



**University of
Sunderland**

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Abstract:

Background: Adherence to post-bariatric surgery nutritional supplements can be poor and is associated with higher micronutrient deficiency rates. There is currently no available study specifically seeking patients' perspectives on the reasons behind poor adherence and how to address it.

Methods: Bariatric surgery patients living in the United Kingdom were invited to take part in an anonymous survey on SurveyMonkey®.

Results: A total of 529 patients (92.61 % females, mean age 47.7 years) took part. Most of these patients had undergone either a Roux-en-Y Gastric Bypass (63.0%) or Sleeve Gastrectomy (24.0 %). Most of the patients were in full-time (49.0 %, n=260/529) or part-time (15.7 %, n=83/529) employment. Approximately 54.0% (n=287/529) of the respondents reported having trouble taking all their supplements. Males were significantly more likely to report complete compliance. The most important reported reason for poor compliance was difficulty in remembering (45.6%), followed by too many tablets (16.4 %), side effects (14.3 %), cost (11.5 %), non-prescribing by GP (10.8%), bad taste (10.1 %), and not feeling the need to take (9.4 %). Patients suggested reducing the number of tablets (41.8 %), patient education (25.7 %), GP education (24.0 %), reducing the cost (18.5 %), and more information from a healthcare provider (12.5 %) or a pharmacist (5.2 %) to improve the compliance.

Conclusion: This study is the first attempt to understand patient perspectives on poor adherence to post-bariatric surgery nutritional recommendation. Patients offered a number of explanations and also provided with suggestions on how to improve it.

Key Words: Bariatric surgery, micronutrient deficiency, vitamin supplementation, compliance

Background:

Patients undergoing bariatric surgery are at an increased risk of developing micronutrient deficiency [1] through a combination of pre-existing deficiency [2], decreased postoperative intake [3], and reduced absorption [4]. Patients are therefore advised lifelong micronutrient supplementation [5-6]. However, adherence to these recommendations can be poor [7-9].

Poor adherence to micronutrient supplementation after bariatric surgery is associated with higher rates of micronutrient deficiency [7, 10-11] and can result in a range of nutritional complications [12] including anaemia, bone loss, or even neurological problems. It is therefore important to understand the reasons behind poor adherence with post-bariatric surgery nutritional supplementation guidelines.

There are very few studies [7, 9] in the scientific literature specifically attempting to understand the factors associated with poor compliance with micronutrient supplementation recommendations after bariatric surgery. Overall tablet burden, need to take them at different times through the day, side effects, cost, and behavioural factors might be some of the important underlying factors but there is no robust scientific proof to conclude this. Studies examining interventions aimed at improving the compliance rates are even fewer [13] and there is none that attempts to understand patients' perspectives on this topic. To the best of our knowledge, there is no published data on why patients find it difficult to adhere to recommended regimes and their thoughts on how it could be addressed.

The purpose of this study was to find outpatient reported knowledge and adherence to supplementation protocols after bariatric surgery, and seek their perspectives on the reasons behind poor adherence and how to improve it.

Methods:

Bariatric surgery patients living in the United Kingdom (UK) were invited to participate in a questionnaire (Appendix 1) designed to understand adherence to nutritional recommendations after bariatric surgery and patient perspectives on how it could be improved. We decided to only include patients living in the UK as some of the reasons behind poor-compliance can be specific to the population and healthcare delivery systems.

Inclusion Criteria: We included all patients who had undergone a bariatric procedure and were living in the United Kingdom at the time of the study irrespective of where the bariatric procedure was carried out as some patients go abroad for a bariatric procedure.

Exclusion Criteria: Patients who have not had a bariatric procedure and those who were not living in the United Kingdom.

Study Design: An anonymous questionnaire-based survey was designed on SurveyMonkey® to capture important information about patient demographics, nutritional supplementation compliance status, and reasons behind poor compliance. We also sought patients' opinion on how compliance with post-bariatric surgery supplements could be improved. The survey was made live on 7th May 2018. The survey link was freely shared on social media and amongst patient support groups. The survey was closed for analysis on 23rd May 2018.

