





# Validation of the Arabic Version Post-COVID-19 Symptom Scale (PCSS-Ar) for Assessing Long COVID-19 Severity Among Arabic-Speaking Populations: A Factor Analysis and Rasch Analysis Study

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**Purpose:** The COVID-19 pandemic has led to long COVID-19, a condition characterized by persistent, multisystemic symptoms. This study validated the Arabic version of the Post-COVID-19 Symptom Scale (PCSS-Ar) to assess long COVID-19 severity in Jordan.

**Patients and Methods:** A cross-sectional online survey was conducted with 582 Jordanian adults (aged  $\geq 18$  years), recruited via social media. The PCSS-Ar underwent content validity evaluation by an expert panel, followed by confirmatory factor analysis (CFA) and Rasch analysis to assess its psychometric properties.

**Results:** The final 24-item, five-factor model demonstrated an excellent fit (CFI = 0.95, TLI = 0.95, SRMR = 0.02) and strong internal consistency (Cronbach's  $\alpha \geq 0.97$ ). Rasch analysis confirmed the tool's ability to differentiate symptom severity levels effectively. Key findings indicated that higher frequencies of COVID-19 infection were significantly associated with more severe long COVID-19 symptoms, whereas mild initial infections were linked to lower symptom severity. Notably, lower income was associated with higher PCSS-Ar scores, suggesting socioeconomic disparities in post-COVID-19 recovery. Female participants had lower PCSS-Ar scores, contrasting with previous studies, indicating a potential population-specific effect.

**Conclusion:** The PCSS-Ar is a validated and reliable tool for assessing long COVID-19 symptoms in Arabic-speaking populations. Its application in both clinical and research settings can help monitor symptom progression and guide targeted interventions.

**Keywords:** long covid-19, post-covid-19, validation, Arabic, disease severity

## Introduction

Post-COVID-19 (long COVID-19) denotes persistent, multisystem symptoms following SARS-CoV-2 infection and is defined by World Health Organization (WHO) as manifestations arising within three months of acute illness, lasting at least two months, and not explained by alternative diagnoses.<sup>1,2</sup> A broad spectrum of sequelae has been documented across organ systems, with dyspnea, fatigue, musculoskeletal pain, cough, headache, chest pain, and chemosensory changes among the most frequent complaints.<sup>3,4</sup> The global burden is substantial, with estimates exceeding 65 million affected individuals, and prominent prevalence even among non-hospitalized cases with initially mild disease.<sup>5,6,7</sup> Long COVID-19 also imposes large economic costs, reflecting both direct care and productivity losses.<sup>8,9</sup>

Jordan has experienced a considerable long COVID-19 burden. Among healthcare workers, 59.3% reported post-COVID-19 syndrome with fatigue predominance, and a population survey found persistent symptoms in 27.4%, including tinnitus,

concentration difficulties, and musculoskeletal aches; several demographic and behavioral factors were associated with risk.<sup>10,11</sup> Regional evidence likewise links post-COVID-19 fatigue with poorer health-related quality of life.<sup>12</sup>

Public attitudes toward COVID-19 vaccination in Jordan have been heterogeneous. A national survey of Jordanian young adults demonstrated low overall willingness to receive COVID-19 vaccines, with acceptance rates varying by vaccine type and being influenced by disease severity and vaccine-related knowledge.<sup>13</sup> Such variability in vaccination attitudes may partially explain differences in infection patterns and post-COVID symptom experiences across demographic groups. In addition to being influenced by public acceptance, vaccination uptake and delivery were found to be affected by health system capacity. Evidence from community pharmacy settings indicates a high willingness among pharmacists to provide COVID-19 vaccination services, although structural and regulatory barriers, such as lack of authorization, limited collaboration with other healthcare professionals, and insufficient infrastructure, have limited wider implementation.<sup>14</sup> Although vaccination reduces the risk and severity of long COVID-19, effects vary by dosing and context, and vaccination does not abolish risk.<sup>15–18</sup> These observations underline the need for robust symptom assessment tools tailored to Arabic-speaking populations.

In Jordan, emerging epidemiological data indicate important subgroup differences that further justify the development of an Arabic long COVID assessment tool. Long COVID-19 symptoms have been linked to younger working-age adults, individuals from lower-income households, and those with limited access to specialist care in population surveys,<sup>11</sup> while healthcare workers and other front-line occupations show particularly high rates of post-COVID-19 syndrome.<sup>10</sup> These patterns intersect with national health system priorities. The Jordan National Rehabilitation Strategic Plan 2020–2024 and related policy frameworks emphasize expanding rehabilitation and long-term care services as part of universal health coverage and post-COVID recovery.<sup>19</sup> A culturally adapted and accessible screening tool such as the Post-COVID-19 Symptom Scale (PCSS) is therefore essential to support the identification and monitoring of long COVID across socio-economic strata and occupational groups that are most affected and most likely to present in primary care and rehabilitation settings.<sup>20</sup>

Although multiple tools have been developed internationally to evaluate the symptom burden associated with long COVID, these instruments were created and validated primarily in non-Arabic-speaking populations and have not undergone linguistic or cultural adaptation for use in Arab countries. Currently available Arabic instruments primarily assess general health-related quality of life or acute COVID-19 symptom screening.<sup>21,22</sup> This gap underscores the need for a culturally adapted tool that can capture the full spectrum of symptoms experienced by Arabic-speaking individuals.

