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Article

Disordered Eating Behaviors and Weight Regain in Patients after Bariatric Surgery

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Abstract: Background/objective: Weight regain after bariatric surgery has serious health consequences, and disordered eating behaviors (DEB) may be involved in it. We compared DEB symptoms after bariatric surgery between patients with low vs. high ratio of weight regain (RWR) and investigated associations between DEB symptoms with weight regain and time since surgery. **Method:** Ninety-four patients who had undergone laparoscopic *Roux-en-Y* gastric bypass or sleeve gastrectomy and had not attended follow-up with the multidisciplinary healthcare team for at least one year were recruited. RWR was calculated with respect to maximal weight loss by the nadir weight achieved after surgery. They were allocated into two groups according to the RWR, defined as high RWR ($\geq 20\%$) or low RWR ($< 20\%$). At their first visit, we had them complete the Eating Disorder Examination and Repetitive Eating Questionnaires [EDE-Q and Rep(eat)-Q]. **Results:** Patients with high RWR reported higher EDE-Q global, dietary restraint, and weight concerns without significant group differences in eating and shape concerns. Compared to those patients with low RWR, these patients also indicated greater Rep(eat)-Q global, compulsive grazing, and repetitive eating. Global EDE-Q score, eating concern, shape concern, weight concern, and all Rep(eat)-Q indexes were positively associated with higher RWR. **Conclusion:** DEB occurred more frequently in the group with high RWR. In these patients, eating behavior symptoms and grazing behavior were both associated with the RWR, suggesting a possible involvement of both conditions in weight regain.

Keywords: bariatric surgery; eating disorder; weight regain; time since surgery

1. Introduction

Obesity is a chronic disease with increasing prevalence over the years and one of the biggest public health problems in the world [1]. Bariatric surgery is the most effective and sustained treatment for severe obesity [2], improving or remitting chronic diseases and reducing mortality [3]. Even after achieving significant weight loss after surgery, it is estimated that 10-20% of patients regain it over the years [4]. Regaining weight after surgery has serious health consequences. It may lead to obesity-related comorbidities recidivism, such as type 2 diabetes *mellitus* (T2D) [5], psychological distress, poorer health-related quality of life, and also an economic burden due to the need for new treatments, including antiobesity drugs and even the need for revisional surgeries [6].

Himpens et al. emphasized one crucial aspect: weight regain coincided with discharge from regular follow-ups with the multidisciplinary healthcare team (MHT) three years after surgery [7]. It is well-recognized that MHT care for bariatric surgery patients may maximize surgical outcomes [8].

However, long-term postoperative management of patients is less common, and these patients may be less likely to follow MHT's recommendations.

Some causes of weight regain are relevant, such as hormonal or metabolic changes, anatomical factors, lifestyle changes, low levels of physical activity, non-adherence to diet, and eating disorders (ED) symptoms [9]. After surgery, some patients may develop disordered eating behaviors (DEB), or the pre-existing ones may return, such as loss of control, overeating, binge eating, night eating, and grazing [10]. These DEB can lead to poor weight outcomes [11], decreasing mental health-related quality of life [12]. Little is known about the presence of ED symptoms and their influences on weight regain, especially in those patients without MHT follow-up post-surgery [13].

Emerging evidence suggests that greater attention is warranted since DEB might hinder weight loss in the short- and long-term post-surgical periods (six months and 2 to 6 years, respectively) [14–16]. Overvaluation of weight/shape appears to be associated with more significant ED psychopathology [17]. Confirming these statements, Conceição et al. [18] observed that DEB predicted greater weight regain two years after gastric bypass and gastric banding procedures.

The increasing number of procedures performed nowadays fosters the need to study these patients, their eating behaviors and clinical aspects, and the impact on post-surgical outcomes for better monitoring by assisting MHTs. The treatment strategies for weight regain must be updated and evaluated according to guidelines and the needs of each patient. Thus, we compared ED symptoms (DEB and grazing) in patients who did not attend MHT follow-up after bariatric surgery. These patients were compared according to low vs. high ratio of weight regain (RWR). We also tested the associations between ED symptoms vs. weight regain and time since surgery.

