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Factor analysis of the COVID-19 Perceived Risk Scale: A preliminary study

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ABSTRACT

This study adapted an 8-item COVID-19 Perceived Risk Scale (CPRS) to assess COVID-19 related personal risk. The sample comprised 3,109 Turkish adults (49.98% males; $Mean_{age} = 38.64 \pm 10.40$). Exploratory and confirmatory factor analyses confirmed a two-factor structure (cognitive and emotional dimensions), with satisfactory reliability. The subscales were correlated with severity and self-efficacy related to COVID-19 and mental health. Women reported higher levels of emotional risk, overall risk, and severity than men. Findings indicate that the CPRS is a psychometrically-sound scale for assessing COVID-19 related perceived risk. The scale can be used to assess people who are vulnerable to the risk of COVID-19.

Introduction

The expeditious spread and high mortality rates of the novel coronavirus-2019 disease (COVID-19) have increased substantially around the globe. As of 17 May 2020, there have been more than 4.6 million confirmed COVID-19 cases worldwide and more than 312,000 deaths, affecting 187 countries and territories (Center for Systems Science and Engineering, 2020). The rapid escalation of the COVID-19 caused not only the risk of death after virus infection, but also created unbearable psychological consequences (Xiao, 2020). Recent research highlighted that there is a wide range of psychological impacts of lockdown, quarantine, and isolation as a result of the COVID-19 outbreak and the impacts can be severe and long-lasting (Arslan, Yıldırım, & Wong, 2020). During pandemics, greater exposure to negative news content related to the COVID-19 on social media increases the likelihood of rumination over information (Brooks et al., 2020). Evidence from China in the context of the COVID-19 outbreak has showed increased levels of anxiety, depression, and susceptibility to social risk and that decreased levels of life satisfaction and positive emotions (Li et al. 2020; Rubin & Wessely, 2020). The prevalence rates of fear, boredom, loss of control, sense of being trapped, feeling of insecurity, loneliness, and helplessness are also reported to be substantially high (Xiao, 2020). Furthermore, a high prevalence of posttraumatic stress disorder (7%) was recorded in China a month following the COVID-19 (Liu et al., 2020). Similar findings have been reported from previous outbreaks and pandemics such as severe acute respiratory syndrome (SARS; Cheng et al., 2004), Middle East respiratory syndrome (MERS; Khalid et al., 2016), and swine flu (H1N1; Wheaton et al., 2012).

The lockdown, quarantine, and isolation resulting from the continuous escalation of the pandemic cause people to worry, feel anxious, and perceive themselves at risk for the COVID-19. Perceived risk refers to individuals' psychological evaluations of the probability and consequences of an adverse outcome (Sjöberg, 2000). Risk is a complex, psychologically-oriented, and socially-constructed phenomenon that is affected by various factors such as probability, severity, controllability, dread, catastrophic potential, and unfamiliarity with a hazard (Renn & Rohrmann, 2000; Slovic, 1987). Risk perception is a critical determinant of the public's willingness to engage in health protective behaviors. One's subjective understanding of risk can influence their behaviors under the context of new, unobservable, and unpredictable hazard such as COVID-19. People have the ability to adapt new situations if they think that they are under the risk of infection with a disease which has potential to cause serious health consequences (Slovic, 1987). To exemplify, their perception of risk can trigger them to

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engage in precautionary behaviors including staying home, avoiding public gatherings, maintaining physical and social distancing, and personal hygiene (Yıldırım, Geçer, Akgül, 2020). Within the context of pandemic, research showed that perceived risk is related with anxiety, worry, and having daily routines disrupted (Kwok et al., 2020), preventive behaviors against COVID-19 (Yıldırım et al., 2020), and health conditions, distress, and life satisfaction (Zhang et al., 2020), coping strategies (Gerhold, 2020), and socioeconomic status (Cao et al., 2020).

