**Frailty Index and its association with the onset of postoperative delirium in older adults undergoing elective surgery – the PAWEL Study.**

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**Additional files**

**Additional figure 1: Study population.**

Study population (FI 30 items)

n = 701

PAWEL-R study population

n = 899

n = 198 participants with missing data for variables considered in the 30-items FI

Sub-population for secondary analysis including functional measurements (FI 32 items)

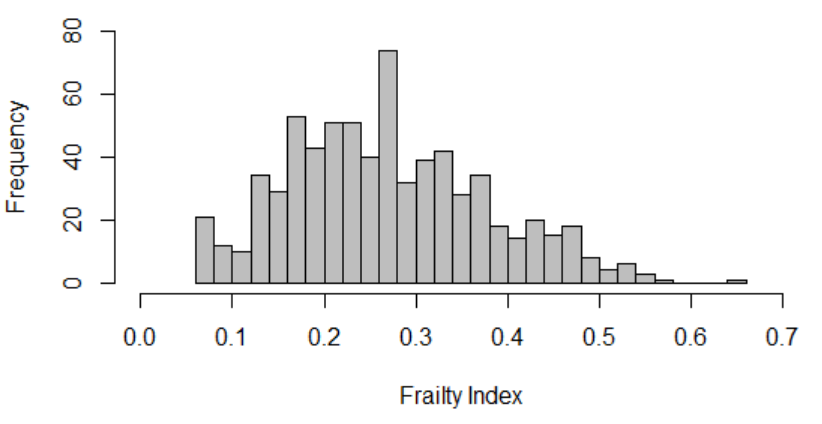
n = 517

n =184 participants with missing data for functional measurements

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| **Additional table 1.** Missing data for the frailty index variables, n (%) | | | | |
|  |  | **Study sample**  **n=899** | **Cardiac**  **n=337** | **Orthopedic/others**  **n=562** |
| **Item** | **Variable** |  |  |  |
|  | **Social situation** |  |  |  |
| 1 | Living alone | 0 (0.0) | 0 (0.0) | 0 (0.0) |
|  | **Physical function** |  |  |  |
| 2 | Falls in last 3 months | 1 (0.11) | 0 (0.0) | 1 (0.18) |
| 3 | Mobility (MNA) | 20 (2.22) | 2 (0.59) | 18 (3.20) |
|  | **Sensory test** |  |  |  |
| 4 | Visual acuity test | 42 (4.67) | 7 (2.08) | 35 (6.23) |
| 5 | Whisper test | 16 (1.78) | 2 (0.59) | 14 (2.49) |
|  | **Comorbidities – case history** |  |  |  |
| 6 | Arterial hypertension | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| 7 | Cardiovascular (MI, heart failure, circulatory disorder in feet, arrhythmia, stroke, cerebral hemorrhage, hemiplegic) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| 8 | Neurological (M. Parkinson, seizures) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| 9 | Chronic lung disease | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| 10 | Dementia | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| 11 | Gastrointestinal ulcer | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| 12 | Osteoarthritis | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| 13 | Urinary incontinence | 19 (2.11) | 3 (0.89) | 16 (2.85) |
| 14 | Tumor | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| 15 | Diabetes mellitus | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| 16 | Liver disease | 0 (0.0) | 0 (0.0) | 0 (0.0) |
|  | **Self-estimated health/emotions** |  |  |  |
| 17 | Subjective memory impairment | 21 (2.33) | 5 (1.48) | 16 (2.85) |
| 18 | General health (SF-12) | 26 (2.89) | 5 (1.48) | 21 (3.74) |
| 19 | Moderate activities (SF-12) | 26 (2.89) | 5 (1.48) | 21 (3.74) |
| 20 | Climbing several flights of stairs (SF-12) | 26 (2.89) | 5 (1.48) | 21 (3.74) |
| 21 | Interference by pain (SF-12) | 28 (3.11) | 5 (1.48) | 23 (4.09) |
| 22 | A lot of energy (SF-12) | 36 (4.00) | 5 (1.48) | 31 (5.52) |
| 23 | Downhearted and blue (SF-12) | 42 (4.67) | 5 (1.48) | 37 (6.58) |
| 24 | Interference with social contacts (SF-12) | 33 (3.67) | 5 (1.48) | 28 (4.98) |
|  | **Measurements** |  |  |  |
| 25 | Weight loss during the last 3 months (MNA) | 62 (6.90) | 7 (2.08) | 55 (9.79) |
| 26 | GFR (ml/min//1.73m2) | 19 (2.11) | 3 (0.89) | 16 (2.85) |
| 27 | BMI (kg/m2) | 3 (0.33) | 1 (0.30) | 2 (0.36) |
| 28 | Anemia | 17 (1.89) | 4 (1.19) | 13 (2.31) |
| 29 | Polypharmacy | 28 (3.11) | 6 (1.78) | 22 (3.91) |
| 30 | Barthel Index | 22 (2.45) | 3 (0.89) | 19 (3.38) |
|  | Total missing (30\*899=26970, cardiac 30\*337=10110; 30\*562=16860) | 487 (1.8) | 78 (0.77) | 409 (2.42) |

