

Supplementary Material

Dimensional Structure of one-year Post-COVID-19 Neuropsychiatric and Somatic Sequelae and Association with Role Impairment

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Supplementary Table S1. Weighted demographics, treatment and acute COVID19 illness severity (N=248)

	n	%	SE	Mean	SE
Demographics					
Age					
Sample (Before weighting)				48.9	1.0
Population (After weighting)				44.6	1.0
Sex, male					
Sample (Before weighting)	114	46.0%	3.20%		
Population (After weighting)	118	47.5%	3.40%		
Education					
Primary or below	20	8.1%	1.50%		
Secondary	120	48.6%	3.40%		
Post-secondary	107	43.3%	3.40%		
Marital status					
Single	87	35.3%	3.30%		
Married	141	56.9%	3.40%		
Divorced	11	4.3%	1.30%		
Widowed	9	3.5%	1.10%		
	n	%	SE	Mean	Range (Q1-Q3)
Treatment					
Days in hospital				17.2	2 - 114 (10-19)
Days since admission				329.9	47 - 570 (209-409)
Intensive care unit stay	14	6%	1.7%		
Supplemental oxygen	30	14%	2.3%		
Mechanical ventilation	8	4%	1.3%		
Drugs					
Lopinavir	72	32%	3.4%		
Ribavirin	84	37%	3.4%		
IFN	106	47%	3.6%		
Remdesivir	27	12%	2.1%		
Steroid	33	15%	2.4%		
	n	%	SE	Mean	SE
Acute COVID19 severity					
C reactive protein (mg/L)				1.6	0.2
Severity ^a					
Asymptomatic	4	2%	1.0%		
Mild	87	40%	3.6%		
Moderate	100	45%	3.6%		
Severe	15	7%	1.6%		
Critical	14	7%	1.7%		
Neuro symptom	73	48%	4.3%		
Cardiac symptom	12	9%	2.5%		
Viral pneumonitis	128	58%	3.6%		
Secondary infections	11	5%	1.5%		

^aMild = No pneumonia but with other symptoms; Moderate = With pneumonia; Severe = Pneumonia with desaturation requiring O₂; Critical = Mechanical ventilation shock or ICU

Supplementary Table S2. Comparison of symptom scores and prevalence between COVID-19 survivors and community respondents

	Community (n=1834) ^a		COVID-19 survivors (n=248)				
	Mean	SE	Mean	SE	t	df	p
Symptom score							
PHQ9	4.3	0.1	4.7	0.3	0.9	2080	0.36
GAD7	3.6	0.1	3.5	0.3	-0.4	2080	0.70
PCL5	2.9	0.1	2.9	0.2	-0.1	2080	0.94
CAGEAID	0.2	0.0	0.2	0.0	0.8	2080	0.40
	n	%	n	%	X ²	df	p
Disorder/ symptom prevalence							
Depression (PHQ9 >=10)	258.0	14.10%	43.0	17.40%	1.9	1	0.20
Generalized anxiety (GAD7 >=10)	190.0	10.40%	23.0	9.40%	0.2	1	0.68
PTSD (PCL5 >=7)	257.0	14%	47.0	19.10%	4.5	1	0.047*
Substance/alcohol abuse (CAGEAID >=1)	166.0	9.10%	32.3	13.00%	3.9	1	0.06
Any disorder	497	27.10%	80.0	32.40%	3.1	1	0.1
Suicidal thoughts or behaviours	329	18%	38	15.50%	0.9	1	0.37

^a Representative community sample via mailing survey invitations to 10,000 randomly drawn addresses. Surveys were completed between Nov 20 and Mar 22.

Both the community and COVID-19 survivors samples were weighted to the age-sex distribution of all COVID-19 survivors recorded on government database as of 18-Dec-21

* = p<.05

Supplementary Table S3. Effects of sex, age, COVID-19 infection severity, time since admission and previous mental disorders on disorder/symptom prevalence and severity (N=248)

