 Second, by assessing both structural and functional support, we resolved a discrepancy in the literature: while several studies had found marital status to confer risk of weight gain, other studies identified marriage as a protective factor.9–11 Based on our research, these conflicting findings may have arisen because marriages differ in quality. This may suggest that it is insufficient to account for structure alone (ie, marital status9–11). Instead, the degree to which a marriage is well-functioning may better predict postsurgical outcomes—in accordance with findings of increased divorce rates following bariatric surgery.28 29

More broadly, our findings suggest that presurgical counselling may benefit from asking patients about spousal support. This aligns with a large body of research...
describing how family support is critical for a person’s physical health. In the case of bariatric surgery, asking patients about their families may guide clinical decisions about patient suitability, or identify subgroups that may require additional postsurgical support. Moving forward, future studies can also explore whether these associations are causal, investigating—for example, whether relationship therapy can boost postoperative weight loss.

While we documented a link between family support and weight trajectories, we did not find any significant association between support and T2DM control. A recent review reported that clinical variables (eg, use of medication, duration of diabetes) explain the bulk of individual differences relating to postoperative T2DM remission. Consequently, psychosocial variables such as family support may have less to contribute within models predicting T2DM outcomes. Further research is needed to explore this possibility.

Several study limitations should be noted. First, family influence is complex, and there are multiple aspects on July 2, 2023 by guest. Protected by copyright. http://bmjopen.bmj.com/ BMJ Open: first published as 10.1136/bmjopen-2022-068810 on 2 May 2023. Downloaded from
that we were unable to control. For example, we only examined preoperative family support. Although this strategy allows clinicians to forecast postsurgical weight trajectories, family support is dynamic and may change after surgery.20 21 Further, we did not factor postsurgical changes in marital status, depth of emotional connection between family members, family members’ weight status or weight loss journeys, nor considered support from persons outside the nuclear family. Second, in terms of measurement, we relied on patients’ brief self-report about their subjective status or weight loss journeys, nor considered support from persons outside the nuclear family. Finally, our patient attrition rates were typical of those observed following bariatric surgery.22 23 Although we found no evidence that attrition resulted in a biased sample, future studies would benefit from proactive methods to ensure subject retention.

CONCLUSION
Notwithstanding these limitations, we present the most comprehensive study tracking how family support relates to 5-year outcomes after bariatric surgery. Patients who were satisfied with their marriages showed more sustained weight loss over time, alluding to the importance of spousal involvement in ongoing patient care.

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Acknowledgements The authors gratefully acknowledge Wong Zhenglong, Jannell Natasha Job and Kylie Heng for their assistance in data and manuscript preparation.

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Funding This research was not funded by any specific grant or funding agency.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval The study was approved by the SingHealth Centralized Institutional Review Board (2011/054/C).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

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BMJ: first published as 10.1136/bmjopen-2022-068810 on 2 May 2023. Downloaded from http://bmjopen.bmj.com/ on July 2, 2023 by guest. Protected by copyright.