Patient-reported outcome measures (PROMs) are essential for capturing the subjective and fluctuating nature of long COVID-19 symptoms that may elude routine clinical examination.<sup>22,23</sup> Existing instruments, such as the Symptom Burden Questionnaire for Long COVID (SBQ-LC),<sup>23</sup> demonstrate the value of PROMs but were primarily developed in non-Arabic contexts and may not fully accommodate linguistic and cultural nuances relevant to Arab populations.<sup>23,24</sup> Barriers related to stigma, health-seeking behavior, and healthcare access further motivate locally validated tools that reflect regional experiences. Against this backdrop, we selected the Post-COVID-19 Symptom Scale (PCSS) for Arabic adaptation. Compared with previously validated long COVID tools, the PCSS provides several conceptual and practical advantages that make it particularly suitable for Arabic adaptation. Unlike broad symptom checklists, it provides a structured, multidimensional framework that includes cognitive, psychological, sensory, and pain-related domains. Importantly, the PCSS was originally validated using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), allowing for a rigorous evaluation of item performance and severity thresholds. The development of the Arabic version of the Post-COVID-19 Symptom Scale (PCSS-Ar) builds on this methodological rigor, extending it to Arabic-speaking populations and marking the first regional adaptation of long COVID measure.<sup>23,25–27</sup>

This study aimed to validate the PCSS-Ar for use in Jordan and the wider Arabic-speaking context, addressing the current gap in validated Arabic instruments for assessing long COVID symptom severity. By applying both CFA and Rasch analysis, our work provides the first comprehensive psychometric evaluation of a multidomain long COVID PROM in Arabic.

## Materials and Methods

An online questionnaire (ie, the instrument) was created using Google Forms. The link to the questionnaire, along with the study aims, was then disseminated through various social media platforms in Jordan. Responses were collected

between May and July 2024. The study inclusion criteria required participants to be Jordanian residents aged 18 years or older. To ensure participants met these criteria before enrollment, two questions were included in the questionnaire regarding place of residency and age. The opening section of the questionnaire outlined the study's aims, assured participants of the confidentiality of their responses, and emphasized that the questionnaire was anonymous. It also confirmed the voluntary nature of participation. Individuals who agreed to participate were required to select the following option: "I have read the study information and agree to participate, consenting to the publication of all collected data". Selecting this option was considered informed consent. The online questionnaire was designed to ensure that no personally identifiable information was collected. The authors obtained ethical approval from the Institutional Review Board and the Deanship of Research at Al-Zaytoonah University of Jordan. This study adhered to the Declaration of Helsinki's ethical guidelines. Ethical approval was granted by Al-Zaytoonah University of Jordan on 10 September 2023 (Ref#21/09/2022-2023).

## Data Collection and Study Instruments

An online questionnaire was chosen as a previous study indicated that this cost-effective method can produce a representative sample of the general population and may even be superior to face-to-face interviews,<sup>28</sup> particularly in countries with high internet penetration.<sup>29</sup> In Jordan, approximately 88% of the population uses the internet, a figure that is likely even higher when excluding children. Although online recruitment may still underrepresent individuals with limited digital literacy or stable internet access, emerging evidence shows that long COVID-19 disproportionately affects younger working-age adults and individuals from lower-income households, groups that were well represented in our sample. Therefore, online recruitment is appropriate for the target population.<sup>30</sup> Moreover, web-based studies provide a safe and confidential environment for respondents,<sup>31</sup> as all responses were collected anonymously. This approach also enables cost-effective recruitment of participants across a wide geographic area by leveraging geographically specialized online groups. Therefore, the questionnaire was distributed through various generic and geographically focused Jordanian groups and platforms.

The second section consisted of three items that inquired about the perceived severity of symptoms experienced during COVID-19 infection, the duration of these symptoms, and whether oxygen therapy had been required. If participants had been infected with COVID-19 more than once, they were instructed to answer the questions based on the most severe symptoms they had experienced during any of their COVID-19 infections. This section also contained questions about hospitalization due to COVID-19, and whether the individual was admitted to the intensive care unit (ICU) because of COVID-19. Participants were then asked how many times they had received the COVID-19 vaccine. The subsequent section collected data on the participants' general health status and any comorbidities.

The final section consisted of 24 items that made up the PCSS (See [appendix, table A1](#)).<sup>20</sup> These 24 items are distributed across five scales that assess the various possible health impacts of long COVID-19. These factors include Life-threatening, Cognitive, Psychological and Non-Life-Threatening, Ache, and Sensory. The tool measures each symptom on a scale of 0 to 10, providing a broader range of assessing symptom severity and enabling long-term evaluation of variations in symptom severity.

Participants were classified into high- or low-risk groups for developing severe COVID-19 complications based on Centers for Disease Control and Prevention (CDC) criteria.<sup>32</sup> Participants were classified into the high-risk group if they had any of the following medical statuses or health conditions: age over 65, pregnancy, overweight/obesity, current or former smoking, chronic lung diseases, diabetes, cardiovascular diseases, mental illnesses, cancer, chronic liver diseases, chronic kidney diseases, cystic fibrosis, dementia or other neurological conditions, disabilities, blood disorders, organ transplant, immunocompromised conditions, or tuberculosis. Participants who did not meet any of these criteria were classified into the low-risk group. Since the online questionnaire was designed to require responses to all items before submission, the final dataset of 582 participants contained no missing data.

To evaluate the demographic representativeness of our sample, we compared the age and income profiles of participants with national census indicators obtained from the Department of Statistics and the Higher Population Council. The median age of the Jordanian population in 2023 was 22.9 years,<sup>33</sup> however, this figure includes children and adolescents. Because our study targeted adults ( $\geq 18$  years), a higher median age in our sample (29 years, IQR 23–37)

is expected and consistent with the adult population structure. Income distribution in our sample also closely mirrored national patterns, with 49.7% of participants reporting a monthly income below 500 JOD, similar to national statistics indicating that the average monthly income in Jordan was 544 JOD in 2022.<sup>34,35</sup> These comparisons support the representativeness of our sample in key demographic dimensions.

