Conference Paper

Reliability Generalization of the Fear of COVID-19 Scale: A Meta-Analysis

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Abstract.
Since the first quarter of 2019, significant research efforts have been dedicated to curtail the spread of COVID-19. This study aimed to complement existing research by synthesizing Cronbach's alpha coefficients and generalizing the Fear of COVID-19 Scale, with the goal of reducing the pandemic's impact. Through a systematic literature search in electronic databases from 2019 to February 2021, we identified 2,753 works published in various sources, including journals, conference proceedings, books, and book chapters. Out of these, only 26 studies provided Cronbach's alpha coefficients and were included in the meta-analysis.
Employing a random-effects model, we analyzed the data and found that the Fear of COVID-19 Scale exhibited excellent internal consistency [$\alpha = 0.87$ (95% CI 0.86–0.88)]. However, there was significant heterogeneity among the included studies. Despite this, the Fear of COVID-19 Scale demonstrated good internal consistency reliability. As the fight against COVID-19 continues, we encourage future psychometric studies of the Fear of COVID-19 Scale to report important characteristics of participants and details of item scores

Keywords: Cronbach's alpha, fear of Covid-19 scale, meta-analysis, reliability generalization, random effect

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1. Introduction

In December 2019, the first case of novel coronavirus disease (COVID-19) was identified in China's Wuhan City in the Hubei Province (Barai & Dhar, 2021; Lupia et al., 2020; Shereen et al., 2020; Singh et al., 2020; Sohrabi et al., 2020). Since then, number of confirmed COVID-19 cases and deaths across the world increased daily. On March 11, 2020, the Director-General of World Health Organization (WHO) has declared the

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COVID-19 outbreak a global pandemic (Ghebreyesus, 2020). The COVID-19 is socioeconomic disease, which rapidly destroys the social and economic structures of the nations. For example, the International Air Transport Association (IATA) has estimated that the COVID-19 outbreak costs the global airline industry as high as US$113 billion loss of passenger revenues in 2020 (Pearce, 2020). COVID-19 outbreak has also prompted the closure of private businesses, governmental organizations and other entities, resulting in lower employee productivity, decreased profitability, and higher fiscal deficit in the oil exporting countries (Isabelle, 2020; Liang, 2020; Moody's Investors Service, 2020).

Due to the magnitude of economic and social consequences of COVID-19, researchers across a wide variety of fields have carried out several studies on this global pandemic. For example, quite a number of these studies have opted for examining psychometric properties of Ahorsu et al (2020) Fear of COVID-19 Scale (FCV-19S), which was initially developed and validated in Iran (Alyami et al., 2020; Broche-Pérez et al., 2020; Chang et al., 2020; García-Reyna et al., 2020; Giordani et al., 2020; Haktanir et al., 2020; Pang et al., 2020; Perz et al., 2020; Sakib et al., 2020; Wakashima Id et al., 2020). Despite these research efforts, what is lacking from the literature is meta-analytic studies to summarize and generalize extant empirical evidence. To address this gap, the purpose of this study was to extend prior research by conducting a reliability generalization meta-analysis of Cronbach's alpha coefficients for the Fear of COVID-19 Scale. Towards this end, we aimed at addressing two important research questions: (1) What is the mean scale score reliability for the Fear of COVID-19 scale across studies? (2) What factors are associated with observed variance in Cronbach's alpha coefficients of the Fear of COVID-19 scale?

2. Methods

2.1. Pre-registration

The datasets and a companion R script for this meta-analysis have been posted to the Open Science Framework (OSF). However, for the purpose of peer review, access to these supplementary materials have been restricted until this paper is published. We specifically pre-registered our meta-analysis plan for the following reasons. First, pre-registration to encourages researchers to freely access datasets and R script for reuse, reanalysis, and extension of our study towards promoting of open science. Second, "preregistration allows researchers to clearly differentiate between theory-driven (i.e., based on prior expectations) and data-driven (i.e., based on the outcome of statistical analyses) choices in the metaanalysis” (Lakens et al., 2016, , p. 6).