Statistics: Basic descriptive statistics were used. Categorical variables were compared using Fisher's exact test on Graphpad®. Two-tailed p-value was used.

Results:

We obtained a total of 533 responses. After excluding those not currently living in the UK (n=1) and those who had not undergone bariatric surgery yet (n=3), we were left with responses of 529 post-bariatric surgery patients living in the UK. Out of these 63.0 % (n=333) had undergone a Roux-en-Y Gastric Bypass (RYGB), 24.0 % (n=129) had undergone a Sleeve Gastrectomy (SG), 7.0 % had undergone a gastric band (n=37), and 5.7 % (n=30) had undergone a One Anastomosis (Mini) Gastric Bypass (OAGB).

Majority of the respondents (92.61 %, n=489) were females. Most of the patients were either in full-time (49.0 %, n=260) or part-time (15.7 %, n=83) employment. Approximately 10.0 % (n=54) were retired and 4.7 % (n=25/529) were unemployed. A little over 13.0 % (n=69) patients described themselves as disabled. The mean age of the patients was 47.7 (range 22-73, median 48) years.

Tables 1,2, and 3 show data on whether patients were recommended any lifelong supplements, and if they knew which supplements to take and the exact amount they needed to take. Significantly, nearly 6.0 % (n=32; 27.0 % bypass, 11.5 % sleeves, and 61.5 % bands) said they had not been recommended lifelong supplements or were unsure about it.

Table 4 shows patient-reported compliance with post-bariatric surgery nutritional supplements. Slightly over half (54.2%, n=287) of the respondents reported having trouble taking all their supplements. Approximately, 45.5 % patients [65.0% males vs 44.0 % females; p value 0.016] reported complete compliance. Approximately 42.0% (n=109) patients in full time employment reported complete compliance compared to 48.6 % of the rest (129) (p value 0.13).

Table 5 lists the reasons behind non-compliance. Among the other reasons reported, commonest were difficulty in swallowing the tablets because of the size, complacency, advice from GP that they don't need them, too many tablets, need to take them several times a day, or being "fed up." When asked what would make it easier for them to take supplements, patients provided with a number of thoughts. Table 6 lists these thoughts. Amongst other thoughts, patients suggested having a national guideline to standardise protocols, educating primary care healthcare professionals, blister packs for medicines, smaller tablets, give them as injections weekly or monthly, reminder app, make them tastier, a "one-stop tablet", liquid form, take them all at the same time, more chewable options, dissolvable, a patch, less side effects, and post-surgery psychology support.

When asked to name the preparations they find most difficult to take, 79 patients mentioned Forceval[®] tablet (15.0%), 28 (5.3%) mentioned other multivitamin preparations, 40 mentioned iron preparations

(7.5%), 30 mentioned Adcal[®] (5.67%), and 52 (9.8 %) mentioned other calcium or vitamin D preparations, and 6 (1.1%) found vitamin B12 injections difficult.

Discussion:

Majority of the respondents in this survey had undergone an RYGB in keeping with the last report of the UK National Bariatric Surgery Report [14] where RYGB was reported to be the more common bariatric procedure in the British practice. In keeping with other published data on bariatric surgery, the majority of the patients were females.

As expected, most (94.0 %) of the respondents in this survey acknowledged that they had been recommended lifelong micronutrient supplementation. Somewhat alarmingly, 6.0 % reported that they had not been recommended or were not sure about it. Data on compliance (Table 4) was, even more, worrying with only 45.5 % of patients reporting complete compliance. Interestingly, 65.0 % (24/37) of the male patient reported complete compliance compared with 44.0 % of females. This is different to study by Sunil et al [7] where male sex was found to be significantly associated with non-adherence. But similar to Sunil et al [7], patients in full-time employment reported lower complete compliance (the difference was not statistically significant).

The most important reported reason for poor compliance was difficult in remembering (45.6%), followed by too many tablets (16.4 %), side effects (14.3 %), cost (11.5 %), non-prescribing by GP (10.8%), bad taste (10.1 %), and not feeling the need to take it (9.4 %).