The literature has reported that in times of the COVID-19 crisis people may behave so differently than their normal behaviors. Thus, risk perception pertaining to the COVID-19 varies significantly across populations and places, indicating that risk perception is potentially a significant determinant of the pandemic evolution, as it can influence the number of new positive cases (Cori et al., 2020). Gender is an important driver of risk with higher severity and mortality rates in response to patients with the coronavirus. Data show that severity of, and death toll from, COVID-19 is higher for women than men (Cai, 2020; Wu & McGoogan, 2020). Some studies have shown that compared to their women counterparts, risk perception for COVID-19 are higher in men (Caramelo et al., 2020; Jin et al., 2020) while others showed that women reported higher levels of risk as a concern than do men (Dryhurst et al., 2020). These results suggest gender differences in risk perception.

Previous studies indicated that the risk perception of COVID-19 was relatively high (Dryhurst et al., 2020; Wise et al., 2020) indicating the public is well-informed and aware of the results of infection. In a study (Dryhurst et al., 2020), public risk perception of COVID-19 was predicted by a wide range of factors such as personal experience with the virus, individualistic and prosocial values, personal and collectivistic efficacy, and social elaboration through family and friends.

The protection-motivation theory asserts that people tend to protect themselves based on the perceived severity of a threatening event, perceived vulnerability, response efficacy, and self-efficacy (Floyd et al., 2000; Rogers, 1975). People make cost-benefit analysis to take precautionary actions and they can engage in more specific precautionary actions during pandemics due to perceived high risk (Sutton, 1982; Wise et al., 2020). Acceptable levels of risk perception can be considered good for people to effectively fight the pandemic and adopt preventive health behaviors while high levels of risk perception of infection can undermine it (Leppin & Aro, 2009).

Although limited, there are several available measurement tools specific to the COVID-19 pandemic such as the Coronavirus Stress Scale (Arslan, Yıldırım, Tanhan, et al., 2020), Fear of COVID-19 Scale (Ahorsu et al., 2020), Coronavirus Anxiety Scale (Lee, 2020), COVID Stress Scales (Taylor et al., 2020), and COVID-19 Phobia Scale (Arpaci et al., 2020). Concerning risk perception within the context of COVID-19, Gerhold (2020) attempted to measure risk perception of infection with a list of items and its relationship with coping strategies. However, he did not form and test this list of items as a standard risk perception scale. Thus, there is an urgent need to develop a risk perception scale related to the COVID-19 to fill the gap in the literature. To address this limitation, we adapted items from those used in an early study assessing SARS-related risk perception and its relationship with perceived threat and efficacy beliefs related to infectious diseases (Brug et al., 2004). The SARS-related risk perception scale includes two factors with eight items and four of these items reflect cognitive aspect of the risk perception and the other four items refer to emotional aspect of the risk perception.

Given the possibility of long-lasting psychosocial impacts of the COVID-19 on lives of people during and after the pandemic, there is inevitable need to develop pandemic-specific scales that can fully serve research and practice. Such a scale would be very useful in identifying individuals' risk perception in respect to pandemic. Thus, in the current study, we adapted a risk perception scale related with coronavirus, *COVID-19 Perceived Risk Scale* (CPRS) and tested its factor structure. We expected that the CPRS would yield a two-factor solution including cognitive and emotional dimensions. We predicted that each dimension of scale would have good internal consistency reliability. Additionally, we hypothesized that the emerging subscales would exhibit a positive correlation with measure of severity and negative correlations with measures of self-efficacy and mental health. Furthermore, there would be some variations in the scores of males and females on the study variables.

Method

Participants

The sample included 3,109 Turkish adults drawn from general public. Their ages ranged between 18 and 70 years with a mean age of 38.64 (SD = 10.40). They

Table 1. Descriptive statistics and factor loadings for the eight items of CPRS ($n = 1565$).

Item	Mean	SD	Skew	Kurt	Factor loadings	
					Cognitive	Emotional
1. Perceived likelihood of acquiring COVID-19	2.98	0.97	0.14	0.00	0.81	0.02
2. Perceived likelihood of acquiring COVID-19 compared to other persons	2.67	1.09	0.42	−0.32	0.84	−0.12
3. Perceived likelihood of other diseases (e.g. diabetes/asthma)	2.58	1.04	0.20	−0.38	0.40	0.06
4. Perceived likelihood of dying from COVID-19	2.48	1.02	0.26	−0.37	0.41	0.26
5. Worry about oneself contracting COVID-19	3.43	1.24	−0.33	−0.88	0.04	0.75
6. Worry about a family member contracting COVID-19	4.14	1.09	−1.19	0.58	0.03	0.78
7. Worry about COVID-19 occurring in the region	3.96	1.12	−0.89	−0.05	−0.02	0.88
8. Worry about COVID-19 emerging as a health issue	4.22	1.04	−1.34	1.14	−0.02	0.80

