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Review Article

Perioperative cardiac risk stratification: is functional capacity assessment able to predict perioperative complications, including death?

Estratificação do risco cardíaco perioperatório: a avaliação da capacidade funcional é capaz de predizer complicações perioperatórias, incluindo óbito?

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ABSTRACT

Introduction: Perioperative risk screening seeks to optimize medical decision-making by identifying cardiac risk in patients undergoing noncardiac surgery. The current guidelines of organizations such as the European Society of Cardiology (ESC) and the Brazilian Society of Cardiology (SBC)incorporate assessments of subjective functional capacity, often using the threshold of 4 METs as a marker of low functional capacity. Despite recent updates to these guidelines, the literature remains conflicting, and the predictive power of subjective tools for perioperative outcomes is uncertain. **Methods:** We conducted a systematic review, in accordance with PRISMA guidelines, on the effectiveness of subjective functional capacity assessment tools regarding their predictive power for perioperative cardiac complications, including death. Four databases were searched: PUBMED, SCOPUS, WOS, and Science Direct. **Results:** The results indicate that the self-reported ability to climb two flights of stairs, although demonstrating associative power, often did not improve the predictive power of risk models. In contrast, more comprehensive assessment tools with continuous data, such as the Duke Activity Status Index (DASI) and weekly levels of physical activity, appear to be more promising. **Conclusion:** These results suggest that current perioperative risk stratification guidelines need to be critically re-evaluated with regard to the inclusion of subjective functional capacity. It is of paramount importance to effectively distinguish the associative power of the subjective assessment of functional capacity from its predictive power when compared with information already obtained from the patient.

Keywords: Perioperative Cardiac Risk. Functional Capacity Assessment. Perioperative. MACE.

INTRODUCTION

Introduction Recent perioperative risk screening guidelines have increasingly emphasized individual clinical assessment, as opposed to the routine indiscriminate use of additional tests. This change reflects the recognition that tests performed without a clear clinical indication often fail to accurately predict perioperative outcomes and may also contribute to higher healthcare costs[1-3]. Within this framework, subjective estimation of functional capacity has been integrated into stratification protocols since the initial American College of Cardiology/ American Heart Association (ACC/AHA) guidelines. It remains a primary criterion in clinical decision-making[4-9]. This measure reflects cardiorespiratory capacity and physiological tolerance to surgical stress. A functional capacity of at least 4 Metabolic Equivalents of Task (METs) is generally accepted as indicative of lower perioperative cardiovascular risk[8-11]. The standard approach for assessing this threshold relies on patient self-report of their ability to climb two flights of stairs or walk a distance of 400 meters without fatigue[4]. This method is susceptible to subjective bias and demonstrates low reproducibility in predicting major adverse cardiac events (MACE) and postoperative mortality[4,12,13]. International guidelines have also recommended the Duke Activity Status Index (DASI) as a structured tool for estimating functional capacity[6,7,14]. However, the lack of standardized criteria

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for activity intensity and and the reliance on dichotomous (yes/no) questions about the patient's perceived ability may undermine the reliability of the assessment. This study presents a critical systematic review of the literature. Its aim to evaluate the predictive validity of the subjective model of functional assessment employed in current perioperative cardiac risk stratification strategies. While objective methods such as cardiopulmonary exercise testing (CPET) and cardiac biomarker measurement are available, these alternatives are costly and have limited applicability[5,6,12]. This study specifically investigates whether subjective assessment of functional capacity effectively predicts perioperative cardiac complications, as recommended in current guidelines.

METHODS

This systematic review was previously registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration number: CRD42024557969-04/07/2024. The review was conducted in accordance with the PRISMA 2020 guidelines[15].

Eligibility Criteria

Randomized controlled or observational studies were selected that included adult patients (18–79 years old) undergoing non-cardiac surgeries. All selected studies used some form of subjective measurement of functional capacity. The outcomes of interest were MACE and/or mortality, occurring during hospitalization or within 30 days after the surgical. We excluded studies involving populations outside the specified age range, cardiac surgery or transplantation, as well as literature reviews, case reports, and expert opinions.

Search Strategy

On September 17 and 25, 2024, data searches were conducted in PUBMED, SCOPUS, WEB OF SCIENCE, and SCIENCE DIRECT, with no restrictions regarding language or publication date. Terms such as "Preoperative cardiac risk assessment," "Perioperative cardiac risk assessment," "Preoperative cardiac risk stratification," and "Perioperative cardiac risk stratification" were used, combined with the Boolean operator OR, and applied to the "Title/Abstract" field. The complete search strategy for the PUBMED database is available in Supplement 1.