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| Additional table 2: Participant’s characteristics differentiated by type of surgery. | | | | | |
|  | |  | Total  (n=701) | **Type of surgery** | |
|  | Cardiac  (n=296) | Orthopedic/others  (n=405) |
| Delirium, n (%) | |  | 165 (23.5) | 108 (36.5) | 57 (14.1) |
| Age (years), mean (SD) | |  | 77.1 (4.7) | 76.4 (4.6) | 77.5 (4.8) |
| Male, n (%) | |  | 367 (52.4) | 203 (68.6) | 164 (40.5) |
| Education >10 years, n (%) | |  | 139 (19.8) | 61 (20.6) | 78 (19.3) |
| Alcohol score, median (Q1|Q3) | |  | 0.34 (0.12|0.69) | 0.39 (0.12|0.85) | 0.34 (0.12|0.60) |
| Living alone, n (%) | |  | 193 (27.5) | 64 (21.6) | 129 (31.9) |
| Fall in last 3 months, n (%) | |  | 106 (15.1) | 29 (9.8) | 77 (19.0) |
| Mobility (MNA) | Goes out |  | 638 (91.0) | 284 (95.9) | 354 (87.4) |
| Gets out of bed/ chair, does not get out |  | 57 (8.1) | 11 (3.7) | 46 (11.4) |
| Bed or chair bound |  | 6 (0.9) | 1 (0.3) | 5 (1.2) |
| Comorbidities, n (%) | Dementia |  | 11 (1.6) | 0 (0.0) | 11 (2.7) |
| Tumor |  | 162 (23.1) | 51 (17.2) | 111 (27.4) |
| Urinary incontinence | None | 633 (90.3) | 282 (95.3) | 351 (86.7) |
|  | Occasional | 60 (8.6) | 10 (3.4) | 50 (12.3) |
|  | Incontinent | 8 (1.1) | 4 (1.4) | 4 (1.0) |
| Hypertension |  | 533 (76.0) | 242 (81.8) | 291 (71.9) |
| CVD |  | 441 (62.9) | 226 (76.4) | 215 (53.1) |
| Chronic lung disease |  | 80 (11.4) | 35 (11.8) | 45 (11.1) |
| GI ulcer |  | 67 (9.6) | 25 (8.4) | 42 (10.4) |
| Osteoarthritis | Mono | 281 (40.1) | 80 (27.0) | 201 (49.6) |
| Poly | 122 (17.4) | 36 (12.2) | 86 (21.2) |
| Diabetes | No EOD | 139 (19.8) | 63 (21.3) | 76 (18.8) |
| With EOD | 27 (3.8) | 15 (5.1) | 12 (2.9) |
| Liver disease | Light | 40 (5.7) | 13 (4.4) | 27 (6.7) |
| Moderate to severe | 16 (2.3) | 5 (1.7) | 11 (2.7) |
| Sensory deficits, n (%) | Visual |  | 140 (20.0) | 51 (17.2) | 89 (22.0) |
| Whisper Test | Only one side correct | 135 (19.3) | 41 (13.9) | 94 (23.2) |
|  |  | None correct | 157 (22.4) | 62 (20.9) | 95 (23.5) |
