

The impact of anxiety experienced by patients scheduled for coronary artery bypass surgery on perceived pain, self-efficacy and body esteem in the perioperative period



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Abstract

Introduction: Despite the large amount of researches addressed the issue of the relationship between the intensity of preoperative symptoms of depression and/ or anxiety with their postoperative intensity and any complications after surgery, there have been almost unaddressed such subjects as how the patients perceive their own capabilities or physical attractiveness, and the emotions which are evoked by various aspects of their own bodies, including postoperative scars. These aspects play a significant role in assessing the quality of patients' life and have a significant impact on the overall assessment of the surgery as an event, in both the short- and long-term perspective.

Aim: To evaluate the relationship between anxiety, pain level, self-efficacy and body esteem in the pre- and postoperative periods among patients scheduled for coronary artery bypass surgery.

Material and methods: Prospective studies were carried out in a group of 50 patients scheduled for coronary artery bypass surgery, either on a planned or urgent basis. Anxiety, both as a state and as a trait, was assessed using the Polish version of the State-Trait Anxiety Inventory (STAI). The Visual Analogue Scale (VAS) was employed to evaluate pain. The Self-Efficacy Gauge measured self-efficacy, while the Body Esteem Scale assessed body esteem.

Results and Conclusions: The intensity of state anxiety significantly negatively correlated with self-efficacy following CABG surgery. There was a statistically significant negative correlation between the intensity of pain and self-efficacy in the postoperative period. Among female patients, the intensity of pain, both pre- and post-operatively, negatively correlated with their assessment of body esteem concerning physical condition at the respective time points. When assessing anxiety as a trait during the perioperative period, a positive correlation with pain intensification after CABG was identified.

Key words: myocardial revascularization, aortocoronary bypass, coronary artery bypass, anxiety, pain, self-efficacy, body esteem, statistical testing.

Introduction

According to the Polish National Registry of Cardiovascular Surgeries [1] in 2022, nearly 24,000 cardiovascular surgeries were performed in our country. These results are a compilation of data from all 38 Polish cardiovascular surgery centers. Among the most frequently performed surgical procedures was coronary artery bypass grafting, with 8,390 cases.

This surgical procedure is performed in patients suffering from an advanced form of ischemic heart disease, where conservative treatment for coronary disease (pharmacotherapy) and interventional procedures (percutaneous coronary angioplasty) were ineffective or insufficient, or treatment guidelines favor this type of therapy.

The decision to perform coronary revascularization on a particular patient is determined by the current surgical recommendations and answers to the following questions: Will the procedure significantly improve the patient's quality of life? Will it extend it? What risks does the procedure pose to the patient and what are the risks of not performing it? Recommendations from the American College of Cardiology, the American Heart Association, the European Society of Cardiology, and the Polish Cardiac Society, which include classes of treatment utility and effectiveness, as well as the European Perioperative Risk Assessment Scale (EUROSCORE) [2], are helpful in choosing therapeutic actions.

Eligibility for coronary artery bypass graft surgery, as determined by the Heart Team, does not change the fact

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that its performance in extracorporeal circulation – on a stopped heart – constitutes a very strong physiological stressor [3]. To ensure that the postoperative period is not an additional significant source of stress for the patient, leading to a significant decline in the quality of life, which is the opposite of the goal of myocardial revascularization, the pre-operative mental state of the individuals undergoing surgical intervention is extremely important [4–14].

Most of the research conducted so far elsewhere has mainly addressed the issue of the relationship between the intensity of preoperative symptoms of depression and/or anxiety (usually measured the day before surgery) with their postoperative intensity (at various time intervals after the procedure – from a few days to several months) and any complications after surgery (e.g., wound infections, re-hospitalizations, heart rhythm disorders, no relief of symptoms, death) [4, 5, 8–10]. Some of the studies have investigated the association of the intensity of anxiety experienced with the postoperative pain intensity [6, 7, 9, 11–16].

Subjects such as how the patients perceive their own capabilities or physical attractiveness, and the emotions which are evoked by various aspects of their own bodies, including postoperative scars, have been almost unaddressed [17].

However, these aspects play a significant role in assessing the quality of patients' life [18] and have a significant impact on the overall assessment of the surgery as an event, in both the short- and long-term perspective (e.g., the patient's assessment of the surgery's necessity).

