Towards a common definition of surgical prehabilitation: a scoping review of randomised trials.

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Title: Towards a common definition of surgical prehabilitation: A scoping review of randomised trials

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Abstract

Background: There is no universally accepted definition for surgical prehabilitation. The objectives of this scoping review were to (1) identify how surgical prehabilitation is defined across randomised controlled trials and (2) suggest a common definition.

Methods: The final search was conducted in February 2023 using MEDLINE, EMBASE, PsychInfo, Web of Science, CINAHL, and Cochrane. We included randomised controlled trials (RCTs) of unimodal or multimodal prehabilitation interventions (nutrition, exercise, psychological support) lasting at least 7 days in adults undergoing elective surgery. Qualitative data were analysed using summative content analysis.

Results: We identified 76 prehabilitation trials of patients undergoing abdominal (n=26, 34%), orthopaedic (n=20, 26%) thoracic (n=14, 18%), cardiac (n=7, 9%), spinal (n=4, 5%) and other (n=5, 7%) surgeries. Surgical prehabilitation was explicitly defined in more than half of these RCTs (n=42, 55%). Our findings consolidated the following definition: "Prehabilitation is a process from diagnosis to surgery, consisting of one or more preoperative interventions of exercise, nutrition, psychological strategies and respiratory training, that aims to enhance functional capacity and physiological reserve to allow patients to withstand surgical stressors, improve postoperative outcomes, and facilitate recovery."

Conclusion: A common definition is the first step towards standardisation, which is needed to guide future high-quality research and advance the field of prehabilitation. The proposed definition should be further evaluated by international stakeholders to ensure that it is comprehensive and globally accepted.

Keywords: prehabilitation, pre-rehabilitation, pre-rehab, preoperative, pre-surgery, Enhanced Recovery After Surgery

BACKGROUND

To our knowledge, the term "prehabilitation" was first mentioned in the *British Medical Journal* in 1946 as a programme to prepare military recruits for physical and cognitive testing (1). In the late 1990s and early 2000s, the concept of prehabilitation as a therapeutic health intervention was introduced to the field of elective surgery as inspiratory muscle training before lung resection (2) and before coronary artery bypass graft surgery (3). In 2007, prehabilitation was initiated before knee arthroplasty (4) and then prior to lumbar spinal surgery (5) using exercise therapy. By 2013, prehabilitation interventions were used to support oncological surgical care pathways including colorectal (6, 7), lung (8) and oesophageal (9) cancers.

As the field of cancer prehabilitation research progressed, a definition was proposed by Silver and Baima: "Cancer prehabilitation may be defined as a process on the continuum of care that occurs between the time of cancer diagnosis and the beginning of acute treatment, includes physical and psychological assessments that establish a baseline functional level, identifies impairments, and provides targeted interventions that improve a patient's health to reduce the incidence and the severity of current and future impairments" (10). While this definition has been extensively cited, a common definition for surgical prehabilitation is still missing more than two decades after the initial published trials. This lack of consensus is an important issue as it may partly explain the heterogeneity in interventions and outcomes across surgical prehabilitation trials, which create difficulties in pooling data, and limit the certainty of the evidence. In fact, in a recent umbrella review of 55 systematic reviews on preoperative prehabilitation, only 15 individual reviews could be pooled for meta-analyses to measure the overall certainty of effect due to heterogeneity (11). Despite this limitation, prehabilitation was found to improve functional recovery after oncological surgeries with moderate certainty, while the certainty of the evidence for non-oncological surgeries was rated as low or critically low. One of the key priorities proposed to improve the quality and certainty of surgical prehabilitation evidence, was to reach a consensus around how this high-priority preoperative intervention is defined (11).

To address this gap, we conducted a scoping review with the aim of consolidating a common definition for surgical prehabilitation as the first step towards consensus of a universally accepted definition. A clear definition will help guide future quality randomised control trials (RCTs) to generate robust evidence regarding the efficacy of surgical prehabilitation on meaningful outcomes.