| Weight loss, n (%) | 1 to 3 kg |  | 133 (19.0) | 63 (21.3) | 70 (17.3) |
| >3kg |  | 140 (20.0) | 56 (18.9) | 84 (20.7) |
| GFR (ml/min/1.73m2), median (Q1|Q3) | |  | 71.8 (57.2|85.0) | 71.3 (56.8|83.3) | 72.3 (57.8|85.8) |
| BMI (kg/m²), median (Q1|Q3) | |  | 26.8 (24.0|29.9) | 26.9 (24.1|29.7) | 26.7 (24.1|30.0) |
| Anemia b, n (%) | Female |  | 72 (21.6) | 25 (26.9) | 47 (19.5) |
| Male |  | 114 (31.1) | 60 (29.6) | 54 (32.9) |
| Polypharmacy, n (%) | |  | 467 (66.6) | 213 (72.0) | 254 (62.7) |
| Barthel Index (points), n (%) | ≥85 |  | 636 (90.7) | 288 (97.3) | 348 (85.9) |
| 35 to 80 |  | 56 (8.0) | 8 (2.7) | 48 (11.9) |
| 0 to 30 |  | 9 (1.3) | 0 (0.0) | 9 (2.2) |
| Subjective memory impairment,  n (%) | |  | 344 (49.1) | 137 (46.3) | 207 (51.1) |
| General health (SF-12) | Excellent to good |  | 453 (64.6) | 221 (74.7) | 232 (57.3) |
| Fair |  | 208 (29.7) | 58 (19.6) | 150 (37.0) |
| Poor |  | 40 (5.7) | 17 (5.7) | 23 (5.7) |
| TUG (sec), median (Q1|Q3) (n = 555) | |  | 12.0 (9.0|16.0) | 10.0 (8.1|12.7) | 13.0 (10.0|19.0) |
| Hand grip strength, median (Q1|Q3) | Female (n = 299) |  | 21.0 (18.0|25.0) | 22.0 (18.0|26.0) | 21.0 (17.0|25.0) |
| Male (n = 334) |  | 36.0 (30.0|42.0) | 36.0 (30.0|42.0) | 34.3 (28.0|40.7) |
| Length of stay (days), median (min, q1, q3, max) | |  | 9  (2,8,12,74) | 9  (3,8,12,57) | 10  (2,8,12,74) |
| MNA = Mini nutritional assessment; CVD = cardiovascular disease; GI = gastrointestinal, EOD = end organ damage; Auditory = both sides incorrect; GFR = glomerular filtration rate; BMI = body mass index; Polypharmacy = ≥ 5 long-term medications; SF-12 = Short form 12; TUG = time-up-and-go-test  a alcohol score = 0.05\*(beer amount) + 0.12\*(wine amount) + 0.4\*(spirits amount)  b anemia: male haemoglobin <13 g/dl; female <12g/dl  c [https://kcgeriatrie.de/Assessments\_in\_der\_Geriatrie/Seiten/Bereich\_-\_Selbstversorgung.aspx](https://deref-web-02.de/mail/client/V52PiE3oWwQ/dereferrer/?redirectUrl=https%3A%2F%2Fkcgeriatrie.de%2FAssessments_in_der_Geriatrie%2FSeiten%2FBereich_-_Selbstversorgung.aspx) | | | | | |

