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THE DEVELOPMENT OF COVID-19 BRIEF ANXIETY SCALE IN OMAN

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ABSTRACT

Introduction: A recent study reported that 99% of its sample experienced anxiety, stress, stigma, and concerns about potential social isolation. **Aims:** This study aims to address the lack of a specific COVID-19 anxiety scale in Oman. **Methods**: The online scale was distributed via Google Form to 431 students, representing 3% of the total student population at Sultan Qaboos University (SQU). Exploratory factor analysis revealed a unidimensional factorial structure consisting of four items. Item loadings ranged from 0.617 (item 4) to 0.847 (item 3). **Results**: Indicated that the validity fit indices were excellent. The RMSEA and SRMR values were greater than 0.05 indicating a perfect fit. The X^2/DF value was 0.854, with a p-value of less than 0.653, while the GFI, AGFI, IFI, NFI, TLI, CFI, RMR, and RMSEA values were 0.999, 0.995, 1.003, 0.998, 0.959, 1.00, 0.015, 0.000, respectively (90% CI [0.000; 0.074]). The COBAS-4 showed convergent validity through its significant association with similar scales. Discriminant validity was established via its insignificant correlation to distinct constructs. McDonald's omega and Cronbach's alpha showed adequate reliability at 0.810 each. The results of multiple group CFA indicated configural, metric, and scalar invariance between male and female students ($\Delta CFI \leq 0.01$, $\Delta RMSEA \leq 0.015$). No significant differences were found between the two sexes. The scale was calibrated using the Rasch rating scale, which provided robust results. The Mantel-Haenszel test showed no differential item functioning (DIF) across sexes. **Conclusion**: The COBAS-4 is a valid, reliable, simple, and easy-to administer self-report instrument for assessing COVID-19-related anxiety.

Keywords: COVID-19, Anxiety, Measurement invariance, Differential item functioning, Rasch analysis, Item response theory

INTRODUCTION

Although the COVID-19 pandemic has ended, the stress remains (Jarvis, 2023). According to the American Psychological Association, Americans are still experiencing the aftermath of pandemic-induced trauma. Furthermore, there has been a rise in global misinformation and conspiracy theories related to the pandemic (Khalaf and Shehata, 2023; Shehata et al., 2023).

Anxiety can have a significant impact on coping mechanisms and adaptation strategies, exacerbating emotional and social stress (Sorokin et al., 2020). The global COVID-19 pandemic has increased the levels of anxiety and stress. Sorokin et al. (2020) reported that 99% of their sample experienced anxiety, stress, stigma, and concerns about potential social isolation. Studies conducted in Oman found high levels of anxiety and depression. Alaloul et al. (2021) reported rates of 21% and 16.7% for anxiety and stress, respectively. Both increased and decreased levels of anxiety can lead to negative outcomes (Özdin and Özdin, 2020). Recent research has examined therapist-guided online therapy and internet-based interventions for anxiety relief during the COVID-19 pandemic (Al-Alawi et al., 2022).

Factors like affective disorders, younger age, single status, and unemployment are associated with higher levels of anxiety and stress (Sorokin et al., 2020). The pandemic has exacerbated anxiety and affected daily functioning (Yang et al., 2020). Consequently, mental health services were less effective (Sorokin et al., 2020). Therefore, accurate diagnosis of

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anxiety and depression is crucial for effective interventions. Rigorous research methods are important for understanding psychological symptoms of virus outbreaks and inform future initiatives (Gardner and Moallef, 2015).

Despite the persistence of global COVID-19 anxiety, Oman currently lacks a validated Arabic instrument for assessing pandemic-related anxiety (Abbady et al., 2022). A study conducted by Alfiqi and Abulftouh (2020) found high rates of psychological issues among university students, including psychological loneliness, insomnia, eating disorders, depressive symptoms, panic, anger, obsessive hygiene disorder, and social fears. Sorokin et al. (2020) attribute anxiety related to COVID-19 to several factors, including the rapid transmission of the virus, strict quarantine measures, uncertain incubation period, rumors on social media, and strain on health and economic systems. Limited scales are available to measure COVID-19 anxiety, such as the 36-item COVID-19 Stress Scales based on data from the US and Canada by Taylor et al. (2020) and a four-item online survey by Sorokin et al. (2020) conducted in Russia.