Screening, Data Extraction, and Quality Assessment

Study selection, data extraction, and risk-of-bias assessment were performed independently by two reviewers (GC, SA). Disagreements were resolved by consulting a third reviewer (JV). The instrument used for data extraction was the Checklist for Critical Appraisal and Data Extraction for Systematic Reviews of Prediction Modelling Studies (CHARMS)[16].

Quality Assessment

Risk of bias in the included studies was assessed using the PROBAST tool, covering the following domains: participants, predictors, outcomes, and statistical analysis. Table 1 summarizes the risk of bias for each study. The rating of the quality of evidence followed the GRADE Handbook guidelines[17] (Supplement 1).

Table 1 - *Summary of PROBAST. Risk of bias and applicability assessment.*

	Risk of Bias				Applicability			Overall	
Author, Year	1.Participants	2. Predictors	3. Outcome	4. Analysis	1.Participants	2.Predictors	3. Outcome	Risk of Bias	Applicability
Deo et al.[22]	+	?	-	-	?	?	?	-	?
Kaw et al.[25]	+	-	-	?	+	+	?	-	?
Buse et al. [19]	+	+	+	-	+	+	+	-	+
Buse et al.[13]	+	+	+	+	+	+	+	+	+

	Risk of Bias				Applicability			Overall	
Author, Year	1.Participants	2. Predictors	3. Outcome	4. Analysis	1.Participants	2.Predictors	3. Outcome	Risk of Bias	Applicability
Buse et al.[18]	+	+	+	-	+	?	+	-	?
Marsman et al.[23]	+	-	-	-	+	?	-	-	-
Reilly et al.[21]	+	+	+	-	+	+	+	-	+
Shah et al.[20]	+	-	-	-	?	-	-	-	-
Tsiouris, A.[27]	+	-	+	-	?	-	+	-	-
Wijeysundera et al.[12]	+	+	+	?	+	+	+	?	+
Wiklund et al.[24]	+	?	+	-	+	?	+	-	?

Note. Symbols for the assessment of Risk of Bias and Applicability using PROBAST: + = low risk of bias or low concern regarding applicability; - = high risk of bias or high concern regarding applicability; ? = unclear risk of bias or unclear applicability. The definitions are based on the PROBAST tool[15].

Data Analysis

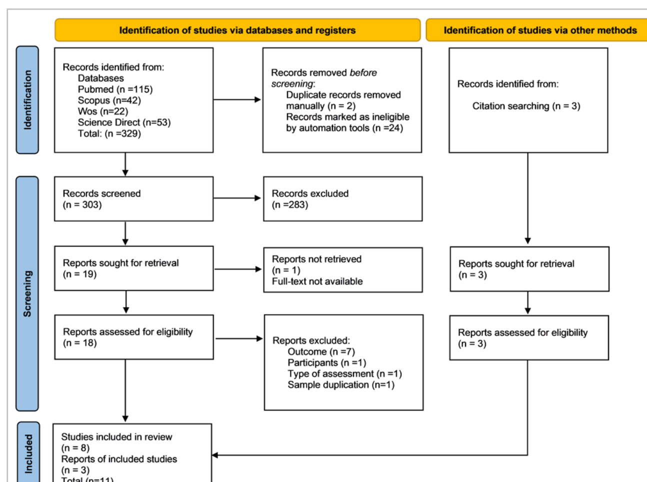
The studies included in this systematic review presented heterogeneity in samples, instruments, metrics, and interventions, and seldom reported direct comparisons between methods. These factors limit the statistical precision necessary for conducting a meta-analysis. Future research may overcome these limitations as methodological understanding of risk-stratification analysis based on advances in subjective functional capacity.

Data were presented descriptively and organized into table (Table 2). Surgical categories are provided in Supplement 1. Measures of association, including relative risk, odds ratio, and hazard ratio, were reported when available. The area under the Receiver Operating Characteristic (ROC) curve was adopted as the primary metric for predictive performance, and was reported with confidence intervals and, when available, significance values.