	Sex			Age			COVID-19 infection severity (at least moderate) ^b			Time since admission			Previous mental disorder		
	X ²	df	p	F ^a	df	p	χ ²	df	p	F ^a	df	p	χ ²	df	p
Symptom prevalence															
Depression (PHQ9 ≥10)	5.8	1	0.03*	0.8	(1, 247)	0.37	0.1	1	0.82	0.0	(1, 222)	0.97	27.8	1	<0.0001***
Generalized anxiety (GAD7 ≥10)	7.9	1	0.01*	1.1	(1, 247)	0.30	0.1	1	0.81	0.0	(1, 222)	1.00	20.0	1	<0.0001***
PTSD (PCL5 ≥7)	3.3	1	0.1	2.0	(1, 247)	0.16	0.7	1	0.44	1.0	(1, 222)	0.31	20.0	1	<0.0001***
Substance/alcohol abuse (CAGEAID ≥1)	3.8	1	0.06	0.0	(1, 247)	0.89	0.2	1	0.65	0.3	(1, 222)	0.59	0.7	1	0.42
Any disorder	7.9	1	0.01*	0.3	(1, 247)	0.59	0.6	1	0.45	0.1	(1, 222)	0.77	23.6	1	<0.0001***
Somatic symptoms (PHQ15 ≥10)	2.1	1	0.18	0.2	(1, 247)	0.69	2.6	1	0.12	1.0	(1, 222)	0.33	5.2	1	0.03*
Fatigue (CFQ ≥4)	6.7	1	0.02*	0.4	(1, 247)	0.51	0.9	1	0.38	0.0	(1, 222)	0.94	16.5	1	<0.0001***
SCI (AMIC ≥3)	7.7	1	0.01*	2.7	(1, 247)	0.10	0.8	1	0.42	0.6	(1, 222)	0.45	16.1	1	<0.0001***
Suicidal thoughts or behaviours	7.8	1	0.01*	2.3	(1, 247)	0.14	0.3	1	0.61	2.0	(1, 222)	0.16	6.9	1	0.01*
Symptom score	t	df	p	F	df	p	t	df	p	F	df	p	t	df	p
PHQ9	2.4	247	0.02*	0.4	(1, 247)	0.52	0.9	218	0.36	0.8	(1, 222)	0.39	-5.9	247	<0.0001***
GAD7	2.9	247	0.004**	2.3	(1, 247)	0.13	2.0	218	0.05	1.3	(1, 222)	0.25	-5.9	247	<0.0001***
PCL5	2.8	247	0.006**	5.5	(1, 247)	0.02*	1.1	218	0.27	2.8	(1, 222)	0.10	-5.7	247	<0.0001***
PHQ15	1.4	247	0.17	0.2	(1, 247)	0.69	1.8	218	0.08	2.1	(1, 222)	0.15	-3.4	247	0.00039***
CFQ	2.5	247	0.01*	1.6	(1, 247)	0.21	1.1	218	0.26	1.3	(1, 222)	0.26	-5.2	247	<0.0001***
AMIC	2.4	247	0.02*	0.7	(1, 247)	0.40	0.9	218	0.38	2.5	(1, 222)	0.12	-4.1	247	<0.0001***

^aWald test

^bWith pneumonia, requiring mechanical ventilation shock or admission to ICU

PHQ9, Patient Health Questionnaire 9; GAD7, Generalized Anxiety Disorder 7; PCL5, Posttraumatic Stress Disorder Checklist for DSM-5; CAGE-AID, Cut, annoyed, guilty, eye-opener questionnaire adapted to include drugs; PHQ15, Patient Health Questionnaire 15; CFQ, Chalder Fatigue Scale; AMIC, Abbreviated Memory Inventory for Chinese; SCI, subjective cognitive impairment

p values were not adjusted for multiple comparison

*, **, *** = p<.05, .01, .001

Supplementary Table S4. Effect of past mental disorder on COVID-19 severity (n=248)

	n	No (70.6) %	SE	n	Yes (29.4) %	SE	χ^2	DF	unadjusted p
COVID-19 severity^a							4.1	4	0.44
Asymptomatic	4	2.8%	1.5%	0	0.0%	0.0%			
Mild	59	38.5%	4.2%	28	42.4%	6.7%			
Moderate	71	46.3%	4.3%	28	42.7%	6.6%			
Severe	8	5.2%	1.7%	7	10.0%	3.7%			
Critical	11	7.2%	2.1%	3	4.9%	2.7%			

^aMild = No pneumonia but with other symptoms; Moderate = With pneumonia; Severe = Pneumonia with desaturation requiring O₂; Critical = Mechanical ventilation shock or ICU

Supplementary Table S5. Demographics, past mental health problems, baseline COVID19 severity, current mental health symptoms and role impairment across 4 latent profiles (n=248)

