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Frailty indexes in perioperative and critical care: A systematic review☆

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ABSTRACT

Background/objectives: Frail patients are increasingly presenting for both perioperative and intensive care, highlighting the need for simple, valid and scaleable frailty measurement. Frailty indexes comprehensively assess a range of deficits in health, and can incorporate routinely collected data. The purpose of this systematic review was to evaluate the effect of frailty indexes on surgical and intensive care risk stratification and patient outcomes (mortality, complications, length of stay, and discharge location).

Methods: A prospectively registered systematic review was performed. MEDLINE, EMBASE, and CINAHL were searched to identify studies enrolling adult surgical or intensive care patients which used a frailty index. Included studies were those published subsequent to 1990, of any study design, which utilised a frailty index consisting of ≥30 health deficits. Primary outcome was mortality; secondary outcomes were complications, length of stay (LOS) and discharge location. Study and frailty index quality were critically appraised by three independent reviewers, with findings narratively described.

Results: 2026 articles were screened, from which nine prospective and four retrospective cohort studies (enrolling 2539 patients) were included. Frailty prevalence ranged between 19–62%; frailty indexes identified patients at risk of increased death [mortality rates ranging between 1.9–73.1%; reported odds ratios (ORs) for death ranging between 1.76–3.09 for frail vs. non-frail patients], surgical complications (ORs = 1.67–4.4), increased LOS, and discharge to residential care (ORs = 1.9–3.64). The term "frailty index" was found to be applied to a number of alternative measurement scales.

Conclusion: Frail patients are at significantly increased risk in critical illness and the perioperative period. Better standardisation of frailty indexes is recommended.

1. Introduction

Growing numbers of older adults will increasingly present for surgical and intensive care unit (ICU) management. During 2015–16 in Australia, a third of both elective surgery and emergency surgery patients were aged over 65 years (Australian Institute of Health & Welfare, 2017). In line with global trends, this age group is projected to double in size to 6.8 million Australians by 2040, with those aged 85 years or over tripling in number (Australian Bureau of Statistics, 2012). Similar increases will be seen in demand for intensive care services for older adults, with significant implications for intensive care provision forecast around the world. This includes Canada (21% of the population aged > 65 years, with an 80% increase in mechanically ventilated patients by 2026) (Needham et al., 2005); Finland (26% of the population aged > 65 years, with a 25% increase in required ICU bed-days by 2030) (Reinikainen, Uusaro, Niskanen, & Ruokonen, 2007); Australia (an increase in ICU bed-days occupied by patients aged > 80 projected to increase from 6% in 1996 to 26% by 2030) (Corke, Leeuw, Lo, & George, 2009); and Norway (a one-third increase in ICU bed-days required by 2025) (Laake et al., 2010).

Frailty, a state of vulnerability resulting from a cumulative decline in many physiological systems over a lifetime, is an increasingly important consideration in these patient cohorts. The two accepted paradigms of frailty are a phenotypic construct (Fried, Tangen, &

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Walston, 2001) and a deficit accumulation model (impairments in health status, Rockwood, Song, & MacKnight, 2005), the sum of which contributes to a multi-dimensional risk state (Fried et al., 2001; Rockwood et al., 2005). Measuring frailty in older adults is increasingly seen as important for risk assessment, as an emerging body of evidence confirms increased perioperative and intensive care morbidity and mortality is conferred by frailty (Bagshaw, Ibrahim, & Majumdar, 2013; Beggs, Sepehri, Szwajcer, Tangri, & Arora, 2015). A recent meta-analysis investigating prognostic factors for harm following elective surgery included over 12,000 patients across 44 studies; frailty and frailty-related factors accounted for almost all the important predictors of adverse outcomes (Watt, Tricco, & Talbot-Hamon, 2018). Frailty in critical illness confers similarly poor outcomes, with a recent Canadian study of 420 patients demonstrating a doubled risk of one year mortality (32% vs. 16%), and increased functional dependence and lower quality of life in survivors (Bagshaw, Stelfox, & Johnson, 2015). Subsequent incorporation of frailty assessment in these populations has been shown to improve prognostication above existing risk stratification tools (Le Maguet, Roquilly, & Lasocki, 2014; Makary, Segev, & Pronovost, 2010; McDermid & Bagshaw, 2014).

The 2010 National Confidential Enquiry into Patient Outcome and Death (NCEPOD) in the UK looked specifically at the population of older adults undergoing surgery, finding that whilst frailty was often considered likely to be present, it was not factored into risk assessment. Two specific recommendations were made: “Comorbidity, disability and frailty need to be clearly recognised and seen as independent markers of risk in the elderly”; and “An agreed means of assessing frailty in the perioperative period should be developed and included in risk assessment” (National Confidential Enquiry into Patient Outcome & Death, 2010). Despite consensus guidelines from major organisations calling for routine surgical frailty assessment (including the American College of Surgeons, the American Geriatrics Society and the Association of Anaesthetists of Great Britain and Ireland), this is not yet incorporated into perioperative care (Chow, Rosenthal, Merkow, Ko, & Esnaola, 2012; Griffiths, Beech, & Brown, 2014). Many unknowns persist, therefore, including the prevalence of frailty in these populations, how frailty intersects with standard risk stratification tools, and how best to quantify it.