## Tool Validation

The PCSS questionnaire underwent a content validity evaluation conducted by a group of experts in the field, including a clinical pharmacist, two infectious disease specialists, and a psychologist. The panel was selected based on their expertise and was tasked with assessing the questionnaire's thoroughness, relevance, and comprehensive coverage of the various effects of long COVID-19, as well as evaluating the clarity and simplicity of the items. In cases of disagreement, an open discussion was held to exchange perspectives until a consensus was reached.

To develop an Arabic version of the questionnaire, a forward-backward translation process was performed by two independent translators, since Arabic is the official language in Jordan. Moreover, a pilot study was conducted to ensure the clarity of the Arabic version of the PCSS (PCSS-Ar) (See [appendix, table A2](#)) questionnaire for the Jordanian study sample. This pilot study involved 30 participants, and the results obtained from this pilot were not included in the final analysis. The reliability of the Post-COVID-19 Symptom Scale was assessed using Cronbach's alpha.

Construct validity refers to the extent to which an instrument aligns with theoretical expectations, demonstrating that it accurately measures the intended construct.<sup>36</sup> The construct validity of the PCSS-Ar was assessed by testing hypotheses related to item distribution within the designated scales and its ability to distinguish symptom severity. To validate the proposed model structure, CFA was performed, while Rasch analysis was conducted to evaluate the instrument's capacity to differentiate symptom severity levels and assess symptom prevalence.

## Sample Size Calculation

As this study involved performing factor analysis, the recommended method for calculating the minimum sample size is the participant-to-item ratio, with a suggested maximum ratio of 20:1.<sup>37</sup> Since the questionnaire consisted of 24 items, the minimum sample size was 480 participants.

## Statistical Analysis

Data analysis for this study was performed using IBM SPSS 26.0 and R software version 4.3.3. Specifically, the Test Analysis Modules (TAM) package version 4.1–4 and latent variable analysis (lavaan) package version 0.6–17 were used. SPSS was selected for its practicality and ease of use, while R was employed to perform tests that could not be conducted with SPSS. Categorical variables were presented as percentages and frequencies, while continuous variables were presented as medians with interquartile ranges (25<sup>th</sup> – 75<sup>th</sup> percentiles). The normality of PCSS-Ar scores was assessed using Q-Q plots and the Kolmogorov–Smirnov test, which indicated that the scores followed a non-normal distribution. Thus, a quantile regression model was applied to assess the association between various socio-economic variables and the PCSS-Ar score. The predictors included in the model were the frequency of previous COVID-19 infections, gender, marital status, high risk for developing severe COVID-19 symptoms, severity of COVID-19 symptoms during the acute infection, frequency of COVID-19 vaccination which was treated as a continuous variable, income status and educational level. Multicollinearity was examined by computing Variance Inflation Factor (VIF) and tolerance values. Statistical significance was determined at  $p < 0.05$ .

## Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) was applied to the original model to assess its suitability for the current data. To evaluate the goodness of fit, several indices were used, including the Comparative Fit Index (CFI), Normed Fit Index (NFI), Standardized Root PCSS Mean Squared Residual (SRMR), and Tucker-Lewis Index (TLI). Acceptable values for SRMR are equal to or less than 0.08.<sup>38</sup> TLI, NFI, and CFI values equal to one indicate a perfect fit, while values close to one indicate a very good fit.<sup>38</sup> The internal consistency of each factor was assessed by computing Cronbach's alpha.

## Rasch Analysis

A multifactorial Rasch analysis for polytomous responses was conducted to assess the validity of PCSS-Ar. Person and item separation reliability indices were computed. Infit/outfit statistics were obtained, with acceptable mean square values (MSQ) ranging between 0.6 and 1.4.<sup>39</sup> Item thresholds were investigated, and a Wright map was produced to visualize the results. Furthermore, differential item functioning (DIF) was examined as a sensitivity analysis. DIF was evaluated separately for sex (male vs female) and for household income (<500 vs  $\geq$ 500 Jordanian dinars) using Wald tests comparing item location parameters between groups. For each contrast, group-specific item difficulties, their standard errors, and corresponding Z statistics were obtained. Absolute Z values greater than 2 were interpreted as evidence of DIF.

## Results

The sociodemographic profiles of the study participants are displayed in Table 1. The study enrolled 582 participants, of whom 59.9% were female. The median age was 29 (with an interquartile range of 23–37). 49.7% of the study's participants reported a monthly income of less than 500 JOD. The median duration of the longest reported periods for COVID-19 symptoms and vaccine side effects were 7 days (interquartile range 3–14) and 4 days (interquartile range 2–7), respectively.

**Table 1** Socio-Demographic Characteristics of the Study Participants

		Count (%) or Median (25–75 Percentiles)
Age		29 (23–37)
Gender	Female	331 (56.9%)
	Male	251 (43.1%)
Marital status	Single	385 (66.2%)
	Married	197 (33.8%)
Did you get COVID-19 while pregnant?	No	112 (84.2%)
	Yes	21 (15.8%)
Were you pregnant while receiving one of the COVID-19 vaccine doses?	No	116 (87.2%)
	Yes	17 (12.8%)
Educational Level	High School or lower	67 (11.5%)
	Diploma	78 (13.4%)
	Bachelor's degree	367 (63.1%)
	Postgraduate	70 (12%)
Income status*	Less than 500 JOD	289 (49.7%)
	500-1000 JOD	200 (34.4%)
	More than 1000 JOD	93 (16%)
BMI status	Underweight	80 (13.7%)
	Normal	158 (27.1%)
	Overweight	200 (34.4%)
	Obese	108 (18.6%)
	Extremely Obese	36 (6.2%)

(Continued)