2. Materials and Methods

2.1. Patients and Data Assessment

Of the 132 recruited, 94 patients [87.2% females, aged 42 ± 9 years, and body mass index (BMI) 32.9 ± 6.5 kg/m²] were included in the study. Of these, 80 underwent Roux-en-Y gastric bypass (RYGB), and 14 had a Sleeve gastrectomy (SG). Twenty-one declined to participate, one was pregnant, six lost follow-ups, and 10 had less than 24 months of surgical procedure. The time since their surgery was 6.1 ± 4.0 years, and almost 8 in 10 (79.8%) patients had their surgeries in the private healthcare system but lost follow-up. Patients were summoned through social media to restart the standard clinical follow-up with our MHT (composed of surgeons, endoscopists, endocrinologists, dietitians, psychologists, psychiatrists, physiotherapists, and physical educators) with expertise in bariatric patients, following the clinical practice guidelines [8]. On their first visit to our unit, they were all invited to be part of this study. As previously described, they entered our public healthcare unit for regular follow-up after this first visit [19]. We included only patients who underwent RYGB or SG performed laparoscopically, with a mean weight loss after surgery of approximately 50% of initial body weight, and had not attended follow-up with the MHT for at least one year. Exclusion criteria were pregnancy, regular physical activity (≥ 150 min/week of moderate-intensity physical activity in the previous three months), use of any medication that influences weight, not having autonomy for diet choices, history of revisional surgery, having less than 24 months from surgery, and incomplete information on anthropometric and surgery data (procedure data and pre and postoperative weight), not being able to understand/read Portuguese texts, and unanswered or not adequately fulfilled questionnaires. A digestive endoscopy was requested for all patients to ensure the informed surgical type.

Recruitment, pre-participation screening, and data collection occurred between November 2018 and December 2019. Clinical history, physical examination, anthropometric assessment, blood pressure, and heart rate were obtained and previously published [20]. Glycated hemoglobin (A1C) $\geq 6.5\%$ or fasting plasma glucose ≥ 126 mg/dl [21], blood pressure ≥ 130 or 80 mmHg [22], and low-density lipoprotein-cholesterol ≥ 160 mg/dL, or triglyceride levels ≥ 150 mg/dL, or high-density lipoprotein-cholesterol < 40 or < 50 mg/dL (for men or women, respectively) [23] were used to categorize the presence of type 2 diabetes (T2D), hypertension, and dyslipidemia, respectively.

Afterward, the patients completed the self-report measures to assess symptoms suggestive of an ED and the presence of grazing.

2.2. Data on Bariatric Outcomes

Preoperative weight and minimum postoperative weight were self-reported, and BMI was calculated according to these self-reported weights. To reinforce these self-reports, we called all these patients six months after their first visit and re-asked them about their preoperative and minimum postoperative weights. Excess weight loss (EWL) and RWR were obtained as follows: (a) $EWL = (\text{preoperative weight} - \text{minimum postoperative weight}) / (\text{preoperative weight} - \text{ideal weight for BMI of } 25 \text{ kg/m}^2) \times 100\%$ and (b) $RWR = (\text{current weight} - \text{minimum weight postoperative}) / (\text{preoperative weight} - \text{minimum weight postoperative}) \times 100\%$. Even knowing that there are many definitions of suboptimal weight outcomes post-surgery, we opted to categorize patients according to the weight regained [24]. High RWR was defined as an increase of $\geq 20\%$ in maximal weight loss, as referred to by the nadir weight achieved between 12 and 18 months after the bariatric surgery [25]. Nadir weight was defined as the lowest weight the participant achieved after surgery. Patients were allocated into low ($< 20\%$) or high ($\geq 20\%$) RWR groups.

2.3. Anthropometry and Blood Pressure Assessments

Body mass and height were measured using a calibrated electronic scale and stadiometer (Welmy™ W300A, São Paulo, SP, Brazil). BMI was calculated as weight in kg/height in m². Neck circumference was measured along the inferior margin of the laryngeal prominence and perpendicular to its long axis. Waist and hip circumferences were measured at the umbilicus after expiration and at the widest circumference around the gluteal region. Blood pressure and heart rate were measured using a standardized sphygmomanometer (G-Tech™ BSP11, Hangzhou, Zhejiang, China), according to American Heart Association recommendations [26].