Note. Full items are available on request from the original authors.

were proportionally distributed by gender (49.98% males). The majority of participants (64.68%) were married, university graduates (39.76%), belonging to average perceived socioeconomic status (68.51%), without any chronic disease (72.40%), living with three or four people (53.30%), and residing in city center (81.76%).

Measures

COVID-19 perceived risk

We measured the COVID-19 related perceived risk by adapting an 8-item SARS Risk Perception Scale (Brug et al., 2004). To adapt the CPRS, we mainly changed the wording of the original items such as replacing "SARS" with "COVID-19" and "cancer/accidents" with "diabetes/asthma" (see Table 1). Each item is rated on a Likert scale ranging between 1 (negligible) and 5 (very large). The scale includes cognitive dimension (e.g. perceived likelihood of acquiring COVID-19) and emotional dimensions (e.g. worry about a family member contracting COVID-19) of personal risk. Higher scores reflect higher levels of personal risk related to COVID-19. In this study, the psychometric properties of the CPRS were investigated to enhance the utility of the scale for use in research and practice, as presented in results section.

Severity

We used a single-item to assess participants' level of COVID-19 related severity on a 10-point scale ranging from 1 = not at all to 10 = very serious (De Zwart et al., 2009): "How serious would it be for you if you contract COVID-19 in the next year?" A higher score indicates greater severity.

Self-efficacy

We assessed the COVID-19 related self-efficacy by adapting the following item rated on a 4-point scale ranging from 1 = not confident to 4 = very confident (De Zwart et al., 2009): "How confident are you that you can prevent getting COVID-19 in case of an outbreak." A higher score refers to greater self-efficacy.

Mental health

To assess general mental health, we used the following single item on a 5-point scale ranging from 1 = poor to 5 = excellent (Ahmad et al., 2014). The item was "In general, would you say your mental health is?" A higher score indicates better mental health.

Procedure

This study was conducted during the COVID-19 pandemic throughout April 2020. A message contained the study link was distributed online to all potential participants. Social networking sites were primarily used to collect data. Before beginning to partake in study, participants were given information explaining the aims of the study, the voluntary nature of involvement, potential benefits and risks, and data confidentiality at the first page of online survey. After providing informed consent, they were allowed to proceed. Participants were not compensated for volunteering. The study protocol was approved through the Ağrı İbrahim Çeçen University ethical committee.

Data analysis

Internal consistency reliability was estimated to assess the reliability of the CPRS using JASP (Love et al., 2019). Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted to examine the factor structure of the CPRS. To achieve this, participants were randomly split into two subsamples of roughly equal size. Subsample 1 ($n = 1565$) was used for EFA and Subsample 2 ($n = 1544$) for CFA, which was conducted using SPSS-AMOS (v.24). Findings from the hypothesized measurement model were evaluated using common indices and their cut–off points where Tucker-Lewis index (TLI) and comparative fit index (CFI) $\geq$0.90 and $\geq$0.95 refer to adequate and good-data model fit, respectively;

Table 2. Internal reliability.

Sample	Dimension	McDonald's ω	Cronbach's α	Gutmann's $\lambda 6$
Subsample 1 ($n = 1565$)	Cognitive	0.74	0.73	0.70
	Emotional	0.88	0.88	0.85
Subsample 2 ($n = 1544$)	Cognitive	0.74	0.72	0.70
	Emotional	0.88	0.87	0.85

standardized root mean square residual (SRMR) and root mean square error of approximation (RMSEA) $\leq$0.10, $\leq$0.08, $\leq$0.05 refer to acceptable, adequate, and good data-model fit, respectively (Hu & Bentler, 1999; Kline, 2015). Correlations between scores on the CPRS and severity, self-efficacy, and mental health were examined to produce further information about the construct validity of the CPRS. Gender differences were investigated using an independent sample *t*-test. SPSS (v.24) was used for the data analysis.