In the early postoperative period, these issues affect the patient's attitude towards the duration of hospitalization and the proposed referral for further rehabilitation in a spa hospital or a cardiological rehabilitation ward.

The available literature indicates probable relationships between such variables as self-efficacy or body esteem, the level of anxiety and pain experienced perioperatively [11, 17].

In relation to the above, the following hypotheses were formed:

Hypothesis A1: The level of state anxiety experienced by patients in the postoperative period is lower than that experienced pre-operatively.

Hypothesis A2: The level of preoperative state anxiety is associated with the intensity of postoperative pain (the higher the level of state anxiety experienced by the patient before the surgery, the greater the pain intensity after the surgery).

Hypothesis A3: The level of trait anxiety perceived pre- and post-operatively is associated with the intensity of postoperative pain (the higher the level of trait anxiety in the patient, the more intense pain they experience after surgery).

Hypothesis A4: The level of preoperative state anxiety is related to the age of the patient waiting for the procedure.

Hypothesis B1: The level of postoperative state anxiety is negatively correlated with self-efficacy (the higher the level of state anxiety experienced postoperatively, the worse the patient perceives their own efficacy after surgery).

Hypothesis B2: The intensity of postoperative pain is negatively correlated with self-efficacy (the stronger the pain the patient feels after surgery, the poorer they assess their postoperative efficacy).

Hypothesis B3: The level of postoperative state anxiety is related to the concurrent body esteem (in terms of physical condition, body strength).

Hypothesis B4: The intensity of pain experienced pre- and post-operatively is related to the concurrent body esteem (in terms of physical condition, body strength).

Hypotheses A1–4 were verified using different research procedures (measurement methods or evaluation times) than the previously conducted, available studies of these variables. Hypotheses B1–4 have not been verified in the literature before.

Aim

The aim of the surveys conducted and described in this article was to analyze the relationships between the level of anxiety experienced pre- and post-operatively and the level of pain, self-efficacy, and body esteem after surgery, and to determine their direction.

Material and methods

The questionnaire-based studies analyzed were conducted from mid-January to the end of November 2022 at the Clinical Department of Heart, Vascular, and Transplantation Surgery in the John Paul II Hospital in Krakow, Poland. Patients were examined twice – the day before surgery (first part of the study) and on the fifth or sixth day after surgery (second part) – just before discharge from the hospital. There were in total 50 patients scheduled for surgical myocardial revascularization who participated in the first part. Complete questionnaire results (from both parts) were finally obtained from 39 patients. Among the patients studied, there was a significant majority of male patients aged 46–79 (mean: 62 years) – $n = 32$ (82%) individuals and a minority of female patients aged 63–74 (mean: 67 years), $n = 7$ (18%).

Inclusion criteria for the study were: urgent or scheduled coronary artery bypass graft surgery, written informed consent to participate in the study, and the cognitive ability to understand the content of the questionnaires (instructions, questions) and to respond to them independently by selecting the appropriate option.

Excluded from participation were those operated on for “life-saving indications” immediately, patients previously diagnosed with a mental illness or undergoing psychiatric or neurological treatment, patients suffering from other serious somatic diseases (e.g., oncological, endocrinological, rheumatological) and those unable to complete the questionnaires independently. Patients who had serious complications postoperatively (e.g., sudden cardiac arrest, stroke, extended stay in the Intensive Care Unit – over 5 days) were excluded from the second part of the study.

The applied research methods and stages of the psychological study are presented in Table I.

Table I. Course of psychological examination, number of groups

Psychological assessment	Assessment date	Methods	Number by gender		Finally analyzed	
					Number by gender	
			Female	Male	Female	Male
Part 1	1 day before surgery	State-Trait Anxiety Inventory (STAI) Pain Visual Analog Scale (VAS) Self-Efficacy Gauge Body Esteem Scale (BES)	11 (22%)	39 (78%)	7 (18%)	32 (82%)
Part 2	On average 5–6 days after surgery	State-Trait Anxiety Inventory (STAI) Pain Visual Analog Scale (VAS) Self-Efficacy Gauge Body Esteem Scale (BES)	7 (18%)	32 (82%)	7 (18%)	32 (82%)

The State-Trait Anxiety Inventory (STAI) was used to assess state anxiety (situational) and trait anxiety (general propensity to respond with anxiety, fear). It is one of the most frequently used methods to measure these variables, allowing comparison of the results obtained in this study with similar findings presented in the available literature. Each of the two parts of the inventory consists of twenty statements about well-being, to which the patient relates on a four-point scale. The overall score, which is the sum of these ratings, is then converted taking into account sex and age into two standard scales – sten (from 1 to 10) and percentile [19].