2.4. Eating Disorder Examination Questionnaire (EDE-Q)

The Portuguese version of EDE-Q was used to assess the suggestive and associated psychological characteristics of ED symptoms, allowing the calculation of four subscale scores: dietary restraint, eating concern, weight concern, and shape (self-image) concern [27,28]. Dietary restraint refers to purposeful efforts to limit food intake for shape and weight reasons. At the same time, the other three subscales reveal dysfunctional eating attitudes and overvalued ideas regarding weight and shape. Twenty-eight EDE-Q items were rated using 0-6 points, with higher scores reflecting greater severity or frequency of ED psychopathology. EDE-Q assesses three types of binges eating: objective bulimic episodes, like eating a substantial amount of food with a sense of having lost control; subjective bulimic episodes, like eating not a large amount of food but having a sense of losing control of overeating and objective overeating, which is eating a substantial amount of food without a sense of having lost control. EDE-Q also includes questions about self-induced vomiting and intensive exercise to control shape or weight [29]. Gero et al. [30] cut-off point was applied, considering total score values < 2.5 to define the absence of symptoms for an ED, classifying them into healthy and unhealthy subgroups.

2.5. Repetitive Eating Questionnaire [Rep(eat)-Q]

The Rep(eat)-Q was used to investigate and screen grazing habits, characterized by unplanned, repetitive eating of small amounts of food and or eating not in response to hunger/satiety sensations, considering the frequency of it in the previous month using a Likert scale ranging from 0 (never) to 6 (every day), which results in a global score and two subscales: compulsive and non-compulsive grazing or repetitive eating, defined by loss of control over eating and its repetitive, distracted quality rather than by a sense of loss of control, respectively [31].

2.6. Ethical Approval

This cross-sectional study was approved by the local Ethics Committee (CAAE: 07662918.1.0000.5259) and registered on ClinicalTrials.gov (NCT04193384). All procedures were performed according to the principles of the Declaration of Helsinki. A signed consent form was obtained from each participant.

2.7. Statistical Analysis

Results were expressed as mean ± standard deviation or frequency (counts and proportions). Shapiro-Wilk tested data normality. Unpaired Student *t*-test and Chi-square test compared between-group differences for continuous or categorical variables. Pearson correlation coefficients were calculated to investigate the associations between the self-reported measures and ED symptoms vs. weight regain and time since surgery. All calculations were analyzed using NCSS™ statistical software (Kaysville, UT, USA). The significance level was set at *P* ≤0.05.

3. Results

Demographic characteristics, clinical history, and surgery data of patients are exhibited in Table 1. The groups were similar, except for BMI, body circumferences, diastolic blood pressure (DBP), RWR, and time since surgery, which were higher in those with high vs. low RWR (*P*≤0.05). A significantly higher percentage of patients with dyslipidemia was detected in the high RWR group (*P*=0.01). Higher associations between the two self-reported preoperative and minimum postoperative weights (*r*=0.97 and *r*=0.94; *P*=0.001) validated patient self-reported data.

Table 1. Demographic characteristics, clinical history, and bariatric surgery data of the patients.

Variable	Pooled sample (n=94)	Low RWR (n=56)	High RWR (n=38)	P-value
<i>Demographic characteristics</i>				
Age (years)	42 ± 9	42 ± 8	42 ± 9	0.27
Female (n, %)	82 (87.2)	51 (91.1)	31 (81.6)	0.17
BMI (kg/m²)	32.9 ± 6.5	30.2 ± 4.2*	36.9 ± 7.3	<0.001
Neck circumference (cm)	36.0 ± 3.8	35.1 ± 3.1*	37.5 ± 4.2	<0.001
Waist circumference (cm)	96.6 ± 19.2	92.4 ± 12.1*	102.9 ± 25.3	<0.001
Hip circumference (cm)	117.3 ± 13.9	111.8 ± 9.9*	125.7 ± 15.1	<0.001
SBP (mmHg)	124.7 ± 15.7	123.4 ± 15.5	126.7 ± 16.0	0.16
DBP (mmHg)	79.2 ± 11.7	77.6 ± 12.1*	81.6 ± 10.9	0.05
Heart rate (bpm)	77 ± 12	76 ± 12	79 ± 11	0.09
<i>Clinical history – (n, %)</i>				
Type 2 diabetes mellitus	5 (5.3)	2 (3.6)	3 (7.9)	0.36
Hypertension	15 (16.0)	8 (14.3)	7 (18.4)	0.59
Dyslipidemia	4 (4.3)	0 (0)*	4 (10.5)	0.01
Tobacco use	12 (12.8)	10 (17.9)	2 (5.3)	0.07
<i>Bariatric surgery data</i>				
Preoperative BMI (kg/m²)	48.6 ± 7.7	48.3 ± 7.0	49.0 ± 8.8	0.34
EWL (%)	88.7 ± 18.6	88.1 ± 17.3	89.6 ± 20.6	0.35
RWR (%)	22.9 ± 20.3	10.1 ± 6.7*	41.7 ± 18.8	<0.001
RYGB (n, %)	80 (85.1)	50 (89.3)	30 (78.9)	0.16
Time since surgery (years)	6.1 ± 4.0	4.6 ± 2.7*	8.3 ± 4.4	<0.001