RESULTS

Study Selection and Characteristics

The initial search identified 329 articles. Following the removal of duplicates, application of eligibility criteria, and inclusion of cross-references, 11 studies were selected for final analysis, as shown in Figure 1. These studies included a heterogeneous population of 45,305 participants, comprising 24,951 males and 20,336 females. The mean participant age ranged from 54.1 to 75 years. Across these studies, 769 deaths and 2,016 major adverse cardiovascular events (MACE) were reported.



Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

Figura 1.

A variety of assessment tools were employed across the included studies. Five studies utilized self-reported ability to climb two flights of stairs[13,18-21], while two studies also included the self-reported ability to walk four blocks[20,21]. Six studies reported outcomes in metabolic equivalents (METs). One study relied on clinical history[12], and three studies used an unstructured questionnaire[22–24]. Two studies implemented the MET-repairs[13,19], a 10-item questionnaire estimating exercise tolerance based on activities requiring effort levels from 1 to 10 METs (Supplement 1). The structured Duke Activity Status Index (DASI) questionnaire was used in two studies[12,25]. The DASI is a self-administered, 12-item questionnaire with items weighted according to the metabolic cost of each activity in MET units[26] (Supplement 1). Activities of Daily Living (ADLs) assessments were used in one study[27], and physical activity (PA) level was reported in two studies[13,19]. The main characteristics of the included studies are summarized in Table 3, with original metrics retained.

Table 3 - *Summary of the described characteristics.*

Authors	Design	N	Age	Instrumento
Deo et al. [22]	Multicenter prospective observational study	770	Group (<65 years): 61.1% Group (>65 years): 38.83%	METs autorreportado
Kaw et al.[25]	Retrospective observational cohort study	509	63.06 ± 11.43 years	DASI
Buse et al.[19]	International prospective cohort study	15.767	40–64 years: 10.4% 65–74 years: 52.1% ≥75 years: 37.5%	METrepairs, Autorrelato da capacidade de subir dois lances de escadas, AVDs, e Nível de Atividade Física (>20 min)
Buse et al.[13]	International prospective cohort study	3.597	45-74 years: 59.3%. ≥ 75 years: 40.7%.	METrepairs, Autorrelato da capacidade de subir dois lances de escadas, AVDs, e Nível de Atividade Física (>20 min)
Buse et al.[18]	Single-center prospective cohort study	4.560	73 ±8 years	Autorrelato da capacidade de subir dois lances de escadas
Marsman et al.[23]	Retrospective observational cohort study	4.879	Group with reduced functional capacity: 73.6 ± 7.9 years. Group with normal functional capacity: 70.1 ± 6.8 years.	METs Anamnese Não-estruturada
Reilly et al.[21]	Prospective observational study	600	63.0 (± 14.8 years)	utorrelato da capacidade de subir dois lances de escadas e/ou andar quatro quadras
Shan et al.[20]	Retrospective cohort study	370	Mild PH: 59 ± 14 years Moderate PH: 62 ± 13 years Severe PH: 59 ± 16 years	Autorrelato da capacidade de subir dois lances de escadas e/ou andar quatro quadras
Tsiouris et al.[27]	Retrospective observational study	6.373	Independent patients: mean age 52.4 years Non-independent patients: mean age 64.7 years	AVDs
Wijeysundera et al.[12]	International prospective cohort study	1.401	65 years (IQ 57-72 years)	METs (por histórico) e DASI

Authors	Design	N	Age	Instrumento
Wiklund et al.[24]	Prospective cohort study	5.939	Patients with cardiovascular complications: 71.4 ± 8.7 years Patients without cardiovascular complications: 54.6 ± 15.7 years	Self-reported METs (based on AHA/ACC)

Note. N= Number of participants; MACE = Major Adverse Cardiac Events; METs = Metabolic Equivalents; DASI = Duke Activity Status Index; ADLs = Activities of Daily Living; PA = Physical Activity; PH = Pulmonary Hypertension; CV = Cardiovascular; IQR = Interquartile Range.

Individual results by outcome

Nine studies evaluated outcomes during hospital admission. Among these, Buse et al.[13] compared different forms of subjective functional capacity assessment. Self-reported ability to climb stairs showed an odds ratio (OR) of 1.90 (95% CI: 1.17–3.11) and an area under the ROC curve (AUC) of 0.746 ($p = 0.074$), without significant improvement over the baseline model. The MET-Repairs questionnaire presented an OR of 1.61 (1.17–2.23) and an AUC of 0.742 ($p = 0.321$), again with no relevant increase in discriminative ability. However, reporting more than 20 minutes of weekly physical activity was statistically significantly associated with complications (OR 2.02; 1.46–2.79) and increased the AUC to 0.753 ($p = 0.009$).