Several studies have investigated the psychological effects of COVID-19 through the development of scales. Alfiqi and Abullftouh (2020) identified eight factors related to psychological issues caused by COVID-19 among Egyptian undergraduate students. Lee (2020) in the USA developed the Coronavirus Anxiety Scale (CAS), which is significantly related to coping strategies such as substance use and suicidal thoughts. Abbady et al. (2021) in Saudi Arabia adapted the COVID-19 Stress Scales (CSS) (Taylor et al., 2020) for university students. Silva et al. (2020) in Brazil validated a seven-item Coronavirus Anxiety Scale. However, limited studies in Oman have addressed the negative psychological impact of COVID-19 on college students. For instance, Al-Qassabi et al. (2021) developed a scale for Omani university students, but their sample lacked representativeness and they did not use confirmatory factor analysis. In addition, their scale showed inflated reliability. To address these limitations, this study proposes a diverse sample representing various age groups across the governorates of Oman.

This study aims to address the lack of a specific COVID-19 anxiety scale in Oman. Previous instruments lacked a focus on anxiety and validity methods, such as the Multitrait-Multimethod Matrix (MTMM), and overlooked gender invariance. Therefore, this study examines the COVID-19 Anxiety Scale (CAS) across sexes to ensure measurement invariance. Additionally, this study is the first to use a COVID-19 Anxiety Scale due to the limited literature on the use of the Rasch rating scale for anxiety measurement in Oman. This study validates its properties using item response theory and examines sociodemographic factors (Alaloul et al., 2021). In doing so, this study responds to the limited tools in previous Omani COVID-19 studies by developing a new measurement tool for research and diagnosis amid the pandemic.

METHODS

This article outlines the development and validation of the COVID-19 Brief Anxiety Scale in Oman, including an examination of its psychometric properties. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were employed to assess its internal structure, followed by an examination of gender invariance. Convergent and discriminant validity were tested against established measurement tools. Scores from the COBAS-4 were analyzed using item response theory. Two samples were used in this study. One sample (n = 421) was used to test validity,

reliability, and measurement invariance, and another sample (n = 876) was used for calibration and Rasch rating scale analysis to identify differential item functioning (DIF). This study aims to assess convergent and discriminant validity, ensure measurement invariance across sexes, identify gender differences in anxiety among Omanis, and analyze the COBAS-4 using the Rasch rating scale.

Participants

This study involved 431 students, predominantly females (62%) with 267 respondents, and males (38%) with 164 respondents (M age = 20.86, SD age = 2.32), from various colleges of Sultan Qaboos University, Muscat, Oman. Convenience sampling was used, which is a commonly accepted method in psychological research, especially among university students (Howitt and Cramer, 2017). An online questionnaire was chosen due to pandemic restrictions (Abbady et al., 2021). Wang and Wang (2012) and Kline (2016) suggested that having 10 to 20 cases per item is sufficient for confirmatory factor analysis, indicating an adequate sample size. Responses were collected from different age groups in Oman through snowball sampling on social media. Rasch rating scale analysis was performed on 876 retained responses using item response theory.

Measurement Tools

The COVID-19 Brief Anxiety Scale (COBAS-4) was developed by reviewing relevant literature on COVID-19. Initially, a 10-item pool was created based on previous studies. The scale was then refined for clarity and relevance by a panel of five experts, resulting in a final version comprising four items rated on a five-point Likert scale. Responses range from 1 to 5 and are intended to assess COVID-19-related anxiety symptoms (Abulela and Khalaf, 2024).