Since the most common reported reason for poor compliance was difficulty in remembering them (45.6%), it should be possible to use the modern technology to at least partially overcome this problem. There are apps out there to support bariatric surgery patients but most of them have been designed without an adequate patient and professional input [15] and are, therefore, inadequate. Any suitable bariatric app should be able to answer common patient queries, provide advice for common symptoms and complications after bariatric surgery, record patients' weight loss journey, remind patients to take supplements daily, and remind them to contact their General Practitioners for blood tests when at the time of the anniversary of their procedure. Healthcare teams, on their part, should explore ways to offer more virtual clinics without the need for physical attendance by the patients [16].

Approximately 16.4 % of patients in this study cited too many tablets as one of the factors behind poor compliance and a significant 41.8 % of patients in this study suggested reducing the number of tablets. Since calcium can interfere with iron absorption [10], it may not be possible to combine all micronutrients into one tablet. Future studies do however need to examine if it is possible to reduce the overall number of tablets that the patients are required to take. Side effect and bad taste were cited as reasons behind poor

compliance by 14.3 % and 10.1 % of the patients respectively. It would be worth finding out if altering the formulation could be of help in such situations. For example, liquid or chewable preparations might help patients struggling with large tablets that need swallowing [17].

Cost, mentioned by 11.5 % of our patients, is probably an even bigger issue in healthcare systems funded privately. But the cost of the supplements should be balanced against the cost of managing the nutritional deficiencies which will inevitably develop. Patients should be educated about this and informed of the additional financial burden prior to the surgery. It may also be possible to look for cheaper non-branded alternatives [18].

Non-prescribing by GP was mentioned as a reason behind poor compliance by 10.8 % of the patients. Previous studies have shown that there is a knowledge gap amongst primary care physicians when it comes to looking after patients who have had bariatric surgery [19]. Bariatric societies around the world need to develop closer links with primary care to address this.

Significantly, 9.4 % of the patients did not feel the need to take their supplements and approximately a quarter of the patients (25.7 %) emphasised the importance of patient education. In a recent study, Lier et al [13] found that preoperative counseling did not improve adherence to treatment guidelines in patients who underwent bariatric surgery. Authors suggested that such interventions might be more useful after surgery. Patient organisations and support groups can help bridge the education gap with the help of professionals. There are several weaknesses to this study. First of all, the data on compliance is patient reported and not measured objectively. This is, however, a general problem with bariatric literature. In a recent review, Hood et al [20] found that the majority of studies have used self-reported data on vitamin use adherence after bariatric surgery.

Secondly, we only studied patients living in the United Kingdom as some of the reasons for poor compliance, like non-prescribing by General Practitioners, may not be applicable universally. However, authors believe most of the themes outlined in this study are generally applicable to different population groups and this study can pave way for future examinations in different population groups. Thirdly, because of the nature of our study-design when the survey link was freely shared on social media, we cannot provide an accurate response rate and may have precluded patients not well-versed with social media and Internet. However, we believe a survey of 529 patients is likely to have captured most of the opinions on this topic as one of our main objectives was to understand the reasons behind non-compliance and patients' perspectives on how to improve it. Finally, because of the design of this study, this survey

may not have captured patients who are less engaged on social media and online bariatric communities
The possibility of some selection bias, therefore, has to be acknowledged.

Conclusion:

This survey of 529 bariatric surgery patients reports on adherence with post-bariatric surgery nutritional recommendation and attempts to identify the reasons behind poor adherence. We further attempt to understand if it is possible to improve it. Patients reported a number of reasons for why they find it difficult to adhere to the recommended supplements.

Conflict of Interest Statement: Author 1 reports that he has been paid honoraria by Medtronic and Olympus for educational activities. Author 2 reports that he is a patient advisor to Novo Nordisk and Novartis.

Statement of Human and Animal Rights: Not Applicable

Statement of Informed Consent: Not Applicable

AUTHOR CONTRIBUTION: First Author conceived the idea for this study, conducted the study, analysed the results, and wrote large sections of the manuscript. All other authors helped conceptualise the study, design the survey, disseminating the survey link, and critically reviewed the manuscript. All authors have seen the final draft and approve of it.

