

Supplementary

Table S1 Structures of the four lymphedema-specific PROMs

PROM	Item	Subscale	Score calculation
ULL-27	1-15	Physical function	The total score (ranges from 0 to 100) is calculated by subtracting 27 (minimum score) from the total raw score, dividing by 108 (maximum score minus minimum score), and multiplying by 100.
	16-22	Psychological dimension	
	23-27	Social dimension	
LYMQOL-ARM	1(a-h)-3	Function	The subscale and total scores were calculated as the average score, which is the sum of the scores of the answered questions divided by the number of answered questions.
	4-8	Appearance	
	9-14	Symptom	
	15-20	Mood	
	21 ^a	Overall quality of life ^a	
LLIS	1-6	Physical	The total score, ranging from 0 to 100, was calculated as the sum of the scores of the answered questions divided by the maximum score and multiplied by 100.
	7-12	Psychosocial	
	13-17	Function	
	18 ^a	Infection ^a	
Lymph-ICF-UL	1-7	Symptoms	The total score, ranging from 0 to 100, was calculated as the average score of the answered questions multiplied by 10.
	8-11	Mental function	
	12-15	Household activities	
	16-23	Mobility activities	
	24-29	Life and social activities	

a. Item #21 of LYMQOL-ARM and item #18 of LLIS were not included in the total score.

Table S2 Item Functioning of Lymph-ICF-UL

Item	Subscale	Item fit				Threshold ordering		Response dependency					
		Outfit MNSQ	Outfit Z	Infit MNSQ	Infit Z	Thresholds	Ordered	Pairs with adjusted Q3 >0.20 / No. of item pairs	Flagged pairs				
									Item_1	Item_2	Mean Q3	Q3	Adjusted Q3
1	Symptoms	0.457	-3.6	0.537	-2.61	-0.71; 0.334; 1.069; 1.298; 1.578; 1.578; 1.761; 1.887; 1.976; 2.308	TRUE	5/21	icf_1	icf_2	-0.126	0.357	0.483
2		0.521	-3.01	0.653	-1.96	-0.549; 0.664; 1.048; 1.141; 1.483; 1.484; 1.651; 1.767; 2.166; 2.355	TRUE		icf_5	icf_6	-0.126	0.305	0.431
3		0.757	-1.34	0.854	-0.78	-0.674; 0.571; 1.125; 1.195; 1.317; 1.318; 1.378; 1.646; 1.971; 2.261	TRUE		icf_3	icf_7	-0.126	0.232	0.358
4		0.59	-2.33	0.789	-1.15	-0.485; 0.606; 1.077; 1.218; 1.287; 1.287; 1.403; 1.475; 1.753; 1.842	TRUE		icf_1	icf_4	-0.126	0.09	0.216
5		2.189	3.81	1.563	2.21	0.262; 1.174; 1.446; 1.447; 1.758; 1.758; 1.895; 2.13; 3.394	TRUE		icf_2	icf_4	-0.126	0.084	0.210
6		1.011	0.12	1.151	0.78	0.028; 0.97; 1.301; 1.355; 1.515; 1.516; 1.944; 2.043; 2.594; 3.039	TRUE						
7		0.66	-1.86	0.712	-1.49	-0.809; 0.689; 0.908; 1.074; 1.481; 1.481;	TRUE						

