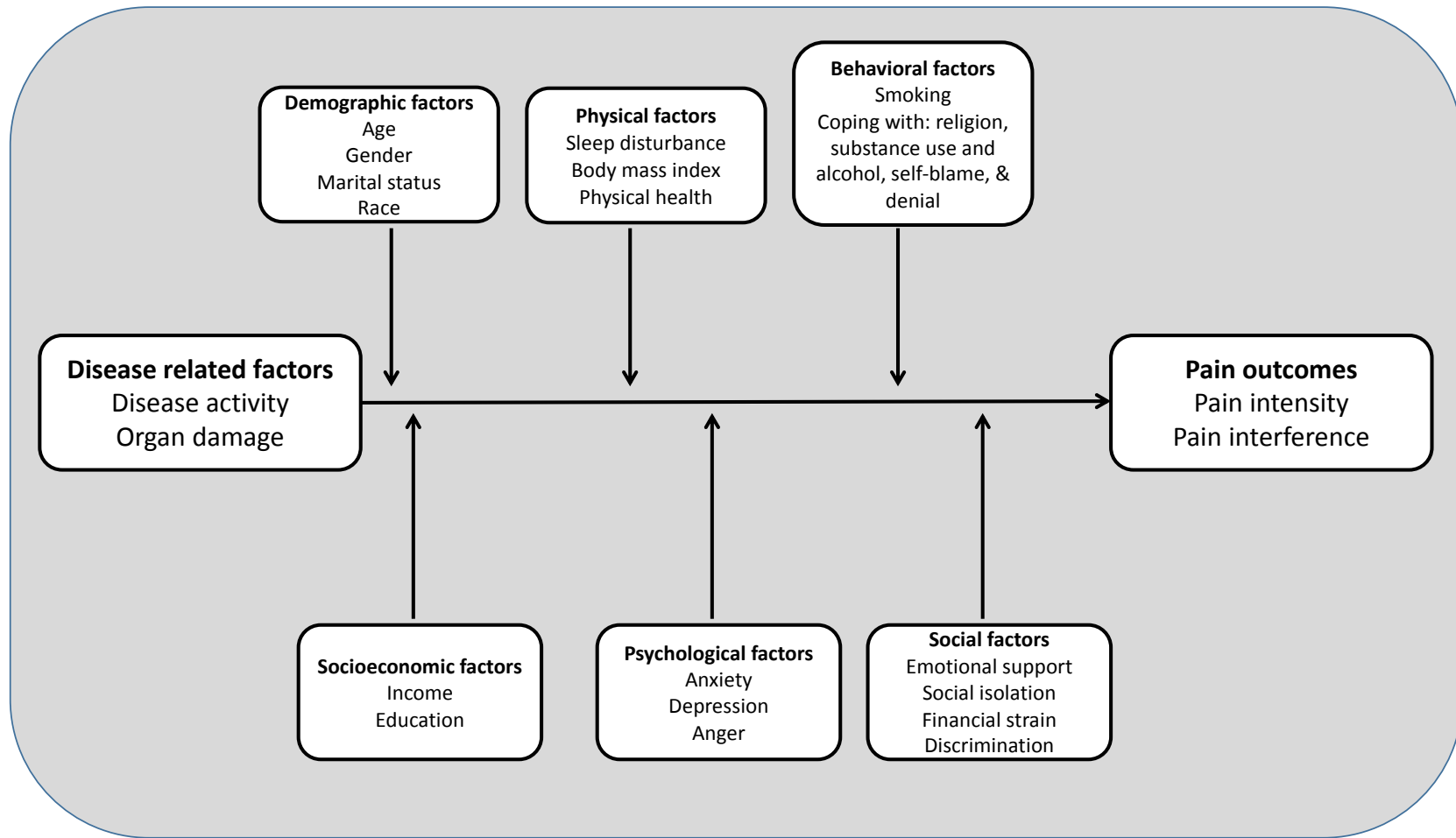


Supplementary Figure 1. The biopsychosocial mechanisms of pain in systemic lupus erythematosus