Pain intensity experienced by patients was assessed using the standard VAS scale (Visual Analog Scale). It is a numerical scale in the form of a 10 cm segment. The endpoints are at the extremes, where “0” means no pain, and “10” indicates the most intense pain ever experienced. The patient marks the current pain intensity on it. The advantage of the scale is its simplicity and quick assessment of a subjective trait or attitude that may have continuous values and is not precisely measurable using available devices [7]. It is commonly used in the hospital environment.

The Self-Efficacy Gauge used in the study was created and mainly used by occupational therapists to assess how seniors perceive their ability to perform various tasks. It consists of 27 activity items with varying levels of effort. The patient assesses on a 10-point scale how much he perceives his ability to independently perform each assessed activity at the moment.

Another scale used in the study was the Body Esteem Scale by Franzoi S.L. and Shields S.A., with the Polish adaptation by Lipowska M. and Lipowski M., which provides significant information about the relationship of people to their own bodies. It consists of 35 items (body parts, physiological aspects). On a five-point Likert scale, feelings are determined for each aspect (strong/moderate negative, neutral, strong/moderate positive). There are three different subscales for each gender. For women they are Sexual Attractiveness, Weight Concern, and Physical Condition, while for men they are Physical Attractiveness, Upper Body Strength, and Physical Condition [20, 21].

For the required part of the conducted studies, permission was obtained from the Bioethics Committee of the Jagiellonian University.

Statistical analysis

The data obtained from the patients were encoded numerically and then subjected to specialized statistical calculations using methods used in social science research, adapted to the variables, their nature, and the dependencies studied. The R environment was used for this purpose.

Results

The obtained results are presented in the form of tables presented below with a short commentary for easier understanding of the topic.

Table II shows the results of the comparison of the distribution of individual indicators' values with the assessment of the statistical significance of the differences between the preoperative period and the postoperative period.

It includes the average values of the indicators obtained in both compared groups and the *p*-values (accurate to 0.001) of the appropriate test used in the study.

For data that met the assumption of a normal distribution, a parametric *t* test for equality of means was used. However, for data that did not meet this assumption, its non-parametric counterpart, the Mann-Whitney *U* test, was used. *P*-values less than the accepted significance level of 0.05 were highlighted in bold font.

The obtained results indicate the following dependencies:

1. There was a statistically significant difference in the intensity of pain felt by patients on the day before myocardial revascularization and just before the end of the hospitalization. After the operation, the pain intensity was significantly stronger, as indicated by the higher VAS index average (3.205 compared to 0.487 before the operation) and a test *p*-value close to zero.

2. The sense of self-efficacy perceived by patients was statistically significantly higher on the day before the coronary artery bypass surgery (mean = 254.436) than in the postoperative period, just before leaving the hospital after this procedure (mean = 231.308). This is evidenced by the higher average score obtained in the group before the operation and a *p*-value close to zero.

To examine the occurrence of a monotonic relationship between selected variables, Spearman's rank correlation in Table III.

Table II. Results of the comparison of the distribution of individual indicators' values between the preoperative and postoperative periods

Indicator	Average score in the group		P-value
	Before surgery	After surgery	
Total (n = 39):			
STAI state	40.513	37.333	0.114
STAI trait	37.410	37.923	0.751
VAS	0.487	3.205	< 0.001
Self-Efficacy	254.436	231.308	< 0.001
Men (n = 32):			
Physical attractiveness	43.063	41.875	0.466
Upper body strength	34.750	32.625	0.227
Physical condition	48.438	46.125	0.361
Total score	132.844	125.969	0.286
Women (n = 7):			
Sexual attractiveness	42.857	39.000	0.5076
Weight concern	37.286	32.857	0.3431
Physical condition	35.000	31.333	0.2115
Total score	130.29	115.43	0.284

Table III. Results of the study on the monotonic dependency between selected variables