**Table 1** (Continued).

		Count (%) or Median (25–75 Percentiles)
Do you smoke?	No	384 (66%)
	Ex-smoker	33 (5.7%)
	Yes	165 (28.4%)
How many times have you been infected with COVID-19?	Never had COVID-19	81 (13.9%)
	1	225 (38.7%)
	2	213 (36.6%)
	3	23 (4%)
	More than 3 times	40 (6.9%)
How severe was your infection with COVID-19?	Never been infected	81 (13.9%)
	Mild	105 (18%)
	Moderate	303 (52.1%)
	Severe	93 (16%)
How long did COVID-19 symptoms last? (longest period in days)		7 (3–14)
How many times have you received the COVID-19 vaccine?	Never taken the vaccine	63 (10.8%)
	1 dose	131 (22.5%)
	2 doses	319 (54.8%)
	3 doses	60 (10.3%)
	More than 3 doses	9 (1.5%)
How long did side effects last after receiving the vaccine? (longest period in days)		4 (2–7)
Do you suffer from any chronic diseases?	No	495 (85.1%)
	Yes	87 (14.9%)

**Note:** \*1 Jordanian dinar (JOD) is equivalent to \$1.4.

## Tool Validation

To assess the validity of the proposed 5-factor model a CFA was conducted. The result showed that the 24-item, 5-factor model was suitable for the data. The model provided acceptable fit indices (NFI = 0.95, SRMR = 0.02, CFI = 0.95, and TLI = 0.95). The highest reported factor loadings were for item 2 and item 6 (0.97), while the lowest were observed for item 23 and item 24 (0.85). The standardized factor loadings for each item are listed in [Table 2](#). Cronbach's alpha values for all five factors were acceptable ( $\geq 0.97$ ).

## Rasch Model

The person reliability was 0.982, and the item separation reliability for life-threatening, cognitive, psychological, ace, and sensory factors were 0.978, 0.963, 0.975, 0.967, and 0.961, respectively. [Table 2](#) displays the infit and outfit values, confirming the model's item hierarchy within the PCSS-Ar and its ability to differentiate between varying levels of symptom severity among participants. The infit and outfit MSQ values were within the acceptable range for all items across the five factors, except for item 16, which slightly exceeded the upper threshold for both infit and outfit MCQ values (1.43, 1.45, respectively).

**Table 2** PCSS-ar Items' Factor Loadings, Outfits, Infits, and Internal Consistency

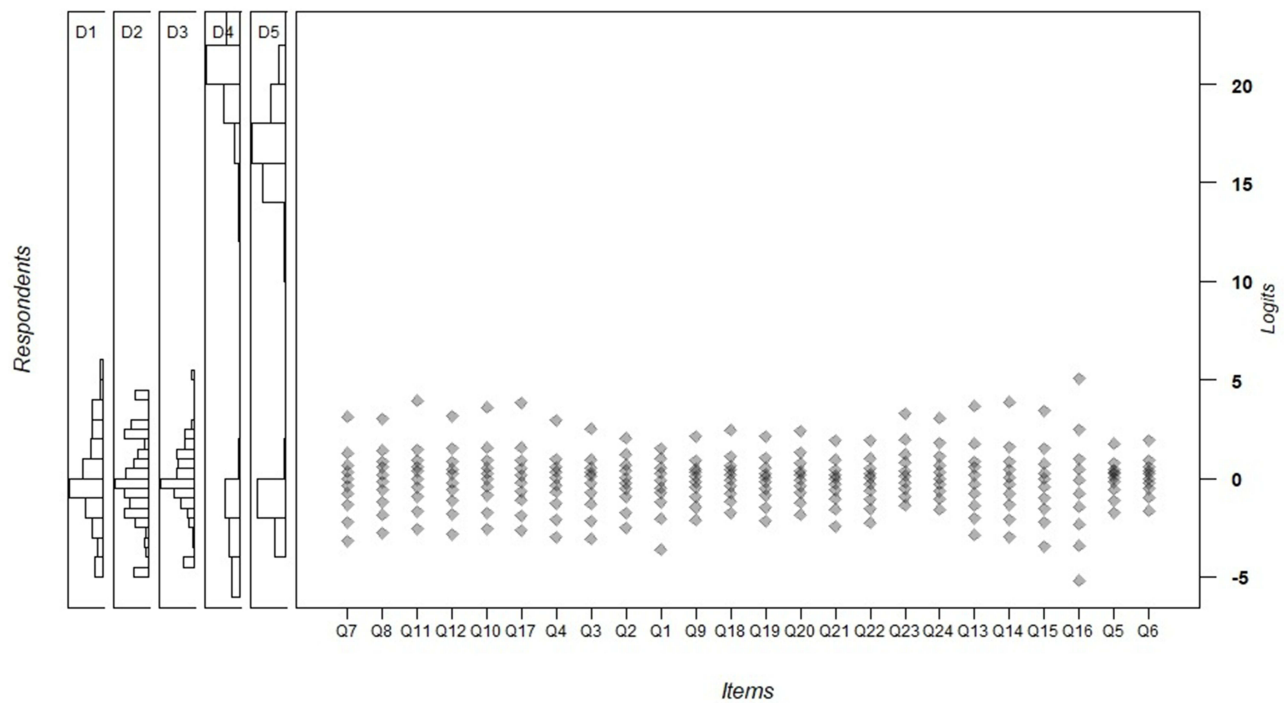
Factors	Standardized Factors Loadings (SE)	Outfit MSQ	Infit MSQ	Cronbach's Alpha
<b>Life-threatening</b>				0.98
Headache	0.91 (0.00)	1.20	1.20	
Vertigo	0.94 (0.02)	0.84	0.95	
Tachycardia	0.92 (0.03)	1.11	1.12	
Heart palpitation	0.93 (0.03)	0.84	1.00	
Difficulty in breathing	0.95 (0.02)	0.76	0.80	
Chest pain	0.95 (0.02)	0.82	0.96	
<b>Cognitive</b>				0.97
Fatigue	0.94 (0.02)	0.93	1.03	
Brain fog	0.97 (0.02)	0.78	0.80	
Difficulty in remembering things	0.93 (0.02)	0.87	0.94	
Difficulty in concentration	0.93 (0.00)	0.87	0.96	
<b>Psychological</b>				0.97
Sleep disturbance	0.91 (0.00)	0.89	1.03	
Numbness	0.94 (0.03)	0.66	0.74	
Hair loss	0.89 (0.03)	1.08	1.17	
Dry mouth	0.94 (0.02)	0.62	0.68	
Anxiety	0.91 (0.03)	0.82	0.89	
Depression	0.91 (0.03)	0.82	0.88	
Diarrhea	0.85 (0.03)	1.28	1.40	
Poor appetite	0.85 (0.03)	1.23	1.33	
<b>Ache</b>				0.98
Cough	0.96 (0.00)	0.89	0.92	
Sore throat	0.96 (0.02)	0.73	0.80	
Muscle pain	0.94 (0.02)	0.81	0.90	
Joint pain	0.95 (0.02)	1.43	1.45	
<b>Sensory</b>				0.97
Anosmia	0.96 (0.00)	0.98	0.85	
Ageusia	0.97 (0.02)	0.74	0.82	