Supplementary Table 1. Hierarchical linear regression analyses of seven constructs with **pain intensity** as outcome (removing 6 pain-related items in SLAQ)**

Characteristic	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
R ²	0.245	0.288	0.348	0.463	0.471	0.493	0.510
ΔR ²	--	0.042	0.060	0.116	0.008	0.022	0.017
Disease related factors							
Disease activity	0.242 (0.208 to 0.275)	0.244 (0.211 to 0.278)	0.215 (0.182 to 0.249)	0.139 (0.105 to 0.173)	0.134 (0.097 to 0.171)	0.131 (0.094 to 0.169)	0.122 (0.083 to 0.160)
Organ damage	0.049 (-0.033 to 0.132)	0.021 (-0.062 to 0.103)	0.004 (-0.078 to 0.085)	-0.023 (-0.099 to 0.052)	-0.021 (-0.097 to 0.054)	-0.032 (-0.109 to 0.046)	-0.015 (-0.093 to 0.064)
Demographic factors							
Age at survey		0.018 (0.004 to 0.032)	0.018 (0.005 to 0.032)	0.017 (0.004 to 0.029)	0.019 (0.007 to 0.032)	0.018 (0.004 to 0.031)	0.019 (0.005 to 0.033)
Gender							
Male		Ref	Ref	Ref	Ref	Ref	Ref
Female		-0.749 (-1.49 to -0.009)	-0.588 (-1.302 to 0.1260)	-0.821 (-1.498 to -0.144)	-0.820 (-1.495 to -0.146)	-0.854 (-1.560 to -0.149)	-0.900 (-1.623 to -0.178)
Marital status							
Not single		Ref	Ref	Ref	Ref	Ref	Ref
Single		0.078 (-0.319 to 0.476)	-0.462 (-0.882 to -0.041)	-0.324 (-0.714 to 0.067)	-0.258 (-0.650 to 0.134)	-0.213 (-0.617 to 0.191)	-0.198 (-0.611 to 0.215)
Race							
Non-black		Ref	Ref	Ref	Ref	Ref	Ref
Black		1.358 (0.863 to 1.853)	0.85 (0.354 to 1.346)	0.737 (0.278 to 1.197)	0.714 (0.253 to 1.175)	0.568 (0.089 to 1.047)	0.644 (0.143 to 1.144)
Socioeconomic factors							
Household income			-0.218 (-0.318 to -0.119)	-0.152 (-0.244 to -0.060)	-0.154 (-0.246 to -0.062)	-0.164 (-0.258 to -0.069)	-0.142 (-0.245 to -0.040)
Education							
High school or less			Ref	Ref	Ref	Ref	Ref
Some college			-0.390 (-0.846 to 0.065)	-0.409 (-0.828 to 0.010)	-0.391 (-0.813 to 0.031)	-0.290 (-0.728 to 0.147)	-0.303 (-0.760 to 0.154)
College or above			-0.930 (-1.454 to -0.406)	-0.883 (-1.366 to -0.400)	-0.865 (-1.348 to -0.382)	-0.624 (-1.127 to -0.120)	-0.681 (-1.202 to -0.160)
Physical factors							
PROMIS sleep disturbance				0.063 (0.044 to 0.083)	0.057 (0.037 to 0.078)	0.058 (0.037 to 0.080)	0.05 (0.028 to 0.072)
Body mass index				0.045 (0.024 to 0.066)	0.044 (0.022 to 0.065)	0.041 (0.018 to 0.063)	0.041 (0.018 to 0.064)
PROMIS physical health				-0.587 (-0.795 to -0.379)	-0.567 (-0.780 to -0.354)	-0.663 (-0.882 to -0.443)	-0.749 (-0.978 to -0.521)
Psychological factors							
PROMIS anxiety					-0.013 (-0.038 to 0.011)	-0.008 (-0.034 to 0.018)	-0.004 (-0.032 to 0.023)
PROMIS depression					-0.011 (-0.034 to 0.012)	-0.007 (-0.031 to 0.017)	-0.005 (-0.030 to 0.020)
PROMIS anger					0.032 (0.012 to 0.051)	0.031 (0.011 to 0.052)	0.031 (0.009 to 0.052)
Behavioral factors							
Smoking							
Not current						Ref	Ref
Current						-0.011 (-0.537 to 0.515)	0.030 (-0.520 to 0.580)
Coping with religion						0.033 (-0.054 to 0.121)	0.032 (-0.059 to 0.124)