						1.59; 1.683; 1.883; 1.884							
8	Mental function	1.016	0.15	0.728	-1.22	-0.614; 1.119; 2.067; 2.285; 3.811; 3.812; 4.208; 4.512; 4.865; 5.327	TRUE	1/6	icf_10	icf_11	-0.255	0.205	0.46
9		0.79	-0.84	1.062	0.34	0.587; 1.65; 2.458; 2.833; 3.931; 3.931; 4.565; 5.125; 5.321; 5.569	TRUE						
10		0.516	-2.12	0.437	-2.91	0.555; 1.259; 2.341; 3.011; 3.928; 3.928; 4.57; 5.121; 5.303; 5.303	TRUE						
11		0.667	-1.78	0.749	-1.05	-0.022; 1.054; 1.945; 2.734; 3.808; 3.809; 4.369; 4.517; 4.852; 5.044	TRUE						
12	Household activities	0.879	-0.57	0.838	-0.71	-1.798; 0.14; 0.737; 1.242; 1.668; 1.669; 1.786; 1.854; 2.626; 4.327	TRUE	1/6	icf_13	icf_14	-0.294	0.275	0.569
13		0.501	-3.11	0.523	-2.77	-1.369; 0.204; 0.961; 1.207; 1.616; 1.616; 1.982; 2.177; 2.579; 4.915	TRUE						
14		0.53	-2.77	0.531	-2.6	-1.468; 0.205; 0.802; 1.217; 1.549; 1.55; 1.804; 2.053; 2.153; 3.612	TRUE						
15		0.87	-0.63	1.165	0.84	-1.153; 0.308; 0.951; 1.201; 1.61; 1.61; 1.895; 2.316; 2.597; 4.915	TRUE						

16	Mobility activities	0.775	-1.12	0.896	-0.66	-0.105; 0.228; 0.523; 0.603; 0.67; 0.67; 0.776; 0.899; 1.18; 2.633	TRUE	5/28	icf_21	icf_23	-0.047	0.678	0.726
17		1.369	1.57	1.049	0.38	-0.41; 0.017; 0.274; 0.341; 0.445; 0.445; 0.472; 0.527; 0.643; 1.164	TRUE		icf_20	icf_22	-0.047	0.292	0.339
18		1.092	0.51	1.017	0.17	-0.436; 0.066; 0.197; 0.322; 0.429; 0.429; 0.531; 0.577; 0.785; 1.182	TRUE		icf_17	icf_18	-0.047	0.272	0.319
19		1.084	0.43	0.86	-0.9	-0.022; 0.244; 0.397; 0.508; 0.609; 0.61; 0.691; 0.728; 0.853; 1.368	TRUE		icf_19	icf_21	-0.047	0.216	0.263
20		0.913	-0.24	0.958	-0.14	0.371; 0.66; 0.818; 0.88; 0.975; 0.975; 1.076; 1.306; 1.519; 1.993	TRUE		icf_16	icf_17	-0.047	0.189	0.236
21		0.503	-2.25	0.613	-2.7	-0.23; 0.304; 0.453; 0.516; 0.617; 0.617; 0.648; 0.683; 0.768; 0.953	TRUE						
22		0.9	-0.3	1.117	0.66	0.171; 0.505; 0.661; 0.72; 0.771; 0.771; 0.824; 0.868; 0.96; 1.308	TRUE						
23		0.523	-2.23	0.66	-2.37	-0.275; 0.225; 0.408; 0.474; 0.62; 0.62; 0.635; 0.667; 0.766; 0.93	TRUE						
24	Life and social activities	1.002	0.09	0.878	-0.63	-0.529; 0.079; 0.345; 0.429; 0.793; 0.794; 0.905; 0.906; 1.025; 1.291	TRUE	4/15	icf_28	icf_29	-0.154	0.414	0.568
25		0.473	-3.12	0.536	-3.12	-0.629; 0.115; 0.371; 0.509; 0.866; 0.866;	TRUE		icf_26	icf_27	-0.154	0.365	0.519

					1.073; 1.16; 1.276; 2.138							
26	1.289	1.43	1.119	0.75	-1.218; -0.212; 0.317; 0.395; 0.71; 0.711; 1.069; 1.224; 1.797; 3.243	TRUE		icf_24	icf_25	-0.154	0.133	0.287
27	0.816	-0.84	0.892	-0.58	-0.492; 0.29; 0.596; 0.687; 0.813; 0.814; 1.144; 1.502; 1.841; 2.559	TRUE		icf_25	icf_26	-0.154	0.046	0.200
28	0.761	-1.04	0.979	-0.05	-0.795; 0.072; 0.322; 0.405; 0.567; 0.567; 0.758; 1.03; 1.292; 1.615	TRUE						
29	0.619	-2.02	0.821	-0.99	-0.636; -0.016; 0.344; 0.518; 0.793; 0.794; 1.035; 1.077; 1.245; 1.667	TRUE						