The item thresholds demonstrate a variation in items' difficulty, with correctly ordered thresholds across all 24 items. The lowest threshold was the 1<sup>st</sup> threshold of item 16 (-5.21), followed by item 1 (-3.63). The highest threshold was the 10<sup>th</sup> threshold of item 16 (5.06), followed by item 14 (3.85). The highest median (25th-75th percentiles) was found for item 21 (5 [3-9]), while the lowest was for item 23 (4 [1-7]). The median PCSS-Ar score was 114 (56-200) out of a maximum possible score of 240. The median scores for the factors ranged from 8 (3-17) for the sensory factor to 38 (19-64) for the psychological factor (Table 3).

**Table 3** PCSS-ar Item Thresholds

Factors	Thresholds										Median (25–75 Percentiles)
	1	2	3	4	5	6	7	8	9	10	
Life-threatening											28 (12–50)
Item 7	-3.18	-2.22	-1.36	-0.77	-0.40	-0.02	0.33	0.66	1.27	3.11	5 (2–9)
Item 8	-2.77	-1.85	-1.20	-0.59	-0.20	0.18	0.56	0.85	1.40	3.03	5 (2–9)
Item 10	-2.59	-1.74	-0.87	-0.41	-0.05	0.26	0.54	0.92	1.54	3.60	4 (2–8)
Item 11	-2.56	-1.70	-0.93	-0.45	-0.05	0.34	0.58	0.91	1.44	3.93	4 (2–9)
Item 12	-2.84	-1.82	-1.16	-0.61	-0.24	0.22	0.47	0.83	1.53	3.15	5 (2–8)
Item 17	-2.65	-1.90	-1.12	-0.65	-0.22	0.15	0.49	0.89	1.55	3.82	5 (2–8)
Cognitive											20 (8–36)
Item 1	-3.63	-2.05	-1.21	-0.74	-0.48	-0.11	0.24	0.54	1.00	1.53	5 (2–9)
Item 2	-2.50	-1.77	-0.94	-0.52	-0.27	0.03	0.41	0.67	1.20	2.01	5 (2–9)
Item 3	-3.07	-2.17	-1.32	-0.73	-0.25	0.11	0.29	0.54	0.95	2.52	5 (2–9)
Item 4	-2.98	-2.10	-1.29	-0.71	-0.35	0.02	0.31	0.57	0.98	2.96	5 (2–9)
Psychological											38 (19–64)
Item 9	-2.13	-1.46	-0.95	-0.46	-0.19	0.10	0.33	0.46	0.89	2.12	5 (2–9)
Item 18	-1.77	-1.17	-0.77	-0.40	-0.07	0.19	0.43	0.64	1.09	2.45	5 (2–8)
Item 19	-2.16	-1.49	-0.88	-0.52	-0.20	0.06	0.24	0.52	1.04	2.15	5 (2–8)
Item 20	-1.85	-1.23	-0.72	-0.40	-0.07	0.18	0.37	0.77	1.33	2.40	5 (2–8)
Item 21	-2.42	-1.58	-1.03	-0.58	-0.29	-0.02	0.16	0.44	0.94	1.92	5 (3–9)
Item 22	-2.26	-1.55	-1.07	-0.64	-0.29	0.03	0.24	0.49	1.01	1.92	5 (3–8)
Item 23	-1.38	-0.93	-0.52	-0.23	0.12	0.37	0.81	1.22	1.98	3.29	4 (1–7)
Item 24	-1.58	-1.03	-0.67	-0.30	0.00	0.32	0.68	1.12	1.79	3.04	4 (2–7)
Ache											20 (8–34)
Item 13	-2.88	-2.03	-1.39	-0.77	-0.29	0.17	0.55	0.84	1.75	3.68	5 (2–8)
Item 14	-2.97	-2.09	-1.35	-0.78	-0.28	0.07	0.44	0.83	1.58	3.85	5 (2–9)
Item 15	-3.47	-2.24	-1.56	-1.00	-0.43	-0.03	0.25	0.73	1.53	3.42	5 (2–9)
Item 16	-5.21	-3.41	-2.34	-1.45	-0.78	-0.08	0.46	0.98	2.48	5.06	5 (2–8)
Sensory											8 (3–17)
Item 5	-1.76	-1.13	-0.57	-0.20	0.02	0.21	0.31	0.44	0.77	1.74	4 (2–9)
Item 6	-1.66	-0.95	-0.53	-0.25	-0.02	0.22	0.36	0.56	0.89	1.93	4 (2–8)