In the following study, Buse et al.[19] included MET-Repairs in models based on the Revised Cardiac Risk Index (RCRI) and the National Surgical Quality Improvement Program (NSQIP) surgical risk calculators. The odds ratios found were 1.86 (1.10–3.16) and 2.07 (1.23–3.50), respectively. However, there was no significant increment in the AUCs for these models (0.704 and 0.690 versus 0.694 and 0.676).

In additional assessments, the ability to climb two flights of stairs did not add discriminative value when included in the clinical models, with OR of 0.65 (0.36–1.17) in the RCRI and 0.59 (0.33–1.05) in the NSQIP, and AUCs of 0.702 and 0.684 ($p > 0.05$). On the other hand, the level of physical activity showed significant ORs (2.40 and 2.51) and AUCs of 0.724 and 0.705, although the increments were not statistically significant.

Two studies analyzed major surgeries. Reilly et al.[21] used self-reports of the ability to climb two flights of stairs or walk four blocks, yielding an OR of 1.94 (1.19–3.17) for general complications and 1.81 (0.94–3.46) for cardiovascular events. Wijeysundera et al.[12] used the DASI and clinical reports of METs. The DASI showed an OR of 0.97 (0.93–1.01; $p = 0.16$) with an AUC of 0.72. METs showed an OR of 1.21 (0.57–2.55) and an AUC also of 0.72.

Three other studies used unstructured questionnaires based on METs. Deo et al.[22] found an association between low functional capacity and MACE (OR 1.8; 1.04–3.13; $p = 0.034$). Marsman et al.25 reported an OR of 1.3 (1.0–1.7) and RR of 1.7 (1.5–2.0) for myocardial injury, with an AUC of 0.70. For acute myocardial infarction, the OR was 2.0 (1.3–3.0), and the RR was 2.9 (1.9–4.4), with an AUC of 0.71. Wiklund et al.[24] reported $p = 0.793$ for low functional capacity, with an AUC of 0.66 — lower than that for age (0.84) and for ASA classification (0.74). Kaw et al.25 reported an OR of 0.32 (0.13–0.82; $p = 0.01$) and an AUC of 0.65, slightly lower than that of the model with RCRI (0.68).

Four studies evaluated events up to 30 days. Buse et al.[18] observed ORs ranging from 1.62 to 1.97 and AUCs ranging from 0.727 to 0.731, with no statistical difference compared to the base model. In Buse et al.[18], the addition of these variables to the RCRI and NSQIP models yielded significant ORs but did not significantly increase AUCs (ranging from 0.668 to 0.686). In Buse et al.[18], subjective assessment had an HR of 1.63 (1.23–2.15), with a slight improvement in AUC only in models without high-risk patients. Shah et al.[20] reported an event incidence of 29.8% among patients with low functional capacity, compared to 20.3% in those with good capacity ($p = 0.010$), but no AUC was reported.

Regarding in-hospital mortality, Tsiouris et al.[27] reported an OR of 3.8 (p < 0.001) using an ADL (activities of daily living) questionnaire. Wiklund et al.[24] found no significant association (p = 0.793), with an AUC of 0.524, lower than that for ASA (0.803) and age (0.782). For 30-day mortality, Buse et al.18 reported an HR of 2.54 (1.64–3.95). Wijeysundera et al.12 found an OR of 0.78 (0.09–6.59; p = 0.64) with an AUC of 0.57 for METs, and an OR of 0.91 (0.83–0.99; p = 0.03) with DASI, which increased the AUC from 0.59 to 0.67. For death due to myocardial injury, METs showed an OR of 1.33 (0.69–2.57; p > 0.05), and DASI had an OR of 0.96 (0.92–0.99; p = 0.05), with an increase in AUC from 0.70 to 0.71. Shah et al.20 observed a mortality of 2.6% among patients with low functional capacity, compared to 1.1% in those with good capacity (p = 0.10), with no AUC reported.

DISCUSSION

Two functional capacity assessment tools, commonly referenced in perioperative management guidelines, were frequently used in the selected studies. These included patients self-report based on the ability to climb two flights of stairs or walk four city blocks, and the DASI questionnaire.

