

Supplementary Materials

England BR et al. Burden and Trajectory of Multimorbidity in Rheumatoid Arthritis: A Matched Cohort Study from 2006-2015

Table S1. Diagnostic codes used for identification of chronic conditions.

Table S2. Prevalence of chronic conditions at baseline in RA vs. non-RA.

Figure S1. Skewness and residuals from generalized estimating equations models specifying a Gaussian or negative binomial distribution of multimorbidity burden.

Histograms and measures of skewness for generalized estimating equations models of multimorbidity trajectory specifying a Gaussian (panel A) or negative binomial (panel B) distribution.

Figure S2. Mean number of chronic conditions observed over time in RA and non-RA.

Observed (raw) mean number of chronic conditions over follow-up in RA and non-RA as well as the number of patients at each time point.

Figure S3. Predicted burden of multimorbidity in incident rheumatoid arthritis compared to non-rheumatoid arthritis patients after diagnosis in sensitivity analyses.

Predicted burden of chronic conditions from generalized estimating equation models comparing rheumatoid arthritis and non-rheumatoid arthritis patients. Shown are the coefficients for the number of chronic conditions in RA vs. non-RA and the interaction term between RA status and follow-up time (years) from generalized estimating equations models. Panel A, primary approach requiring 1 year in the dataset without RA diagnostic codes or medications. Panel B, requiring at least 1 year of follow-up after the index date. Panel C, censoring the pair for drop out by either of the matched RA or non-RA patients. Panel D, requiring 2 years in the dataset without RA diagnostic codes or medications. Panel E, only requiring at least 1 diagnostic code

for a condition to be present. Panel F, adjusting for baseline number of chronic conditions.

Panel G, removing silent chronic conditions (hypertension, hyperlipidemia, diabetes mellitus, hypothyroid, osteoporosis, and anemia).

Supplementary Table 1. Diagnostic codes used for identification of chronic conditions.	
Condition	ICD-9-CM Codes
Congestive heart failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 425.4-425.9, 428.x
Peripheral vascular disease / aneurysm	093.0, 437.3, 440.x, 441.x, 443.1-443.9, 447.1, 557.1, 557.9, V43.4
Cardiac arrhythmias	426.0, 426.13, 426.7, 426.9, 426.10, 426.12, 427.0-427.4, 427.6-427.9, 785.0, 996.01, 996.04, V45.0, V53.3
Pulmonary circulation disorders	415.0, 415.1, 416.x, 417.0, 417.8, 417.9
Hypertension	401.x, 402.x-405.x
Valvular heart disease	093.2, 394.x-397.x, 424.x, 746.3-746.6, V42.2, V43.3
Coronary artery disease	410.x-414.x, 429.7, V45.81, V45.82
Asthma	493.x (excluding 493.81)
Chronic obstructive pulmonary disease	491.x-492.x, 496.x
Interstitial lung disease	515.x, 516.3, 516.8-516.9, 714.8
Cerebrovascular disease	362.34, 430.x-438.x
Dementia	290.x, 294.1, 331.2
Severe vision reduction	361.x-362.x, 363.8-363.9, 365.x-366.x, 369.x, 370.x, 377.0-377.2, 377.4-377.9
Hearing loss	389.x
Neuropathy	350.x-357.x
Chronic headache	339.x, 346.x, 784.0
Parkinson's disease	332.x

Peptic ulcer disease	531.x–534.x
Liver disease	070.22, 070.23, 070.32, 070.33, 070.44, 070.54, 070.6, 070.9, 456.0-456.2, 570.x, 571.x, 572.2-572.8, 573.3, 573.4, 573.8, 573.9, V42.7
Diverticulitis/diverticulosis	562.x
Gastroesophageal reflux disease	530.11, 530.81; 530.85
Diabetes	250.x
Hypothyroid	240.9, 243.x, 244.x, 246.1, 246.8
Obesity	278.0
Hyperlipidemia	272.0, 272.2-272.4
Renal disease	403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 582.x, 583.0–583.7, 585.x, 586.x, 588.0, V42.0, V45.1, V56.x
Prostatic hyperplasia	600.x
Urinary incontinence	788.3
Non-inflammatory gynecologic disorders	618.x; 620.x-624.x; 626.x-627.x
Cancer	140.x–172.x, 174.x–208.x, V10.60-10.63, V10.69, V10.71-V10.72, V10.79
Chronic back pain disorders	720.1-724.x
Osteoarthritis	715.x, v13.4
Gout	274.x
Osteoporosis	733.0

