

# Clustering by Multiple Long-Term Conditions and Social Care Needs: A cohort study amongst 10,026 older adults in England

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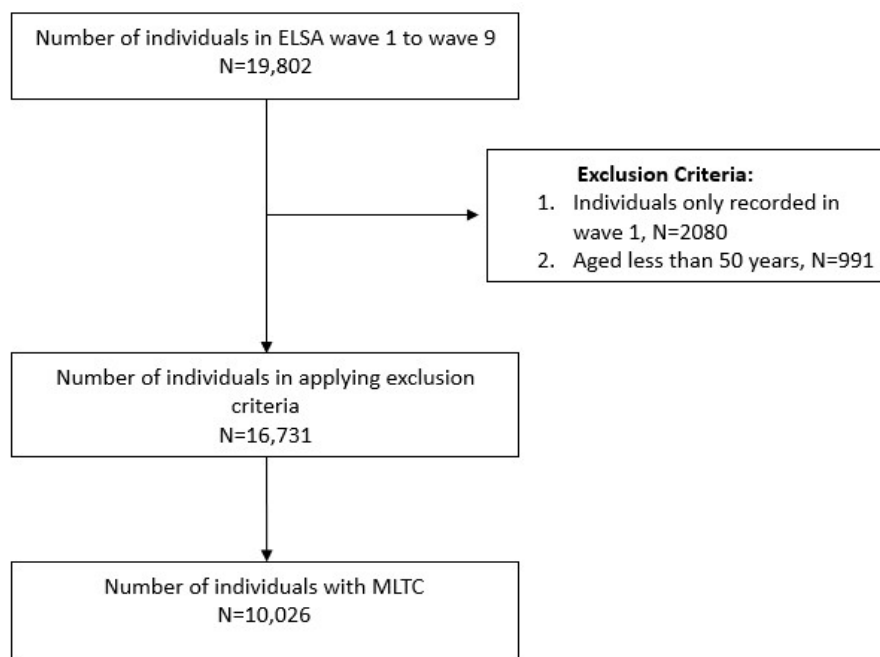
## Supplementary

**Supplementary Table 1.** List of 59 long-term conditions based on our previous works and consensus on defining multiple long-term conditions.

Long-term conditions
Stroke
Coronary heart disease
Heart failure
Peripheral arterial disease
Heart valve disorder
Arrhythmia
Venous thromboembolism
Aneurysm
Hypertension (Treated and untreated)
Diabetes
Addison's disease
Cystic fibrosis
Thyroid disorders
COPD
Asthma
Bronchiectasis
Parkinson's disease
Epilepsy
Multiple sclerosis
Paralysis
Transient ischaemic attack
Peripheral neuropathy
Chronic primary pain
Solid organ cancer
Haematological cancer
Metastatic cancer
Melanoma
Benign cerebral tumours causing disability
Dementia
Schizophrenia
Depression
Anxiety
Bipolar disorder
Drug or alcohol misuse
Eating disorder
Autism
Post-traumatic stress disorder
Connective tissue disorder
Osteoarthritis
Osteoporosis
Gout
Long-term musculoskeletal problem due to injury

Chronic liver disease  
 Inflammatory bowel  
 Chronic pancreatic disease  
 Peptic ulcer  
 Chronic kidney disease  
 End-stage kidney disease  
 Endometriosis  
 Chronic urinary tract infection  
 Anaemia (including pernicious anaemia and sickle cell anaemia)  
 Visual impairment that cannot be corrected  
 Hearing impairment that cannot be corrected  
 Meniere's disease  
 HIV/AIDS  
 Chronic lyme disease  
 Tuberculosis  
 Post-acute COVID-19 disease  
 Chromosomal abnormalities  
 Congenital heart disease

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**Supplementary Figure 1.** Flow chart for the study population in ELSA.

**Supplementary Table 2:** Model fit and diagnostic criteria for competing latent class models.

	LL	BIC(LL )	AIC(LL)	Npa r	df	Classificati on Error	Dissimilari ty index	Entrop y R <sup>2</sup>
<b>1- Cluster</b>	- 64952.8	130025 .1	129931. 7	13	8178	0	0.40	1
<b>2- Cluster</b>	- 61986.9	124221 .9	124027. 8	27	8164	0.0717	0.28	0.7401

<b>3-Cluster</b>	-	123843	123548.	41	8150	0.0736	0.27	0.7999
	61733.4	.6	8					
<b>4-Cluster</b>	-	123656	123260.	55	8136	0.1224	0.26	0.7194
	61575.3		5					
<b>5-Cluster</b>	-	123377	122781.	69	8122	0.1688	0.25	0.6751
	61421.7	.6	5					
<b>6-Cluster</b>	-	123449	122952.	83	8108	0.2082	0.24	0.6605
	61293.3	.3	5					

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**Abbreviations:** AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; df, degrees of freedom; LL, Log Likelihood; Npar, Number of parameters

**Supplementary Table 3:** Item response probabilities (95%CI) of the clusters of multiple long-term conditions and social care needs.

Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5	
Condition/SCN	Probability	Condition/SCN	Probability	Condition/SCN	Probability	Condition/SCN	Probability	Condition/SCN	Probability
Hypertension	0.81 (0.75 - 0.86)	Difficulty with mobility	0.85 (0.81 - 0.89)	Difficulty with mobility	0.98 (0.94 - 0.99)	Difficulty with ADLs	0.98 (0.94 - 0.99)	Difficulty with ADLs	0.99 (0.92 - 1.00)
Mental health disorders	0.37 (0.33 - 0.41)	Arthritis	0.63 (0.59 - 0.66)	Arthritis	0.51 (0.47 - 0.55)	Arthritis	0.75 (0.72 - 0.77)	Difficulty with mobility	0.98 (0.96 - 0.99)
Cardiovascular diseases	0.34 (0.31 - 0.38)	Mental health disorders	0.61 (0.58 - 0.64)	Health limit work	0.49 (0.44 - 0.55)	Hypertension	0.67 (0.65 - 0.69)	Health limit work	0.80 (0.74 - 0.85)
Difficulty with mobility	0.25 (0.14 - 0.42)	Health limit work	0.46 (0.41 - 0.51)	Difficulty with ADLs	0.38 (0.32 - 0.44)	Mental health disorders	0.64 (0.62 - 0.66)	Hypertension	0.65 (0.59 - 0.70)
Arthritis	0.23 (0.20 - 0.27)	Cardiovascular diseases	0.37 (0.34 - 0.40)	Mental health disorders	0.36 (0.34 - 0.39)	Cardiovascular diseases	0.50 (0.48 - 0.52)	Arthritis	0.54 (0.48 - 0.60)
Lung condition	0.23 (0.20 - 0.27)	Lung condition	0.36 (0.33 - 0.39)	Cardiovascular diseases	0.36 (0.33 - 0.38)	Lung condition	0.36 (0.34 - 0.38)	Cardiovascular diseases	0.53 (0.48 - 0.59)
Diabetes	0.22 (0.19 - 0.25)	Difficulty with ADLs	0.30 (0.25 - 0.35)	Diabetes	0.22 (0.19 - 0.24)	Diabetes	0.24 (0.22 - 0.26)	Dementia	0.53 (0.38 - 0.67)
Health limits work	0.16 (0.13 - 0.20)	Cancer	0.28 (0.25 - 0.31)	Lung condition	0.19 (0.16 - 0.21)	Cancer	0.20 (0.19 - 0.22)	Mental health disorders	0.46 (0.40 - 0.52)
Cancer	0.15 (0.13 - 0.18)	Diabetes	0.11 (0.09 - 0.14)	Cancer	0.17 (0.16 - 0.19)	Stroke	0.14 (0.12 - 0.16)	Stroke	0.37 (0.32 - 0.43)
Stroke	0.05 (0.04 - 0.07)	Stroke	0.04 (0.03 - 0.05)	Stroke	0.06 (0.04 - 0.07)	Dementia	0.04 (0.02 - 0.06)	Diabetes	0.23 (0.19 - 0.28)
Difficulty with ADLs	0.02 (0.01 - 0.05)	Dementia	0.02 (0.01 - 0.03)	Dementia	0.00 (0.00 - 0.02)	Parkinson's disease	0.02 (0.01 - 0.03)	Cancer	0.19 (0.15 - 0.24)
Parkinson's disease	0.00 (0.00 - 0.01)	Parkinson's disease	0.01 (0.00 - 0.02)	Parkinson's disease	0.00 (0.00 - 0.01)	Difficulty with mobility	0.00 (0.00 - 0.00)	Lung condition	0.19 (0.15 - 0.23)
Dementia	0.00 (0.00 - 0.00)	Hypertension	0.00 (0.00 - 0.00)	Hypertension	0.00 (0.00 - 1.00)	Health limit work	0.00 (0.00 - 0.00)	Parkinson disease	0.10 (0.07 - 0.13)

\*ADL is a composite of 13 variables = difficulty dressing, including putting on shoes and socks, difficulty walking across a room, difficulty bathing or showering, difficulty eating, such as cutting up food, difficulty getting in and out of bed, difficulty using the toilet, including getting up or down, difficulty using map to figure out how to get around strange place, difficulty preparing a hot meal, difficulty shopping for groceries, difficulty making telephone calls, difficulty taking medications, difficulty doing work around house and garden, difficulty managing money, e.g. paying bills, keeping track expense