METHODS

Study Design

We conducted a scoping review to synthesize a common definition of surgical prehabilitation. This review was performed in accordance with the framework suggested by Arksey and O'Malley (12) and recommendations of Levac and colleagues (13) which include five essential steps: 1) identifying the research question, 2) identifying relevant studies, 3) selecting studies, 4) charting the data, and 5) collating, summarizing, and reporting the results. A multidisciplinary team composed of prehabilitation health researchers and practitioners designed, charted, analysed and interpretated the results of this study. The reporting of our findings followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist (14). A detailed description of the methodology that includes the search strategy, study selection and data charting has been published elsewhere (15, BJA-D-23-01894R1).

Identifying the research question

The objectives of this scoping review were to (1) identify how surgical prehabilitation is defined across RCTs and (2) consolidate a common definition for future research.

Identifying relevant studies

We focused our search to published "prehabilitation" labelled (in title, abstract or keywords) trials, in which the participants were randomised to different groups (independent of the type and method of randomisation). Prehabilitation labelled trials were then included if the following working definition of prehabilitation was met (15-18): A unimodal intervention consisting of exercise, nutrition or psychological support, or a multimodal intervention that combines exercise, nutrition and/or psychological support with or without other interventions, undertaken for seven or more days before surgery to optimize a patient's preoperative condition and improve post-operative outcomes. The search strategy was developed by a librarian (GG; Supplementary Material 1). The first search was conducted on March 25th, 2022 (15) and was updated using the same strategy and with the same librarian on February 22nd, 2023. Six bibliographic databases were searched: MEDLINE, EMBASE, PsychInfo, Web of Science, CINAHL, and Cochrane. No date restrictions were applied. The reference lists

of relevant systematic reviews and narrative reviews were hand searched for additional relevant articles.

Study selection

Two independent reviewers used the Rayyan web-application (www.rayyan.ai, Cambridge, MA 02142, USA) to screen titles and abstracts for inclusion (in the initial search DE and GDT, for the updated search CG and CFG). Studies were considered for full-text review if the following criteria were met: 1) studies delivering a "prehabilitation" labelled programme before surgery for adult patients (aged ≥18 years) and in accordance with the above definition, and 2) were primary RCTs (including pilot and feasibility RCTs) with interventions lasting at least 7 days (a period consistent with Enhanced Recovery After Surgery initiatives, not prehabilitation). Exclusion criteria were as follows: narrative reviews, editorials, systematic reviews, meta-analyses, scoping reviews, pooled analyses, secondary analyses, study protocols, consensus guidelines, conference abstracts, publications not in English or French and isolated medical treatments (e.g., medication management alone). Full-text review was performed independently (in the initial search DE and GDT, for the updated search CG and CFG) and all disagreements between reviewers were addressed by discussion until consensus was reached.

Charting the data & analysis

Charting of the data (CFG and NB) included baseline study characteristics (author, year of publication, surgical specialty, and cancer type) published elsewhere (BJA-D-23-01894R1). Intervention characteristics along with explicit and implicit definitions of surgical prehabilitation were extracted from the main manuscript and entered into the data charting sheet (using Excel, Microsoft 2010, Redmond, WA).

Intervention characteristics and definition components were quantified using counts and proportions. The qualitative text was analysed by two independent coders (CFG and NB) using summative content analysis which involves familiarization with the text, coding, counting and comparisons of codes, followed by an interpretation of the underlying meaning of the content (19, 20). Definition components, words or small phrases were assigned pre-determined codes (i.e., deductive approach) and "ground-up" codes based on the dataset (i.e., inductive approach) (19). The occurrence of each identified code was tabulated (19). Investigator and method triangulation were employed to ensure the trustworthiness of the analysis by reducing the influence of individual biases (21). That is,

two independent coders and two content analysis approaches (inductive and deductive) were used to form the common definition. The first coder used an inductive coding strategy that prioritized the most prevalent keywords in the explicit and implicit definitions provided by study authors (19). Codes with similar meanings were grouped under an overarching category (20). The categories with 10 counts or more were included in the final inductive definition, representing the most frequently stated words of each category. The threshold of 10 counts was prespecified (arbitrarily) to denote commonalty across trials. The second coder used a deductive approach by pre-specifying important categories prior to analysis (purpose or goal, descriptor of the intervention, intervention type, timing and target population) guided by the Template for Intervention Description and Replication (TIDieR) reporting guidelines for interventions (22). In the deductive approach, the TIDieR framework was prioritized regardless of the frequency of the individual codes. The inductive and deductive definitions were then compared to form a consolidated extensional (i.e., lists all things that are applicable to the defined subject) definition that represents typical surgical prehabilitation programs (23).