The COBAS showed convergent validity with significant correlations with similar constructs such as the COVID-19 Anxiety Scale (CAS-7), Coronavirus Anxiety Scale (CAS-5), Functional Impairment (WSAS-5), Brief Anxiety and Depression Scale, and Psychological Effects and Maladaptive Coping. The discriminant validity of the scores was confirmed as they had lower correlations with different constructs such as the Brunnsviken Brief Quality of Life Scale and Brief Adjustment Scale (Hair et al., 2010 as cited in Cheng, 2017). The results of reliability analyses using McDonald's omega and Cronbach's alpha are presented in Table 4.

COVID-19 Anxiety Scale (CAS-7)

The CAS (Silva et al., 2020) was developed to measure coronavirus-related anxiety in Brazilians. Convergent validity was established by hypothesizing a positive correlation between the COBAS-4 and other COVID-19 anxiety scales. The CAS is a four-point scale with high reliability (Cronbach’s alpha and McDonald’s omega at 0.89). Its validity was confirmed through tests including EFA and CFA, as well as assessments with the Depression Anxiety and Stress Scale and Intergroup Differentiation Scale.

Functional Impairment (WSAS-5)

The Work and Social Adjustment Scale (WSAS) (Mundt et al., 2002) was employed to evaluate functional impairment attributed to COVID-19. This self-report measurement tool is widely used to assess functional impairment in individuals with anxiety and depression due to its sensitivity and accuracy. Adequate reliability was indicated by a test-retest reliability correlation (r = 0.73) for the total score and a

Cronbach's alpha internal consistency reliability ($\alpha = 0.882$). Factorial validity was assessed by item loadings, ranging from 0.66 to 0.93. Criterion validity was established by the correlation ($r = 0.76$, $p < 0.001$) between the WSAS and the Hamilton Depression Rating Scale (Hamilton, 1960).

Psychological Effects and Maladaptive Coping (PEMC-4)

The Psychological Effects Scale (Lee, 2020) assesses hopelessness, suicidal thoughts, negative religious coping, and alcohol/drug use coping on a five-point scale. The alcohol/drug use coping item was modified to align with the Islamic culture in Oman where alcohol consumption is prohibited.

Brief Adjustment Scale (BASE-6)

The BASE-6 is a quick assessment tool consisting of six items rated on a seven-point scale that measures general psychological adjustment, where higher scores indicate lower adjustment levels. The assessment can be completed in less than a minute (Cruz et al., 2019).

The Brunnsviken Brief Quality of Life Scale (BBQ-12)

The BBQ-12 (Linder et al., 2016) uses a five-point Likert scale ranging from 0 to 4.

Brief Anxiety and Depression Scale (BADS-8)

The BADS-8 consists of eight items (Mansbach, Mace and Clark, 2015). The response categories ranged from 0 (no), 1 (somewhat), and 2 (yes). It takes three minutes or less to complete the assessment. Previous research has reported a Cronbach's alpha of 0.75 for the BADS (Mansbach, 2015).

Data Analysis

This study used online surveys to investigate the impact of pandemic restrictions on reduced social desirability bias. Participants were sent survey links via email without any incentives. The dataset were complete with no missing values. The data were analyzed using IBM SPSS for EFA, convergent analysis, and discriminant analysis. CFA was performed using AMOS version 22, while Rasch analysis was performed using WINSTEPS.

Validity

Exploratory Factor Analysis (EFA)

The purpose of this validation study was to gather preliminary evidence on the factor validity and reliability of the COBAS-4.

RESULTS

Table 1. Gender differences and descriptive statistics of the COBAS-4 items *(males, N = 164; females, N = 267)*

			M (SD)					
Items	**Skewness**	**Kurtosis**	**Total**	**Males**	**Females**	***T***	***P***	***η2***
Item 1	0.008	-1.15	2.95 (1.4)	2.68 (1.3)	3.12 (1.31)	–3.32	0.001	0.03
Item 2	0.465	-0.917	2.48 (1.3)	2.27 (1.2)	2.61 (1.31)	–2.60	0.01	0.02
Item 3	0.512	-0.927	2.5 (1.32)	2.26 (1.2)	2.59 (1.36)	–2.55	0.01	0.01
Item 4	0.046	-0.1.14	2.9 (1.34)	3.01 (1.4)	2.88 (1.30)	0.917	0.360	0.00
Total score	0.203	-0.759	10.8 (4.1)	10.2 (4.0)	11.19 (4.0)	–2.46	0.014	0.01