Variable 1	Variable 2	Spearman's coefficient	P-value
STAI state before surgery	Age	0.175	0.287
STAI trait before surgery	Age	0.235	0.149
STAI trait before surgery	STAI trait after surgery	0.698	< 0.001
STAI state before surgery	VAS after surgery	0.036	0.826
STAI trait before surgery	VAS after surgery	0.323	0.045
STAI trait after surgery	VAS after surgery	0.427	0.007
STAI state after surgery	Self-efficacy after surgery	-0.359	0.025
VAS after surgery	Self-efficacy after surgery	-0.396	0.013
Men before surgery:			
VAS	Upper body strength	-0.226	0.215
VAS	Physical condition	-0.234	0.197
Men after surgery:			
STAI state	Upper body strength	-0.318	0.082
STAI state	Physical condition	-0.341	0.060
VAS	Upper body strength	-0.113	0.467
VAS	Physical condition	-0.160	0.381
Women before surgery:			
VAS	Physical condition	-0.757	0.049
Women after surgery:			
STAI state	Physical condition	0.086	0.919
VAS	Physical condition	-0.837	0.038

These results indicate the following relationships:

1. There was a significant positive monotonic relationship between the trait anxiety levels before and after the surgery (Spearman's coefficient = 0.698, p -value < 0.001). The higher the level of trait anxiety patients experienced preoperatively, the higher was its level post-operatively.

2. A statistically significant positive relationship was observed between pre- and post-operative trait anxiety scores

and post-operative pain perception (Spearman's coefficient = 0.323, p = 0.045, Spearman's coefficient = 0.427, p -value = 0.007). This implies that the higher the value of one variable was, the higher was the value of the other.

3. The comparison of post-operative state anxiety and self-efficacy indicates the existence of a significant negative relationship between the compared variables. The negative value of Spearman's coefficient (-0.359) and the p -value

< 0.05 suggest that the higher the state anxiety the patient experienced after the surgery, the lower they rated their own self-efficacy.

4. There was a negative relationship between the intensity of pain felt by patients after coronary artery bypass grafting just before being discharged from the hospital, and their self-efficacy at that time (Spearman's coefficient = -0.396 , p -value = 0.013). This means that the higher a patient's post-operative pain perception was, the lower they rated their own post-operative efficacy.

5. Among women, a statistically significant negative correlation was detected both between pre-operative pain perception and their concurrent physical condition assessment (Spearman's coefficient = -0.757 , p -value = 0.049), and between these factors evaluated post-operatively (Spearman's coefficient = -0.837 , p -value = 0.038). The higher the pain perception was (VAS), the lower (more negative) was the reported assessment of physical condition.

Discussion

The statistical analysis showed a higher level of state anxiety in patients scheduled for coronary artery bypass grafting on the day before surgery compared to anxiety assessed just before leaving the hospital (on average on the fifth-sixth postoperative day). However, this difference was not statistically significant, probably due to the low number of subjects enrolled. This is consistent with results regarding pre- and postoperative anxiety levels obtained by Gallagher and McKinley [4]. The exact time and research methods were differed from ours. Nevertheless, the mentioned lack of statistical significance is puzzling. Studies by Pawlak *et al.* [8] are procedurally similar to ours. However, these researchers did not directly compare state anxiety before and after coronary artery bypass graft surgery but in relation to the level of depressive symptoms (no depression, mild, moderate, severe). Their results for the specific groups allow prediction of a given relationship. Moreover, this is consistent with the prevailing belief and studies on endourological patients conducted by Klopfenstein [22]. However, there have been some studies on patients undergoing surgery in which the highest intensity of situational anxiety occurred in the first days postoperatively [23].

In the studies conducted so far on patients undergoing myocardial revascularization, preoperative pain and self-efficacy were not examined. Thus, we decided to examine how these aspects are perceived by patients scheduled for coronary artery bypass grafting on the day before surgery and on average on the fifth-sixth postoperative day. The intensity of preoperative pain turned out to be statistically significantly lower than that of postoperative pain. Similarly, statistically significant differences emerged in the patients' self-efficacy. Before the operation, they rated their ability to independently perform many tasks much higher.

Our research results showed that trait anxiety evaluations did not differentiate between pre- and postoperative periods. Patients' anticipation of the upcoming surgery did not disrupt their evaluation of their general predisposition to react with anxiety and fear (STAI trait) [19].