RESULTS

Search results

Our search identified 1257 unique articles (Figure 1). After abstract screening, 149 articles were suitable for full-text review. A total of 79 articles were excluded because of publication type (n=36), population (n=13), study design (n=9), additional duplicates (n=17), language (n=2) and intervention type (n=2), leaving 70 articles. Hand searching produced 6 additional articles. A total of 76 articles were included in the final review (24-99).

Study Characteristics

A total of 76 RCTs met the inclusion criteria (BJA-D-23-01894R1). Trials included abdominal (n=26/76, 34%), orthopaedic and spinal (n=24/76, 32%), thoracic (n=14/76, 18%), cardiac (n=7/76, 9%) and other types (n=5/76, 7%) of surgeries. Surgical prehabilitation was explicitly defined in more than half of the RCTs (n=42/76, 55%) (Table 1). Trials that did not report an explicit definition, provided an explicit description of the intervention such as "...maintaining good exercise capacity using aerobic and inspiratory muscle training program" (76) or "short-term HIIT program was intended to augment preoperative physiological reserves and to facilitate postoperative functional recovery" (56). More than half of the explicit definitions (n=42) were from exercise-only trials (n=22/42, 52%) and approximately one-third originated from multimodal interventions trials (n=15/42, 36%). Together, nutritional-only and

psychological-only prehabilitation accounted for 12% (n=5/42) of the RCTs providing an explicit definition. Half of the trials with an explicit definition stemmed from the oncology literature (n=21/42). Only 14% (n=6/42) and 5% (n=2/42) of definitions were derived from RCTs of thoracic and cardiac surgical populations, respectively.

Defining Surgical Prehabilitation

For both inductive and deductive qualitative methods, the identified categories and predominant codes across all explicit definitions and descriptions are shown in Table 2. The findings from the inductive approach revealed 23 different categories (i.e., codes with similar content or meaning). Nearly three quarters (n=55) of trials included "physical activity" in their definition and used the codes "exercise/exercise therapy" (n=25, 33%) most often. Forty-two percent (n=32) of trials used a "descriptor of prehabilitation" category with the most prevalent code being "intervention" (n=16, 21%). The category of "increasing function" was reported in more than one-third (n=28, 37%) of trials with the code "enhance functional capacity" being the most prevalent (n=17, 22%). When using the deductive approach, similar results were observed as the codes "enhance functional capacity/aerobic capacity/physical fitness" (n=28, 37%) and "exercise" (n=42, 55%) were also the most frequent (after the code "preoperative"). Ten inductive categories were excluded from the definition as they were infrequently (< 10 counts) reported (e.g., rehabilitation, treatment benefits, cost, attenuate deterioration, education, medical management, lifestyle modification). The two qualitative approaches produced separate definitions (Table 3). There were two discrepancies observed between the inductively and deductively derived definitions: the inductive definition did not include medical optimization nor education. As medical optimization and education categories were reported rarely (n=5, 7%; n=3, 4% respectively) across the 76 trials, these uncommon codes did not meet the proposed criteria for the inductive definition. Figure 2 represents the most frequently reported codes of each category across trials using the inductive method.

DISCUSSION

The Need for a standardised definition

Currently, there is no standardised, universally accepted definition for surgical prehabilitation. Harmonized definitions in clinical research give rise to more robust evidence by facilitating use of consistent designs, interventions, and reported outcomes, which may improve pooling of data for future meta-analysis, leading to higher levels of evidence certainty (11). In fact, scoping reviews of surgical

prehabilitation intervention (15) and outcome reporting (BJA-D-23-01894R1) reveal significant heterogeneity, and this lack of consensus has impeded the ability to draw strong conclusions regarding the effectiveness of surgical prehabilitation (11). Given that prehabilitation is a complex intervention (100) involving different components, targeted behaviours, and levels of provider expertise, consolidating a definition is an important step to inform standardised and rigorous research. Ultimately, adoption of a common intervention definition, in addition to a core outcome set, could enhance the ability to develop, evaluate and implement preoperative interventions that support optimal patient recovery after surgery (11). As a first step toward standardisation, this scoping review proposes a common extensional definition of surgical prehabilitation, developed by qualitatively triangulating and synthesizing prehabilitation definitions across 76 primary RCTs.