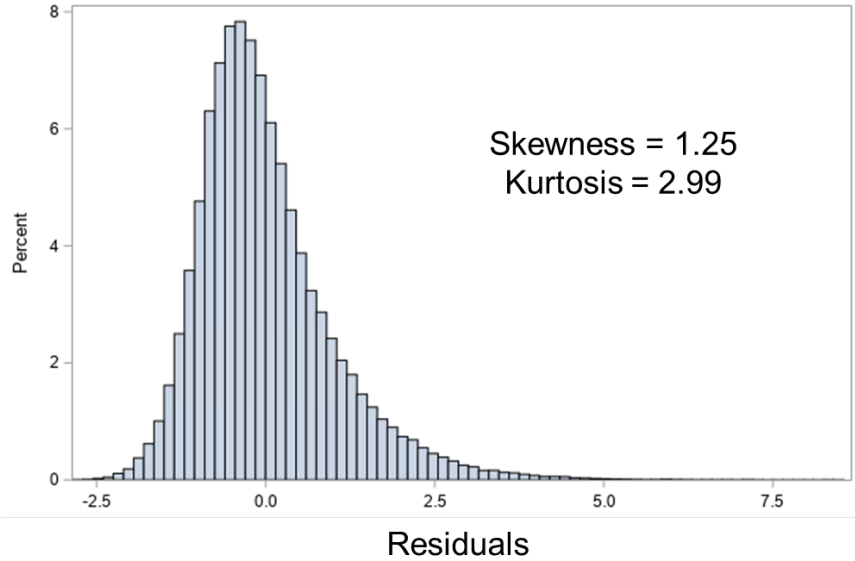
Inflammatory skin diseases	690.x, 694.x-698.x
Fibromyalgia	729.1
Anemia	280.x-285.x
Alcohol abuse	265.2, 291.1-291.3, 291.5-291.9, 303.0, 303.9, 305.0, 357.5, 425.5, 535.3, 571.0-571.3, 980.x, V11.3
Drug abuse	292.x, 304.x, 305.2-305.9, V65.42
Depression	296.2, 296.3, 300.4, 309.x, 311.x
Bipolar	296.0-296.1, 296.4-296.8
Anxiety	293.84, 300.x, 308.x
Post-traumatic stress disorder	309.81
Sleep disorder	307.4, 780.5