Table S3 Item Functioning of ULL-27

Item	Subscale	Item fit				Threshold ordering		Response dependency					
		Outfit MNSQ	Outfit Z	Infit MNSQ	Infit Z	Thresholds	Ordered	Pairs with adjusted Q3 >0.20 / No. of item pairs	Flagged pairs				
									Item_1	Item_2	Mean Q3	Q3	Adjusted Q3
1	Physical function	0.735	-1.94	0.752	-1.81	-2.122; 0.71; 2.084; 3.213	TRUE	15/105	ull_6	ull_7	-0.065	0.848	0.913
2		0.731	-1.88	0.75	-1.74	-1.481; 1.208; 2.706; 3.452	TRUE		ull_1	ull_2	-0.065	0.452	0.517
3		1.028	0.23	0.947	-0.28	-1.07; 1.768; 3.179; 3.855	TRUE		ull_3	ull_4	-0.065	0.437	0.501

4		1.282	1.65	1	0.05	-1.06; 1.608; 2.793; 3.658	TRUE		ull_11	ull_12	-0.065	0.345	0.409
5		0.713	-1.81	0.79	-1.29	-0.819; 2.292; 3.145; 4.214	TRUE		ull_10	ull_12	-0.065	0.249	0.313
6		1.578	2.87	1.381	2.17	-0.607; 2.179; 3.034; 4.831	TRUE		ull_9	ull_10	-0.065	0.234	0.298
7		1.472	2.48	1.391	2.19	-0.796; 1.897; 3.027; 3.883	TRUE		ull_2	ull_5	-0.065	0.207	0.272
8		0.84	-0.99	0.855	-0.9	-1.171; 2.205; 3.037; 4.829	TRUE		ull_13	ull_15	-0.065	0.199	0.263
9		0.616	-2.54	0.682	-2.12	-0.745; 2.191; 3.012; 4.268	TRUE		ull_4	ull_14	-0.065	0.184	0.249
10		0.698	-1.44	0.806	-1.06	0.094; 2.849; 3.634; 4.559	TRUE		ull_4	ull_13	-0.065	0.167	0.232
11		0.534	-2.86	0.643	-2.48	-0.321; 1.926; 2.909; 4.326	TRUE		ull_7	ull_8	-0.065	0.162	0.227
12		0.614	-1.45	0.883	-0.64	0.678; 3.026; 4.624; 5.124	TRUE		ull_3	ull_13	-0.065	0.161	0.226
13		0.998	0.06	0.999	0.05	0.08; 3.367; 4.585; 5.104	TRUE		ull_13	ull_14	-0.065	0.155	0.219
14		1.229	1.26	1.134	0.79	-0.956; 2.232; 3.079; 3.529	TRUE		ull_5	ull_10	-0.065	0.151	0.216
15		0.842	-0.55	1.148	0.77	0.474; 3.265; 4.084; 4.415	TRUE		ull_2	ull_9	-0.065	0.15	0.215
16	Psychological dimension	0.677	-0.62	0.656	-2.39	-0.832; 2.694; 4.208; 5.554	TRUE	8/21	ull_18	ull_19	-0.072	0.497	0.569
17		0.503	-0.07	0.545	-3.13	-0.144; 3.553; 4.064; 5.544	TRUE		ull_16	ull_18	-0.072	0.494	0.566
18		0.44	-0.6	0.508	-3.63	-0.128; 3.129; 4.125; 5.551	TRUE		ull_17	ull_19	-0.072	0.458	0.53
19		0.443	-0.8	0.503	-3.61	-0.411; 3.15; 4.126; 5.551	TRUE		ull_17	ull_18	-0.072	0.449	0.521
20		0.812	0.4	0.988	-0.02	0.134; 3.539; 4.06; 5.545	TRUE		ull_21	ull_22	-0.072	0.392	0.464
21		1.256	0.87	1.317	2.01	-2.774; -0.223; 2.676; 5.179	TRUE		ull_16	ull_19	-0.072	0.367	0.439
22		1.297	36.53	1.391	2.3	-1.477; 0.338; 3.069; 4.121	TRUE		ull_16	ull_17	-0.072	0.34	0.412
									ull_17	ull_20	-0.072	0.13	0.202
23	Social dimension	0.734	-1.52	0.663	-1.99	-0.767; 2.74; 4.391; 5.356	TRUE	2/10	ull_25	ull_26	-0.159	0.305	0.464
24		0.704	-1.84	0.658	-2.11	-0.665; 2.527; 4.415; 5.36	TRUE		ull_23	ull_24	-0.159	0.071	0.23
25		0.817	-0.78	0.676	-1.84	0.904; 3.456; 4.789; 5.76	TRUE						
26		0.339	-4.11	0.332	-4.46	0.712; 3.866; 4.738; 5.743	TRUE						
27		1.362	1.55	1.772	2.92	0.712; 3.965; 5.186; 5.187	TRUE						