2.2. Literature search and inclusion criteria

We employed several search techniques to identify potential studies for our meta-analysis, using the keywords ”Fear of COVID-19” OR ”Fear of coronavirus”. First, we conducted a systematic literature search in the electronic databases of Web of Science, SCOPUS, PsychINFO, ScienceDirect and PubMed from 2019 to February 2021. Second, we manually reviewed the reference lists of the previously retrieved articles for additional studies. Finally, we manually reviewed all articles that had cited the original work of Ahorsu et al (2020) in the Google Scholar. After removing duplicate, these search techniques yielded 2,753 conceptual and empirical works published in the journals, conference proceedings, books, and book chapters. Of the 2,753 only empirical studies that satisfied the following criteria, were included in the meta-analysis: (1) reported Cronbach’s alpha (2) adapted or adopted of Ahorsu et al (2020) Fear of COVID-19 Scale (FCV-19S) (3) reported mean age of the participants and (4) reported sample size. After implementing these criteria 26 studies were identified and subsequently included in the meta-analysis (Table 1).

2.3. Data extraction and quality assessment

We utilized Microsoft Excel to develop a standardized data extraction template, which was then used by two independent authors to facilitate their data extraction. Any disagreements between the two authors were deliberated and resolved by a third author. Each of the article included was assessed for methodological quality using COSMIN’s 4-point quality assessment criteria with 1 = ”*inadequate*”, 2 = ”*doubtful*”, 3 = ”*adequate”* and 4 = ”*very good*” (Prinsen et al., 2018).

2.4. Analytical technique

The analysis was carried out using the transformed Cronbach’s alpha as the outcome measure. A random-effects model was fitted to the data. The amount of heterogeneity (i.e., $\tau 2$), was estimated using the restricted maximum-likelihood estimator (Viechtbauer, 2005). In addition to the estimate of $\tau 2$, the Q-test for heterogeneity (Cochran, 1954) and the I2 statistic (Higgins & Thompson, 2002) are reported. In case any amount

Table 1: Characteristics of the studies included.

No.	Authors	Sample size	Cronbach's alpha	Number of items	Context	Mean Age
1	Alyami et al., 2020	639	0.88	7	Saudi	34.75
2	Bakioğlu, et al., 2020	960	0.88	7	Turkey	29.74
3	Breakwell & Jaspal, 2020	251	0.81	7	multiple	33.99
4	Broche-Pérez et al., 2020	772	0.87	7	Cuba	36
5	Chang et al., 2020	400	0.93	7	Taiwan	46.91
6	Evren et al., 2020	1023	0.87	7	Turkey	43.32
7	García-Reyna et al., 2020	2860	0.902	7	Mexico	35.4
8	Gasparro et al., 2020	735	0.87	7	Italy	44.8
9	Gritsenko et al., 2020	939	0.803	9	Russia	21.8
10	Haktanir et al., 2020	668	0.86	7	Turkey	31.04
11	Harper et al., 2020	324	0.88	7	multiple	34.32
12	Jaspal et al., 2020	411	0.86	7	UK	44.85
13	Labrague & De los Santos, 2020	261	0.87	7	Philippines	30.95
14	Lin et al., 2020	1078	0.89	7	Iran	26.24
15	Nguyen et al., 2020	5423	0.9	7	Vietnam	22
16	Nikopoulou et al., 2020	538	0.87	7	Greece	42.7
17	Pang et al., 2020	228	0.893	7	Malaysia	26
18	Perz et al., 2020	237	0.91	7	US	30.3
19	Sajid et al., 2020	380	0.82	7	Pakistan	31.5
20	Sakib et al., 2020	8550	0.871	7	Bangladesh	26.5
21	Satici et al., 2020a	1772	0.87	7	Turkey	24.42
22	Satici, et al., 2020b	1304	0.847	7	Turkey	29.47
23	Seyed et al., 2020	651	0.87	7	Iran	33.53
24	Soraci et al., 2020	249	0.871	7	Italy	34.5
25	Wakashima et al., 2020	450	0.87	7	Japan	48.13
26	Giordani et al., 2020	4638	0.86	7	Brazil	41.5

