**Supplementary Table 1. The formula of four comorbidity indexes**

|  |  |  |
| --- | --- | --- |
| **Index** | **Number of conditions** | **Formula** |
| **Dartmouth-Manitoba's CCI (range 0–33)** | **17** | **6 × (metastatic solid tumor + acquired immune deficiency syndrome)****+3 × (severe or moderate liver disease)****+2 × (hemiplegia + renal disease + diabetes with chronic complications + any malignancy, including leukemia and lymphoma)** **+1 × (myocardial infarction + congestive heart failure + peripheral vascular disease + cerebrovascular disease + dementia + chronic obstructive pulmonary disease + connective tissue disease + ulcer + mild liver disease + diabetes, mild to moderate)** |
| **Elixhauser point system****(range -19 to 89)** | **30** | **12 × metastatic cancer****+11 × liver disease****+9 × lymphoma****+7 × (congestive heart failure + paralysis)****+6 × (weight loss + other neurological disorder)****+5 × (cardiac arrhythmias + renal failure + fluid or electrolyte disorder)****+4 × (pulmonary circulation disorder + solid tumor without metastasis)****+3 × (chronic pulmonary disease + coagulopathy)****+2 × peripheral vascular disease****+0 × (acquired immune deficiency syndrome + alcohol abuse + diabetes, complicated + diabetes, uncomplicated + hypertension + hypothyroidism + peptic ulcer disease + psychoses + RA/collagen vascular disease)****- 1 × valvular disease** **- 2 × (blood loss anemia + deficiency anemia)** **- 3 × depression** **- 4 × obesity** **- 7 × drug abuse** |
| **Counted MMI****(range 1–12)** | **12** | **1 × (hypertension + obesity + depression + cancer + diabetes mellitus + asthma + coronary heart disease + viral hepatitis + chronic obstructive pulmonary disease + chronic kidney disease + diverticulitis + stroke)** |
| **RDCI (range 0–9)** | **11** | **2 × lung disease + [2 × (heart attack, other cardiovascular disease, or stroke) or 1 × hypertension] + fracture + depression + diabetes + cancer + (ulcer or stomach problem)** |

**Supplementary Table 2. Comparison of the different comorbidity indexes**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **CDI** | **ECI** | **MMI** | **RDCI** |
| **Number of diseases** | **19** | **30** | **40** | **11** |
| **Original outcome** | **One-year mortality** | **Hospital stay, cost, and mortality** | **Quality of life** | **Mortality, hospitalization, disability, and costs** |
| **Unique disease** | **Dementia** | **Alcohol related disease, obesity, and thyroid disorders** | **Blindness, dementia, alcohol related disease, obesity, and thyroid disorders** | **Fracture** |
| **Common disease** | **Lung disease, stroke, cancer, heart failure, diabetes, coronary heart disease** |
| **Number of papers about rheumatoid arthritis before 2018** | **Numerous** | **2** | **1** | **2** |
| **Dementia** | **O** | **X** | **O** | **X** |
| **Epilepsy** | **X** | **O** | **O** | **X** |
| **Liver disease** | **O** | **O** | **O** | **X** |
| **Lung disease** | **O** | **O** | **O** | **O** |
| **Blindness** | **X** | **X** | **O** | **X** |
| **Renal disease** | **O** | **O** | **O** | **X** |
| **Substance/alcohol use** | **X** | **O** | **O** | **X** |
| **Depression** | **X** | **O** | **O** | **O** |
| **Heart failure** | **O** | **O** | **O** | **O** |
| **Obesity** | **X** | **O** | **O** | **X** |
| **Thyroid disorder** | **X** | **O** | **O** | **X** |
| **Stroke** | **O** | **O** | **O** | **O** |
| **Cancer** | **O** | **O** | **O** | **O** |
| **Diabetes**  | **O** | **O** | **O** | **O** |
| **Connective tissue disease** | **O** | **O** | **X** | **X** |

O Comorbidity which is included in the comorbidity index

X Comorbidity which is not included in the comorbidity index

**Supplementary Table 3. Comparison of comorbidity indexes in patients with rheumatoid arthritis**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Author, year of publication (Ref) | Country | Study design | No. of RA patients | Comorbidity index | Summary of the study |
| England et al., 2015 (20) | USVeterans Affairs RheumatoidArthritis (VARA) registry and the Rheumatology andArthritis Investigator’s Network Database (RAIN-DB) | Cohort | 4765 | RDCI,CDI, FCI, ETS, EPS, and COUNT | ETS and RDCI best predicted death. The FCI best predicted function |
| Radner et al., 2015 (18) | USBrigham and Women’s Rheu- matoid Arthritis Sequential Study(BRASS) and COMOrbidities in Rheumatoid Arthritis Study(COMORA) | Cohort | 876 | MMI.count, MMI.weight, MMI.weight using beta-coefficients, CCI, and FCI | MMI based on EQ-5D performed better than CCI. Not much improvement was obtained by weighting.  |
| Putrik et al., 2018 (25) | NorwayNorwegian Register-DMARD study (patients with inflammatory joint diseases treated with DMARDs) | Cohort  | 4126 | RDCI, CDI, FCI | Three indexes performed comparably well. CDI performing slightly worse when predicting functioning and health. |
| Nikiphorou et al., 2019 (26) | UKThe Royal College of General Practitioners (RCGP) Research and Surveillance Centre (RSC) database | Cohort | 6591 | CCI, RDCI | In early RA, both the RDCI and CCI were associated with an increased risk of all-cause mortality. RDCI predicts all-cause mortality better than CCI.  |
| England et al., 2021(27) | USCommercial insurance database(MarketScan) | Cohort | 138891 | CCI, RDCI | CCI and RDCI showed a higher burden of multimorbidity in RA. Similar findings were obtained when requiring ≥1 year of follow-up after RA diagnosis. |

Abbreviations: Rheumatic Disease Comorbidity Index (RDCI) with the Charlson-Deyo Index (CDI), functional comorbidity index (FCI), Elixhauser Total Score (ETS), Elixhauser Point System (EPS), simple comorbidity count (COUNT), counted multimorbidity index (MMI.count), weighted multimorbidity index (MMI.weight), MMI.weight using beta-coefficients (weighted multimorbidity index using beta-coefficients), Charlson comorbidity index (CCI)

**Supplementary Figure 1. The impact of comorbidity on disease-specific survival showed in weighted Kaplan-Meire curve. (a) Charlson Comorbidity Index. (b) Elixhauser Comorbidity Index. (c) Multimorbidity Index. (d) Rheumatic Disease Comorbidity Index. (All log-rank test’s p-values <0.001)**

**a**



**b**



**c**



**d**

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\*The comorbidity indexes are calculated during the diagnostic period (the period of 4 months before and after the initial diagnosis)

**Supplementary Figure 2. Receiver Operating Characteristic (ROC) Curve for Prediction of (a) 1-year Mortality and (b) 5-year Mortality by Four Comorbidity Indexes.**

**a**

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**b**

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