\*\*Mobility is a composite of 10 variables = difficulty walking 100 yards, difficulty sitting for 2 hours, difficulty getting up from a chair after sitting for long periods, difficulty climbing several flights of stairs without resting, difficulty climbing one flight of stairs without resting, difficulty stooping, kneeling or crouching, difficulty reaching or extending arms above shoulder level, difficulty pulling or pushing large objects, difficulty lifting or carrying weights over 10 pounds, difficulty picking up 5p coin from the table

**Supplementary Table 4.** Association of SCN/MLTC clusters with all-cause mortality.

		Alive		Dead		Adjusted OR	95% CI	p-value
		N	%	N	%			
Clusters								
	Cluster 4	4647	94.13	290	5.87	Reference		
	Cluster 1	908	97.11	27	2.89	1.05	0.65-1.68	0.856
	Cluster 2	1337	97.59	33	2.41	0.79	0.53-1.18	0.251
	Cluster 3	2111	96.09	86	3.91	1.05	0.80-1.37	0.721
	Cluster 5	524	89.27	63	10.77	1.07	0.80-1.47	0.678
Age (years)								
	50-59	1700	97.76	39	2.24	Reference		
	60-69	2027	96.94	64	3.06	0.91	0.59-1.40	0.673
	70-79	1598	90.03	177	9.97	2.82	1.88-4.22	<0.0001
	80+	704	79.64	180	20.33	6.78	4.44-10.40	<0.0001
Sex								
	Male	4,263	94.00	272	5.99	Reference		
	Female	5,264	95.87	227	4.13	0.52	0.42-0.64	<0.0001
Ethnicity								
	White	9,143	94.89	492	5.11	Reference		
	Non-white	383	98.21	7	1.79	0.81	0.37-1.78	0.601
Marital status								
	Married/ Partnered	6,614	95.65	301	4.35	Reference		
	Separated/ Divorced/ Widowed	2,386	92.91	182	7.08	0.88	0.70-1.11	0.284
	Never married	526	97.05	16	2.95	0.61	0.35-1.08	0.088
Education								
	Less than upper secondary	3,491	93.09	259	6.91	Reference		
	Upper secondary and vocational training	3,959	96.37	149	3.62	0.80	0.63-1.01	0.062
	Tertiary education	1,213	96.12	49	3.88	0.95	0.67-1.37	0.798
	Other	767	94.9	41	5.0	0.86	0.60-	0.406

		3		7		1.23		
<b>Employment</b>								
Not working	6,085	92.90	465	7.09	Reference			
Currently working	3,440	99.05	33	0.95	0.39	0.25-0.60	<0.0001	
Adjusted for all sociodemographic variables when not stratified by these.								

**Supplementary Table 5.** Association of SCN/MLTC clusters with nursing home admission.

		Alive		Dead		Adjusted OR	95% CI	p-value
		N	%	N	%			
Clusters								
	Cluster 4	222	75.77	71	24.23	Reference		
	Cluster 1	26	96.30	1	3.70	0.38	0.05-3.13	0.371
	Cluster 2	28	84.85	5	15.15	0.92	0.30-2.77	0.88
	Cluster 3	71	82.56	15	17.44	0.81	0.41-1.60	0.542
	Cluster 5	21	33.33	42	66.67	8.71	4.22-18	<0.0001
Age (years)								
	50-59	35	89.74	4	10.26	Reference		
	60-69	60	92.31	5	7.69	0.75	0.17-3.34	0.701
	70-79	150	83.80	29	16.20	1.50	0.45-5.02	0.511
	80+	97	53.89	83	46.11	4.34	1.31-14.3	0.016
Sex								
	Male	219	80.22	54	19.78	Reference		
	Female	59.51	59.62	40.38	40.38	1.44	0.83-2.51	0.193
Ethnicity								
	White	361	72.93	134	27.07	Reference		
	Non-white	7	100.00	0	0.00	NA	NA	NA
Marital status								
	Married/ Partnered	247	81.5	56	18.4	Reference		

		2		8			
Separated/ Divorced/ Widowed	111	60.9 9	71	39.0 1	2.36	1.32- 4.22	0.004
Never married	10	58.8 2	7	41.1 8	3.52	0.92- 13.5	0.067

#### Education

Less than upper secondary	184	70.5 0	77	29.5 0	Reference		
Upper secondary and vocational training	114	76.0 0	36	24.0 0	1.01	0.57- 1.79	0.967
Tertiary education	41	83.6 7	8	16.3 3	0.62	0.22- 1.77	0.373
Other	28	68.2 9	13	31.7 1	0.90	0.36- 2.26	0.829

#### Employment

Not working	338	72.2 2	130	27.7 8	Reference		
Currently working	30	90.9 1	3	9.09	0.70	0.17- 2.84	0.614

Adjusted for all sociodemographic variables when not stratified by these.