Source: The authors

of heterogeneity is detected (i.e., τ∧2>0, regardless of the results of the Q-test), a credibility/prediction interval for the true outcomes is also provided (Riley et al., 2011). Studentized residuals and Cook's distances are used to examine whether studies may be outliers and/or influential in the context of the model (Viechtbauer & Cheung, 2010). Studies with a studentized residual larger than the 100×(1−0.05/(2×k))th percentile of a standard normal distribution are considered potential outliers (i.e., using a Bonferroni correction with two-sided α=0.05 for k studies included in the meta-analysis). Studies with a Cook's distance larger than the median plus six times the interquartile range of the Cook's distances are considered to be influential. The rank correlation test (Begg & Mazumdar, 1994) and the regression test (J A C Sterne & Egger, 2005), using the standard error of the observed outcomes as predictor, are used to check for funnel plot asymmetry. The analysis was carried out using R (version 4.0.3) (R Core Team, 2018) and the metafor package (version 2.4.0) (Viechtbauer, 2010).

3. Results

3.1. Reliability Generalization

TABLE 2: Random-Effects Model (k = 26).

	Estima te	se	Z	p	CI Lower Bound	CI Upper Bound
Interce pt	0.497	0.0070 1	70. 9	< .001	0.483	0.511

Note. Tau^2 Estimator: Restricted Maximum-Likelihood

TABLE 3: Heterogeneity Statistics.

Tau	Tau^2	I^2	H^2	R ^{2}	df	Q	p
0.03 4	0.0012 (SE= 4e-04)	95.82%	23.91 3	.	25.0 00	456.83 4	< .00 1

Source: The authors

A total of k=26 studies were included in the analysis. The raw Cronbach's alphas ranged from 0.81 to 0.93, with most estimates being positive (100%). The estimated average transformed Cronbach's alpha based on the random-effects model was μ∧=0.497 (95% CI: 0.483 to 0.511). Therefore, the average outcome differed significantly from zero (z=70.87, p<0.001). A forest plot showing the observed outcomes and the estimate based on the random-effects model is shown in Figure 4.

Figure 4: Forest plot showing the observed outcomes and the estimate of the randomeffects model

According to the Q-test, the true outcomes appear to be heterogeneous (Q(25) = 456.8338, p<0.0001, τ∧2=0.0012, I2=95.8182%). A 95% credibility/prediction interval for the true outcomes is given by 0.4287 to 0.5649. Hence, even though there may be some heterogeneity, the true outcomes of the studies are generally in the same direction as the estimated average outcome. An examination of the studentized residuals revealed that none of the studies had a value larger than ±3.1019 and hence there was no

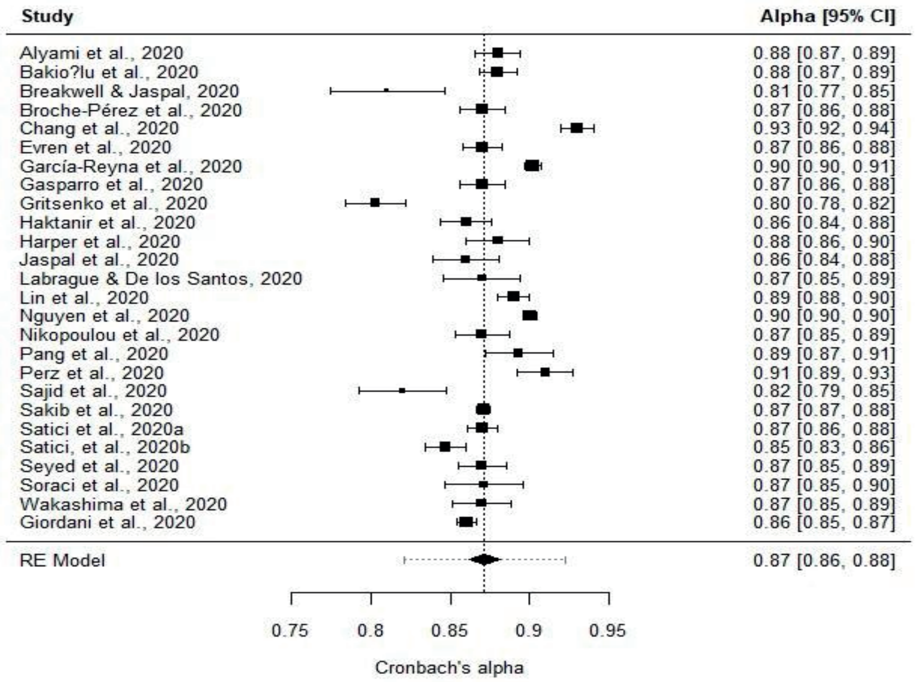

Figure 1: Forest plot.