Supplementary Table 2. Prevalence of individual chronic conditions in RA vs. non-RA at baseline (n=277,782).			
Condition	RA N (%)	Control N (%)	Conditional OR (95% CI)
Alcohol abuse	203 (0.2)	181 (0.1)	1.12 (0.92, 1.37)
Anemia	6105 (4.4)	2498 (1.8)	2.56 (2.44, 2.69)
Anxiety	3173 (2.3)	2225 (1.6)	1.45 (1.37, 1.53)
Asthma	4385 (3.2)	2389 (1.7)	1.88 (1.79, 1.98)
Bipolar	303 (0.2)	264 (0.2)	1.15 (0.97, 1.36)
Benign prostatic hyperplasia*	1061 (3.3)	820 (2.5)	1.33 (1.21, 1.46)
Cancer	3891 (2.8)	4225 (3.0)	0.92 (0.88, 0.96)
Cardiac arrhythmia	3654 (2.6)	2652 (1.9)	1.42 (1.35, 1.49)
Cerebrovascular disease	1522 (1.1)	1218 (0.9)	1.26 (1.17, 1.36)
Chronic back pain	19968 (14.4)	10203 (7.4)	2.23 (2.17, 2.29)
CHF	1720 (1.2)	1237 (0.9)	1.41 (1.31, 1.52)
COPD	3378 (2.4)	1872 (1.4)	1.86 (1.75, 1.97)
Coronary artery disease	5264 (3.8)	3753 (2.7)	1.46 (1.39, 1.52)
Dementia	60 (0.04)	126 (0.1)	0.48 (0.35, 0.65)
Depression	4332 (3.1)	2633 (1.9)	1.69 (1.60, 1.77)
Diabetes	10,681 (7.7)	8,790 (6.3)	1.24 (1.21, 1.28)
Diverticular disease	870 (0.6)	586 (0.4)	1.49 (1.34, 1.66)
Drug abuse	202 (0.2)	125 (0.1)	1.62 (1.30, 2.03)
Fibromyalgia	6524 (4.7)	1212 (0.9)	5.86 (5.50, 6.25)
GERD	5673 (4.1)	3035 (2.2)	1.94 (1.85, 2.03)
Gout	1458 (1.1)	475 (0.3)	3.15 (2.83, 3.50)
Headaches	4174 (3.0)	2648 (1.9)	1.62 (1.54, 1.70)
Hearing loss	698 (0.5)	470 (0.3)	1.49 (1.33, 1.68)
Hyperlipidemia	14947 (10.8)	12103 (8.7)	1.30 (1.26, 1.33)

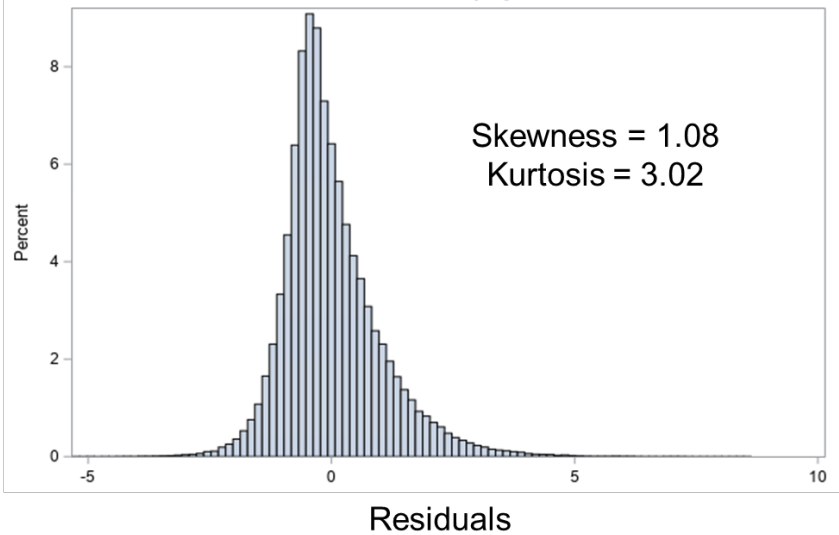
Hypertension	27176 (19.6)	20313 (14.6)	1.51 (1.48, 1.54)
Hypothyroid	7247 (5.2)	4189 (3.0)	1.80 (1.73, 1.88)
Interstitial lung disease	1620 (1.2)	133 (0.1)	12.62 (10.54, 15.11)
Inflammatory skin disease	4603 (3.3)	1724 (1.2)	2.77 (2.61, 2.93)
Liver disease	982 (0.7)	527 (0.4)	1.88 (1.69, 2.09)
Neuropathy	6464 (4.7)	2310 (1.7)	2.98 (2.83, 3.13)
Non-inflammatory gynecologic**	12890 (12.1)	11299 (10.6)	1.16 (1.13, 1.20)
Obesity	2499 (1.8)	1571 (1.1)	1.61 (1.51, 1.72)
Osteoarthritis	19133 (13.8)	4718 (3.4)	5.16 (4.98, 5.35)
Osteoporosis	3373 (2.4)	780 (0.6)	4.54 (4.19, 4.92)
Parkinson's	172 (0.1)	216 (0.2)	0.80 (0.65, 0.97)
Pulmonary circulation disorder	680 (0.5)	328 (0.2)	2.08 (1.83, 2.38)
Peptic ulcer disease	342 (0.3)	157 (0.1)	2.18 (1.80, 2.63)
Peripheral vascular disease	1284 (0.9)	822 (0.6)	1.58 (1.45, 1.73)
PTSD	62 (0.04)	36 (0.03)	1.72 (1.14, 2.60)
Renal disease	1589 (1.1)	1096 (0.8)	1.47 (1.36, 1.59)
Severe vision reduction	4270 (3.1)	2948 (2.1)	1.49 (1.42, 1.56)
Sleep disorder	3044 (2.2)	1651 (1.2)	1.88 (1.76, 1.99)
Urinary Incontinence	758 (0.6)	414 (0.3)	1.85 (1.64, 2.08)
Valvular heart disease	1282 (0.9)	828 (0.6)	1.56 (1.43, 1.71)
*males only, **females only			