EFA was performed on data collected from 431 Omani university students to determine the factor structure of the four items in the COBAS-4. Using O'Connor's syntax in SPSS 26, parallel analysis and principal component analysis (PCA) were used to determine the number of components. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.755, and the Bartlett's test of sphericity was significant ($p < 0.01$), satisfying the assumptions for EFA. One factor was identified using oblique rotation (Promax), with an eigenvalue of 2.35, explaining 58.74% of the cumulative variance. The factor loadings ranged from 0.872 to 0.617, with communalities between 0.717 and 0.381. The eigenvalue of 2.35 accounted for 58.743% of the cumulative variance.

Horn (1965) suggested that roots greater than 1.6 are considered acceptable. The COBAS-4 showed a first eigenvalue of 2.35, indicating a single significant root. This is consistent with the results of the PCA. Item discrimination analysis revealed a unidimensional construct for COVID-19 anxiety, supported by high item-total correlations (0.777, 0.781, 0.827, and 0.667) and significant point-biserial correlations (0.315 to 0.598, $p < 0.01$) among the four items (Wu et al., 2014; Petrillo et al., 2015).

The Multitrait-Multimethod Matrix (MTMM)

The multitrait-multimethod matrix (MTMM), based on Campbell and Fiske's (1959) framework, is commonly used to assess construct validity. Convergent validity measures correlations between related constructs, while discriminant validity examines the lack of relationship between measures. CFA is also employed to assess instrument validity. Convergent and discriminant validity play crucial roles in establishing construct validity, especially in fields such as education and psychology (APA, 2022).

Convergent and Discriminant Validity

The MTMM is a tool used to assess convergent and discriminant validity in psychological research (Kalleberg and Kluegel, 1975). The COBAS-4 was shown to be valid through its correlation with CAS, WSAS, and psychological effects and maladaptive coping. The results of the Pearson correlations are presented in Table 5.

Table 2. Correlation matrix among measurement tools

Measures	COBAS-4	CAS-5	WSAS-5	BASE-6	BBQ-12	BADS-8	PEMC-4
COBAS-4	1						
CAS-7	0.758**	1					
WSAS-5	0.489**	0.445**	1				
BASE-6	-0.135*	-0.106	-0.057	1			
BBQ-12	-0.144*	-0.162**	-0.141*	0.211**	1		
BADS-8	0.184**	0.139*	0.159**	-0.553**	-0.428**	1	
PEMC-4	0.447**	0.468**	0.484**	-0.035	-0.174**	0.165**	1

*Note ** $p < 0.01$, * $p < 0.05$.*

Confirmatory Factor Analysis (CFA)

CFA was performed on the four items to assess their structural validity. The unifactor model showed a good fit, meeting the established criteria for goodness-of-fit indices, as outlined by Hu and Bentler (1998), Taylor et al. (2020), Marsh et al. (2004), and Brannick (1995). These criteria include RMSEA of 0.06 or lower and CFI of 0.95 or higher. The CFA results comply with the goodness-of-fit criteria. The model fit statistics are reported in Table 7, demonstrating excellent fit: GFI, AGFI, CFI, and TLI of greater than 0.959; RMSEA of 90% CI (0.071; 0.038, 0.104) (Kline, 2016); SRMR from 0.05 and –0.08) (Hu and Bentler, 1999); and X2/df lower than five (Bentler, 1990). As presented in Table 7, the unifactor model showed strong fit (X2 = 0.854 (p = .653); X2/df = 0.427, GFI = 0.999, NFI = 0.998, CFI = 1.00, TLI = 1.00, RMR = 0.015, RMSEA (90% CI) = 0.000 [0.000 - 0.074]), indicating excellent model fit.