Components of a common prehabilitation definition

Using both inductive and deductive approaches, we identified consistent surgical prehabilitation components across 76 trials, including timing (prior to surgery), modalities (exercise, nutrition, psychological and respiratory training) and objectives (enhancing functional capacity and physiological reserve to improve outcomes and recovery), which inform our proposed common definition. Given the heterogeneity of the included study interventions/definitions, our proposed definition should be seen as an initial step toward the foundational work required to finalize a widely accepted definition that can be adopted internationally by the multidisciplinary and intersectoral field of prehabilitation.

We must acknowledge that uncertainty and possible controversy remains about whether medical optimization (101, 102) and education are components of surgical prehabilitation interventions. The findings of this scoping review suggest that these components are not common interventions in prehabilitation. That said, the modalities included in our proposed definition may be enhanced by medical optimization (e.g., anaemia correction), and inherently involve modality-specific education (103) (i.e., education or counselling related to anxiety management, nutrition, exercise and breathing techniques). Exclusion of “medical optimization” and broad “education” across trials of prehabilitation, and therefore our proposed definition, may reflect the distinct nature of prehabilitation modalities. For example, medical optimization (and the related concept of medical clearance) as well as preoperative education (e.g., procedure-specific logistics, expectations of surgery, carbohydrate loading, etc.) are well-established and long-standing practices, often led by perioperative care clinicians (i.e., anaesthesiologists, surgeons, internal medicine specialists, nurses, or others) as part of standard care, *independent* of prehabilitation (104). Conceptually, the prehabilitation modalities included in our

definition would be expected to supplement and occur in parallel with medical optimisation and pre-operative education. Prehabilitation interventions focus primarily on health care professionals supporting changes in patient behaviours with the specific purpose of building physiological reserve and psychological resilience before surgery. In contrast, surgery-specific medical optimization focuses on health care professional supported optimisation of long-term health conditions primarily involving pharmacological interventions and devices (e.g., diabetes control, blood pressure management, anaemia management, sleep apnoea diagnosis and management) (104). Furthermore, education is one of the pillars of Enhanced Recovery After Surgery (ERAS) programs which are well established, evidence-based perioperative care improvement interventions that are already embedded within surgical pathways (105, 106). These education programmes provide information about the planned procedure, pain management, early mobilisation and establishment of oral intake. Medical optimisation is also embedded within ERAS programs (105). The infrequent reporting of education and medical optimisation in prehabilitation trials may thus reflect that these interventions are already viewed as part of the routine perioperative pathway in many centres. Prehabilitation, by our definition, is complementary to the existing surgical preparation pathways inclusive of risk stratification, shared decision making, medical optimisation and patient education, and aims to confer *additional benefit* by improving both patient experience and post operative outcomes (107). It is possible that sites lacking standardised medical optimization and patient education services were more inclined to include these components in their definition of prehabilitation. Ultimately, broad collaboration between patients, clinicians, researchers, and health system leaders internationally, informed by robust knowledge synthesis, will be required to achieve a widely accepted definition.

Limitations and future directions

The common definition produced from this scoping review is not without limitations. First, the definition has been generated using only published definitions (in English and French), meaning it is limited to commonly reported components of surgical prehabilitation trials, which does not necessarily reflect validity nor consensus. Secondly, we must acknowledge that the cut-off of 10 used to denote commonality in the inductive summative content analysis was arbitrary and led to exclusion of two modalities that remained in the deductive approach: medical optimization (n=5) and education (n=3). A consultation exercise is required to achieve consensus in support of the inclusion or exclusion of medical optimization and broad education as part of surgical prehabilitation. Thirdly, as observed in Figure 2, the consolidated definition is limited by the historical perspective of prehabilitation which has been

predominantly described as “preoperative exercise” even though multimodal models in cancer and surgery have expanded beyond exercise therapy alone (108). Fourth, the trials that reported explicit definitions (n=42, 55%) were mainly from abdominal, orthopaedic, and spinal specialties; therefore, this common definition may not reflect the priorities of other surgery types. Given that the goal of this scoping review was to describe how surgical prehabilitation is currently being defined, we did not additionally consult a group of experts in the prehabilitation field for further input and consensus. We suggest that the next step is to consult international stakeholders and experts in the field to ensure the development of a comprehensive and globally accepted definition.