The use of these tools in perioperative screening is based on the principle that they can provide relevant information. Such information may not be captured by the patient's history, clinical factors, or even age alone. The ability to climb two flights of stairs was, in many of the selected studies, associated with perioperative complications[13,18-21]. This could indicate a promising screening approach: a simple, cost-free evaluation that can be used on a large scale. However, some facts have not gone unnoticed.

The studies that, in addition to the odds ratio, reported the area under the ROC curve, showed a limited ability to improve the predictive power of the baseline equation1[3,18,19]. Typically, there was no significant difference between the baseline area under the ROC curve and the area under the ROC curve based on the ability to climb two flights of stairs. This indicates that information about on poor functional capacity, as measured by the ability to climb two flights of stairs, did not provide any additional relevant information for clinical decision-making. This pattern was also observed in the two studies with the largest sample sizes[13,19].

Of the selected studies, only Buse et al.[18] reported an improvement in the baseline equation regarding the area under the ROC curve. Self-reported stair climbing, when added to the baseline equation that included surgical risk, significantly increased the discriminatory power. This result was not observed when the baseline model used the RCRI.

Even in studies where there were positive statistical associations, it was observed that other variables, such as ASA class, type of surgery, and comorbidities, demonstrated superior predictive influence[18,21].

Although an association was found with a 63% higher risk of perioperative complications in patients classified as having poor functional capacity, other variables, such as surgical risk class, showed associations of up to 145%[18], which is more than twice that of poor functional capacity.

Even the associative power of the self-reported ability to climb stairs is questionable. In the study with the largest sample size, no significant difference was observed between patients at high cardiovascular risk classified as having poor or good functional capacity, regarding in-hospital MACE[13]. This demonstrates that these results are unusual.

Although the addition of this variable did not provide discriminatory value, this is possibly due to overlap with information already contained in other baseline variables, given that, in the study in question, all study variables were added to baseline variables such as RCRI and age.

For the specific outcome of mortality, only one study utilized the self-reported ability to climb two flights of stairs. The data behavior was similar to that observed for the MACE outcome[18]. Analysis of the data demonstrates that, even though an association was present, the ability to climb two flights of stairs was not the most effective predictor in terms of odds ratio.

When the DASI was incorporated into a baseline model, there was an increase in the discriminative capacity for MACE and mortality. It is possible that, since the DASI is analyzed in some cases as a continuous variable, this improves the sensitivity of the assessment, in contrast to studies evaluating the ability to climb two flights of stairs, where the data are dichotomized as <4 vs. ≥4 METs. This may have resulted in a more robust analysis.

Some studies suggest that the 4-MET value, defined in most clinical guidelines, represents a cutoff with low sensitivity[4,12,13]. Notably, when assessed as a continuous variable, an increase of 3.5 points in the DASI score (i.e., for each increase of 1 MET) was associated with a 9% reduction in the odds of death or myocardial infarction[12,28].

Wijeysundera et al.[28] reported that the optimal cutoff point for cardiac risk on the DASI is 35 points, corresponding to approximately 7 METs—substantially higher than the 4 METs proposed in the guidelines. The assessment of DASI as a continuous variable may have enhanced its predictive power by reflecting a higher cutoff point.

Expanding the range of questions to approximate actual functional capacity appears to be a promising approach. The MET-Repairs demonstrated associative power in both types of analyses—dichotomized and continuous. The continuous variable proved more robust, similar the findings with the DASI.

However, despite being designed for perioperative risk stratification, MET-Repairs did not significantly improve the discriminative power of predictive models for any outcome. It is worth noting that MET-Repairs is a simpler questionnaire when compared to DASI.

While the DASI assigns a score based on the sum of multiple activities the patient reports being able to perform, MET-Repairs follows an increasing order of METs per activity and records the value corresponding to the most vigorous activity reported. However, even the DASI demonstrated inferior results when compared to objective biomarkers such as NT-proBNP. NT-proBNP is strongly associated with vascular events and cardiac overload29–31, which underscores the need for more precise and reproducible methods[19].

In addition to DASI, the level of physical activity was the only subjective functional capacity assessment tool to demonstrate an association with MACE and to significantly improve the baseline model[19].

It appears that tools assessing functional capacity by summing multiple tasks, as well as those that consider the frequency and regularity of physical activity, were more effective at providing clinically relevant information.

Other tools, such as unstructured questionnaires, were not only low in reproducibility but also lacked predictive power compared with baseline models[12,24-27,31].