Measurement Invariance across Sexes

Recent studies, including one in the Omani context, have shown that COVID-19 anxiety is consistent across configural, metric, and scalar levels and does not vary by sexes (Silva et al., 2020). This study found no significant differences between sexes in COVID-19 anxiety, which contradicts with previous studies suggesting higher anxiety levels among women.

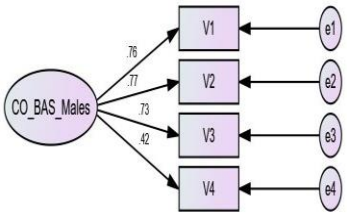

Figure 1. CFA for Males

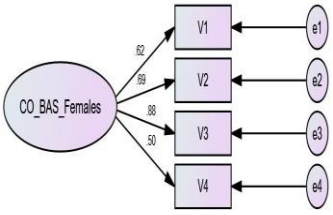

Figure 2. CFA for Females

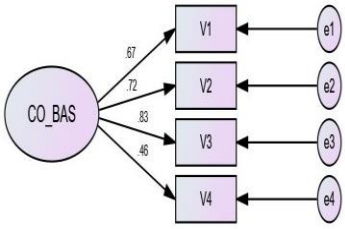

Figure 3. One-Factor Model CFA

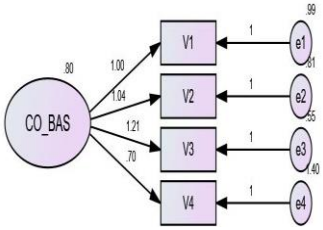

Figure 4. Multi-Group Comparison CFA

Reliability

McDonald's omega and Cronbach's alpha were used to assess the reliability of the COBAS-4. Alpha coefficients of 0.75 or higher are deemed acceptable for internal consistency reliability (Mundt et al., 2002). Values of alpha (α) and omega (ω) higher than 0.70 are also considered acceptable (Silva et al., 2020). McDonald's omega was calculated because recent research suggests that it is more accurate than Cronbach's alpha due to fewer assumptions (Green and Yang, 2009; Cho and Kim, 2015; Deng and Chan, 2017; Khalaf and Abulela, 2021). The values of alpha and omega reported in Table 9 are deemed acceptable for diagnosis and screening (Nunnally and Bernstein, 1994; Mansbach, 2015).

Local Independence

WINSTEPS was used to examine local dependence among the COBAS-4 items (Linacre, 2020). The correlations (Q3) ranged from -0.21 to -0.49, indicating a lack of local dependence. This finding supports the unidimensional structure of the scale, which is consistent with previous literature emphasizing unidimensionality for local independence (Hambelton, 1991).

Table 3. Goodness-of-fit statistics of multiple group CFA

Model	X^2	df	X^2/df	CFI	ΔCFI	RMSEA (90%CI)	ΔRMSEA
Configural	17.165	12	1.430	0.994	---	0.022 (0.000–0.044)	---
Males	1.085	2	0.543	1.00	---	0.000 (0.000–0.130)	---
Females	4.338	2	2.169	0.992	---	0.066 (0.000–0.154)	---
Metric	17.545	14	1.253	0.996	0.002	0.017 (0.000–0.039)	0.005
Scalar	22.03	22	1.004	1.00	0.006	0.002 (0.000–0.029)	0.02

Note. df = degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; CI = confidence interval

Table 4. Alpha and omega reliability coefficients, standard errors, and confidence intervals of all measurement tools

Measure		No. of items	Coefficient	SE	95% CI. Lower	CI. Upper
COBAS-4	Omega	4	0.806	0.023	0.753	0.841
	Alpha		0.813	0.019	0.768	0.846
CAS-7	Omega	7	0.876	0.013	0.845	0.900
	Alpha		0.874	0.014	0.842	0.898
WSAS-5	Omega	5	0.777	0.025	0.719	0.819
	Alpha		0.777	0.025	0.724	0.821
BASE-6	Omega	6	0.822	0.021	0.776	0.857
	Alpha		0.829	0.018	0.790	0.860
BBQ-12	Omega	12	0.812	0.026	0.748	0.854
	Alpha		0.821	0.022	0.771	0.860
BADS-8	Omega	8	0.738	0.026	0.681	0.781
	Alpha		0.740	0.024	0.688	0.780
PEMC-4	Omega	4	0.687	0.044	0.585	0.756
	Alpha		0.661	0.051	0.548	0.740