Characteristic	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Coping with substance use and alcohol						-0.027 (-0.192 to 0.138)	-0.039 (-0.206 to 0.127)
Coping with self-blame						-0.184 (-0.308 to -0.059)	-0.198 (-0.327 to -0.070)
Coping with denial						0.152 (0.033 to 0.271)	0.154 (0.032 to 0.276)
Social factors							
PROMIS emotional support							0.006 (-0.017 to 0.028)
PROMIS social isolation							0.002 (-0.023 to 0.027)
Financial strain							0.036 (-0.033 to 0.105)
Discrimination score							-0.189 (-0.509 to 0.131)

Model 1: Disease-related factors; Model 2: Model 1 + demographic factors; Model 3: Model 2 + socioeconomic factors; Model 4: Model 3 + physical factors; Model 5: Model 4 + psychological factors; Model 6: Model 5 + behavioral factors; Model 7: Model 6 + social factors.

** These models comprise the sensitivity analyses that include the modified Systemic Lupus Activity Questionnaire (SLAQ) which removes overt mentions of pain including stomach pain, chest pain, headache, joint swelling, joint pain, muscle

* Statistically significant variables in the final model are bolded

Supplementary Table 2. Hierarchical linear regression analyses of seven constructs with **pain interference** as outcome (removing 6 pain-related items in SLAQ)**