The Wright map indicated acceptable person–item targeting (Figure 1). Person locations clustered near 0 logits with moderate dispersion and few extremes. Item locations were concentrated around the latent mean, with thresholds spanning roughly -2 to +3 logits, yielding continuous coverage and minimal gaps. Items positioned at higher logits represent symptoms that required greater latent severity to endorse at higher response levels, whereas items at lower

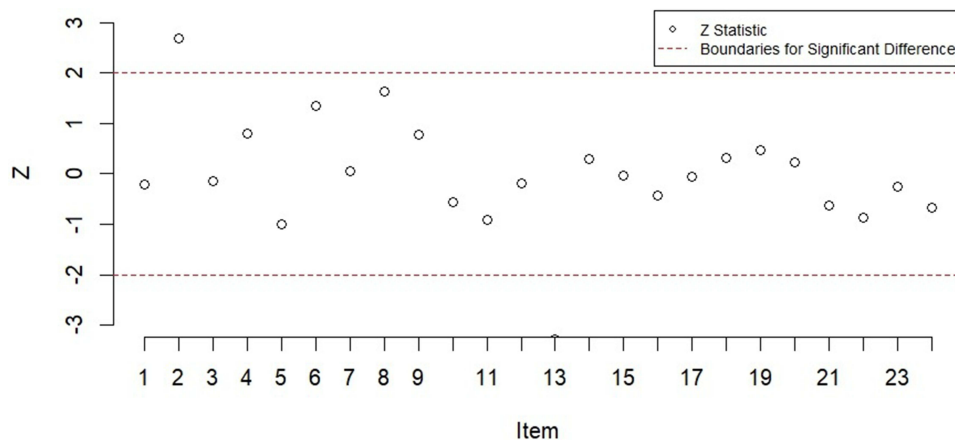


**Figure 1** Wright's map of the Arabic version of the Post-COVID-19 Symptom Scale (PCSS-Ar). D1=Life-threatening, D2=Cognitive, D3=Psychological, D4=Ache, D5=Sensory.

logits corresponded to symptoms endorsed at lower latent severity. Floor or ceiling effects were not evident. Domain panels (D1–D5) showed modest shifts, consistent with variation in symptom severity across subscales rather than measurement misfit. These interpretations align with the symptom-based content of the PCSS items.

DIF screening by sex and income did not identify any substantial item bias. As shown in Figures 2 and 3, all item-wise Z statistics for the sex comparison remained within the  $\pm 2$  boundary, indicating that item difficulties were comparable for males and females after conditioning on overall symptom severity. For the income comparison (<500 vs  $\geq 500$  JOD), Z statistics ranged from approximately  $-2.0$  to  $+1.5$ , with no item exceeding the  $|Z| > 2$  criterion. These results suggest that the PCSS-Ar items functioned equivalently across sex and income strata.

A quantile regression analysis was conducted to assess the association between various variables and the PCSS-Ar score. The result indicated that participants with a higher frequency of COVID-19 infections had significantly higher



**Figure 2** DIF by sex.

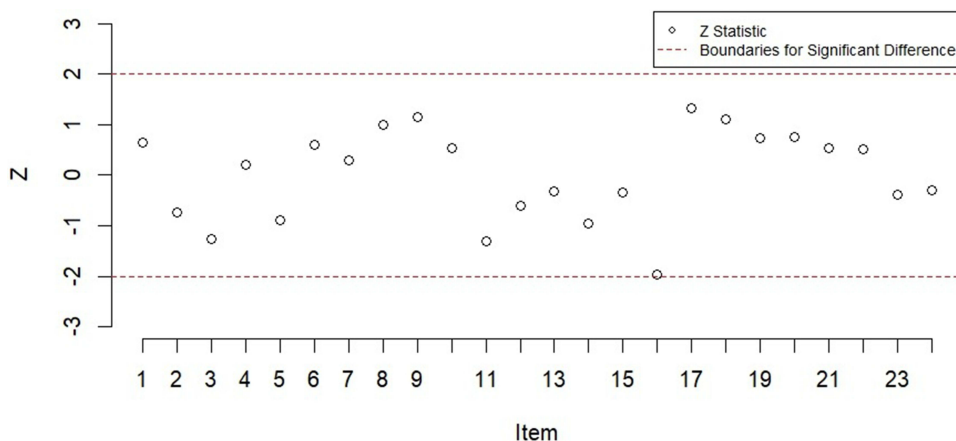


Figure 3 DIF by income.

PCSS-Ar scores (coefficient = 10.402, 95% CI [0.998–10.806],  $p = 0.03$ ). Moreover, participants who had never been infected with COVID-19 or who reported having mild symptoms during their COVID-19 infections had significantly less PCSS-Ar scores compared to those who had reported perceived severe COVID-19 symptoms (coefficient =  $-42.035$ , 95% CI [ $-75.448, -8.623$ ],  $p = 0.014$  and coefficient =  $-58.040$ , 95% CI [ $-84.139, -31.941$ ],  $p < 0.001$ , respectively). Females had significantly lower PCSS-Ar scores (coefficient =  $-27.525$ , 95% CI [ $-43.284, -11.766$ ],  $p < 0.001$ ). Additionally, participants with a high school education or lower had lower PCSS-Ar scores compared to those with postgraduate degrees (coefficient =  $-37.168$ , 95% CI [ $-68.872, -5.464$ ],  $p = 0.022$ ). (Table 4)