indication of outliers in the context of this model. We used Cook's distances approach to determine outliers

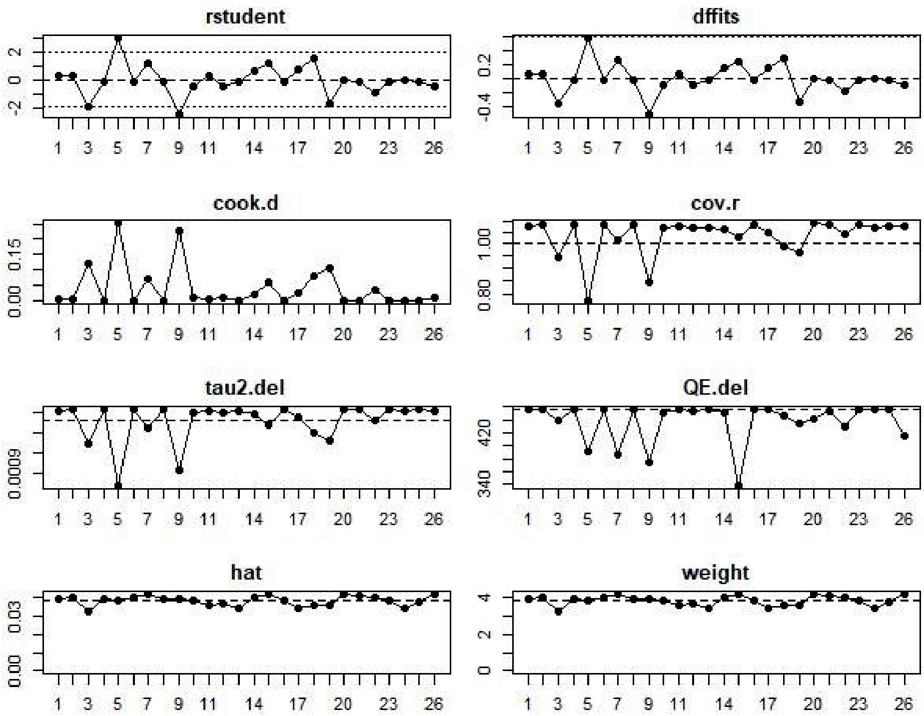

Figure 2: Graphical assessment of influential studies (outliers).

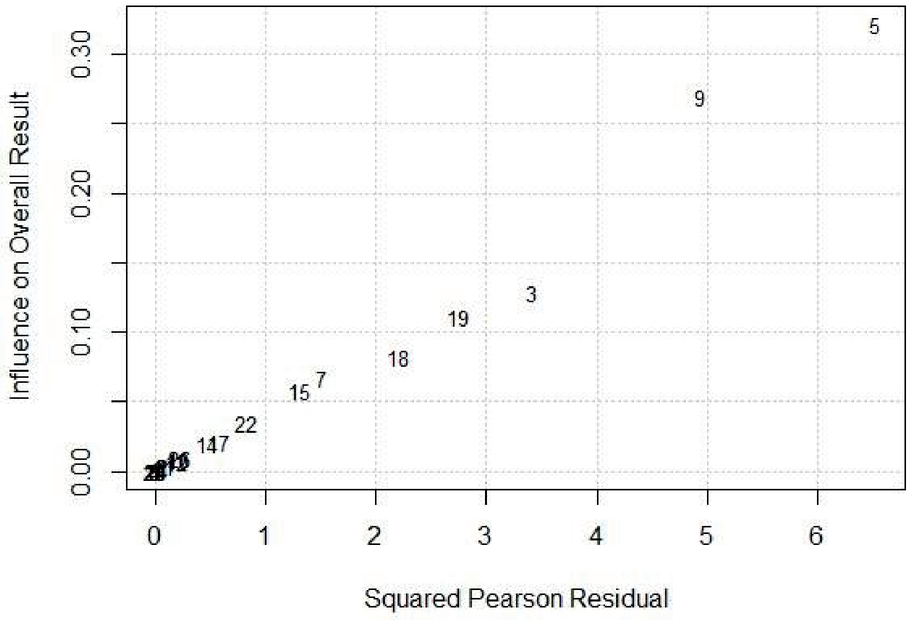

Figure 3: Baujat plot to identify studies contributing to heterogeneity?.