Table S4 Item Functioning of LYMQOL-ARM

Item	Subscale	Item fit				Threshold ordering		Response dependency				
			Outfit Z			Thresholds	Ordered		Flagged pairs			

		Outfit MNSQ		Infit MNSQ	Infit Z			Pairs with adjusted Q3 >0.20 / No. of item pairs	Item_1	Item_2	Mean Q3	Q3	Adjusted Q3
1	Function	0.632	-2.45	0.606	-2.75	-0.41; 2.664; 4.918	TRUE	0/3					
2		0.622	-2.45	0.613	-2.61	-0.894; 2.794; 4.306	TRUE						
3		0.694	-1.8	0.735	-1.68	-1.307; 2.835; 4.893	TRUE						
4	Appearance	0.874	-0.55	0.913	-0.42	-0.148; 2.66; 3.731	TRUE	3/10	arm_5	arm_6	-0.18	0.358	0.539
5		0.855	-0.53	0.795	-1.2	0.808; 3.685; 4.869	TRUE		arm_4	arm_7	-0.18	0.05	0.231
6		0.618	-1.95	0.693	-1.87	0.486; 3.301; 4.645	TRUE		arm_6	arm_8	-0.18	0.042	0.222
7		0.939	-0.17	0.916	-0.39	-1.699; 2.504; 3.569	TRUE						
8		0.535	-2.34	0.639	-2.22	0.635; 3.735; 4.588	TRUE						
9	Symptom	0.672	-2.08	0.689	-2.16	-1.423; 2.895; 4.44	TRUE	1/15	arm_11	arm_13	-0.161	0.048	0.209
10		1.131	0.78	1.108	0.71	-0.865; 3.111; 4.401	TRUE						
11		0.907	-0.45	0.956	-0.24	-0.19; 3.519; 4.964	TRUE						
12		0.961	-0.17	0.956	-0.23	-1.414; 2.528; 3.788	TRUE						
13		0.605	-2.62	0.599	-2.94	-1.102; 3.139; 4.693	TRUE						
14		0.813	-1.12	0.791	-1.37	-1.501; 2.661; 4.217	TRUE						
15	Mood	1.444	1.87	1.073	0.47	-2.367; 2.28; 3.335	TRUE	4/15	arm_17	arm_18	-0.15	0.424	0.574
16		0.938	-0.17	1.123	0.68	0.013; 3.351; 3.682	TRUE		arm_19	arm_20	-0.15	0.241	0.391
17		0.488	-3.14	0.53	-3.08	-0.457; 3.297; 4.48	TRUE		arm_18	arm_20	-0.15	0.139	0.289
18		0.612	-2.09	0.709	-1.67	-0.874; 3.127; 3.952	TRUE		arm_17	arm_20	-0.15	0.094	0.244
19		0.778	-1.11	0.742	-1.63	-0.137; 3.475; 5.254	TRUE						
20		0.575	-2.16	0.655	-2.08	0.084; 3.84; 4.73	TRUE						