Table 4 Quantile Regression of Variables Associated with PCSS-ar Score

Parameter		Coefficient	p-value	95% Confidence Interval	
				Lower Bound	Upper Bound
(Intercept)		73.184	0.016	13.740	132.629
Age		0.553	0.175	-0.247	1.353
How many times have you received the COVID-19 vaccine?		0.943	0.840	-8.220	10.107
How many times have you been infected with COVID-19?		10.402	0.030	0.998	19.806
Gender	Female	-27.525	0.001	-43.284	-11.766
	Male	REF			
Marital status	Single	0.364	0.968	-17.260	17.988
	Married	REF			
High risk	No	-10.648	0.199	-26.914	5.618
	Yes	REF			
Perceived severity of COVID-19 infection	Never been infected	-42.035	0.014	-75.448	-8.623
	Mild	-58.040	<0.001	-84.139	-31.941
	Moderate	13.988	0.191	-6.975	34.952
	Severe	REF			

(Continued)

**Table 4** (Continued).

Parameter		Coefficient	p-value	95% Confidence Interval	
				Lower Bound	Upper Bound
Income status	Less than 500 JOD	74.468	<0.001	50.248	98.688
	500-1000 JOD	30.121	0.013	6.391	53.850
	More than 1000 JOD	REF			
Educational Level	High School or lower	-37.168	0.022	-68.872	-5.464
	Diploma	-17.634	0.255	-48.044	12.777
	Bachelor's degree	-2.636	0.834	-27.320	22.048
	Postgraduate	REF			

**Abbreviation:** REF, Reference group.

## Discussion

The COVID-19 pandemic has posed a significant global challenge in recent years, with high rates of morbidity and mortality.<sup>40</sup> Long COVID-19 is a well-documented medical condition, with an estimated prevalence of 65 million people affected worldwide.<sup>41</sup> This study successfully validated an Arabic tool, the PCSS-Ar, designed to assess the severity of long COVID-19 symptoms. The results of the study indicate that PCSS-Ar is both a valid and reliable tool.

The 5-factor model proposed by the original questionnaire was also suitable for the Arabic version, with acceptable factor loadings across all designated factors and high overall model fitness indices. The model demonstrated high internal consistency, as indicated by the computed Cronbach's alphas. Rasch analysis further confirmed the instrument's ability to differentiate between levels of symptom severity and evaluate the prevalence of various symptoms. According to the Rasch analysis, the most commonly reported symptom was fatigue, which also had one of the highest scores in the original PCSS,<sup>20</sup> while the least reported symptom was diarrhea.

The current study found that a higher frequency of confirmed COVID-19 infections was significantly associated with higher PCSS-Ar scores, indicating a greater severity of post-COVID-19 symptoms. This finding suggests that recurrent infections may have cumulative negative effects on health, which may exacerbate the overall severity of the disease and its related symptoms. Therefore, healthcare systems should prioritize the close monitoring and management of patients with recurrent infections and develop tailored interventions to prevent further infections. On the other hand, participants who reported mild symptoms during their COVID-19 infections exhibited significantly lower PCSS-Ar scores compared to those who had experienced severe symptoms. Previous research has also identified a significant relationship between the severity of acute COVID-19 infection and the persistence of long-term COVID-19 symptoms.<sup>42</sup> This finding is reasonable, as individuals with milder initial symptoms are less likely to develop severe post-COVID symptoms. Conversely, severe early symptoms may lead to a greater risk of extensive health damage and more severe post-COVID-19 symptoms. This association underscores the necessity of creating tailored care plans that take into account the severity of initial COVID-19 symptoms when planning patient follow-up and support. Our findings are consistent with previous research that suggest severe acute COVID-19 infections and reinfections are strong predictors of prolonged post-infection symptoms. A systematic review reported that individuals with severe COVID-19 are significantly more likely to develop long COVID-19 symptoms compared to those with milder cases, with persistent symptoms lasting for months after recovery.<sup>43</sup> Additionally, studies have indicated that reinfections may lead to cumulative damage, exacerbating inflammation and increasing the risk of long-term complications such as cardiovascular and neurological impairments.<sup>44</sup>

Severe COVID-19 has been associated with neurological effects, such as cognitive decline and memory loss, especially in older adults, due to the virus's impact on vascular and immune function in the brain.<sup>45</sup> Moreover, the

concept of “immune imprinting” indicates that while initial infections provide some level of immunity, repeated reinfections may not enhance immune response effectively and can instead lead to dysregulated immune function, contributing to prolonged symptoms.<sup>46</sup>

Recent multidisciplinary perspectives, particularly from rheumatology and rehabilitation sciences, further highlight the importance of characterizing long COVID phenotypes. Individuals with immune-mediated inflammatory rheumatic diseases often develop complex symptom clusters after COVID-19, requiring phenotype-based and function-oriented rehabilitation strategies.<sup>47</sup> Integrating such approaches into post-COVID care is crucial, as these patients may present with increased vulnerability to musculoskeletal, cognitive, and fatigue-related manifestations. Our findings on symptom heterogeneity and severity support the need to incorporate structured rehabilitation pathways, particularly those targeting functional recovery, endurance, joint mobility, and psychosocial well-being, within long COVID management frameworks.

Unlike previous research that reported a significant link between being female and experiencing prolonged COVID-19 symptoms,<sup>48</sup> the current study found that female gender was associated with lower PCSS-Ar. This finding suggests the need for further investigation to better understand the relationship between gender and the severity of post-COVID-19 symptoms. The present results may be influenced by socioeconomic and medical differences between the sexes, such as the median age of females in the present study being 27 years compared to 30 years for males. Beyond age differences, several factors may explain why female participants reported lower PCSS-Ar scores. Studies indicate that women often engage in more proactive health behaviors, like seeking medical attention and maintaining healthier lifestyles, which may contribute to better symptom management and lower perceived severity.<sup>49</sup> Cultural factors may also influence symptom reporting. Men may underreport symptoms due to societal expectations regarding masculinity and health resilience.<sup>50</sup> Lastly, hormonal and immunological differences could play a role. Klein and Flanagan<sup>51</sup> discuss how females generally mount stronger innate and adaptive immune responses than males, which can result in faster clearance of pathogens and potentially lower severity of symptoms. Future research should explore these factors further, incorporating qualitative methods and healthcare utilization data to better understand gender-based differences in long COVID-19 experiences.