CONCLUSION

There are many distinctive published definitions for surgical prehabilitation. This scoping review has consolidated the available literature to suggest a common definition using a qualitative triangulation approach. The proposed common definition is the first step towards standardisation, which is needed to guide future high-quality RCTs and advance the prehabilitation field.

Details of author contributions: CFG, NB, LD and CG equally contributed to the study design, analysis of the data and writing of the manuscript. CFG created tables and figures. Finally, all co-authors contributed to the study design, interpretation of data, and meaningfully revised the final manuscript as well as provided their expertise in the fields of prehabilitation and perioperative medicine throughout.

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Table 1. Baseline study characteristics

Characteristics	Number of trials (n=76)	Trials with an explicit definition (n=42)
Type of prehabilitation program		
Exercise only	41 (54)	22 (52)
Multimodal	25 (33)	15 (36)
Nutrition only	3 (4)	2 (5)
Psychological support only	3 (4)	3 (7)
Respiratory only	3 (4)	0 (0)
Pelvic floor training only	1 (1)	0 (0)
Population included		
Oncological surgery	35 (46)	21 (50)
Non-oncological Surgery	33 (43)	17 (41)
Mixed cohort	8 (11)	4 (10)
Type of surgical population		
Abdominal surgery	26 (34)	18 (43)
Orthopedic and spinal surgeries	24 (32)	14 (33)
Thoracic surgery	14 (18)	6 (14)
Cardiac surgery	7 (9)	2 (5)
Other surgeries*	5 (7)	2 (5)

*Including breast only and mixed cohorts

Table 2. Identified inductive and deductive categories and their most reported codes using a summative content analysis approach

Category	Total category count and frequency* (n=76)	Most reported code(s)	Code count and frequency** (n=76)
Inductive approach			
Surgical time period	74 (97)	*Preoperative*	37 (49)
Physical activity	55 (72)	*Exercise/exercise training*	25 (33)
Descriptor of prehabilitation	32 (42)	*Intervention*	16 (21)
Increase function	28 (37)	*Enhance/improve/augment functional capacity*	17 (22)
Withstand stress	20 (26)	*Withstand a stressful event/stressor of surgery*	11 (15)
Continuous (from diagnosis to treatment)	18 (24)	*Process*	12 (16)
Improve reserve	18 (24)	*Enhance/increase/optimize physiological reserve*	8 (11)
Optimize nutrition	13 (17)	*Nutrition/nutrition support*	6 (8)
Delivery modal	13 (17)	*Multimodal*	6 (8)
Improve outcomes	11 (15)	*Improve post-operative outcomes*	4 (5)
Respiratory training	10 (13)	*Pulmonary rehabilitation*	3 (4)
		Inspiratory muscle training	3 (4)
Psychological	10 (13)	*Anxiety-reducing strategies*	2 (3)
		Psychological intervention	2 (3)
		Reduce stress and anxiety	2 (3)
Recovery	10 (13)	*Facilitate recovery of functional capacity*	2 (3)
Rehabilitation	7 (9)	*Rehabilitation*	4 (5)
Medical optimization	5 (7)	*Optimization of medical conditions*	1 (1)
		Smoking cessation	1 (1)
		Medical support	1 (1)
		Medical management	1 (1)
		Weight loss	1 (1)
Treatment benefits	4 (5)	*Benefits/beneficial effect*	3 (4)
Attenuate deterioration	4 (5)	*Reduce patient disability*	1 (1)
		Reduce the incidence and/or severity of future impairments	1 (1)
		Ameliorate the post-surgical physiologic deterioration	1 (1)
		Prevent or attenuate functional decline	1 (1)
Behavioural support	4 (5)	*Behavioural support*	2 (3)
Education	3 (4)	*Education/education program*	3 (4)
Personalized to population	3 (4)	*For patients with lower fitness*	1 (1)