This is obvious for a personality trait represented by this variable.

Body evaluation using the Body Esteem Scale (BES) does not provide a general result but only in the form of subscales. For women these are specified as Sexual Attractiveness, Weight Concern, and Physical Condition, and for men they are Physical Attractiveness, Upper Body Strength, and Physical Condition [21]. Despite the similarity of two of them for both genders, slightly different body parts and physiological aspects are included. This does not allow for joint calculations for women and men but only enables separate data analysis. In the body evaluations (separately for men and women), no significant differences were found between the compared pre- and postoperative results in any of the considered areas. Here, the rather small sample size (especially in the case of the female group) might have mattered. However, it should be noted that in both the female and male groups, the average value of each of the analyzed indicators is higher before the surgery than after it. Unfortunately, the tests we performed did not confirm that these differences were statistically significant. Our overall assessment (contrary to the above, to satisfy cognitive curiosity) representing the sum of evaluations of all body parts and physiological aspects made by patients before and after surgery, despite higher preoperative values, revealed statistically insignificant differences.

It is worth mentioning here the research performed by Adib-Hajbaghery M., Miranzadeh S., Tahmouresi M. and Azizi-Fini I. on body image in patients undergoing coronary artery bypass surgery. Their results appear to be in contradiction with our results. The cited study was conducted on a sample of 140 patients, 1 day before the procedure and then 4 weeks after it. The researchers used the Multidimensional Body Relationship Questionnaire (MBSRQ – Brown *et al.* 1990). Their results indicated statistically significant ($p \leq 0.001$) differences in body image before (overall score = 139 ± 13.21) and after surgery (overall score = 160.25 ± 7.75) [17]. However, they did not decide to look at body evaluation in the early postoperative period, as in our present study. Postoperative wounds are inescapable, regardless of the time since surgery. In the longer term, however, evaluations of one's body in terms of experienced body strength and physical condition can undergo significant change. Thus, evaluating the body of patients after coronary artery bypass grafting at the same time (i.e., 4 weeks after surgery) as by the cited authors might confirm the existence of the same, statistically significant relationship.

Probably postoperative hospital care (dressing changes by a surgical nurse) and hospitalization conditions (limited access to mirrors) at this time do not give patients space to verify the current appearance of broken skin layers and confront them with the preoperative image of their bodies, and to emotionally relate to these issues. In the early postoperative days, this may protect them from a more painful sensation of the mutilating aspect of life-saving/prolonging surgery, hence the lack of statistically significant differences.

The statistically significant positive monotonic relationship between pre- and postoperative trait anxiety levels

that we detected indicated that the higher the trait anxiety experienced by patients preoperatively was, the higher was the reported postoperative level. This is consistent with the nature of the phenomenon under investigation – as a personality trait – hence something stable and enduring [19, 24]. It is therefore not surprising that patients who reacted with greater anxiety to various phenomena before surgery perceived and reacted similarly after the procedure.

Most studies to date performed on the relationship between perceived preoperative anxiety and postoperative pain intensity have focused on measuring postoperative pain and assessing the analgesics used during the first 24 hours after surgery [6, 12, 13]. These studies showed a significant positive correlation between both of these variables.

The relationship between the state and trait anxiety levels experienced 1–2 days before coronary artery bypass graft surgery and various aspects of postoperative pain sensations in the first week after the procedure was explored by Greszta and Siemińska [14]. Their results showed a significant negative correlation between the intensity of state anxiety and the degree of postoperative pain reduction ($p < 0.01$). However, there was no statistically significant difference between the level of situational anxiety and the average intensity of post-surgical pain. The authors found a correlation between trait anxiety experienced at a given stage and the degree of post-surgical wound pain reduction after administering pain relievers ($p < 0.001$) and the intensity of the extreme postoperative wound pain experienced ($p < 0.01$) [14]. However, there was no significant correlation between the given level of anxiety and the average intensity of postoperative pain.

The assessment of preoperative anxiety in individuals undergoing myocardial revascularization and the postoperative pain they experienced was also addressed by Poole *et al.* [9]. A statistically significant positive correlation was found between the variables – a higher intensity of anxiety symptoms was associated with higher postoperative pain ($\beta = 0.215$, $p = 0.023$). Anxiety assessment was carried out a month before the coronary artery bypass using the anxiety subscale from the Hospital Anxiety and Depression Scale (HADS), while pain measurement was performed, on average, 397 days after the procedure using the McGill Pain Questionnaire (MPQ-SF).