Lower income was linked to higher PCSS-Ar scores, possibly due to limited access to healthcare resources and services. Additionally, financial stress and socioeconomic disadvantages may exacerbate health conditions, leading to more severe symptoms and worse overall health outcomes. Interestingly, lower education levels were associated with lower PCSS-Ar scores. This could be due to differences in health literacy, which may affect the perception and reporting of symptoms, potentially leading to an underestimation of symptom severity. To ensure that everyone receives appropriate care and support, public health campaigns and educational initiatives should aim to increase awareness and understanding of post-COVID symptoms across all educational levels.

Despite evidence suggesting that COVID-19 vaccination reduces the risk of long COVID-19,<sup>15,52</sup> our findings did not indicate a significant association between vaccination status and PCSS-Ar scores. This suggests that while vaccines reduce the severity of acute infection, their effect on persistent post-COVID-19 symptoms may vary. Several factors may explain this discrepancy. First, the timing of vaccination relative to infection plays a critical role; protection is strongest shortly after vaccination and wanes over time. Second, heterogeneity in vaccine type (eg, mRNA vs inactivated vaccines) may influence long-term immune responses. Third, individual immune variability, including previous infections, breakthrough infections during different variants, and variable booster uptake, may obscure clear associations at the population level. Prior studies similarly report mixed results, suggesting that while vaccination lowers the incidence of long COVID-19, it does not eliminate all post-COVID-19 symptoms in those who develop the condition.<sup>53</sup> Additionally, population differences and reporting biases may contribute to variability in findings. Despite the lack of direct association in our study, the importance of vaccination remains clear, given its role in reducing severe illness and hospitalization. Further research should explore whether booster doses or hybrid immunity (natural infection plus vaccination) influence long COVID-19 severity over time.

The selection of participants for the current study was designed to ensure the generalizability of findings while maintaining methodological rigor. Given that long COVID-19 is a patient-reported condition with highly subjective symptomatology, an online survey was considered a suitable approach to reaching individuals who may not seek formal medical care but still experience persistent symptoms.<sup>54</sup> This strategy aligns with previous research demonstrating that online recruitment is effective for capturing diverse populations, particularly in regions with high internet penetration.<sup>24</sup>

While clinical diagnoses and objective indicators provide valuable insights, the subjective experience of long COVID-19 remains a crucial component in understanding its burden and progression.

Our study focused on self-reported symptoms, as patient-reported outcome measures have been widely recognized as essential in assessing chronic and post-viral conditions (O'Connor et al, 2022). Future studies may complement this approach with clinical evaluations to further validate findings. However, the current methodology allows for a broader, more inclusive assessment of long COVID-19 within Arabic-speaking populations, particularly in settings where healthcare access may be limited.<sup>55</sup>

## Study Limitations and Future Directions

Unlike longitudinal studies, the cross-sectional design of the present study was unable to establish a cause-and-effect relationship or track changes in the severity of post-COVID-19 symptoms over time or the impact of the interventions. Additionally, while this study captured a wide array of sociodemographic factors, it did not deeply explore the specific cultural and social nuances within Jordan that might affect the severity of post-COVID-19 symptoms. Consequently, our understanding of how traditional beliefs, social norms, and practices influence the severity of post-COVID-19 symptoms remains limited. Finally, the reliance on patients' use of internet platforms for participant recruitment may have introduced a selection bias toward younger individuals or those with reliable internet access. Although internet penetration in Jordan is high and aligns with the demographic groups most affected by long COVID-19, particularly younger working-age adults, those with limited digital access may still be underrepresented.

Future research should adopt longitudinal or mixed-method designs to better understand the progression and long-term impact of post-COVID-19 symptoms, as well as to evaluate the effectiveness of interventions over time. Such approaches would also allow for assessment of the temporal stability, test-retest reliability, and responsiveness of the PCSS-Ar to clinical change. Furthermore, incorporating qualitative methodologies, such as in-depth interviews and cognitive debriefing, would enable exploration of cultural variations in symptom interpretation and scale comprehension, providing richer insights into the lived experiences of Arabic-speaking individuals with long COVID. Additionally, more in-depth studies are needed to explore the cultural and social factors within Jordan that may influence the severity of long COVID-19 symptoms. Such studies could include qualitative methods, employing interviews or focus groups, to gain a deeper understanding of how traditional beliefs, social norms, and practices impact health outcomes. Moreover, expanding this research to include a broader range of geographic regions and cultural contexts would provide a more comprehensive understanding of post-COVID-19 symptoms and their management.

## Conclusion

This study adds to the growing body of literature on the psychometric properties of instruments developed to assess long COVID. The findings confirm that the PCSS-Ar is a valid and reliable tool for evaluating the severity of long COVID-19 symptoms. The use of this screening tool offers valuable information for healthcare professionals to aid them in tailoring patient-specific treatment regimens. Furthermore, the PCSS-Ar can serve as a key instrument in both clinical and research domains, facilitating the identification of long COVID-19 symptom patterns and helping to inform the development of targeted interventions. By offering a culturally relevant and scientifically robust method for symptom assessment, this tool has the potential to enhance patient outcomes and improve the overall quality of care for individuals experiencing long COVID-19 in Jordan and similar contexts. Future research should continue to refine and expand the use of such tools, ensuring that they remain responsive to the evolving understanding of long COVID-19 and its diverse manifestations.

## Data Sharing Statement

The data that support the findings of this study are openly available in [Zenodo] at <https://doi.org/10.5281/zenodo.13338412>.

## Disclosure

The authors report no competing interests in this work.

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