Table S5 Internal Consistency of the Chinese versions of the four BCRL PROMs

	Cronbach's alpha
ULL-27	
Physical function	0.964
Psychological dimension	0.953
Social dimension	0.933
Total	0.975
LYMQOL-ARM	
Function	0.914
Appearance	0.935
Symptom	0.928
Mood	0.918
Total	0.918
LLIS	
Physical	0.911
Psychosocial	0.914
Function	0.902
Total	0.960
Lymph-ICF-UL	
Symptoms	0.923
Mental function	0.984
Household activities	0.960
Mobility activities	0.914
Life and social activities	0.942
Total	0.968

Table S6 Clinical validity: comparison of Chinese version of the four BCRL PROMs scores across severity stages

	Scores of Chinese version of BCRL PROMs (mean [95%CI])			
	Stage 0 (n=43)	Stage 1 (n=37)	Stage 2 (n=24)	Kruskal-Wallis H (p)
ULL-27				
Physical function	16.24 [12.15, 20.33]	24.31 [18.59,30.02]	29.06 [18.48, 39.63]	6.759(0.034)
Psychological dimension	19.02 [14.37, 23.67]	22.12 [17.42, 26.82]	26.09 [14.28, 37.89]	1.363(0.506)
Social dimension	12.44 [7.92, 16.96]	19.86 [14.32, 25.40]	20.87 [8.98, 32.76]	4.967(0.083)
Total score	16.26 [12.33, 20.18]	22.92 [18.11, 27.72]	26.77 [16.60, 36.94]	5.720(0.057)
LYMQOL-ARM				
Function	1.60 [1.42, 1.79]	1.95 [1.75, 2.15]	1.94 [1.52, 2.36]	7.800(0.020)
Appearance	1.46 [1.28, 1.64]	1.74 [1.54, 1.95]	1.97 [1.50, 2.43]	6.195(0.045)
Symptom	1.59 [1.45, 1.73]	1.88 [1.68, 2.07]	2.19 [1.75, 2.62]	8.056(0.018)
Mood	1.60 [1.43, 1.77]	1.79 [1.62, 1.96]	1.92 [1.52, 2.32]	4.045(0.132)
Total score	1.56 [1.42, 1.70]	1.83 [1.67, 1.99]	2.02 [1.63, 2.40]	6.766(0.034)
LLIS	Stage 0 (n=41)	Stage 1 (n=37)	Stage 2 (n=22)	
Physical	16.46 [11.47, 21.45]	23.54 [17.75, 29.32]	49.81 [39.00, 60.62]	28.051 (0.000)

Psychosocial	17.07 [10.71, 23.43]	18.69 [13.40, 23.99]	41.86 [27.47, 56.24]	11.664 (0.003)
Function	14.88 [8.50, 21.25]	17.16 [11.53, 22.80]	38.86 [25.46, 52.27]	12.210 (0.002)
Total score	15.31 [10.09, 20.53]	18.88 [13.98, 23.78]	41.41 [29.98, 52.85]	19.668 (0.000)
Lymph-ICF-UL				
Symptoms	11.11 [6.44, 15.79]	18.46 [12.01, 24.90]	40.52 [28.65, 52.39]	24.847 (0.000)
Mental function	13.05 [5.36, 20.73]	13.24 [6.40, 20.09]	32.50 [17.14, 47.86]	7.757 (0.021)
Household activities	19.78 [12.67, 26.88]	18.11 [10.47, 25.75]	49.55 [34.37, 64.72]	14.956 (0.001)
Mobility activities	26.96 [20.10, 33.83]	27.84 [20.41, 35.27]	53.11 [38.77, 67.45]	10.885 (0.004)
Life and social activities	24.78 [16.61, 32.95]	23.04 [15.92, 30.16]	48.37 [33.13, 63.61]	8.833 (0.012)
Total score	19.78 [14.52, 25.03]	21.23 [15.70, 26.75]	45.76 [33.91, 57.60]	16.071 (0.000)

