**Supplementary Data**

**Table 1:** Prospective studies evaluating associations between frailty and outcomes after general surgery.

|  |  |  |  |
| --- | --- | --- | --- |
| **Author and location** | **Study population** | **Frailty Measure Used** | **Association of Frailty with Surgical Outcome**  |
| \*Robinson et al, 2009(1)USA | 110 patients undergoing major elective colorectal or cardiac surgery. Age group: >65 years; 95% men | Novel point-based risk score combining frailty (cognition, albumin, falls, haematocrit), disability (Katz score) and co-morbidity (Charlson index) | A frailty score of >4 points was associated with higher 6-month mortality. Each component also strongly associated with discharge to institutional care. |
| \*Robinson et al., 2011(2)USA | 223 patients undergoing major elective colorectal or cardiac surgery. Age group: >65 years; 96% men | Novel point-based risk score combining frailty (cognition, albumin, falls, haematocrit, timed-up-and-go), disability (Katz score) and co-morbidity (Charlson index) | A frailty score of >3 points was associated with discharge to institutional care. |
| \*Robinson et al., 2013(3)USA | 201 patients admitted for elective colorectal or cardiac surgery.Age group: >65 years; 98% men | Novel point-based risk score combining frailty (cognition, albumin, falls, haematocrit, timed-up-and-go), disability (Katz score) and co-morbidity (Charlson index) | A frailty score of >4 points was associated with higher incidence of at least 1 post-operative complication. |
| \*Robinson et al., 2013(4)USA | 272 patients admitted for elective colorectal and cardiac surgery.Age group: >65 years; 98% men | Timed-up-and-go test (seconds): fast: <10s, intermediate: 11-14s & slow: >15s | Slower performance was associated with higher incidence of post-operative complications.For colorectal surgery the timed-up-and-go was more able to predict post-operative complications than a standard surgical risk calculator. |
| Hewitt et al., 2014(5)UK | 325 patients admitted to acute surgical units in 3 centres.Age group: >65 years; 43% men | 7-point clinical frailty scale (Rockwood) | Frailty was associated with longer hospital length of stay and higher 30 and 90 day mortality.Re-admission rates did not differ.  |
| Revenig et al., 2013(6)USA | 189 patients undergoing elective inpatient abdominal surgery Age group: >18 years; 59.8% men | Fried-Hopkins Physical Frailty Phenotype | Frailty and pre-frailty was associated with higher incidence of post-operative complications.The ASA grade was not associated with post-operative complications. |
| Kim et al., 2014(7)Republic of Korea | 275 patients undergoing elective intermediate-high risk elective surgery Age group: >65 years; 54.9% men | New multi-dimensional frailty score (MFS) based on: comprehensive geriatric assessment patient characteristics  laboratory values | The MFS was associated with higher mortality at 1 year, higher post-operative complications and institutionalisation on discharge. The MFS was superior to the ASA grade in terms of predicting these outcomes. |
| Joseph et al, 2014(8)USA | 250 patients admitted to a trauma unit as an emergency.Age group: >65 years; 69.2% men | Canadian Study of Health & Aging Frailty Index (FI; 50 item)  | A FI of >0.25 was associated with a higher odds of in-hospital complications and death/ institutionalisation.  |
| Pol et al., 2011(9)The Netherlands | 142 patients admitted for elective vascular surgery. Age group: >18 years; 70% men | The Groningen Frailty Indicator (a 15 item questionnaire assessing mobility, vision, hearing, nutrition, co-morbidity, cognition and physical fitness)  | A frailty score of > 4 points was associated with higher odds of post-operative delirium.  |
| Dale et al., 2014(10)USA | 76 patients referred for elective pancreaticoduodenectomyAge group: >18 years; 55.3% men | Grip strength, slow walking speed, self-reported exhaustion, weight loss, Vulnerable Elders Survey-13 (a function based frailty screening tool), and the Short Physical Performance Battery (a series of objective tests of lower extremity function)  | Only self-reported exhaustion was consistently associated with adverse outcome after surgery, longer hospital stay and intensive care unit admission.The ASA grade was not associated with any of the outcomes considered. |
| Odonkor et al., 2013(11)USA | 602 patients admitted for elective ambulatory surgery. Age group: >18 years; 46% men | 20ft gait speed test (meters/second) | Gait speed was associated with the probability of being ready for discharge home within 90 minutes of surgery. Those with fast (>1.0m/s) gait speed also had a lower probability of unplanned admission following surgery.No association with post-operative complications. |
| Lasithiotakis et al., 2012(12)Crete | 57 patients admitted for elective laparoscopic cholecystectomy.Age group: >65 years; 49.1% men | Comprehensive geriatric assessment(frailty was defined as being ‘unfit’ in 1 or more domains of the assessment). | The probability of post-operative complication was higher in those who were frail vs non-frail (OR 6.0 95% CI 1.2, 30.4). Frail patients also had longer in-patient stay (OR 4.2, 95% CI 1.3, 13.5). The ASA grade was not associated with either outcome measure.  |
| Leung et al., 2011(13)USA | 63 patients undergoing non-cardiac surgery with an anticipated length of stay >48 hours.Age group: >65 years; 46% men | Fried physical frailty phenotype (but used as a continuous score: 0-5) | Higher frailty score was associated with higher odds of post-operative delirium  |