Results

Internal consistency

We estimated internal consistency reliability using Cronbach's α, McDonald's ω, and Gutmann's $\lambda 6$ across two subsamples. Results are presented in Table 2. The reliability ranged from 0.70 to 0.74 for cognitive dimension and from 0.84 to 0.88 for emotional dimension, suggesting a satisfactory internal consistency reliability for the CPRS. Further descriptive statistics for each of the item is presented in Table 1.

Exploratory factor analysis

We investigated the underlying factor structure of the CPRS using EFA. We based these analyses on the first subsample of 1565 participants. In EFA, all 8 items on CPRS were subjected to a principal axis factoring and promax rotation. Kaiser-Meyer-Olkin value was 0.80 and Bartlett's test of sphericity was significant, χ^2 (df = 28) = 5298.53, $p < .001$, supporting a rationale for performing EFA. The number of factors to extract was based on Eigenvalues greater than one rule, scree plot test, and a parallel analysis. The results yielded a two-factor solution with Eigenvalues of 3.59 and 1.62. This factor solution was also confirmed by scree plot visual examination. A parallel analysis of 1000 random datasets with 1565 subjects and 8 variables using the 95% cutoff supported a clear two-factor solution as the third eigenvalue (3.59, 1.62, and .83) from the real dataset failed to exceed the third eigenvalue in the random dataset (1.11, 1.07, and 1.04). The two factors accounted for 44.89% (cognitive dimension) and 20.23% (emotional dimension) of the total variance. We assessed statistically meaningful loadings by using the criteria of 0.32 ("poor"), 0.45 ("fair"), 0.55 ("good"), 0.63 ("very good"), and 0.71 ("excellent") (Tabachnick & Fidell, 2007). As seen in Table 1, the factor loadings of the eight items ranged between 0.40 and 0.88, suggesting that each item substantially contributes to the factor at fair and excellent levels.

Confirmatory factor analysis

We then examined whether the two-factor measurement model emerged from EFA produced an appropriate representation of responses to the CPRS. We conducted these analyses on the second subsample of 1544 participants. Using AMOS v24 (Arbuckle, 2014), we performed CFA to estimate the two-factor measurement model using maximum likelihood estimation. The hypothesized measurement model provided satisfactory data–model fit statistics, χ^2 (df = 18) = 282.89, $p < 0.001$, CFI = 0.95, TLI = 0.92, RMSEA = 0.10, and SRMS = 0.06. As illustrated in Figure 1, the standardized factor loadings ranged from 0.38 to 0.86 for cognitive dimension and from 0.71 to 0.89 for emotional dimension. All loadings were significant at $p < 0.001$. The correlation between the two dimensions was 0.36.

Correlations with other variables

Table 3 shows the correlation between overall and dimensions of the CPRS and severity, self-efficacy, and mental health calculated on the full sample ($N = 3109$). Cognitive and emotional dimensions of the CPRS were significantly positively correlated with severity and significantly negatively correlated with self-efficacy and mental health. Severity was significantly negatively related with self-efficacy and mental health. Self-efficacy was significantly positively related with mental health.

Gender differences

An independent sample *t*-test was conducted to measure the mean scores difference between the study variables of male and female groups on the full sample ($N = 3109$). Except cognitive dimension of the CPRS, all variables violated the equality of variance