**Additional figure 2:** Distribution of frailty index (N=701).

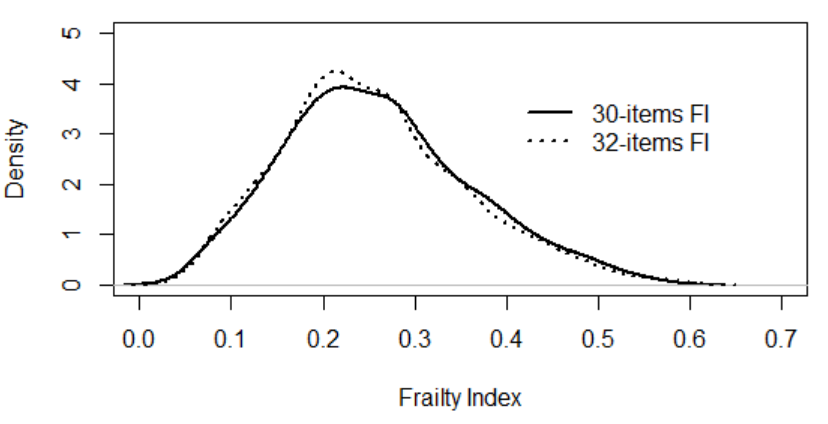


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| **Additional table 3:** Contributing factors to the frailty index separated by surgery type and sorted by percentages (i.e. proportion of subjects with 0.5 points in each variable of the frailty index) in descending order. | | | |
| **Type of surgery** | | | |
| **Cardiac** | | **Orthopedic/others** | |
| **%** | **Frailty index variables sorted by frequencies in descending order** | | **%** |
| 81.8 | Arterial hypertension | Climbing several flights of stairs (SF-12) | 80.0 |
| 76.4 | Cardiovascular disease | Moderate activities (SF-12) | 74.1 |
| 72.0 | Polypharmacy | Interference by pain (SF-12) | 72.6 |
| 67.2 | Climbing several flights of stairs (SF-12) | Arterial hypertension | 71.9 |
| 56.4 | A lot of energy (SF-12) | Osteoarthritis | 70.9 |
| 48.3 | Moderate activities (SF-12) | Polypharmacy | 62.7 |
| 46.3 | Subjective memory impairment | A lot of energy (SF-12) | 60.5 |
| 40.2 | Weight loss during the last 3 months (MNA) | Cardiovascular disease | 53.1 |
| 39.2 | Osteoarthritis | Subjective memory impairment | 51.1 |
| 34.8 | Whisper test | Whisper test | 46.7 |
| 32.4 | Interference by pain (SF-12) | General health (SF-12) | 42.7 |
| 30.4 | GFR (ml/min/1.73m2) | Interference with social contacts (SF-12) | 38.5 |
| 28.7 | Anemia | Downhearted and blue (SF-12) | 38.3 |
| 27.7 | Downhearted and blue (SF-12) | Weight loss during the last 3 months (MNA) | 38.0 |
| 26.4 | Diabetes mellitus | Living alone | 31.9 |
| 25.3 | General health (SF-12) | Tumor | 27.4 |
| 24.0 | BMI (kg/m2) | GFR (ml/min/1.73m2) | 27.2 |
| 21.6 | Living alone | BMI (kg/m2) | 26.2 |
| 17.9 | Interference with social contacts (SF-12) | Anemia | 24.9 |
| 17.2 | Visual acuity test | Visual acuity test | 22.0 |
| 17.2 | Tumor | Diabetes mellitus | 21.7 |
| 11.8 | Chronic lung disease | Falls in last 3 months | 19.0 |
| 9.8 | Falls in last 3 months | Barthel Index | 14.1 |
| 8.5 | Gastrointestinal ulcer | Urinary incontinence | 13.3 |
| 6.1 | Liver disease | Mobility (MNA) | 12.6 |
| 4.7 | Urinary incontinence | Chronic lung disease | 11.1 |
| 4.1 | Mobility (MNA) | Gastrointestinal ulcer | 10.4 |
| 4.1 | Neurological disease (Parkinson) | Liver disease | 9.4 |
| 2.7 | Barthel Index | Dementia | 2.7 |
| 0.0 | Dementia | Neurological disease (Parkinson) | 2.5 |