SBP – Systolic blood pressure; DBP – Diastolic blood pressure; BMI – Body mass index; EWL – Excess weight loss; RWR – Ratio of weight regain; RYGB – Roux-en-Y gastric bypass; **P*-value, unpaired Student *t*-test or chi-square test; results expressed as mean ± standard deviation and (n) %.

Table 2 exhibits ED symptoms and the screening of grazing behavior. Compared to patients with low RWR, those with high RWR exhibited higher scores in the global EDE-Q (0.18 to 5.75 points),

dietary restraint (0 to 18 points), and weight concern (0 to 6 points; $P\leq0.02$), as well as in global Rep(eat)-Q score, compulsive grazing, and repetitive eating subscales (0 to 6 points each; $P\leq0.03$). Eating and shape concerns were not different between groups, with a range of 0.1 to 6 points ($P\geq0.08$). In addition, similar numbers and percentages of patients reporting objective/subjective bulimic episodes, objective overeating, self-induced vomiting, and intense exercise at least once over the previous 28 days were noticed between low vs. high RWR ($P\geq0.08$).

Table 2. Eating disorder/cognitive symptoms, and the screening of grazing of the patients.

Variable	Pooled sample (n=94)	Low RWR (n=56)	High RWR (n=38)	P value
<i>EDE-Q</i>				
Global EDE-Q score (nbs)	2.94 ± 1.31	2.72 ± 1.37*	3.26 ± 1.15	0.02
Dietary Restraint	2.33 ± 2.32	1.91 ± 1.69*	2.53 ± 1.53	0.01
Eating Concern	2.17 ± 1.57	1.99 ± 1.62	2.44 ± 1.45	0.08
Shape Concern	4.18 ± 1.58	4.00 ± 1.71	4.43 ± 1.37	0.09
Weight Concern	3.26 ± 1.51	3.00 ± 1.61*	3.66 ± 1.27	0.02
Objective binge eating episodes (n, %)	55 (58.5)	32 (57.1)	23 (60.5)	0.74
Subjective binge eating episodes (n, %)	55 (58.5)	32 (57.1)	23 (60.5)	0.74
Objective overeating (n, %)	54 (57.4)	32 (57.1)	22 (57.9)	0.94
Self-induced vomiting (n, %)	12 (12.8)	6 (10.7)	6 (15.8)	0.47
Excessive exercise (n, %)	15 (16)	12 (21.4)	3 (7.9)	0.08
<i>Rep(eat)-Q</i>				
Global Rep (eat)-Q score (nbs)	2.94 ± 1.67	2.62 ± 1.62*	3.40 ± 1.65	0.02
Compulsive grazing subscale	2.83 ± 1.72	2.52 ± 1.73*	3.29 ± 1.61	0.03
Repetitive eating subscale	2.89 ± 1.77	2.56 ± 1.74*	3.37 ± 1.73	0.03

RWR – Ratio of weight regain; EDE-Q – Eating Disorder Examination Questionnaire; Rep(eat)-Q – Repetitive Eating Questionnaire; nbs – Norm-based score; n, % – Number and percentage of patients reporting the target problem at least once over the previous 28 days. *P value, unpaired Student t-test or chi-square test; results expressed as mean ± standard deviation and (n) %.