	P1 (12.4%)			P2 (23.1%)			P3 (45.2%)			P4 (19.3%)			F ^a	DF	unadjusted p
	n	Mean/ %	SE	n	Mean/ %	SE	n	Mean/ %	SE	n	Mean/ %	SE			
Demographics															
Age	31	47.2	3.1	57	47.0	2.1	112	42.3	1.4	48	45.5	2.1	1.7	(3, 245)	0.18
Sex, male	18	58.5%	9.3%	30	51.9%	6.9%	51	45.8%	5.1%	19	39.5%	7.7%	1.0	(3, 740)	0.41
Education													1.0	(6, 1394)	0.39
Primary or below	2	7.6%	3.8%	7	11.5%	3.9%	8	6.8%	2.1%	4	7.8%	3.2%			
Secondary	19	60.7%	9.4%	27	47.2%	6.9%	48	42.9%	5.0%	27	55.7%	7.7%			
Post-secondary	10	31.7%	9.3%	24	41.3%	6.8%	56	50.3%	5.1%	18	36.6%	7.7%			
Marital status													1.7	(8, 2074)	0.10
Single	8	27.2%	9.2%	15	25.8%	6.2%	47	41.8%	5.1%	17	36.4%	7.6%			
Married	22	70.9%	9.2%	39	68.1%	6.4%	58	51.5%	5.1%	23	47.2%	7.7%			
Divorced	1	1.9%	1.9%	2	3.1%	1.8%	5	4.3%	1.9%	3	7.2%	4.3%			
Widowed	0	0.0%	0.0%	2	3.0%	1.7%	3	2.3%	1.5%	4	9.2%	4.0%			
Past mental disorder	3	9.9%	6.5%	4	7.0%	3.6%	42	37.1%	4.9%	24	50.7%	7.8%	8.7	(2, 732)	0.00018***
Mental health symptoms															
PHQ9	31	0.2	0.1	57	1.1	0.2	112	5.3	0.4	48	10.3	0.8	68.6	(3, 244)	<0.0001***
GAD7	31	0.0	0.0	57	0.1	0.0	112	4.9	0.4	48	6.4	0.7	51.4	(3, 244)	<0.0001***
PCL5	31	0.0	0.0	57	0.1	0.0	112	4.4	0.3	48	4.2	0.5	52.3	(3, 244)	<0.0001***
PHQ15	31	0.7	0.1	57	2.4	0.3	112	5.9	0.4	48	10.4	1.0	49.0	(3, 244)	<0.0001***
CFQ	31	0.0	0.0	57	1.4	0.2	112	2.6	0.2	48	2.8	0.3	34.4	(3, 244)	<0.0001***
AMIC	31	0.0	0.0	57	1.3	0.2	112	4.9	0.4	48	5.0	0.7	29.4	(3, 244)	<0.0001***
Baseline COVID19 severity															
Days in hospital	30	15.0	1.9	49	15.6	1.2	105	19.0	1.4	39	16.1	1.8	1.4	(3, 220)	0.26
Severity ^b													1.1	(11, 2791)	0.40
Asymptomatic	1	2.7%	2.7%	1	2.9%	2.9%	0	0.0%	0.0%	2	5.4%	4.0%			
Mild	17	55.2%	9.3%	20	41.0%	7.6%	37	35.7%	5.1%	14	36.4%	8.6%			
Moderate	9	29.7%	7.9%	25	50.7%	7.6%	50	48.3%	5.3%	16	42.2%	8.5%			
Severe	2	5.8%	3.4%	1	1.2%	1.2%	9	8.8%	2.8%	3	8.4%	4.4%			
Critical	2	6.6%	4.9%	2	4.1%	2.4%	7	7.2%	2.5%	3	7.6%	5.1%			
Intensive care unit stay	2	6.6%	4.9%	2	4.1%	2.4%	7	7.1%	2.4%	3	7.3%	4.9%	0.2	(3, 705)	0.90
Supplemental oxygen	4	12.4%	5.8%	3	5.3%	2.7%	17	15.8%	3.6%	7	19.0%	6.9%	1.5	(3, 715)	0.20
Neuro symptom	4	25.5%	11.6%	17	49.8%	9.1%	35	47.1%	6.2%	17	61.4%	9.8%	1.6	(3, 741)	0.20
Cardiac symptom	1	4.0%	4.0%	5	15.9%	6.6%	6	9.4%	3.9%	0	0.0%	0.0%	1.7	(3, 693)	0.17
Viral pneumonitis	13	42.1%	9.1%	27	56.0%	7.6%	66	64.3%	5.1%	22	58.2%	8.7%	1.4	(3, 739)	0.23
Secondary infections	3	9.5%	6.3%	1	2.9%	2.1%	4	4.0%	1.8%	2	5.1%	3.8%	0.6	(3, 711)	0.58
Mechanical ventilation	1	4.7%	4.6%	1	2.9%	2.1%	4	4.0%	1.8%	1	3.6%	3.5%	0.1	(3, 703)	0.98
C reactive protein (mg/L)	29	2.0	0.6	47	1.6	0.3	105	1.7	0.3	39	1.3	0.3	0.5	(3, 216)	0.69
Drugs															
Lopinavir	7	24.8%	8.9%	17	34.0%	7.0%	39	37.4%	5.1%	8	20.2%	7.1%	1.3	(3, 739)	0.27
Ribavirin	10	34.1%	9.1%	20	41.0%	7.2%	42	39.8%	5.1%	11	28.8%	8.0%	0.6	(3, 740)	0.64
IFN	13	43.3%	9.5%	22	45.0%	7.4%	57	54.8%	5.3%	13	34.2%	8.2%	1.6	(3, 740)	0.19
Remdesivir	4	14.4%	6.1%	5	9.4%	4.0%	16	14.8%	3.5%	2	6.1%	3.0%	1.0	(3, 725)	0.39
Steroid	5	16.6%	6.4%	3	5.2%	2.6%	20	18.7%	3.8%	6	15.4%	6.3%	1.8	(3, 715)	0.15