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| **Additional table 4.** Logistic regression for the association between frailty and POD after exclusion of those with a length of stay < 7 days and missing information on POD at 2-months follow-up (n=672). | | | | | | | | |
|  | | incident delirium/n (%) | | Model 1a | | | Model 2b | |
|  | | OR [95% CI] | | c-statistic | OR [95% CI] | c-statistic |
| Frailty (categorical) (FI ≥0.2) | frail: 134/510 (26.3%) | | 1.64 [1.05, 2.58] | | 0.600 | | 2.16 [1.34, 3.49] | 0.712 |
| Frailty Index continuous (increase of 0.1) | 165/672 (24.6%) | | 1.32 [1.11, 1.56] | | 0.615 | | 1.60 [1.32, 1.94] | 0.729 |
| OR-odds ratio; CI-confidence interval  a adjusted for age and sex  b adjusted for age, sex, education, smoking, alcohol-score and type of surgery | | | | | | | | |

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| **Additional Table 5:** Participants’s characteristics of the study population (n=701) vs. sub-population (n=517). | | |
|  | Study population  (n=701) | Sub-sample for secondary analysis  (n=517) |
| Age (years), mean (SD) | 77.1 (4.7) | 76.6 (4.6) |
| Male, n (%) | 367 (52.4) | 285 (55.1) |
| Cardiac surgery, n (%) | 296 (42.2) | 258 (49.9) |
| Orthopedic surgery, n (%) | 405 (57.8) | 259 (50.1) |
| Polypharmacy\*, n (%) | 467 (66.6) | 328 (63.4) |
| Fall in the last 3 months, n (%) | 106 (15.1) | 55 (10.6) |
| Delirium, n (%) | 165 (23.5) | 125 (24.2) |
| \*Polypharmacy: ≥ 5 long-term medications | | |

**Additional figure 3:** Distribution of frailty index comparing 30- and 32-items frailty index in sub-population (n=517).