Regarding the use of functional capacity in risk stratification algorithms within clinical guidelines (ACC/AHA, ESC, and SBC)—based on self-reported ability to climb stairs—it appears that, in none of the scenarios evaluated, this assessment substantially modified the predictive performance of clinical models. In the context of this review, self-reported ability to climb two flights of stairs is dispensable from a discriminative standpoint, as it does not provide any meaningful information to support clinical decision-making.

It is important to acknowledge that the methods evaluated present several relevant methodological limitations. Subjective assessments of functional capacity rely on perception and recall, which may lead to overestimation or underestimation of actual physical activity. Moreover, the predominance of dichotomous measures (e.g., ability or inability to climb two flights of stairs) increases the risk of misclassification of functional capacity, thereby introducing measurement bias. Subjective questionnaires are also susceptible to response bias due to familiarity or social desirability. Although the use of structured and standardized instruments may mitigate these issues, it does not fully eliminate them. Finally, the heterogeneity of assessment tools, populations, types of surgical procedures, and the relatively low number of events limit comparability across studies, even when similar instruments are employed.

Future studies in perioperative risk stratification should aim to develop objective, efficient, and easily applicable metrics. For this purpose, it is necessary to conduct research with comparative and combined evaluations of different stratification instruments. Such studies should primarily on their discriminative capacity in relation to clinical data and avoiding redundancy of information that may obscure the true clinical utility of functional capacity—that is, providing key information for perioperative decision-making and management.

CONCLUSION

Consequently, the evidence suggests that assessing subjective functional capacity with dichotomized measures, such as self-reported ability to climb two flights of stairs, demonstrates limited sensitivity and low reproducibility in predicting cardiac events.

In contrast, structured instruments such as the DASI, especially when analyzed as continuous variables, have demonstrated greater discriminative capacity. These tools, however, still require broad validation and integration with models that avoid redundancy.

This highlights the need to develop more objective, standardized, and sensitive methods. Such strategies should add value to clinical practice, improving risk stratification and.

RESUMO

Introdução: *A triagem de risco perioperatório visa otimizar a tomada de decisão clínica por meio da identificação do risco cardíaco em pacientes submetidos a cirurgias não cardíacas. As diretrizes atuais de organizações como a European Society of Cardiology (ESC) e Sociedade Brasileira de Cardiologia (SBC) incorporam avaliações subjetivas da capacidade funcional, frequentemente utilizando o limiar de 4 METs como marcador de baixa capacidade funcional. Apesar das atualizações recentes dessas diretrizes, a literatura permanece conflitante, e o poder preditivo das ferramentas subjetivas para desfechos perioperatórios é incerto.* **Métodos:** *Conduzimos uma revisão sistemática, em conformidade com as diretrizes PRISMA, sobre a eficácia de ferramentas de avaliação subjetiva da capacidade funcional quanto ao seu poder preditivo para complicações cardíacas perioperatórias, incluindo morte. Foram pesquisadas quatro bases de dados: PUBMED, SCOPUS, WOS e Science Direct.* **Resultados:** *Os resultados indicam que a capacidade autorreferida de subir dois lances de escadas, embora demonstre poder associativo, frequentemente não melhora o poder preditivo dos modelos de risco. Em contraste, ferramentas de avaliação mais abrangentes com dados contínuos, como o Duke Activity Status Index (DASI) e os níveis semanais de atividade física, parecem ser mais promissoras.* **Conclusões:** *Esses resultados sugerem que as diretrizes atuais de estratificação de risco perioperatório necessitam de reavaliação crítica no que se refere à inclusão da capacidade funcional subjetiva. É de suma importância distinguir de forma eficaz o poder associativo da avaliação subjetiva da capacidade funcional de seu poder preditivo, quando comparado às informações já obtidas do paciente.*

Palavras-chave: *Risco Cardíaco Perioperatório. Avaliação da Capacidade Funcional. Perioperatório. MACE.*

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Data availability

Datasets related to this article will be available upon request to the corresponding author..