4. Publication bias assessment

We utilized funnel plot to assess and address the issue of publication bias in in this study. To confirm that publication bias is not a major concern in a meta-analysis, the plot needs to be a triangle shape/symmetrical funnel with higher variation in effect sizes for studies high in standard errors compared to more those studies with lower values of standard errors. As shown in Figure ??, there is no is indication of publication bias because neither the rank correlation nor the regression test formed any funnel plot asymmetry (p=0.6310 and p=0.3218, respectively; Table 4). (Egger et al., 1997; Sterne & Harbord, 2004).

Table 4: Results of the assessment of publication bias.

Rank Correlation Test for Funnel Plot Asymmetry	Regression Test for Funnel Plot Asymmetry
Kendall's Tau p	Z p
0.071 0.631	-0.991 0.322

Source: The authors Moderator analyses

Given the substantial heterogeneity in the Cronbach's alphas of Fear of COVID-19 Scale, we performed moderator analyses to find out the potential factors that could influence internal consistency (see, Table 5). Particularly, none of the moderators fully accounted for the observed variability in internal consistency estimates of Fear of

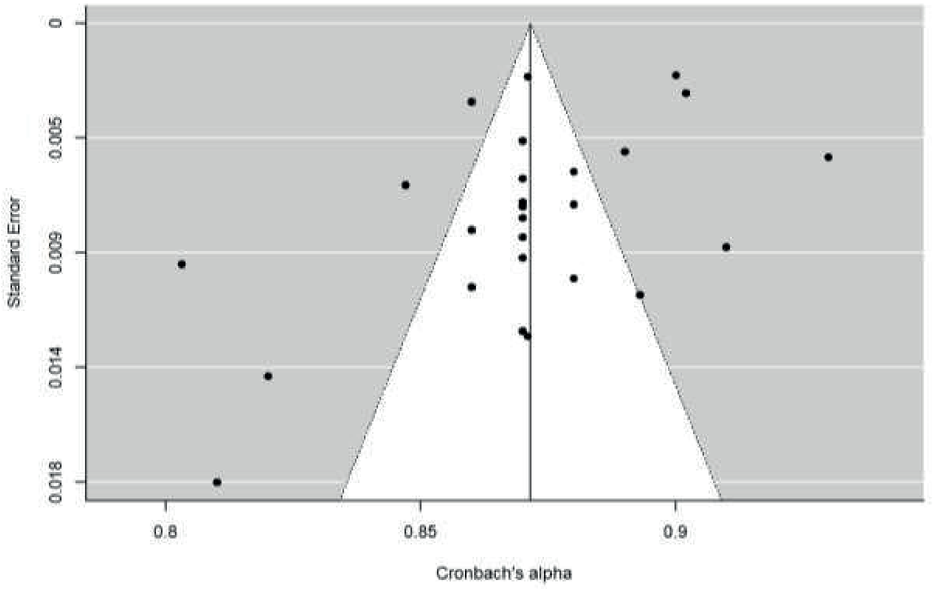

Figure 4: Funnel plot .

COVID-19 scores, as evidenced in Table 5. The moderating effect of age and study quality were examined. These variables were examined as a continuous moderator.

TABLE 5: Results of moderator analyses for Cronbach’s alphas of Fear of COVID-19 Scale.