		Varies according to context and the patient's needs	1 (1)
		Older patients with frailty	1 (1)
Baseline function	2 (3)	*Establish a baseline functional level*	1 (1)
		Identify impairments	1 (1)
Cost	1 (1)	*Reduce financial burden on the health system*	1 (1)
Lifestyle modification	1 (1)	*Lifestyle modification*	1 (1)
Deductive approach			
Purpose/goal	104 (137)	*Enhance functional capacity/aerobic capacity/physical fitness*	28 (37)
		Improve post-operative outcomes	17 (22)
		Combat surgical stressors	15 (20)
Intervention type	77 (101)	*Exercise/physical activity*	42 (55)
		Nutrition	12 (16)
		Psychological	7 (9)
		Medical optimization	5 (7)
		Education	3 (4)
Timing	51 (67)	*Before surgery/preoperative*	47 (62)
Descriptor	47 (62)	*Program*	14 (18)
		Process	12 (16)
		Intervention	8 (11)
Target population	4 (5)	*Patients with lower preoperative fitness*	1 (1)
		Older patients with frailty	1 (1)
		Individualised to patients needs and context	1 (1)
		Surgical patients	1 (1)

*Total category count and frequency: number of times codes within a specific category was reported across 76 trials; **Total code count and frequency: number of times a code was reported across 76 trials; Studies may report multiple codes in one category

Table 3. Surgical prehabilitation definitions using inductive and deductive qualitative approaches

Method	Definition
Inductive qualitative approach using most common keywords	*"Prehabilitation is a process from diagnosis to treatment that consists of a unimodal or multimodal pre-operative intervention including exercise, nutrition, psychological strategies and/or respiratory training, and aims to enhance functional capacity and physiological reserve to allow patients to withstand surgical stressors, improve postoperative outcomes and facilitate recovery."*
Deductive qualitative approach using TiDER checklist	*"Prehabilitation can be defined as a program delivered prior to surgery that may consist of a number of interventions including exercise therapy, nutritional optimisation, psychological strategies, respiratory training, medical optimisation, and education, and aims to enhance functional capacity and physiological reserve to allow a patient to withstand surgical stressors and improve postoperative outcomes."*
Proposed common definition	***"Prehabilitation is a process from diagnosis to surgery, consisting of one or more preoperative intervention(s) of exercise, nutrition, psychological strategies and respiratory training, that aims to enhance functional capacity and physiological reserve to allow patients to withstand surgical stressors, improve post-operative outcomes, and facilitate recovery."***