Characteristic	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
R ²	0.254	0.264	0.307	0.478675	0.500	0.509	0.524
ΔR ²	--	0.010	0.043	0.172	0.018	0.012	0.015
Disease related factors							
Disease activity	0.794 (0.683 to 0.906)	0.803 (0.690 to 0.917)	0.718 (0.604 to 0.833)	0.371 (0.260 to 0.483)	0.309 (0.189 to 0.428)	0.302 (0.179 to 0.425)	0.277 (0.150 to 0.403)
Organ damage	0.358 (0.084 to 0.632)	0.292 (0.011 to 0.573)	0.255 (-0.025 to 0.535)	0.123 (-0.125 to 0.372)	0.156 (-0.089 to 0.402)	0.152 (-0.102 to 0.406)	0.183 (-0.076 to 0.443)
Demographic factors							
Age at survey		0.047 (-0.001 to 0.094)	0.048 (0.001 to 0.094)	0.054 (0.013 to 0.095)	0.065 (0.024 to 0.106)	0.051 (0.008 to 0.095)	0.042 (-0.004 to 0.088)
Gender							
Male		Ref	Ref	Ref	Ref	Ref	Ref
Female		-0.222 (-2.726 to 2.283)	0.194 (-2.25 to 2.638)	-1.152 (-3.365 to 1.062)	-1.201 (-3.381 to 0.98)	-1.109 (-3.413 to 1.194)	-1.171 (-3.575 to 1.233)
Marital status							
Not single		Ref	Ref	Ref	Ref	Ref	Ref
Single		0.096 (-1.253 to 1.445)	-1.421 (-2.867 to 0.026)	-0.483 (-1.769 to 0.802)	-0.186 (-1.462 to 1.090)	-0.194 (-1.522 to 1.134)	-0.446 (-1.815 to 0.923)
Race							
Non-black		Ref	Ref	Ref	Ref	Ref	Ref
Black		2.030 (0.352 to 3.708)	0.570 (-1.140 to 2.28)	0.219 (-1.294 to 1.731)	0.192 (-1.307 to 1.692)	-0.241 (-1.817 to 1.336)	0.070 (-1.596 to 1.735)
Socioeconomic factors							
Household income			-0.605 (-0.948 to -0.263)	-0.276 (-0.581 to 0.028)	-0.269 (-0.569 to 0.031)	-0.33 (-0.641 to -0.019)	-0.316 (-0.655 to 0.024)
Education							
High school or less			Ref	Ref	Ref	Ref	Ref
Some college			-0.943 (-2.507 to 0.62)	-0.830 (-2.205 to 0.546)	-0.695 (-2.063 to 0.673)	-0.463 (-1.899 to 0.974)	-0.418 (-1.928 to 1.092)
College or above			-2.683 (-4.486 to -0.88)	-2.286 (-3.874 to -0.697)	-2.229 (-3.799 to -0.658)	-1.73 (-3.385 to -0.076)	-1.764 (-3.491 to -0.038)
Physical factors							
PROMIS sleep disturbance				0.289 (0.225 to 0.353)	0.244 (0.177 to 0.310)	0.242 (0.172 to 0.311)	0.223 (0.150 to 0.296)
Body mass index				0.105 (0.035 to 0.174)	0.096 (0.027 to 0.164)	0.087 (0.015 to 0.159)	0.090 (0.014 to 0.166)
PROMIS physical health				-2.704 (-3.385 to -2.024)	-2.444 (-3.131 to -1.757)	-2.639 (-3.356 to -1.923)	-2.898 (-3.654 to -2.141)
Psychological factors							
PROMIS anxiety					-0.009 (-0.088 to 0.071)	0.022 (-0.063 to 0.108)	0.006 (-0.085 to 0.097)
PROMIS depression					-0.025 (-0.1 to 0.051)	-0.006 (-0.084 to 0.073)	0.002 (-0.08 to 0.084)
PROMIS anger					0.148 (0.084 to 0.212)	0.146 (0.078 to 0.213)	0.143 (0.071 to 0.215)
Behavioral factors							
Smoking							
Not current						Ref	Ref
Current						0.165 (-1.553 to 1.882)	0.161 (-1.646 to 1.967)
Coping with religion						0.116 (-0.171 to 0.402)	0.204 (-0.099 to 0.507)

Characteristic	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Coping with substance use and alcohol						-0.307 (-0.847 to 0.234)	-0.285 (-0.835 to 0.265)
Coping with self-blame						-0.357 (-0.765 to 0.051)	-0.473 (-0.899 to -0.048)
Coping with denial						0.091 (-0.301 to 0.483)	0.091 (-0.313 to 0.496)
Social factors							
PROMIS emotional support							-0.030 (-0.105 to 0.046)
PROMIS social isolation							0.049 (-0.032 to 0.131)
Financial strain							-0.024 (-0.253 to 0.206)
Discrimination score							-0.526 (-1.586 to 0.534)

Model 1: Disease-related factors; Model 2: Model 1 + demographic factors; Model 3: Model 2 + socioeconomic factors; Model 4: Model 3 + physical factors; Model 5: Model 4 + psychological factors; Model 6: Model 5 + behavioral factors; Model 7: Model 6 + social factors.

** These models comprise the sensitivity analyses that include the modified Systemic Lupus Activity Questionnaire (SLAQ) which overt mentions of pain including stomach pain, chest pain, headache, joint swelling, joint pain, muscle pain

* Statistically significant variables in the final model are bolded

Supplementary Table 3. Hierarchical linear regression analyses of seven constructs with **pain intensity** as outcome stratified by individual components of SLAQ