**Supplementary Table 6.** Association of SCN/MLTC clusters with all-cause mortality considering the “healthiest” cluster as the reference group.

		Alive		Dead		Adjusted OR	95% CI	p-value
		N	%	N	%			
Clusters								
	Cluster 1	908	97.1 1	27	2.8 9	Reference		
	Cluster 2	1,337	97.5 9	33	2.4 1	2.39	0.24- 24.02	0.458
	Cluster 3	2,111	96.0 9	86	3.9 1	2.10	0.24- 18.19	0.499
	Cluster 4	4,647	94.1 3	290	5.8 7	2.61	0.32- 21.26	0.371
	Cluster 5	524	89.2 7	63	10.7 7	22.7	2.59- 198.4	0.005
Age (years)								
	50-59	1,700	97.7 9	39	2.2 4	Reference		
	60-69	2,027	96.9 4	64	3.0 6	0.74	0.17- 3.34	0.701
	70-79	1,598	90.0 3	177	9.9 7	1.50	0.45- 5.02	0.511
	80+	704	79.6 4	180	20.4 4	4.34	1.31- 14.33	0.016
Sex								
	Male	4,263	94	272	6	Reference		
	Female	5,26	95.8	22	4.1	1.44	0.83-	0.193

	4	7	7	3		2.51		
<b>Ethnicity</b>								
White	9,143	94.89	492	5.11	Reference			
Non-white	383	98.21	7	1.79	NA	NA	NA	
<b>Marital status</b>								
Married/ Partnered	6,614	95.65	301	4.35	Reference			
Separated/ Divorced/ Widowed	2,386	92.91	182	7.09	2.36	1.32-4.22	0.004	
Never married	526	97.05	16	2.95	3.51	0.92-13.5	0.067	
<b>Education</b>								
Less than upper secondary	3,491	93.09	259	6.91	Reference			
Upper secondary and vocational training	3,959	96.37	149	3.63	1.01	0.57-1.79	0.967	
Tertiary education	1,213	96.12	49	3.88	0.62	0.22-1.77	0.373	
Other	767	94.93	41	5.07	0.90	0.36-2.26	0.829	
<b>Employment</b>								
Not working	6,085	92.9	465	7.10	Reference			
Currently working	3,440	99.05	33	0.95	0.69	0.17-2.84	0.614	

Adjusted for all sociodemographic variables when not stratified by these.

**Supplementary Table 7.** Association of SCN/MLTC clusters with nursing home admission considering the “healthiest” cluster as the reference group.

	Alive		Dead		Adjusted OR	95% CI	p-value
	N	%	N	%			
<b>Clusters</b>							
Cluster 1	26	96.3	1	3.7	Reference		
Cluster 2	28	84.9	5	15.1	0.76	0.42-1.36	0.354
Cluster 3	71	82.6	15	17.4	1.00	0.60-1.67	0.986
Cluster 4	222	75.8	71	24.2	0.96	0.59-1.54	0.856
Cluster 5	21	33.3	42	66.7	1.02	0.59-1.77	0.935
<b>Age (years)</b>							
50-59	35	89.7	4	10.	Reference		



					3			
	60-69	60	92.3	5	7.7	0.91	0.59-1.40	0.673
	70-79	150	83.8	29	16.2	2.82	1.88-4.23	<0.0001
	80+	97	53.9	83	46.1	6.78	4.44-10.4	<0.0001
Sex								
	Male	219	80.2	54	19.8	Reference		
	Female	149	65.0	80	34.9	0.52	0.42-0.64	<0.0001
Ethnicity								
	White	361	72.9	13	27.1	Reference		
	Non-white	7	100	0	0	0.81	0.67-1.78	0.601
Marital status								
	Married/ Partnered	247	81.5	56	18.5	Reference		
	Separated/ Divorced/ Widowed	111	60.9	71	39	0.88	0.70-1.11	0.284
	Never married	10	58.8	7	41.2	0.61	0.35-1.08	0.088
Education								
	Less than upper secondary	184	70.5	77	29.5	Reference		
	Upper secondary and vocational training	114	76	36	24	0.80	0.63-1.01	0.062
	Tertiary education	41	83.6	8	16.3	0.95	0.67-1.36	0.798
	Other	28	68.2	13	31.7	0.86	0.60-1.23	0.406
Employment								
	Not working	338	72.2	13	27.8	Reference		
	Currently working	30	90.9	3	9.0	0.39	0.25-0.60	<0.0001

Adjusted for all sociodemographic variables when not stratified by these.