Supplementary Figure 1. Skewness and residuals from generalized estimating equations models specifying a Gaussian or negative binomial distribution of multimorbidity burden.

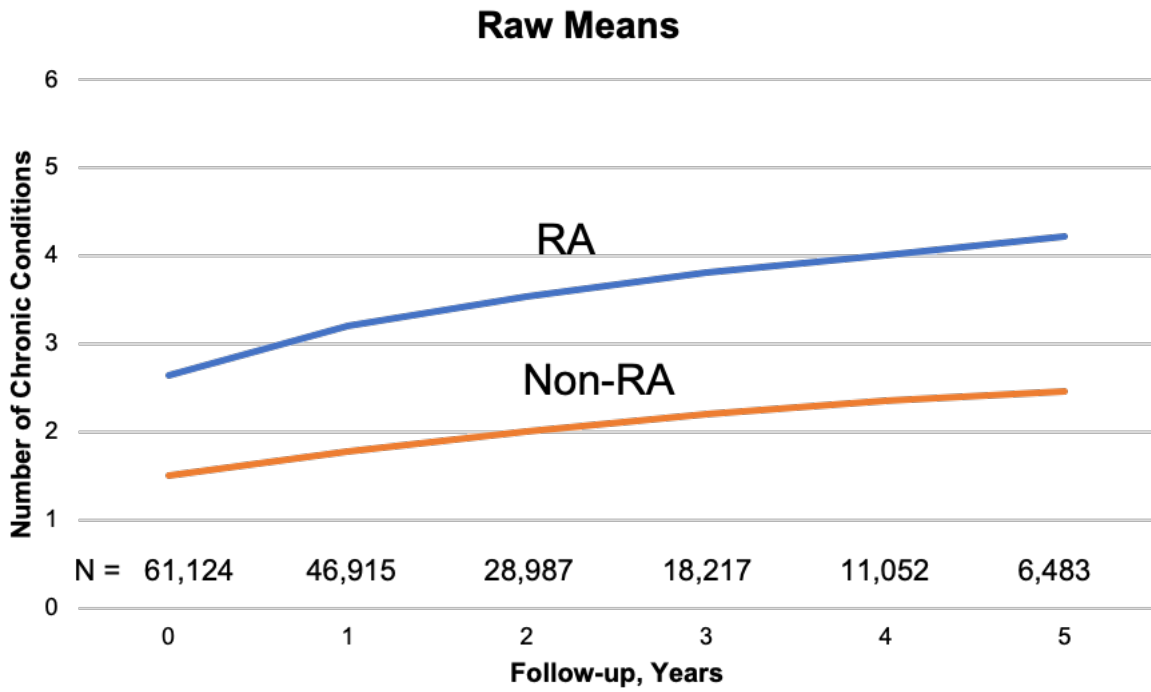
A. Gaussian Distribution



B. Negative Binomial Distribution



Supplementary Figure 2. Mean number of chronic conditions observed over time in RA and non-RA.



Supplementary Figure 3. Predicted burden of multimorbidity in incident rheumatoid arthritis compared to non-rheumatoid arthritis patients after diagnosis in sensitivity analyses.