Characteristic	Constitutional		Mucocutaneous		Organ system		Musculoskeletal	
	Model 1	Model 7	Model 1	Model 7	Model 1	Model 7	Model 1	Model 7
R ²	0.187	0.508	0.177	0.493	0.253	0.509	0.379	0.564
ΔR ²	--	.321	--	0.316	--	.256	--	0.185
Disease related factors								
Disease activity	0.484 (0.403 to 0.566)	0.234 (0.152 to 0.316)	0.283 (0.233 to 0.332)	0.121 (0.071 to 0.172)	0.245 (0.211 to 0.279)	0.131 (0.091 to 0.172)	0.456 (0.412 to 0.501)	0.292 (0.24 to 0.344)
Organ damage	0.115 (0.032 to 0.198)	0.014 (-0.063 to 0.09)	0.126 (0.041 to 0.21)	0.01 (-0.069 to 0.089)	0.021 (-0.063 to 0.104)	-0.042 (-0.121 to 0.037)	0.092 (0.022 to 0.162)	0.015 (-0.054 to 0.085)
Demographic factors								
Age at survey		0.018 (0.004 to 0.032)		0.019 (0.005 to 0.033)		0.023 (0.009 to 0.038)		0.018 (0.005 to 0.03)
Gender								
Male		Ref		Ref		Ref		Ref
Female		-0.865 (-1.57 to -0.16)		-0.689 (-1.416 to 0.038)		-0.899 (-1.62 to -0.179)		-0.845 (-1.498 to -0.193)
Marital status								
Not single		Ref		Ref		Ref		Ref
Single		-0.239 (-0.647 to 0.17)		-0.094 (-0.51 to 0.322)		-0.142 (-0.558 to 0.275)		-0.139 (-0.519 to 0.241)
Race								
Non-black		Ref		Ref		Ref		Ref
Black		0.645 (0.15 to 1.139)		0.709 (0.207 to 1.212)		0.593 (0.089 to 1.097)		0.584 (0.125 to 1.043)
Socioeconomic factors								
Household income		-0.134 (-0.235 to -0.032)		-0.137 (-0.24 to -0.034)		-0.127 (-0.23 to -0.024)		-0.134 (-0.228 to -0.041)
Education								
High school or less		Ref		Ref		Ref		Ref
Some college		-0.259 (-0.706 to 0.189)		-0.298 (-0.754 to 0.157)		-0.36 (-0.816 to 0.097)		-0.226 (-0.641 to 0.19)
College or above		-0.709 (-1.222 to -0.195)		-0.638 (-1.16 to -0.115)		-0.696 (-1.217 to -0.175)		-0.444 (-0.921 to 0.034)
Physical factors								
PROMIS sleep disturbance		0.055 (0.033 to 0.077)		0.061 (0.039 to 0.083)		0.052 (0.029 to 0.074)		0.049 (0.029 to 0.07)
Body mass index		0.047 (0.024 to 0.07)		0.032 (0.009 to 0.056)		0.041 (0.018 to 0.064)		0.024 (0.003 to 0.045)
PROMIS physical health		-0.753 (-0.979 to -0.527)		-0.785 (-1.012 to -0.557)		-0.682 (-0.914 to -0.451)		-0.592 (-0.804 to -0.38)
Psychological factors								
PROMIS anxiety		-0.002 (-0.029 to 0.025)		-0.003 (-0.03 to 0.024)		-0.013 (-0.04 to 0.015)		-0.003 (-0.027 to 0.022)
PROMIS depression		0 (-0.024 to 0.024)		0.002 (-0.022 to 0.026)		-0.012 (-0.037 to 0.012)		-0.01 (-0.032 to 0.011)
PROMIS anger		0.028 (0.007 to 0.049)		0.029 (0.007 to 0.05)		0.038 (0.016 to 0.06)		0.026 (0.006 to 0.046)
Behavioral factors								
Smoking								
Not current		Ref		Ref		Ref		Ref
Current		0.144 (-0.394 to 0.683)		0.068 (-0.48 to 0.616)		0.076 (-0.471 to 0.624)		-0.055 (-0.556 to 0.446)
Coping with religion		0.03 (-0.06 to 0.121)		0.029 (-0.063 to 0.12)		0.039 (-0.053 to 0.13)		0.012 (-0.073 to 0.096)
Coping with substance use and alcohol		-0.022 (-0.181 to 0.138)		-0.001 (-0.168 to 0.167)		-0.012 (-0.176 to 0.153)		-0.007 (-0.156 to 0.143)
Coping with self-blame		-0.21 (-0.335 to -0.085)		-0.215 (-0.345 to -0.086)		-0.183 (-0.311 to -0.055)		-0.213 (-0.33 to -0.095)
Coping with denial		0.162 (0.043 to 0.281)		0.168 (0.046 to 0.29)		0.154 (0.031 to 0.276)		0.188 (0.077 to 0.3)
Social factors								
PROMIS emotional support		0.004 (-0.018 to 0.026)		0.009 (-0.014 to 0.031)		0.008 (-0.015 to 0.031)		0.008 (-0.013 to 0.028)
PROMIS social isolation		0.002 (-0.022 to 0.026)		0.005 (-0.02 to 0.029)		0.007 (-0.018 to 0.032)		0 (-0.022 to 0.023)
Financial strain		0.052 (-0.016 to 0.12)		0.032 (-0.036 to 0.1)		0.043 (-0.025 to 0.111)		0.038 (-0.025 to 0.1)
Discrimination score		-0.162 (-0.474 to 0.149)		-0.162 (-0.482 to 0.157)		-0.261 (-0.582 to 0.059)		-0.163 (-0.455 to 0.129)