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SUPPLEMENTARY

Table S1 - *PUBMED Summary of the search strategy.*

Number of search terms or combinations used in PubMed
#1 Preoperative cardiac risk assessment
#2 Perioperative cardiac risk assessment
#3 Perioperative cardiac risk
#4 Preoperative cardiac risk
#5 Preoperative cardiac risk stratification
#6 Perioperative cardiac risk stratification
#7 Perioperative cardiac risks stratification
#8 Preoperative cardiac risks stratification
#9 Perioperative cardiac risks assessment
#10 Preoperative cardiac risks assessment
#11 Perioperative cardiac risks
#12 Preoperative cardiac risks
#13 OR/1-12
#14Functional capacity assessment
#15 Functional capacity
#16 Subjective assessment functional capacity
#17 Subjective evaluation functional capacity
#18 Subjective measurement functional capacity
#19 Subjective analysis functional capacity
#20 Subjective assessments functional capacity
#21 Subjective evaluations functional capacity
#22 Subjective measurements functional capacity

Number of search terms or combinations used in PubMed
#23 Subjective analyses functional capacity
#24 DASI
#25 Assessment functional capacity
#26 Assessments functional capacity
#27 Evaluation functional capacity
#28 Measurement functional capacity
#29 Analysis functional capacity
#30 Evaluations functional capacity
#31 Measurements functional capacity
#32 Analyses functional capacity
#33 METS
#34 4METS
#35 Self-reported exercise tolerance
#36 OR/14-35
#37 Randomized Controlled Trial (RCT)
#38 Clinical Trial
#39 Randomized Clinical Trial
#40 Randomised Controlled Trial (Ortografia britânica)
#41 Trial
#42Clinical study
#43 Comparative study
#44 Observational study
#45 Cohort study
#46 OR/37-45
#38 AND/13-36-45

Table S2

DUKE ACTIVITY STATUS – Are you able to...	Weight
1. Take care of yourself, i.e., eat, dress, bathe, or use the toilet?	2.75
2. Walk around your house?	1.75
3. Walk one or two blocks on level ground?	2.75
4. Climb a flight of stairs or walk up a hill?	5.50
5. Run a short distance?	8.00
6. Do light housework, such as dusting or washing dishes?	2.70
7. Do moderately heavy housework, such as vacuuming, sweeping floors while carrying grocery bags?	3.50
8. Do heavy housework, such as scrubbing floors, moving heavy furniture?	8.00
9. Do yard work, such as raking leaves, pruning, or mowing the lawn with an electric mower?	4.50
10. Have sexual relations?	5.25
11. Participate in moderate recreational activities such as dancing, doubles tennis, jogging, volleyball, or playing catch (baseball or football)?	6.00
12. Participate in strenuous sports, such as swimming, singles tennis, soccer, basketball, or skiing?	7.50

Tabela S3. GRADE. Strength of Evidence Assessment

N° of studies	Certainty assessment						Effect	Certainty
	Study design	Risk of bias	Inconsistence	Indirectness	Imprecision	Other considerations	Rate (95% CI)	
All-cause mortality								
4	observational study	serious a	very seriousb	not serious	serious b	not applicable	not pooled	Very low[a,b]
Perioperative complications								
10	observational study	seriousb	serious a	Not serious	Not serious	not applicable	not pooled	Low[a,b]

Explanations
a. Most of the information is from studies with a high risk of bias. b. Heterogeneity in effects and methodology. c. Confidence intervals are very wide or not reported.

The assessment of the strength and certainty of evidence in observational studies, according to the GRADE methodology, is subject to a mandatory downgrade due to the high risk of bias that observational studies may present, resulting in an initial rating of low certainty.

For the outcome of mortality, a second GRADE downgrade was applied due to the fragility of the eligible studies with respect to risk of bias, sample size, number of studies, and methodological heterogeneity. This scenario makes it impossible to draw assertive conclusions regarding these outcomes. Given the low confidence in the evidence for the abovementioned outcomes, it is crucial that new studies with high methodological quality and low risk of bias be conducted to provide more robust conclusions for clinical practice.

The outcome of perioperative complications was maintained within the initial GRADE framework, being supported by studies with large sample sizes and fewer methodological limitations. Nevertheless, it remains essential to conduct future research with high methodological rigor to provide stronger evidence regarding this outcome.