Due to the vast procedural differences in the methods used, it is challenging to compare the results of our research and others, especially the latter ones mentioned. Our findings are closest to the study by Greszta and Siemińska [14].

The issue of pain levels experienced over an extended period of time after coronary artery bypass surgery in relation to preoperative anxiety was addressed by Zemła *et al.* [11]. They posited the hypothesis that the postoperative period, if preceded by intense anxiety, typically correlates with higher levels of perceived pain. Our collected data did not confirm this in terms of preoperative state anxiety. However, they did find a statistically significant relationship between the level of trait anxiety experienced preoperatively and the intensity of pain felt postoperatively. Such a result was not found by Greszta and Siemińska [14].

Our statistical analyses revealed a significant positive correlation between the postoperative evaluation of trait anxiety and postoperative pain sensation. This means that as the value of one variable increased, the value of the other also rose. Regrettably, the mechanism governing their relationship remains elusive as they occur simultaneously. Anxiety can affect perceived pain and vice versa [14]. However, in the latter direction, it would be more apt to refer to state anxiety.

A comparison of postoperative state anxiety and self-efficacy indicated a statistically significant negative relationship between these variables. The higher the postoperative state anxiety a patient experienced, the lower they assessed their own efficacy. This aligns with the findings of Zemła *et al.* [11].

The statistically significant negative correlation we detected between the intensity of pain felt by patients after myocardial revascularization just before discharge from the hospital (typically on the fifth or sixth postoperative day) and their self-efficacy at that time aligns with the conclusions drawn by Zemła *et al.*, among others, regarding the effectiveness of postoperative rehabilitation and the subjective evaluation of treatment efficacy from the patient's perspective [11]. It suggests that the higher the patient's pain perception after surgery is, the lower they rate their postoperative functionality.

In contrast to the results obtained by Pawlak *et al.* [8], our research did not reveal any correlation between the level of state anxiety experienced by those awaiting myocardial revascularization and their age. Similarly, no relationship was found between preoperatively assessed trait anxiety in patients in relation to their age [8], which contradicts the positive correlation of trait anxiety with the age of patients in the surgical department revealed in the research by Robaszkiewicz-Bouakaz *et al.* [24] and the consistency of the absence of an influence of age on state anxiety. However, among those they studied, none were awaiting cardiothoracic surgery.

The anticipated presence of a statistically significant relationship between postoperative state anxiety and the concurrent body evaluation by patients after coronary artery bypass grafting, in terms of physical condition and body strength, based on the findings discussed in the article by Adib-Hajbaghery *et al.* [17], was not confirmed.

The expected correlation between the intensity of pre- and postoperative pain and the concurrent body assessment in terms of physical condition and body strength proved to be statistically significant and negatively directed only among women after myocardial revascularization concerning physical condition. The higher the sensation of pain perceived before or after the surgery was, the weaker they assessed their physical condition.

Conclusions

Conclusion 1.

Hypothesis A3: The level of trait anxiety observed pre- and postoperatively is positively correlated with the inten-

sity of postoperative pain (the higher the level of trait anxiety characterizing the patient, the more intense the pain they experience after surgery).

Hypothesis B1: The level of state anxiety experienced postoperatively is negatively correlated with self-efficacy (the higher the postoperative state anxiety the patient experiences, the worse they perceive their self-efficacy after surgery).

Hypothesis B2: The intensity of postoperative pain is negatively correlated with self-efficacy (the stronger the pain a patient feels after surgery, the lower they rate their postoperative efficacy).

Hypothesis B4: Among females, the intensity of pain experienced both pre- and post-operatively is negatively correlated with their assessment of physical condition at those respective times (i.e., the stronger the pain female patients experience before and after surgery, the lower they rate their physical condition at those moments).

Future study plans:

We are currently implementing psychological preventive measures at the prehabilitation outpatient clinic for patients scheduled for cardiac surgery, which include a psychologist [25, 26].

Data collected in that study will be the source of multiple future publications citing this article as the first in a series.

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Ethical approval

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Disclosure

The authors report no conflict of interest.

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