Frailty measurement is complicated by significant heterogeneity in measurement tools used, as well as reliance on functional testing, which may be difficult or impossible in ICU or surgical populations. A comprehensive approach to operationalizing frailty, without these disadvantages, involves a deficit index, wherein the number of accumulated health deficits are summed, and divided by the total number of possible deficits (Searle, Mitnitski, Gahbauer, Gill, & Rockwood, 2008). This approach has demonstrated consistency and reproducibility across a range of populations, and more importantly, a range of indexes (Kulminski, Ukraintseva, Akushevich, Arbeev, & Yashin, 2007; Rockwood & Mitnitski, 2007). As long as at least 30 variables encompassing a range of systems associated with health status are included, the same health deficits need not be measured across populations, yet the resultant frailty index scores and rate of deficit accumulation are comparable. This approach also has the potential advantage of incorporating routinely collected patient data, which is then able to be used to automatically generate a frailty index without requiring clinician time or training (Hubbard, Peel, & Samanta, 2015).

Although systematic reviews of frailty measurement tools in both intensive care and surgical patients exist (Beggs et al., 2015; Lin, Watts, Peel, & Hubbard, 2016; Muscedere, Waters, & Varambally, 2017), we have not identified any reviews that have specifically examined frailty index application to perioperative or intensive care. We sought, therefore, to perform a systematic review encompassing any study design involving critically ill and surgical patients that utilised a frailty index comprising at least 30-items for risk stratification, with outcomes including mortality (primary outcome), complications, length of stay, and discharge location.

2. Methods

2.1. Search strategy

A systematic review was conducted of electronic databases including MEDBASE, EMBASE and COCHRANE CENTRAL in January 2018. The search terms used were a combination of both Medical Subject Headings (MeSH) and free text, and is outlined in Appendix A. Conference proceedings and reference lists of obtained articles were not systematically searched. Results were limited to English language studies concerning human subjects published after 1990. The systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta- Analyses (PRISMA) statement (Liberati, Altman, & Tetzlaff, 2009), and the study protocol was prospectively registered with Prospero (http://www.crd.york.ac.uk/PROSPERO/, registration number: CRD42017081336).

2.2. Study selection criteria

Included studies were those of any study design published as a full text (including randomized controlled trials, case series, cohort and cross-sectional studies), incorporating a frailty index in the assessment of surgical or ICU patients. Frailty indexes had to accord with the guidelines published by Searle et al. (2008) (Appendix B). Studies were restricted to English language studies published subsequent to 1990. Participants aged 18 years or older undergoing surgery or admitted to an ICU were included, in studies using a frailty index for risk stratification in surgical or critical care. Primary outcome was mortality, with secondary outcomes including length of stay, surgical or in-ICU complications, and discharge location. Studies were excluded if they included fewer than 30 health deficits, or if included deficits only encompassed one area of health rather than a range of health systems. Eligibility assessment was performed in an unblinded manner by two reviewers (JD and RH). Quality of studies was evaluated with an adapted version of the epidemiological appraisal instrument of Genaidy, Lemasters, and Lockey (2007) (Appendix C), classifying studies as low, medium or high methodological quality. In addition, evaluation of the frailty index employed was conducted using the above guidelines (Appendix D). JD reviewed all included studies, KG and KL reviewed half each such that two reviewers appraised each study. Disparity in study assessment was resolved initially by reaching a consensus score, or if not possible then resolved through adjudication by a third reviewer.

2.3. Data extraction and synthesis

Studies were interrogated for population characteristics studied (including age, type of surgery or ICU admission), exposure and outcome variables (primary outcome mortality, secondary outcomes length of stay, complications and discharge location), frailty index composition (including characteristics of included health deficits), and method of data collection. Because of significant heterogeneity in exposures, outcomes, and frailty index composition, meta-analysis of results was not possible. A narrative synthesis was instead performed.

3. Results

The search strategy yielded 2026 articles. After screening relevant titles and abstracts and excluding duplicates, 76 full text publications were obtained for further assessment. Of these, 63 articles were excluded, due to being editorials or systematic reviews (12 studies), conference proceedings (16 studies), involving a non-surgical or ICU population (three studies), utilising frailty measures that were not true multi-dimensional frailty indexes or containing < 30 variables (29 studies), or utilising a full comprehensive geriatric assessment (three studies). 13 studies in total were thus included, enrolling 2539 patients