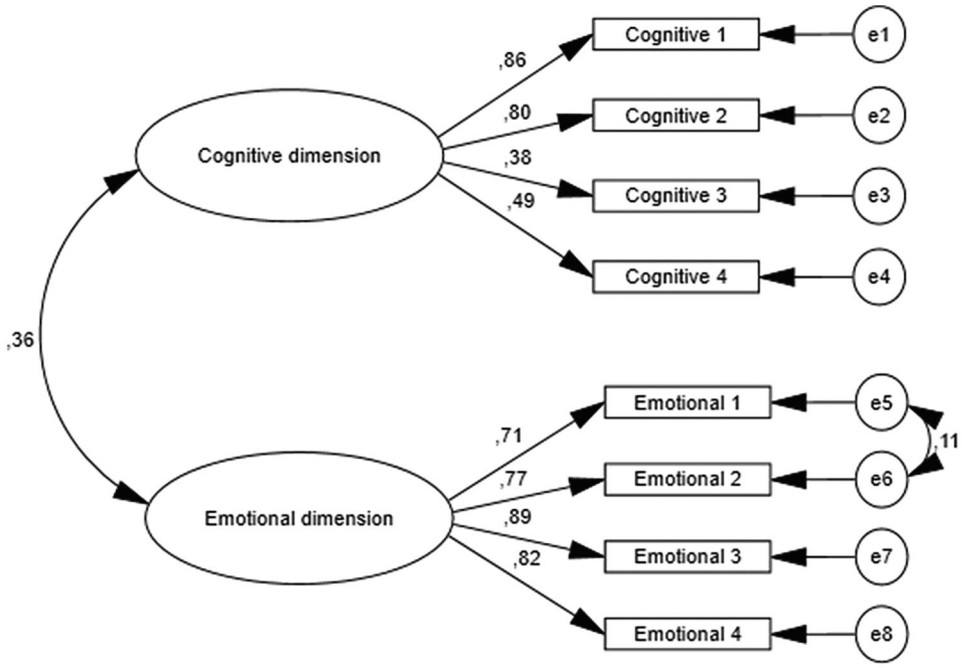

Figure 1. The standardized factor loadings for the hypothesized model.

Table 3. Descriptive statistics and correlation analysis ($n = 3109$).

	Mean	SD	Skew	Kurt	1.	2.	3.	4.	5.	6.
COVID-19 risk										
1. Cognitive dimension	10.65	3.00	0.16	0.08	—	0.36**	0.77**	0.14**	−0.35**	−0.25**
2. Emotional dimension	15.65	3.84	−0.83	0.12		—	0.87**	0.48**	−0.17**	−0.15**
3. Overall risk	26.30	5.66	−0.48	0.19			—	0.40**	−0.30**	−0.23**
4. Severity	8.12	2.15	−1.12	0.71				—	−0.09**	−0.15**
5. Self-efficacy	2.87	0.60	−0.78	1.78					—	0.24**
6. Mental health	4.01	0.64	−0.31	0.52						—

**Correlation is significant at the 0.01 level (2-tailed).

Table 4. Gender differences in the study variables ($N = 3109$).

Variable	Gender	*N*	Mean	SD	*t*	df	*p*
COVID-19 perceived risk							
Cognitive dimension	Male	1554	10.59	3.03	−1.16	3107	0.25
	Female	1555	10.72	2.97			
Emotional dimension	Male	1554	15.03	3.95	−9.07	3084.68	0.00
	Female	1555	16.26	3.63			
Overall risk	Male	1554	25.62	5.81	−6.75	3090.80	0.00
	Female	1555	26.98	5.41			
Severity	Male	1554	7.90	2.31	−5.48	3024.45	0.00
	Female	1555	8.33	1.96			
Self-efficacy	Male	1554	2.86	0.64	−1.53	3050.88	0.13
	Female	1555	2.89	0.56			
Mental health	Male	1554	4.02	0.67	0.42	3084.30	0.67
	Female	1555	4.01	0.61			

assumption. Thus, we corrected the degree of freedom and reported the results based on unequal variances. As presented in Table 4, females reported significantly high levels of COVID-19 related emotional risk, overall risk, and severity. There were no statistically significant differences in the mean scores of COVID-19 related cognitive risk, self-efficacy, and mental health despite high levels of mean scores.

Discussion

Undoubtedly, the COVID-19 pandemic has significant impacts on psychosocial and physical health of individuals. Using a nationally representative sample of Turkish adults, this study adapted the CPRS and tested its initial psychometric properties. In general, the findings indicated that the CPRS had a two-factor structure, good internal consistency reliability, convergent validity, and evidence of gender differences in the patterns of overall and subscales of the CPRS. The two-factor structure, comprising cognitive and emotional dimensions, suggests that the CPRS is a multidimensional scale including cognitive and emotive aspects of perceived personal risk related to COVID-19. The cognitive dimension of perceived risk refers to the probability and severity of outcomes that are evaluated from extant information while the emotional dimension of perceived risk is related with worry, concern, and fear that an individual experience about a potential threat (Lee et al., 2010). These results are in accordance with our expectation and

those of original study where Brug et al. (2004) reported a two-factor solution for the risk perception scale in the context of SARS. These results are also comparable with results from previous translations of SARS scale into Danish, Spanish, Polish, Mandarin, and Cantonese (de Zwart et al., 2009).