Table S7 Correlation between BCRL stages and the Chinese versions of the four BCRL PROMs

	Spearman's ρ^a	P value
ULL-27		
Physical function	0.259	0.008
Psychological dimension	0.116	0.240
Social dimension	0.154	0.118
Total score	0.208	0.034
LYMQOL-ARM		
Function	0.208	0.034
Appearance	0.238	0.016
Symptom	0.286	0.003
Mood	0.172	0.082
Total score	0.248	0.012
LLIS		
Physical	0.501	0.000
Psychosocial	0.309	0.002
Function	0.321	0.001
Total score	0.412	0.000
Lymph-ICF-UL		
Symptoms	0.488	0.000
Mental function	0.271	0.006
Household activities	0.258	0.009
Mobility activities	0.267	0.007
Life and social activities	0.234	0.019
Total score	0.338	0.001

a. The correlation between BCRL stages and the Chinese versions of the four BCRL PROMs was analyzed using Spearman's rank correlation coefficient.

Table S8 AUC of subscales and global scales of the four Chinese versions of BCRL PROMs

	AUC	95% CI	P value
ULL-27			
Physical function	0.654	[0.548, 0.759]	0.008
Psychological dimension	0.567	[0.456, 0.678]	0.248
Social dimension	0.601	[0.492, 0.711]	0.081
Total score	0.638	[0.531, 0.746]	0.017
LYMQOL-ARM			
Function	0.633	[0.525, 0.740]	0.023
Appearance	0.634	[0.572, 0.742]	0.021
Symptom	0.646	[0.540, 0.752]	0.012
Mood	0.595	[0.485, 0.706]	0.101
Total score	0.639	[0.531, 0.746]	0.017
LLIS			
Physical	0.725	[0.625, 0.825]	0.000
Psychosocial	0.629	[0.517, 0.740]	0.029
Function	0.635	[0.524, 0.747]	0.022
Total score	0.680	[0.573, 0.787]	0.002
Lymph-ICF-UL			
Symptoms	0.734	[0.633, 0.834]	0.000
Mental function	0.624	[0.511, 0.737]	0.036
Household activities	0.569	[0.456, 0.681]	0.245
Mobility activities	0.596	[0.485, 0.707]	0.103
Life and social activities	0.581	[0.466, 0.695]	0.172
Total score	0.628	[0.518, 0.738]	0.030

Table S9 Optimal cutoff and parameters for subscales and global scales of the four Chinese versions of BCRL PROMs

	Cutoff	Sensitivity	Specificity
ULL-27			
Physical function	≥ 28.33	39.34%	86.05%
Psychological dimension	≥ 35.71	21.31%	93.02%
Social dimension	≥ 15	57.38%	62.80%
Total score	≥ 26.85	40.98%	83.72%
LYMQOL-ARM			
Function	≥ 1.96	52.46%	76.74%
Appearance	≥ 1.6	60.00%	62.79%
Symptom	≥ 1.83	65.57%	67.44%
Mood	≥ 2	47.54%	72.09%
Total score	≥ 1.51	75.00%	55.81%
LLIS			
Physical	≥ 20.83	71.19%	68.29%
Psychosocial	≥ 16.67	64.40%	60.98%
Function	≥ 10	69.49%	60.98%
Total score	≥ 18.06	64.41%	65.85%
Lymph-ICF-UL			
Symptoms	≥ 8.57	74.58%	63.41%
Mental function	≥ 2.5	67.80%	58.54%
Household activities	≥ 40	33.89%	85.37%
Mobility activities	≥ 24.28	64.41%	56.10%

Life and social activities	≥ 26.67	50.85%	65.85%
Total score	≥ 11.31	79.61%	43.90%