Note. SE = standard error, CI = confidence interval

Rasch Analysis

Table 5. Infit and outfit statistics, separation index, and reliability for persons and items (N = 876)

	Infit IMNSQ, M(SD)	Outfit OMNSQ, M(SD)	Separation index	Reliability
Persons	0.97 (-0.1)	0.97 (-0.1)	2.08	0.81
Items	1.05 (0.3)	0.95 (-0.2)	4.52	0.95

Table 6. Item calibration, standard error, point-biserial correlations, and infit/outfit generated by WINSTEPS

			Infit		Outfit		
Items	**Measure**	**S. E**	**MNSQ**	**ZSTD**	**MNSQ**	**ZSTD**	**PTME**
1	0.29	0.18	1.03	0.21	0.9	-0.5	0.84
2	0.02	0.17	1.02	0.16	0.94	-0.28	0.84
3	1.02	0.19	0.86	-0.71	0.75	1.15	0.84
4	-1.34	0.17	1.28	1.56	1.21	1.2	0.79

Unidimensionality

The first eigenvalue shows more than 20% of the cumulative variance (Sabah et al., 2013), indicating unidimensionality of this measure. The total raw variance explained by the measure was 11.11 (100%), while the total unexplained variance was 4.00. The unexplained variances in the first and second contrast were 1.63 (14.7%) and 1.35 (12.2%), respectively.

Gender Differential Item Functioning (DIF)

No differential item functioning was detected across sexes using the Mantel-Haenszel test. This indicated that the COBAS-4 works equally well for both sexes.

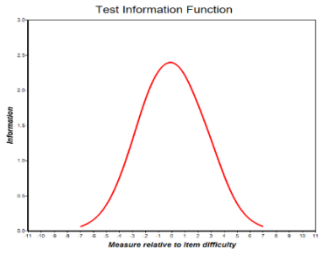

Figure 5. Test Information Function

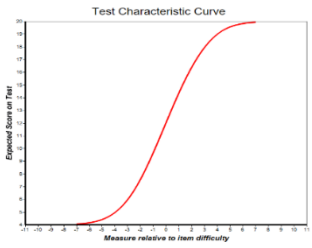

Figure 6. Test Characteristic Curve

Table 7. DIF analysis of the items using Mantel-Haenszel's Chi-squared index

	Females			Males					Mantel Haenszel	
Items	**Av.**	**DIF measure**	**DIF S. E**	**Av.**	**DIF measure**	**DIF S. E**	**DIF Contrast**	**Joint S. E**	**Chi**	**P**
1.	0.05	0.18	0.19	-0.45	1.2	0.55	-1.02	0.58	2.033	0.154
2.	-0.08	0.18	0.19	0.69	1.32	0.54	1.51	0.57	3.240	0.072
3.	0.03	0.96	0.2	-0.23	1.51	0.56	-0.55	0.6	0.784	0.376
4.	0	-1.34	0.18	-0.01	1.34	0.54	0	0.57	0.187	0.666

Note, Av.= average

DISCUSSION

This study aims to develop and validate the COBAS-4, a COVID-19 anxiety scale, and investigated gender differences in anxiety. EFA and CFA were used to establish construct validity, confirming the unidimensionality of the scale. The parallel analysis method, created by Horn (1956) and recognized for its accuracy, was used to determine the number of retained factors (Velicer et al., 2000; Hayton et al., 2004).