Table S4. Summary of Surgical Categories

Authors	Main Surgical Categories
Deo et al.[22]	Orthopaedic, urological, gynaecological, general, vascular (vascular access), laparoscopic, and neurosurgical procedures
Kaw et al.[25]	Does not specify surgical types, only risk (intermediate/high) – not classifiable
Lurati et al.[19]	Orthopaedic, vascular, and thoracic procedures
Lurati et al.[13]	Orthopaedic, vascular, and thoracic procedures
Lurati et al.[18]	Orthopaedic, vascular, thoracic, urological, trauma, visceral (abdominal), and spine procedures
Marsman et al.[23]	General, orthopaedic, vascular, otolaryngological, neurosurgical, and urogenital procedures
Reilly et al.[21]	Oncological, gynaecological, urological, vascular, thoracic, orthopaedic, peritoneal (abdominal), otolaryngological, and neurosurgical procedures
Shan et al.[20]	Unspecified surgical procedures – not classifiable
Tsiouris et al.[27]	Thoracic procedures (detailed: VATS, thoracotomy, lobectomy, etc)
Wijeysundera et al.[12]	Thoracic, abdominal (intra-/retroperitoneal), gynaecological, and urological procedures
Wiklund et al.[24]	Abdominal procedures (including gastrointestinal, cholecystectomy, colostomy, pancreatectomy), orthopaedic, gynaecological, thoracic, urological, neurosurgical, vascular, and otolaryngological procedures

Search Strategy Appendix

SCOPUS

Appendix 1

("Preoperative cardiac risk assessment" OR "Perioperative cardiac risk assessment" OR "Perioperative cardiac risk" OR "Preoperative cardiac risk" OR "Preoperative cardiac risk stratification" OR "Perioperative cardiac risk stratification" OR "Perioperative cardiac risks stratification" OR "Preoperative cardiac risks stratification" OR "Perioperative cardiac risks assessment" OR "Preoperative cardiac risks assessment" OR "Perioperative cardiac risks" OR "Preoperative cardiac risks")

Appendix 2

AND ("Functional capacity assessment" OR "Functional capacity" OR "Subjective assessment functional capacity" OR "Subjective evaluation functional capacity" OR "Subjective measurement functional capacity" OR "Subjective analysis functional capacity" OR "Subjective assessments functional capacity" OR "Subjective evaluations functional capacity" OR "Subjective measurements functional capacity" OR "Subjective analyses functional capacity" OR "Assessment functional capacity" OR "Assessments functional capacity" OR "Evaluation functional capacity" OR "DASI" OR "Measurement functional capacity" OR "Analysis functional capacity" OR "Evaluations functional capacity" OR "Measurements functional capacity" OR "Analyses functional capacity" OR "METS" OR "4METS" OR "Self-reported exercise tolerance" OR status functional)

Appendix 3

AND ("Randomized Controlled Trial" OR "Clinical Trial" OR "Randomized Clinical Trial" OR "Randomised Controlled Trial" OR "Trial" OR "Clinical study" OR "comparative study" OR "Observational study" OR "Cohort study" OR "Case-control study" OR "Cross-sectional study" OR "Prospective study")
NOT (medline)
NOT REVIEWS

SCIENCE DIRECT

Advanced search

Appendix 1

Find articles with these terms

(Preoperative cardiac risk OR Perioperative cardiac risk OR Preoperative cardiac risk assessment OR Perioperative cardiac risk assessment OR Cardiac risk stratification)

Appendix 2

Title, abstract or author-specified keywords

(Functional capacity assessment OR DASI OR Subjective functional capacity OR Self-reported exercise tolerance)

Filtro: Research articles

WEB OF SCIENCE

Appendix 1

("Preoperative cardiac risk assessment" OR "Perioperative cardiac risk assessment" OR "Perioperative cardiac risk" OR "Preoperative cardiac risk" OR "Preoperative cardiac risk stratification" OR "Perioperative cardiac risk stratification" OR "Perioperative cardiac risks stratification" OR "Preoperative cardiac risks stratification" OR "Perioperative cardiac risks assessment" OR "Preoperative cardiac risks assessment" OR "Perioperative cardiac risks" OR "Preoperative cardiac risks")

Appendix 2

AND ("Functional capacity assessment" OR "Functional capacity" OR "Subjective assessment functional capacity" OR "Subjective evaluation functional capacity" OR "Subjective measurement functional capacity" OR "Subjective analysis functional capacity" OR "Subjective assessments functional capacity" OR "Subjective evaluations functional capacity" OR "Subjective measurements functional capacity" OR "Subjective analyses functional capacity" OR "Assessment functional capacity" OR "Assessments functional capacity" OR "Evaluation functional capacity" OR "DASI" OR "Measurement functional capacity" OR "Analysis functional capacity" OR "Evaluations functional capacity" OR "Measurements functional capacity" OR "Analyses functional capacity" OR "METS" OR "4METS" OR "Self-reported exercise tolerance" OR "status functional").

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