TiDER: Template for Intervention Description and Replication

Figure 1 - PRISMA flow diagram

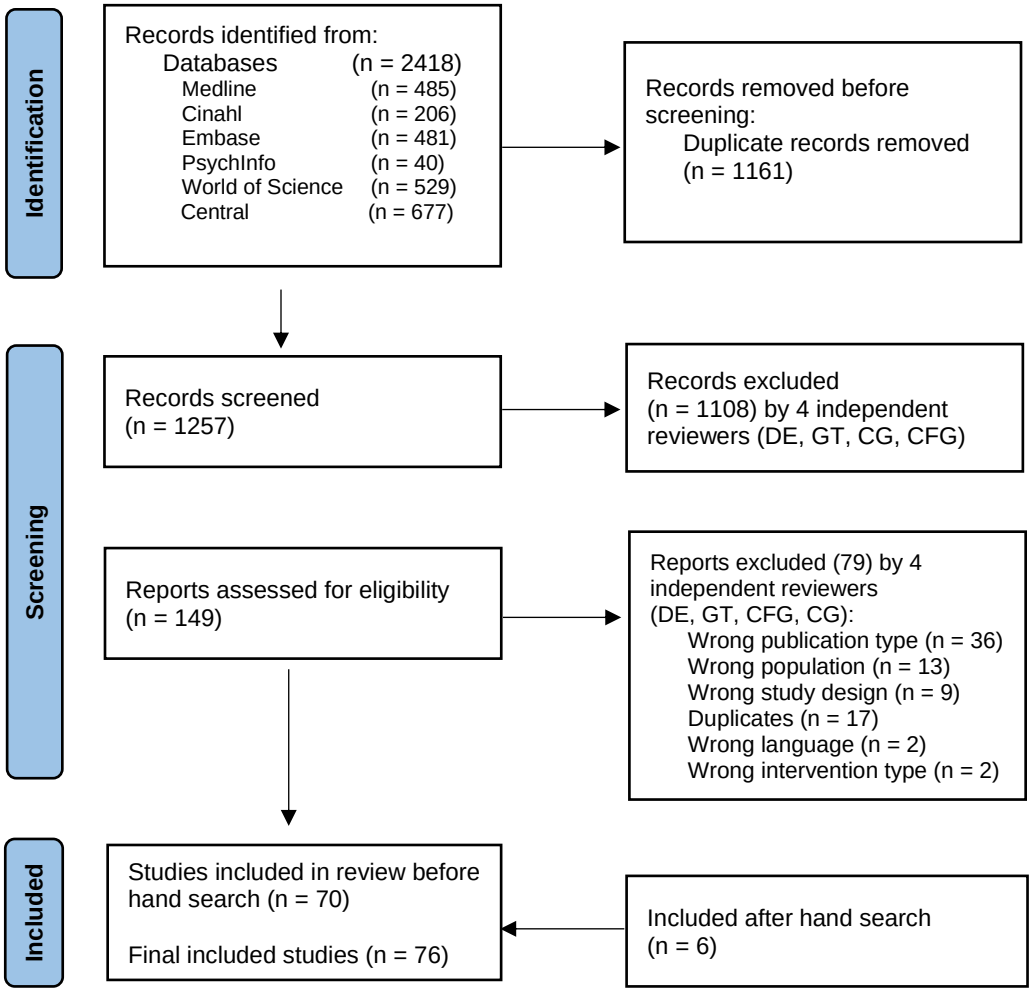
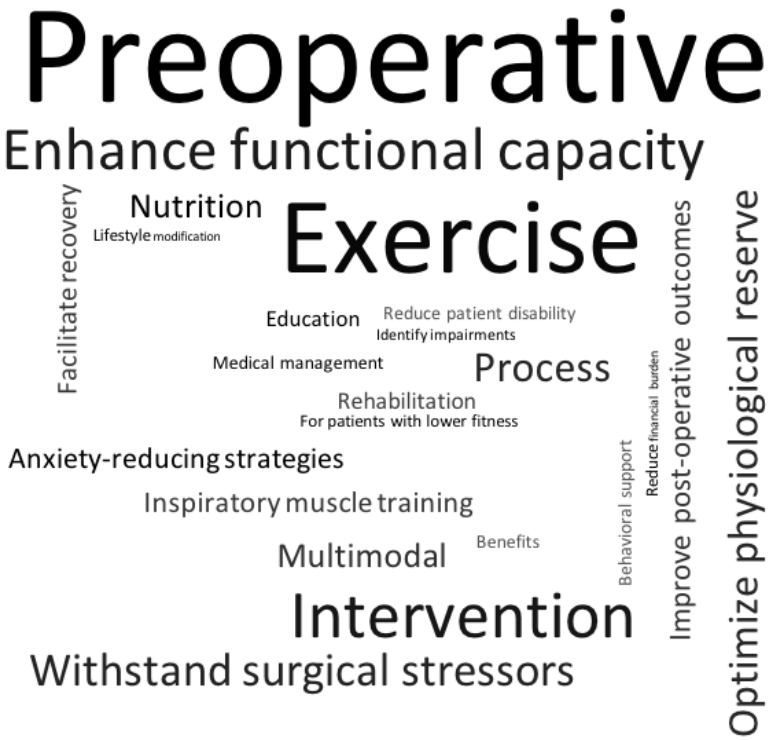


Figure 2. Word cloud using an inductive qualitative approach to define surgical prehabilitation. The scaling of each code is proportional to the number of times it was reported across the 76 trials included.


Preoperative
Enhance functional capacity
Facilitate recovery
Nutrition
Lifestyle modification
Exercise
Education
Reduce patient disability
Identify impairments
Medical management
Process
Rehabilitation
For patients with lower fitness
Anxiety-reducing strategies
Inspiratory muscle training
Multimodal
Benefits
Intervention
Withstand surgical stressors
Behavioral support
Reduce financial burden
Improve post-operative outcomes
Optimize physiological reserve