To investigate these patients further, we correlated their weight regain and DEB and possibly the effects of the time since surgery on these outcomes. Table 3 presents these correlations stratified into pooled samples and according to RWR groups.

Table 3. Correlations between eating disorder symptoms vs. recurrent weight gain and time since surgery of the patients.

	Pooled sample (n=94)		Low RWR (n=56)		High RWR (n=38)	
	RWR	Time since surgery	RWR	Time since surgery	RWR	Time since surgery
<i>EDE-Q</i>						
Global EDE-Q score	0.29 (P<0.001)	0.13 (P=0.19)	0.12 (P=0.36)	-0.03 (P=0.79)	0.35 (P=0.03)	0.13 (P=0.42)
Dietary Restraint	0.18 (P=0.06)	0.22 (P=0.02)	0.01 (P=0.90)	0.01 (P=0.91)	0.03 (P=0.83)	0.21 (P=0.19)
Eating Concern	0.26 (P=0.01)	0.08 (P=0.43)	0.12 (P=0.37)	-0.17 (P=0.18)	0.37 (P=0.01)	0.21 (P=0.19)
Shape Concern	0.21 (P=0.03)	0.10 (P=0.32)	0.04 (P=0.74)	0.002 (P=0.98)	0.31 (P=0.05)	0.09 (P=0.55)
Weight Concern	0.32 (P=0.001)	0.19 (P=0.06)	0.23 (P=0.07)	0.04 (P=0.73)	0.33 (P=0.03)	0.19 (P=0.25)
<i>Rep(eat)-Q</i>						
Global Rep (eat)-Q score	0.41 (P<0.001)	0.29 (P<0.001)	0.38 (P<0.001)	0.18 (P=0.18)	0.43 (P<0.001)	0.25 (P=0.12)

Compulsive grazing subscale	0.38 (P<0.001)	0.22 (P=0.03)	0.32 (P=0.01)	0.05 (P=0.66)	0.42 (P<0.001)	0.23 (P=0.16)
Repetitive eating subscale	0.32 (P=0.001)	0.32 (P=0.001)	0.41 (P=0.001)	0.19 (P=0.15)	0.51 (P<0.001)	0.32 (P=0.04)

RWR – Ratio of weight regain; LWR – Low ratio of weight regain; HWR – High ratio of weight regain; EDE-Q – Eating Disorder Examination Questionnaire; Rep(eat)-Q – Repetitive Eating Questionnaire.

4. Discussion

The present study recruited patients who had undergone bariatric surgery and did not attend their MHT follow-up for at least one year. It also compared those with low vs. high RWR to investigate the role of DEB on RWR. ED symptoms occurred more frequently in those who regained more weight. Significant clinical differences between groups were also observed in BMI, body circumferences, diastolic BP, and dyslipidemia, possibly reflecting the impact of regaining weight after effective bariatric surgery [4]. The self-reported EWL, greater than 50% of our patients, may confirm the latter assertion [32].

The EDE-Q showed significant differences in the global score, which was higher in the high vs. low RWR. Our patients had higher global scores of symptoms suggestive of an ED than healthy young individuals [33] and patients after bariatric surgery in their first year postoperative [30]. Among the candidates for bariatric surgery, we usually diagnose and treat those with ED symptoms. The DEB tends to reduce in the first year after surgery [30]. However, it relapses due to a lack of nutritional and psychological counseling and follow-up for more healthy food choices, understanding physical/emotional hunger and satiety, controlled food intake [34], and even the need for drugs to treat them. Although our patients had a mean of 6.1 years of surgery, they were without MHT follow-up for at least one year before enrollment in the present study. It is unknown if/what level of care was provided in the interim between bariatric surgery and their first visit in this study, and we can only speculate that ED symptoms may be one of the factors that contributed to weight regain.