Model 1: Disease-related factors; Model 7: Disease-related factors + Demographic factors + Socioeconomic factors + Physical factors + Behavioral factors + Social factors.

* Statistically significant variables in the final model are bolded

Supplementary Table 4. Hierarchical linear regression analyses of seven constructs with **pain interference** as outcome stratified by individual components of SLAQ

Characteristic	Constitutional		Mucocutaneous		Organ system		Musculoskeletal	
	Model 1	Model 7	Model 1	Model 7	Model 1	Model 7	Model 1	Model 7
R ²	0.213	0.524	0.181	0.515	0.269	0.536	0.389	0.577
ΔR ²	--	0.311	--	0.334	--	0.267	--	0.188
Disease related factors								
Disease activity	1.674 (1.407 to 1.94)	0.632 (0.362 to 0.902)	0.902 (0.738 to 1.066)	0.222 (0.056 to 0.387)	0.819 (0.707 to 0.932)	0.295 (0.163 to 0.426)	1.508 (1.362 to 1.655)	0.814 (0.643 to 0.984)
Organ damage	0.553 (0.279 to 0.826)	0.243 (-0.009 to 0.495)	0.628 (0.347 to 0.909)	0.262 (0.001 to 0.522)	0.284 (0.006 to 0.562)	0.136 (-0.122 to 0.394)	0.482 (0.249 to 0.714)	0.24 (0.011 to 0.468)
Demographic factors								
Age at survey		0.048 (0.003 to 0.093)		0.039 (-0.007 to 0.085)		0.043 (-0.004 to 0.089)		0.041 (-0.001 to 0.084)
Gender								
Male		Ref		Ref		Ref		Ref
Female		-1.461 (-3.796 to 0.874)		-1.366 (-3.771 to 1.039)		-1.317 (-3.681 to 1.047)		-1.547 (-3.703 to 0.609)
Marital status								
Not single		Ref		Ref		Ref		Ref
Single		-0.426 (-1.773 to 0.921)		-0.326 (-1.696 to 1.043)		-0.385 (-1.746 to 0.976)		-0.113 (-1.363 to 1.138)
Race								
Non-black		Ref		Ref		Ref		Ref
Black		0.115 (-1.522 to 1.752)		0.217 (-1.446 to 1.879)		-0.043 (-1.697 to 1.611)		-0.065 (-1.583 to 1.454)
Socioeconomic factors								
Household income		-0.289 (-0.625 to 0.046)		-0.336 (-0.675 to 0.003)		-0.327 (-0.664 to 0.011)		-0.279 (-0.588 to 0.03)
Education								
High school or less		Ref		Ref		Ref		Ref
Some college		-0.143 (-1.617 to 1.331)		-0.164 (-1.662 to 1.334)		-0.405 (-1.895 to 1.085)		-0.103 (-1.47 to 1.263)
College or above		-1.769 (-3.463 to -0.074)		-1.773 (-3.495 to -0.05)		-1.591 (-3.296 to 0.113)		-1.171 (-2.746 to 0.403)
Physical factors								