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Abbreviations:

UK: United Kingdom

RYGB: Roux-en-Y Gastric Bypass

Table 1: Patients' response on if their bariatric teams have recommended any lifelong mineral/vitamin supplementation

Any recommendation from your bariatric team for lifelong mineral/vitamin supplementation?	Frequency (n= 529)
Yes	93.0 %
No	5.0%
Not sure	1.0%
Other	1.0%

Table 2: Patients' response on if they knew which supplements to take

If you have been recommended lifelong supplements, do you know which supplements to take?	Frequency (n= 497)
Yes, all of them	86.0 %
Yes, some of them	9.0%
NO	2.0%
Other	3.0%

Table 3: Patients' response on if they knew the exact amount of each supplement they need to take

If you have been recommended lifelong supplements, do you know which supplements to take?	Frequency (n= 511)
Yes, all of them	82.0 %
Yes, some of them	11.0%
NO	7.0%
Other	0.0%

Table 4: Patient-reported compliance with post-bariatric surgery nutritional supplements

Patient-reported compliance	Frequency (n=525)
Always take them all	45.5%
Take most of them most of the time	32.4%
take them 3-4 days a week	6.7%
take them 1-2 days a week	4.7 %
Never or rarely take them	8.4%
Others	2.3%

Table 5: Patient-reported reasons for difficulty in adhering to nutritional supplements post-bariatric surgery.

Patient-reported reasons for non-compliance	Frequency (n=287)
I find it difficult to remember	45.6%
There are too many tablets	16.4%
They give me side effects	14.3%
I can't afford to buy them	11.5%
My GP won't prescribe them	10.8%
I don't like the taste	10.1%
I do not feel I need to take all/some of them	9.4%
Others	22.6%

Table 6: Patients' thoughts on what would make it easier for them to take supplements

What would make it easier to take supplements	Frequency (n=440)
Reduce the number of tablets	41.8%
Patient Education on its importance	25.7%
GPs should prescribe them	24.0%
Reduce the cost	18.5%
More information from a healthcare provider	12.5%
Take them by mouth by instead of injections	6.4%
Help from pharmacist	5.2%
Others	20.7%

The Questionnaire

Serial Number	Questions	Choices Offered
1.	Do you live in the United Kingdom? This survey is only for UK residents, please.	-Yes -No
2.	Have you had a bariatric surgery?	-Yes -No -Other
3.	Which operation have you had?	-Roux-en-Y Gastric Bypass -Sleeve Gastrectomy -One Anastomosis (Mini) -Gastric Bypass -Gastric Band -Don't know -Other (please specify)
4.	Are you a?	-Male -Female -Prefer not to say -Other (please specify)
5.	I am	-in full-time employment -in part-time employment -student -unemployed -disabled -retired -other (please specify)
6.	How old are you?	
7.	Have you been recommended by your bariatric team to take any mineral/vitamin supplements for the rest of your life?	-Yes -No -Not sure -Other (please specify)
8.	If the answer to question number 7 is yes, do you know which supplements you need to take?	-Yes, all of them -Yes, some of them -No -Other (please specify)
9.	If you have trouble taking all your supplements regularly, what are the reasons behind it? (Please select all that apply). Please skip if you are not having any trouble taking your supplements.	-I find it difficult to remember -There are too many tablets - I do not feel I need to take all/some of them - My GP won't prescribe them - I can't afford to buy them - They give me side effects - I don't like the taste - Other (please specify)
10.	If the answer to question number 7 is yes, do you know the amounts of each supplement you need to take?	-Yes, all of them -Yes, some of them -No -Other (please specify)
11.	How good (or bad) are you at taking your supplements?	-Always take them all -take most of them most of the time -take them 3-4 days a week -take them 1-2 days a week -Never or rarely take them -Other (please specify)
12.	What would make it easier to take the supplements? (Please select all that apply)	-Reduce the number of tablets -GPs should prescribe them -Reduce the cost -Take them by mouth instead of injections -Patient education on its importance -Help from pharmacist -More information from a healthcare provider -Other (please specify)
13.	Please list the supplement you find most difficult to take (if any).	
14	Any other thoughts relevant to this survey?	

