## Supplementary Data

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

<table>
<thead>
<tr>
<th>Author and location</th>
<th>Study population</th>
<th>Frailty Measure Used</th>
<th>Association of Frailty with Surgical Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Robinson et al., 2009</em>(1) USA</td>
<td>110 patients undergoing major elective colorectal or cardiac surgery. Age group: &gt;65 years; 95% men</td>
<td>Novel point-based risk score combining frailty (cognition, albumin, falls, haematocrit), disability (Katz score) and co-morbidity (Charlson index)</td>
<td>A frailty score of ≥4 points was associated with higher 6-month mortality. Each component also strongly associated with discharge to institutional care.</td>
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<tr>
<td><em>Robinson et al., 2011</em>(2) USA</td>
<td>223 patients undergoing major elective colorectal or cardiac surgery. Age group: &gt;65 years; 96% men</td>
<td>Novel point-based risk score combining frailty (cognition, albumin, falls, haematocrit, timed-up-and-go), disability (Katz score) and co-morbidity (Charlson index)</td>
<td>A frailty score of ≥3 points was associated with discharge to institutional care.</td>
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<tr>
<td><em>Robinson et al., 2013</em>(3) USA</td>
<td>201 patients admitted for elective colorectal or cardiac surgery. Age group: &gt;65 years; 98% men</td>
<td>Novel point-based risk score combining frailty (cognition, albumin, falls, haematocrit, timed-up-and-go), disability (Katz score) and co-morbidity (Charlson index)</td>
<td>A frailty score of ≥4 points was associated with higher incidence of at least 1 post-operative complication.</td>
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<tr>
<td><em>Robinson et al., 2013</em>(4) USA</td>
<td>272 patients admitted for elective colorectal and cardiac surgery. Age group: &gt;65 years; 98% men</td>
<td>Timed-up-and-go test (seconds): fast: &lt;10s, intermediate: 11-14s &amp; slow: ≥15s</td>
<td>Slower performance was associated with higher incidence of post-operative complications.</td>
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<td>Hewitt et al., 2014*(5) UK</td>
<td>325 patients admitted to acute surgical units in 3 centres. Age group: &gt;65 years; 98% men</td>
<td>7-point clinical frailty scale (Rockwood)</td>
<td>For colorectal surgery the timed-up-and-go was more able to predict post-operative complications than a standard surgical risk calculator. Frailty was associated with longer hospital length of stay and higher 30 and 90 day mortality.</td>
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<tr>
<td>Revenig et al., 2013*(6) USA</td>
<td>189 patients undergoing elective inpatient abdominal surgery. Age group: &gt;65 years; 43% men</td>
<td>Fried-Hopkins Physical Frailty Phenotype</td>
<td>Re-admission rates did not differ. Frailty and pre-fraility was associated with higher incidence of post-operative complications.</td>
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<tr>
<td>Kim et al., 2014*(7) Republic of Korea</td>
<td>275 patients undergoing elective intermediate-high risk elective surgery. Age group: ≥18 years; 59.8% men</td>
<td>New multi-dimensional frailty score (MFS) based on: comprehensive geriatric assessment</td>
<td>The ASA grade was not associated with post-operative complications. The MFS was associated with higher mortality at 1 year, higher post-operative complications and institutionalisation on discharge.</td>
</tr>
</tbody>
</table>
Age group: \( \geq 65 \) years; 54.9% men  

Patient characteristics  

Laboratory values  

The MFS was superior to the ASA grade in terms of predicting these outcomes. A FI of \( \geq 0.25 \) was associated with a higher odds of in-hospital complications and death/ institutionalisation.

Joseph et al., 2014\(^{(8)}\)  
250 patients admitted to a trauma unit as an emergency.  
Canadian Study of Health & Aging Frailty Index (FI; 50 item)  

The Groningen Frailty Indicator (a 15 item questionnaire assessing mobility, vision, hearing, nutrition, co-morbidity, cognition and physical fitness)  

A frailty score of \( \geq 4 \) points was associated with higher odds of post-operative delirium.

USA  

Pol et al., 2011\(^{(9)}\)  
142 patients admitted for elective vascular surgery.  

The Groningen Frailty Indicator (a 15 item questionnaire assessing mobility, vision, hearing, nutrition, co-morbidity, cognition and physical fitness)  

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.

The Netherlands  

Dale et al., 2014\(^{(10)}\)  
76 patients referred for elective pancreaticoduodenectomy  

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)  

The ASA grade was not associated with either outcome measure.  

USA  

Odonkor et al., 2013\(^{(11)}\)  
602 patients admitted for elective ambulatory surgery.  

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 (\( \geq 1.0 \) m/s) gait speed also had a lower probability of unplanned admission following surgery.  

No association with post-operative complications. 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).

USA  

Lasithiotakis et al., 2012\(^{(12)}\)  
57 patients admitted for elective laparoscopic cholecystectomy.  

Comprehensive geriatric assessment (frailty was defined as being ‘unfit’ in 1 or more domains of the assessment).  

The ASA grade was not associated with either outcome measure.

Crete  

Leung et al., 2011\(^{(13)}\)  
63 patients undergoing non-cardiac surgery with an anticipated length of stay \( \geq 48 \) hours.  

Fried physical frailty phenotype (but used as a continuous score: 0-5)  

Higher frailty score was associated with higher odds of post-operative delirium.

USA  

ASA: American Society of Anaesthesiologists classification system;  

*same study population
References


**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)