As predicted, our results showed that high levels of COVID-19 related perceived risk was positively correlated with severity related with the COVID-19, and that negatively correlated with self-efficacy related with the COVID-19, and mental health, suggesting that those individuals whose risk perception against the COVID-19 are high, tend to have greater severity of the disease, and low ability to execute to behaviors required to cope with the COVID-19, and poor mental health. These results are similar to those reported from previous outbreaks. For example, individuals' perceptions of SARS-related risks were found to be significantly positively related with mental health problems such as posttraumatic stress (Wu et al., 2009). However, it is important to note that the size of relationships between the measured variables are typically small which requires a great caution when interpreting the results (Cohen, 1992; Ferguson, 2009). Indeed, emotional and cognitive dimensions of perceived risk are conceptually related yet distinct constructs. The correlates and predictors of emotional and cognitive risk are different. Oh et al. (2015) demonstrated differential functions of the cognitive and emotional aspects of individuals' perceived risk characteristics in risk perception.

With regards to gender differences, we found that women scored higher on emotional subscale of the CPRS, overall risk, and severity than men. On the other hand, no significant results were observed in the mean score of cognitive subscale of the CPRS, the COVID-19 self-efficacy, and mental health between gender despite reporting high scores on those variables. These gender differences in risk perception related to the COVID-19 have been found in recent studies. For example, using an online sample in Germany, Gerhold (2020) found that, compared to men, women were more concern about the COVID-19. In that study, individuals were found to worry about being infected in places where high risk of infection is present such as public transport and shops or restaurants. Insignificant differences between men and women in cognitive aspect of risk perception can be expected because risk perception may vary across and within cultures and gender (de Zwart et al., 2009).

Our results provide preliminary support for the adaptation and validation of the CPRS. The results showed that the CPRS has a two-factor solution (cognitive and emotional dimensions) with robust psychometric properties. Thus, the scale can be used in research and practice as a measure of perceived risk related to the COVID-19. We hope that the newly adapted CPRS will play a critical role in advancing the extant COVID-19 literature and our understanding of the relationship between risk perception of the COVID-19 and potential psychosocial variables. In the lights of previous pandemic like SARS, research highlights that even though the COVID-19 pandemic ends, its long-term psychological impact may still continue in public (Taylor et al., 2020). Thus, the adaptation of pandemic-specific scales like the CPRS can be very useful in identifying individuals' risk perception both during and after the COVID-19 pandemic.

Despite good evidence of reliability and validity of the CPRS, this study is not without limitations. The foremost limitation is that, we assessed the COVID-19 related severity, self-efficacy, and mental health of the participants using a single-item scale. Although a single-item scale to assess physical and mental health of people for providing general health indicators is widely used in epidemiological studies to minimize burden on participants, it would be useful to assess the severity, self-efficacy, and mental health of people using validated scales to deliver more valid measurement of those variables. Second, the sample was drawn from general Turkish population and we are uncertain as to whether they have been diagnosed with any psychiatric disorders such as depression and anxiety. Thus, future research is warranted to test the sensitivity and specificity of the scale. Third, the current study was exclusively based on self-report measures and correlation in nature. The nature of the self-report measures cannot allow us to objectively evaluate the associations between the study variables and they may be simply affected by social desirability factors or risk of source of biases. The emerging correlations among the study variables can be tested using longitudinal research design to have more valid findings. Finally, although we employed a large sample of adults covering a wide age range (18–70 years), adolescents were excluded in this study that requires further investigation to increase the generalizability of current findings. Testing the psychometric properties of the CPRS on clinical samples can also be very useful to enhance the applicability of the scale in wider contexts.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all participants included in the study

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Disclosure statement

No potential conflict of interest was reported by the authors.

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