Supplementary Table S5. Demographics, past mental health problems, baseline COVID19 severity, current mental health symptoms and role impairment across 4 latent profiles (n=248)

	P1 (12.4%)			P2 (23.1%)			P3 (45.2%)			P4 (19.3%)			F ^a	DF	unadjusted p
	n	Mean/ %	SE	n	Mean/ %	SE	n	Mean/ %	SE	n	Mean/ %	SE			
Role impairment															
WHODAS	31	7.2	4.8	57	8.8	2.8	112	20.1	2.6	48	27.8	4.4	6.5	(3, 245)	0.0003***

PHQ9, Patient Health Questionnaire 9; GAD7, Generalized Anxiety Disorder 7; PCL5, Posttraumatic Stress Disorder Checklist for DSM-5; CAGE-AID, Cut, annoyed, guilty, eye-opener questionnaire adapted to include drugs; PHQ15, Patient Health Questionnaire 15; CFQ, Chalder Fatigue Scale; AMIC, Abbreviated Memory Inventory for Chinese; SCI, subjective cognitive impairment

^aFor categorical variables, this is a variant of the second-order Rao-Scott adjusted chi-square statistic. Significance is based on the adjusted F and its degrees of freedom. For continuous variables, this is a one-way ANOVA.

^bMild = No pneumonia but with other symptoms; Moderate = With pneumonia; Severe = Pneumonia with desaturation requiring O₂; Critical = Mechanical ventilation shock or ICU

*** = p<.001

Supplementary Table S6. Bayesian Information Criterion for different covariance structures and number of components

		Bayesian Information Criterion												
	EII	VII	EEI	VEI	EVI	VVI	EEE	VEE	EVE	VVE	EEV	VEV	EVV	VVV
Number of profiles	1	-4255.3	-4255.3	-4282.9	-4282.9	-4282.9	-3429.3	-3429.3	-3429.3	-3429.3	-3429.3	-3429.3	-3429.3	-3429.3
	2	-3574.6	-3249.5	-3575.8	-3268.6	NA	NA	-3468.1	-2832.2	NA	NA	-3368.7	-2630.5	NA
	3	-3457.1	-2817.5	-3434.3	-2787.1	NA	NA	-3313.9	-2700.9	NA	NA	-3372.4	-2535.5	NA
	4	-3495.7	-2716.6	-3409.5	-2629.1	NA	NA	-3409.6	-2612.6	NA	NA	-3356.0	-2349.34*	NA
	5	-3452.9	-2695.6	-3400.2	-2585.2	NA	NA	-3367.4	-2591.4	NA	NA	-3346.8	-2461.1	NA
	6	-3457.4	NA	-3402.0	-2521.3	NA	NA	-3372.6	-2595.1	NA	NA	-3367.4	-2531.4	NA
	7	-3338.1	NA	-3312.9	-2491.0	NA	NA	-3364.9	-2591.0	NA	NA	-3419.3	-2504.8	NA
	8	-3376.5	NA	-3378.3	-2565.9	NA	NA	-3364.1	-2590.3	NA	NA	-3382.1	-2541.3	NA
	9	-3353.5	NA	-3317.1	-2559.4	NA	NA	-3327.9	NA	NA	NA	-3538.3	-2671.9	NA