Higher EDE-Q subscale values and percentage of patients with eating and compensatory behaviors have been observed in our sample. Significant changes between the high and low RWR groups were dietary restraint and weight concern. Although no difference between study groups has been found for eating and shape concern, correlations between global EDE-Q score, eating concern, shape concern, and weight concern vs. RWR were detected only in the high RWR group. Shape concerns call attention to the high values in both groups, which are far from the maximum score since 2.5 is considered healthy status [30]. Severe ED symptoms can develop after surgery [35], and many cases are likely to be underreported [36]. Many patients reported food and self-image issues, as bulimic episodes, both objective, subjective, and objective overeating at least once over the previous 28 days (mean 57.95% of 94 patients). The clinical relevance appears that 58.5% of patients in this sample are endorsing binge eating/loss-of-control eating by an average of 6.1 years post-surgery, although this finding is unrelated to relative weight regain. Our study showed a higher frequency of individuals who reported subjective bulimic episodes than those detected by De Zwaan et al. in patients with a mean of two years post-RYGB (approximately 25% of 59 patients) [37].

The Rep(eat)-Q showed high values of the global score on the compulsive grazing subscale and the repetitive eating subscale in the high vs. low RWR. However, positive correlations between global Rep (eat)-Q score and their subscales (compulsive and non-compulsive grazing) vs. RWR were detected for both groups. This result raises the question that the dysfunctional eating behavior of grazing may start early and remain over the years after surgery. Colles et al. found a significant increase in grazing behavior at baseline (26.4%) and 12 months after surgery (38.0%) [38]. Grazing is a high-risk behavior that compromises weight maintenance after bariatric surgery [18,38] and is considered a predictor of worsening weight loss trajectories [18].

Although the high RWR group had a significantly longer time since surgery than those who regained less weight, which makes interpreting the results difficult, a significant direct association was detected only for the repetitive eating subscale in this group. Even if a causal relationship cannot

be established, the extended time since surgery may have also influenced our results, rather than the eating behavior itself, exposing these patients to many weight regain causes. Our findings partially ratified this premise. Nicanor-Carreón et al. showed an association between weight regain and the frequency of cravings for sweets, higher global scores in the EDE-Q, and time elapsed since surgery [39]. These authors also detected that those with an RWR of $\geq 20\%$ had increased global scores in the EDE-Q compared to those with an RWR of $< 20\%$. Some studies demonstrated an amelioration in ED symptoms after surgery, but only in the short term (1 to 3 years follow-up) [30,40–42]. In contrast, Conceição et al. showed an increase in the frequency of pinching or nibbling (defined as eating modest amounts of food in an unplanned and repetitious way, without a sense of loss of control), increasing from 17.5% in the first year to 47.3% after two years from surgery [43].

Some of our limitations need to be mentioned. The cross-sectional design does not allow us to establish causal relationships. Eating habits before surgery were not investigated. However, it is known that not all of those patients with preoperative DEB will develop them after surgery [37]. Furthermore, this study was based on self-reported questionnaires. Although these questionnaires can be inaccurate because of response distortions [27], standardized instruments and objective diagnostic methods for assessing ED symptoms are still limited [44]. The presence of other factors that could influence recurrent weight gain has not been assessed, except for any anatomical cause investigated at digestive endoscopy. Additionally, one of our main limitations is the difference observed between groups in the time since surgery. The group with high RWR had a longer time since surgery, suggesting more exposition to other causes of weight regain. The loss of MHT follow-up is a novel aspect of our manuscript, and while we included the time since surgery, we presented no data on the length of time without regular healthcare follow-up. Finally, a higher proportion of females and RYGB occurred in our sample, which is commonly observed in bariatric samples. Our findings also reflect our country's preferred choices for operative techniques [45].

5. Conclusions

Our study originally reported the prevalence of a range of DEB in a group of patients after bariatric surgery without regular healthcare follow-up, on average, six years after surgery. These patients presented high RWR and scores for ED and grazing behavior. The high values in global EDE-Q and Rep(eat)-Q scores in both groups are noteworthy, which is of concern given the association with poorer surgical outcomes. In both low and high RWR, grazing behavior significantly correlated with RWR, but ED symptoms (except the dietary restraint) were associated with RWR only in those who regained more weight. Our patients reflect real-world patients. Unfortunately, many of them do not follow regular healthcare. Receiving these patients on our unit allowed us to speculate that postoperative follow-up could detect precocious DEB, add adherence to current recommendations, and may increase successful outcomes. Future research could shed light on our suggestion for clinical practice.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. No participants can be identified and therefore written consent is not needed for publication of this paper.

Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author. .

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