PROMIS sleep disturbance		0.222 (0.15 to 0.293)		0.236 (0.164 to 0.308)		0.219 (0.147 to 0.292)		0.183 (0.116 to 0.25)
Body mass index		0.113 (0.037 to 0.188)		0.077 (0.001 to 0.153)		0.107 (0.032 to 0.182)		0.047 (-0.022 to 0.116)
PROMIS physical health		-2.87 (-3.615 to -2.124)		-2.942 (-3.693 to -2.191)		-2.886 (-3.643 to -2.129)		-2.463 (-3.162 to -1.764)
Psychological factors								
PROMIS anxiety		0.222 (0.15 to 0.293)		0.026 (-0.064 to 0.116)		0.015 (-0.075 to 0.105)		0.036 (-0.046 to 0.117)
PROMIS depression		0.113 (0.037 to 0.188)		0.016 (-0.064 to 0.096)		-0.01 (-0.09 to 0.071)		-0.02 (-0.091 to 0.051)
PROMIS anger		-2.87 (-3.615 to -2.124)		0.139 (0.068 to 0.211)		0.143 (0.07 to 0.215)		0.134 (0.069 to 0.199)
Behavioral factors								
Smoking								
Not current		Ref		Ref		Ref		Ref
Current		0.794 (-0.967 to 2.555)		0.363 (-1.427 to 2.154)		0.348 (-1.426 to 2.122)		-0.013 (-1.651 to 1.625)
Coping with religion		0.176 (-0.121 to 0.473)		0.198 (-0.103 to 0.499)		0.189 (-0.11 to 0.488)		0.182 (-0.094 to 0.459)
Coping with substance use and alcohol		-0.382 (-0.907 to 0.143)		-0.182 (-0.731 to 0.367)		-0.369 (-0.904 to 0.166)		-0.348 (-0.839 to 0.142)
Coping with self-blame		-0.43 (-0.843 to -0.016)		-0.495 (-0.919 to -0.07)		-0.478 (-0.896 to -0.06)		-0.456 (-0.844 to -0.069)
Coping with denial		0.038 (-0.355 to 0.431)		0.11 (-0.292 to 0.513)		0.018 (-0.383 to 0.42)		0.12 (-0.248 to 0.488)
Social factors								
PROMIS emotional support		-0.034 (-0.107 to 0.04)		-0.023 (-0.097 to 0.051)		-0.011 (-0.085 to 0.064)		-0.012 (-0.08 to 0.056)
PROMIS social isolation		0.041 (-0.039 to 0.121)		0.051 (-0.029 to 0.132)		0.061 (-0.021 to 0.143)		0.039 (-0.035 to 0.114)
Financial strain		0.001 (-0.224 to 0.225)		-0.011 (-0.236 to 0.215)		0 (-0.223 to 0.224)		-0.008 (-0.213 to 0.197)
Discrimination score		-0.542 (-1.569 to 0.486)		-0.343 (-1.396 to 0.709)		-0.72 (-1.766 to 0.326)		-0.554 (-1.516 to 0.407)

Model 1: Disease-related factors; Model 1: Disease-related factors; Model 7: Disease-related factors + Demographic factors + Socioeconomic factors + Physical factors + Behavioral factors + Social factors.

* Statistically significant variables in the final model are bolded