Test of Moderators (coefficient 2):							
QM(df=1) = 0.587, p-val = 0.443							
Model	Results:						
Age	estimate	se	zval	pval	ci.lb	ci.ub	
Intercept	0.8534	0.0243	35.1425	<.0001	0.8058	0.901	***
Age	0.0005	0.0007	0.7665	0.4434	-0.0008	0.0019	
Test of Moderators (coefficient 2):							
QM(df=1) = 0.488, p-val = 0.485							
Model	Results:						
Study quality	estimate	se	zval	pval	ci.lb	ci.ub	
Intercept	0.88	0.014	64.805	<.001	0.854	0.907	***
Study quality	-0.004	0.005	-0.699	0.485	-0.014	0.007	

Note. Signif. codes: 0.000 ’***’ 0.001 ’**’ 0.01 ’*’ 0.05 ’.’ 0.1 ’ ’ 1

5. Discussion

Given the magnitude of economic and social consequences of COVID-19, several studies have been carried out by researchers across a wide variety of fields to respond to this global pandemic. For example, the development and validation of the Fear of COVID-19 scale have received considerable attention from researchers. The goal of the current study was to complement extant research efforts in reducing the spread of COVID-19 pandemic by synthesizing Cronbach's alpha coefficients and generalizing the Fear of COVID-19 Scale. To estimate the reliability scores and classify the characteristics of studies statistically correlated with the variability of the reliability coefficients, an RG meta-analysis was conducted. The reliability induction rate was also calculated, and the characteristics of studies that recorded and induced reliability were compared. Our RG meta-analysis included studies that reported any internal consistency and/or test-retest reliability estimates based on the data available. For testing purposes, the internal accuracy reliability of test scores must be greater than.80, and for other purposes, greater than 0.90 (Charter, 2003; Nunnally & Bernstein, 1991). In the literature, there is no consensus about how to view the adequacy of test-retest coefficients (Charter, 2003). Due to the lack of studies reporting these coefficients, our test-retest reliability findings must be viewed with caution.

Another RG meta-analysis looked at the internal accuracy and test-retest reliability of the Maudsley Obsessive-Compulsive Inventory (MOCI), with averages of .76 and .70, respectively (Sánchez-Meca et al., 2011). As a result, when compared to the effectiveness of other obsessive-compulsive scales. Alpha coefficients showed significant heterogeneity, indicating that the reliability scores could not be generalized to any research implementation, as it depends on the context where the test was applied, characteristics of studies, and structure, target population, and variability of the samples. The wide heterogeneity found among alpha coefficients led us to look for moderator variables able to explain variability.

To avoid the malpractice of inducing the reliability of test scores, several initiatives have been developed (Bruce Thompson & Vacha-Haase, 2000). The APA Task Force on Statistical Inference, scientific associations such as the American Educational Research Association and the National Research Council on Measurement in Education, and editorial policies of scientific journals such as Educational and Psychological Measurement (Thompson, 2003) have all proposed recommendations for reporting reliability estimates of test scores with the data at hand. Psychological Association specifically recommended for quantitative studies: "Estimate and report values of reliability coefficients for the scores analyzed (i.e., the researcher's sample), if possible (Appelbaum et al., 2018). Our study aimed to see how far the findings of our RG meta-analysis could be applied to the entire population of studies. When the studies that documented reliability used samples similar in composition and variability to those that caused it, the findings of an RG meta-analysis can be generalized to the entire population of studies; hence, reporting bias in terms of reliability can be dismissed as a challenge to the validity of the meta-analytic results (Jonathan A.C. Sterne et al., 2011).

6. Conclusion

In the Management Literature, the Cronbach alpha coefficient was widely used as a measure of variable reliability, according to the findings of the study. The studies acknowledged a Cronbach alpha coefficient value of 0.8, which is higher than the 0.7 threshold value (Nunally, 1978). We suggest that researchers stop using the.70 thresholds and instead focus on enhancing and measuring measurement precision in terms of systematic moderators of the alpha coefficient. We discovered that the number of items on a scale has a complex relationship with alpha that goes beyond the basic idea that adding items increases alpha. Furthermore, the rater of the behavior has a big impact on alpha, particularly for behaviors where third-party (other) ratings consistently outperform selfratings. We developed RG best practices and discussed the advantages of such research for researchers, reviewers, and editors. RG, in our opinion, provides a solid foundation for comparing reliability across various methods of measurement and can be used to support or refute the use of and evaluation of tests in many situations. The Fear of COVID-19 scale had good internal consistency and test–retest reliability. Future psychometric studies of the Fear of COVID-19 scale should report important characteristics of the participants, details of item scores, and test–retest reliability.

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7. Declaration of Conflicting Interests

”The authors declared no potential conflicts of interest concerning the research, authorship and/or publication of this article”

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