The CFA results indicated that the one-factor solution fit the data properly, demonstrated by the excellent fit indices. The reliability values of Cronbach's alpha and McDonald's omega coefficients were higher than 0.70. Taken together, these findings indicated that the COBAS-4 has promising psychometric properties for screening purposes. Anxiety is considered a unidimensional construct in the psychological literature (Francis et al., 2019; Silva et al., 2020). COVID-19 anxiety is a specific psychological state of anxiety (Silva et al., 2020). The findings of this study support this unidimensionality as evidenced by the large difference between the model variance explained by the Rasch rating scale (11.11%) and the unexplained variance in the first contrast (residuals) (1.35%).

The results of the Rasch rating scale analysis indicated that the infit and outfit IMNSQ values, as well as the separation index for persons (2.08) and items (4.52), were within acceptable limits. The reliability values for both persons and items met the criteria outlined in Khalaf and Omara (2022), indicating high parameter estimation stability. Previous research suggested that acceptable infit and outfit statistics typically range from 0.6 to 1.4 (Lambert et al., 2015) or from 0.7 to 1.3 (Bond & Fox, 2007). In this study, the infit and outfit mean-square statistics ranged from 0.86 to 1.21, indicating an excellent fit. Additionally, the item separation index of two suggested an acceptable participant-to-item ratio (Jong et al., 2015).

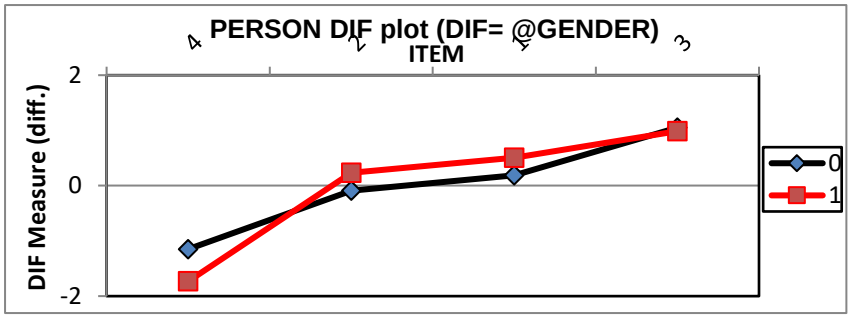

Figure 7. DIF in the COBAS-4 by Sex

The COBAS-4 showed strong discriminant ability with point bi-serial correlation values exceeding 0.5 (Khalaf and Omara, 2022). Gender measurement invariance was confirmed through multiple group CFA and DIF analysis using WINSTEPS. The Mantel-Haenszel method supported equal functionality for both sexes. A Wright map was used to assess item difficulty and participant level (Khalaf and Omara, 2022).

This study identified significant gender differences in COVID-19 anxiety, which is consistent with previous research (Kelly and Hutson-Comeaux, 1999). Women may experience increased distress due to traditional gender roles and concerns about domestic violence (Silva et al., 2020;

Wenham et al., 2020). Khalaf and Omara (2022) reported insignificant gender differences, emphasizing anxiety as a universal human trait. However, the results of this study align with recent Omani studies indicating elevated anxiety, depression, and stress levels among females (Al Omari et al., 2020; Badahdah et al., 2021). Therefore, counseling programs should prioritize females to reduce COVID-19 anxiety and improve psychological well-being.

Limitations and Future Research

The COBAS-4 scale shows good psychometric properties, but its relevance is limited as it was tested on healthy students rather than COVID-19 patients. Future research should include COVID-19 survivors to better understand the effects of anxiety. Cross-cultural validation and testing in clinical settings are essential for wider use. Despite limitations such as potential bias from online distribution, the scale is valid and reliable for research and diagnosis.

CONCLUSION

The COBAS-4 is a valid and reliable self-report instrument that fills a significant gap in measuring COVID-19 anxiety in Oman using item response theory. Its robust psychometric properties support its utility in research. Validating its convergent and discriminant validity would enhance its applicability as a screening and diagnostic tool. It is important to note that the scale is tailored for COVID-19 anxiety contexts and may not be suitable for general anxiety disorder assessment.

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