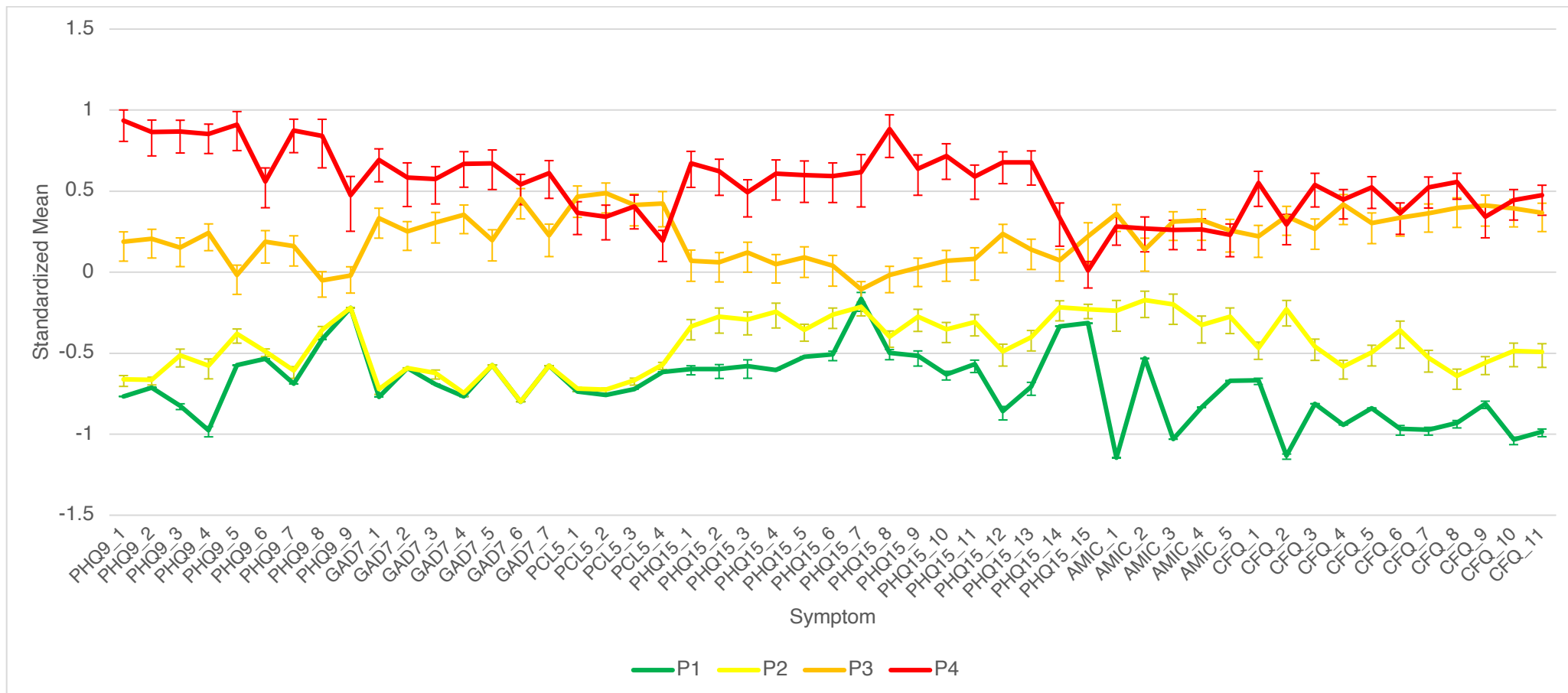
Covariance structures as described in Mclust v 5.4.8