ASA: American Society of Anaesthesiologists classification system; \*same study population

**References**

1. Robinson TN, Eiseman B, Wallace JI, et al. (2009) Redefining geriatric preoperative assessment using frailty, disability and co-morbidity. *Ann. Surg.* **250**, 449–55.

2. Robinson T, Wallace J & Wu D (2011) Accumulated frailty characteristics predict postoperative discharge institutionalization in the geriatric patient. *J. Am. Coll. Surg.* **213**, 37–42.

3. Robinson TN, Wu DS, Pointer L, et al. (2013) Simple frailty score predicts postoperative complications across surgical specialties. *Am. J. Surg.* **206**, 544–50.

4. Robinson TN, Wu DS, Sauaia A, et al. (2013) Slower walking speed forecasts increased postoperative morbidity and 1-year mortality across surgical specialties. *Ann. Surg.* **258**, 582–8; discussion 588–90.

5. Hewitt J, Moug SJ, Middleton M, et al. (2014) Prevalence of frailty and its association with mortality in general surgery. *Am. J. Surg.*, 1–6. Elsevier Inc.

6. Revenig LM, Canter DJ, Taylor MD, et al. (2013) Too frail for surgery? Initial results of a large multidisciplinary prospective study examining preoperative variables predictive of poor surgical outcomes. *J. Am. Coll. Surg.* **217**, 665–670.e1.

7. Kim S, Han H-S, Jung H, et al. (2014) Multidimensional frailty score for the prediction of postoperative mortality risk. *JAMA Surg.* **149**, 633–40.

8. Joseph B, Pandit V, Zangbar B, et al. (2014) Superiority of frailty over age in predicting outcomes among geriatric trauma patients: a prospective analysis. *JAMA Surg.* **149**, 766–72.

9. Pol R a, van Leeuwen BL, Visser L, et al. (2011) Standardised frailty indicator as predictor for postoperative delirium after vascular surgery: a prospective cohort study. *Eur. J. Vasc. Endovasc. Surg.* **42**, 824–30. Elsevier Ltd.

10. Dale W, Hemmerich J, Kamm A, et al. (2014) Geriatric assessment improves prediction of surgical outcomes in older adults undergoing pancreaticoduodenectomy: a prospective cohort study. *Ann. Surg.* **259**, 960–5.

11. Odonkor CA, Schonberger RB, Dai F, et al. (2013) New utility for an old tool: can a simple gait speed test predict ambulatory surgical discharge outcomes? *Am. J. Phys. Med. Rehabil.* **92**, 849–63.

12. Lasithiotakis K, Petrakis J, Venianaki M, et al. (2013) Frailty predicts outcome of elective laparoscopic cholecystectomy in geriatric patients. *Surg. Endosc.* **27**, 1144–50.

13. Leung J, Tsai T & Sands L (2011) Preoperative frailty in older surgical patients is associated with early postoperative delirium. *Anesth. Analg.* **112**, 1199–1201.

**Search Strategy**

PubMed was last searched on 21st November 2014 using the following search strategy:

(((((frailty OR frail OR sarcopenia))) OR (((((walking speed OR gait speed)) OR ((grip strength OR hand strength OR chair rise\* OR chair stand OR postural control OR standing balance))))))) AND (surgery OR peri-operative)