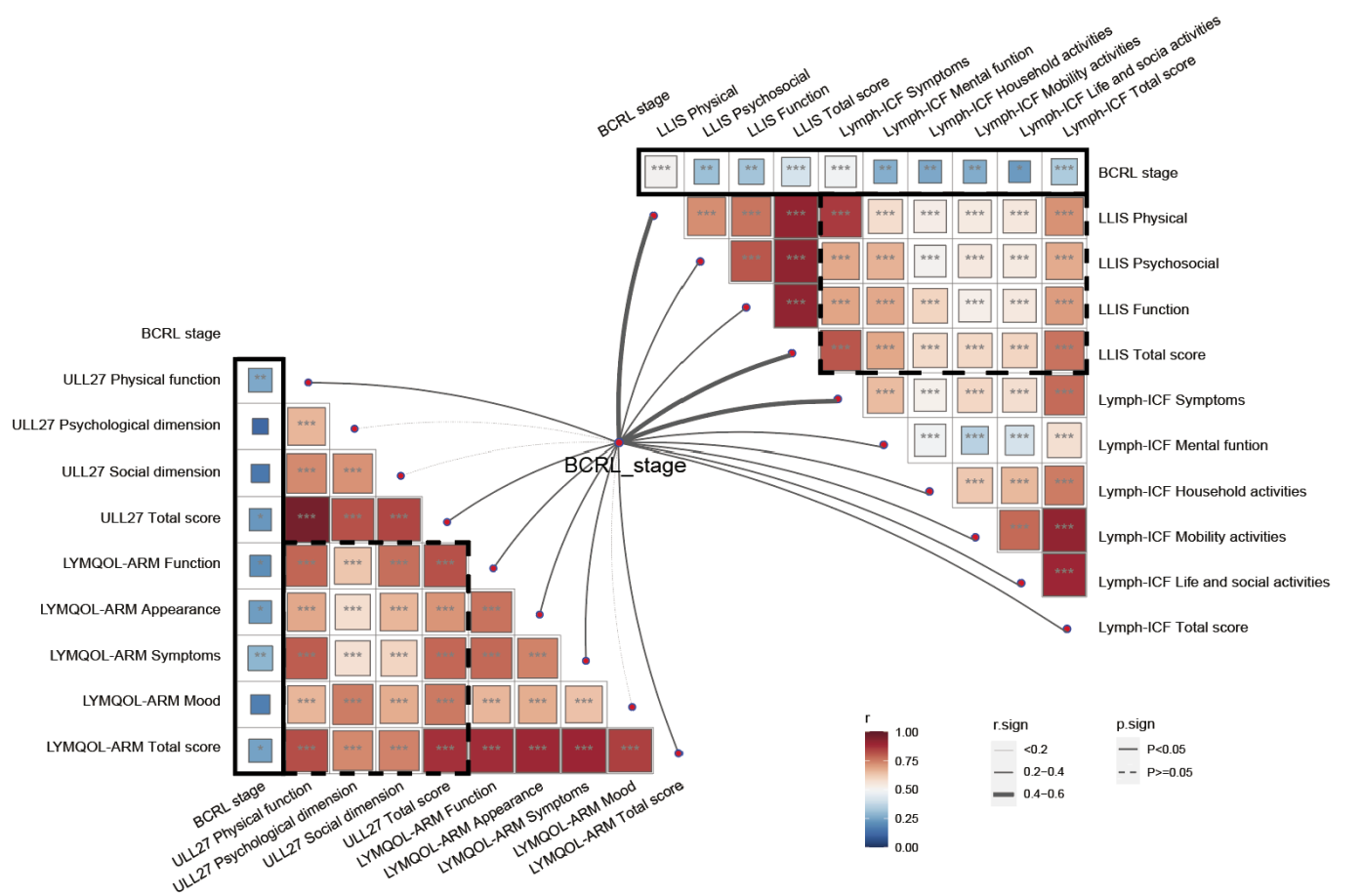


Figure S1 Correlation between BCRL stages and the Chinese versions of the four BCRL PROMs. Rectangles bordered by solid lines and arcs indicated the correlation between BCRL stage and lymphedema-specific PROMs. Rectangles with dashed borders indicated correlations between different BCRL PROMs. Spearman's rank correlation coefficient was used to analyze the correlation between BCRL stages and the four BCRL PROMs and the correlation between different PROMs.