*4 profiles with a VEV covariance structure was found to best fit the data

Supplementary Table S7. Classification probabilities to the four latent profiles

Assigned profile	Classification probability ^a							
	Profile 1		Profile 2		Profile 3		Profile 4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.96	0.10	0.03	0.09	0.01	0.04
3	0.00	0.00	0.01	0.03	0.95	0.10	0.04	0.09
4	0.00	0.00	0.00	0.01	0.04	0.10	0.96	0.10

^aObtained from the z matrix returned from the Mclust command (Mclust package v5.4.8 in R)



Supplementary Figure S1. Standardized mean scores from six self-rated scales across latent profiles. Error bars represent 95% confidence interval
 PHQ9, Patient Health Questionnaire 9; GAD7, Generalized Anxiety Disorder 7; PCL5, Posttraumatic Stress Disorder Checklist for DSM-5; PHQ15, Patient Health Questionnaire 15; AMIC, Abbreviated Memory Inventory for Chinese; CFQ, Chalder Fatigue Scale

Supplementary Table S8. WHODAS Impairment regressed on past mental disorder and current symptom severity and latent profiles (n=248)

	Model 1			Model 2		
	Univariate Standardised beta (SE) [p]	Multivariate Standardised beta (SE) [p]	VIF	Univariate Standardised beta (SE) [p]	Multivariate Standardised beta (SE) [p]	VIF
Demographics						
Sex (Male)	-0.16 (0.12) [0.19]	-0.01 (0.11) [0.948]	1.06	-0.16 (0.12) [0.19]	-0.06 (0.12) [0.597]	1.02
Age	0.01 (0.06) [0.82]	0.05 (0.06) [0.389]	1.06	0.01 (0.06) [0.82]	0.04 (0.06) [0.557]	1.03
Past mental disorder	0.48 (0.13) [$<0.0001^{***}$]	0.11 (0.14) [0.407]	1.26	0.48 (0.13) [$<0.0001^{***}$]	0.3 (0.14) [0.035*]	1.18
Current symptom severity						
Depression (PHQ9)	0.38 (0.06) [$<0.0001^{***}$]	0.14 (0.11) [0.205]	3.77	-	-	-
Anxiety (GAD7)	0.36 (0.06) [$<0.0001^{***}$]	0.01 (0.11) [0.9]	3.39	-	-	-
PTSD (PCL5)	0.32 (0.06) [$<0.0001^{***}$]	0.05 (0.09) [0.567]	2.63	-	-	-
Somatization (PHQ15)	0.32 (0.06) [$<0.0001^{***}$]	0.12 (0) [0.125]	2.01	-	-	-
SCI (AMIC)	0.22 (0.06) [$<0.0001^{***}$]	-0.11 (0.08) [0.16]	1.97	-	-	-
Fatigue (CFQ11)	0.38 (0.06) [$<0.0001^{***}$]	0.23 (0.09) [0.017*]	2.92	-	-	-
Latent profiles						1.18
P1	-	-	-		ref	-
P2	-	-	-	0.05 (0.21) [0.80]	0.06 (0.21) [0.776]	-
P3	-	-	-	0.46 (0.19) [0.017*]	0.38 (0.19) [0.051]	-
P4	-	-	-	0.74 (0.22) [$<0.0001^{***}$]	0.61 (0.22) [0.007**]	-
Model building						
Demographics	-	ref	-	-	ref	-
+ past mental disorders	-	F=13.89(1, 244) $p<0.0001^{***}$	-	-	F=12.36(1, 244) $p<0.0001^{***}$	-
+ current symptom severity	-	F=7.6(6, 238) $p<0.0001^{***}$	-	-	-	-
+ latent profiles	-	-	-	-	F=3.78(3, 241) $p=0.011^*$	-
Model evaluation						
R-squared	-	0.21	-	-	0.1	-
Adjusted r-squared	-	0.18	-	-	0.07	-
F-test	-	F=6.85(9, 238) $p<0.0001^{***}$	-	-	F=4.26(6, 241) $p<0.0001^{***}$	-

PHQ9, Patient Health Questionnaire 9; GAD7, Generalized Anxiety Disorder 7; PCL5, Posttraumatic Stress Disorder Checklist for DSM-5; PHQ15, Patient Health Questionnaire 15; CFQ, Chalder Fatigue Scale; AMIC, Abbreviated Memory Inventory for Chinese; SCI, subjective cognitive impairment

*, **, *** = $p<0.05$, 0.01, 0.001