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| Additional table 6: Characteristics of study population and excluded population. | | | | | | |
|  | |  | | Study population  (n=701) | Excluded population | |
|  | |  | | (n=198) | Missings (n) |
| Delirium, n (%) | |  | | 165 (23.5) | 44 (22.2) | 0 |
| Age (years), mean (SD) | |  | | 77.1 (4.7) | 78.2 (5.2) | 0 |
| Male, n (%) | |  | | 367 (52.4) | 88 (44.4) | 0 |
| Education >10 years, n (%) | |  | | 139 (19.8) | 32 (16.3) | 2 |
| Alcohol score, median (Q1|Q3) | |  | | 0.34 (0.12|0.69) | 0.36 (0.12|0.62) | 7 |
| Living alone, n (%) | |  | | 193 (27.5) | 71 (35.9) | 0 |
| Fall in last 3 months, n (%) | |  | | 106 (15.1) | 47 (23.9) | 1 |
| Mobility (MNA), n (%) | Goes out | |  | 638 (91.0) | 152 (85.4) | 20 |
| Gets out of bed/ chair, does not go out | |  | 57 (8.1) | 20 (11.2) |
| Bed or chair bound | |  | 6 (0.9) | 6 (3.4) |
| Comorbidities, n (%) | Dementia | |  | 11 (1.6) | 3 (1.5) | 0 |
| Tumor | |  | 162 (23.1) | 42 (21.2) | 0 |
| Urinary incontinence | | None | 633 (90.3) | 155 (86.6) | 19 |
|  | | Occasional | 60 (8.6) | 19 (10.6) |
|  | | Incontinent | 8 (1.1) | 5 (2.8) |
| Hypertension | |  | 533 (76.0) | 135 (68.2) | 0 |
| CVD | |  | 441 (62.9) | 111 (56.1) | 0 |
| Chronic lung disease | |  | 80 (11.4) | 26 (13.1) | 0 |
| GI ulcer | |  | 67 (9.6) | 16 (8.1) | 0 |
| Osteoarthritis | | Mono | 281 (40.1) | 84 (42.4) | 0 |
| Poly | 122 (17.4) | 30 (15.2) |
| Diabetes | | No EOD | 139 (19.8) | 31 (15.7) | 0 |
| With EOD | 27 (3.8) | 9 (4.5) |
| Liver disease | | Light | 40 (5.7) | 6 (3.0) | 0 |
| Moderate to severe | 16 (2.3) | 1 (0.5) |
| Sensory deficits, n (%) | Visual | |  | 140 (20.0) | 45 (28.8) | 42 |
| Whisper Test | | Only one side correct | 135 (19.3) | 51 (28.0) | 16 |
|  |  | | None correct | 157 (22.4) | 43 (23.6) |
| Weight loss, n (%) | 1 to 3 kg | |  | 133 (19) | 21 (15.4) | 62 |
| >3kg | |  | 140 (20.0) | 26 (19.1) |
| GFR (ml/min//1.73m2), median (Q1|Q3) | |  | | 71.8 (57.2|85.0) | 69.9 (55.2|82.7) | 19 |
| BMI (kg/m²), median (Q1|Q3) | |  | | 26.8 (24.1|29.9) | 26.1 (23.9|29.7) | 3 |
| Anemia b, n (%) | Female | |  | 72 (21.6) | 28 (27.5) | 8 |
| Male | |  | 114 (31.1) | 16 (20.3) | 9 |
| Polypharmacy, n (%) | |  | | 467 (66.6) | 111 (65.3) | 28 |
| Barthel Index (points), n (%) | ≥85 | |  | 636 (90.7) | 143 (81.3) | 22 |
| 35 to 80 | |  | 56 (8.0) | 23 (13.1) |
| 0 to 30 | |  | 9 (1.3) | 10 (5.7) |
| Subjective memory impairment, n (%) | |  | | 344 (49.1) | 88 (49.7) | 21 |
| General health (SF-12) | Excellent to good | |  | 453 (64.6) | 94 (54.7) | 26 |
| Fair | |  | 208 (29.7) | 65 (37.8) |
| Poor | |  | 40 (5.7) | 13 (7.6) |
| TUG (sec), median (Q1|Q3) (n = 555) | |  | | 12.0 (9.0|16.0) | 12.6 (8.9|17.7) | 73 |
| Hand grip strength, median (Q1|Q3) | Female (n = 299) | |  | 21.0 (18.0|25.0) | 20.0 (17.0|26.0) | 33 |
| Male (n = 334) | |  | 36.0 (30.0|42.0) | 36.0 (28.3|45.0) | 20 |
| MNA = Mini nutritional assessment; CVD = cardiovascular disease; GI = gastrointestinal, EOD = end organ damage; Auditory = both sides incorrect; GFR = glomerular filtration rate; BMI = body mass index; Polypharmacy = ≥ 5 long-term medications; SF-12 = Short form 12; TUG = time-up-and-go-test  a alcohol score = 0.05\*(beer amount) + 0.12\*(wine amount) + 0.4\*(spirits amount)  b anemia: male haemoglobin <13 g/dl; female <12g/dl  c [https://kcgeriatrie.de/Assessments\_in\_der\_Geriatrie/Seiten/Bereich\_-\_Selbstversorgung.aspx](https://deref-web-02.de/mail/client/V52PiE3oWwQ/dereferrer/?redirectUrl=https%3A%2F%2Fkcgeriatrie.de%2FAssessments_in_der_Geriatrie%2FSeiten%2FBereich_-_Selbstversorgung.aspx) | | | | | | |