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The relationship between fear of COVID-19 and health anxiety among families with COVID-19 infected: The mediating role of metacognitions, intolerance of uncertainty, and emotion regulation

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Abstract

The current study aimed to investigate the mediating role of metacognitions, intolerance of uncertainty, and emotion regulation in the relationship between fear of COVID-19 (FC-19) and health anxiety, among families with COVID-19 infected. Participants were 541 individuals from family members of patients with COVID-19 ($F = 52.3\%$, Mean age = 41.3 ± 13.2 years). Data were collected with a packet including socio-demographic and risk factors, the Fear of COVID-19 Scale, the Short Health Anxiety Inventory, the Metacognitions Questionnaire-30, the Intolerance of Uncertainty Scale-12, and the Emotion Regulation Questionnaire. Structural equation modeling analyses revealed a full mediation of metacognitions (i.e., positive beliefs about worry, negative beliefs about thoughts concerning uncontrollability and danger, cognitive confidence, and beliefs about the need to control thoughts), intolerance of uncertainty, and expressive suppression in the relation between FC-19 and health anxiety. Moreover, the strongest indirect links were found between FC-19 and health anxiety through negative beliefs about thoughts concerning uncontrollability and danger and intolerance of uncertainty. These associations were independent of gender and risk status. The final model accounted for 71% of the variance of health anxiety. These findings suggest that particularly metacognitions, intolerance of uncertainty and expressive suppression play a full mediational role in the relation between FC-19 and health anxiety.

Keywords: emotion regulation; health anxiety; fear of COVID-19; intolerance of uncertainty; metacognition.

Key practitioner messages

- First study to examine the mediation role metacognitions, intolerance of uncertainty, and emotion regulation in the relationship between FC-19 and health anxiety among families with COVID-19 infected.
 - Metacognitions, intolerance of uncertainty, and expressive suppression fully mediated the association between FC-19 and health anxiety.
 - The strongest indirect links were found between FC-19 and health anxiety through negative beliefs about thoughts concerning uncontrollability and danger and intolerance of uncertainty.
 - The final model accounted for 71% of the variance of health anxiety.
 - Our findings highlight important factors including metacognitions, intolerance of uncertainty, and expressive suppression subdimension of emotion regulation that may be targeted in reducing health anxiety.
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1. Introduction

In recent months, COVID-19, one of the world's largest health pandemics over the last century, has made headlines around the world. At the time of writing, according to the World Health Organization (WHO; 2021), this novel virus has infected over 139 million people and caused over 2.9 million deaths until mid-April 2021. In Iran, over 2.2 million people have been infected with COVID-19 and over 66 thousand have died (Ministry of Health and Medical Education of Iran, 2021).

The COVID-19 outbreak has also brought a variety of negative psychological costs including stress (Khan et al., 2020), depression and anxiety (Bueno-Notivol et al., 2020; Ma et al., 2020; Nikčević & Spada, 2020; Nikčević et al., 2021; Parker et al., 2020), acute stress disorder symptoms (Parker et al., 2020), post-traumatic stress disorder (Li et al., 2020), post-traumatic stress symptoms (Chen et al., 2020), suicide ideation (Mamun et al., 2020), stigma (Chopra & Arora, 2020), sleep problems (Idrissi et al., 2020; Yang et al., 2020), and psychological distress, burnout and somatization (Pablo et al., 2020). In addition, researchers have reported the fear of COVID-19 (FC-19) as a key consequence of the pandemic (Ahorsu et al., 2020; Asmundson & Taylor, 2020a). Although fear can be a normal and adaptive response in crisis conditions such as the pandemic, it can escalate into pathological worry and health anxiety. Indeed, recent research has highlighted the risk of escalating health anxiety during the pandemic (e.g., Landi et al., 2020; Özdin & Özdin, 2020) especially through behaviours that aim to improve distress but inadvertently increase anxiety and physical symptoms (Haig-Ferguson et al., 2020).

1.1. The link between FC-19 and health anxiety

Schimmenti, Billieux, and Starcevic (2020) have introduced a four-domain conceptualization of FC-19 (fear of/for the body, fear of/for significant others, fear of not knowing/knowning, and fear of taking action/inaction) which reflects the bodily, interpersonal, cognitive, and

behavioural aspects of fear. Recently, a body of studies have shown FC-19 as independent variable in their mediational models (e.g., Bakioğlu, Korkmaz, & Ercan, 2020; Mahmud, Talukder, & Rahman, 2020; Saricali et al., 2020; Satıcı, Gocet-Tekin et al., 2020). Furthermore, FC-19 is correlated with anxiety factors such as pathological worry and health anxiety (Alizadehfard & Alipour, 2020; Lee et al., 2020; Mertens et al., 2020) however, little is known about possible mediators linking FC-19 to health anxiety.

Recent research has shown there are three possible candidate mediators: metacognitions (Melli et al., 2018; Seyed Hashemi et al., 2020), intolerance of uncertainty (Satıcı, Saricali et al., 2020; Tull et al., 2020), and emotion dysregulation (Brandt et al., 2012; Jungmann & Witthöft, 2020) which have all been found to be correlated with FC-19 and health anxiety.

1.2. The link between metacognitions and health anxiety

Metacognitions are beliefs about thinking (e.g., “I need to control thought X at all costs”) and to control it (e.g., “If I worry, I will find a solution” (Wells, 2009). These types of beliefs have been found to be associated, in many studies, with all forms of psychological distress including anxiety (e.g., Ghaderi, Mohammadkhani, & Hasanabadi, 2016; Spada et al., 2012), pathological worry (e.g., Mahmoud Alilou, Movahedi, & Karazi Notash, 2015; Spada et al., 2012), generalized anxiety disorder (Aydın et al., 2019), and health anxiety (e.g., Melli et al., 2018). According to Wells (2009) metacognitions drive the activation of maladaptive behaviours (e.g., rumination, worry, avoidance) in response to unwanted/threatening cognitive-affective intrusions, bringing to the escalation and perpetuation of psychological distress.

A recent study by Seyed Hashemi and colleagues (2020), has found that the relationship between problematic Internet use and Cyberchondria relating to FC-19 was mediated by both anxiety sensitivity and metacognitions. Furthermore, it has been repeatedly demonstrated that metacognitions are related to health anxiety (Bailey & Wells, 2013; 2016; Melli et al., 2016;

Melli et al., 2018). A central aim of the current study is therefore to investigate the mediational role of metacognitions in the relation between FC-19 and health anxiety.

1.3. The link between intolerance of uncertainty and health anxiety

Intolerance of uncertainty is a cognitive bias that impacts on individual's perception, interpretation, and behavioral, emotional, and cognitive responses to uncertain situations (Buhr & Dugas, 2002). A growing literature base suggests that intolerance of uncertainty is associated with increased health anxiety (Fergus & Bardeen, 2013; Tull et al., 2020; Wright, Lebell, & Carleton, 2016). Fergus and Valentiner (2011), for example, have reported that catastrophic health appraisals are only associated with health anxiety at high levels of intolerance of uncertainty. Alizadehfard and Alipour (2020) have recently reported that intolerance of uncertainty was indirectly correlated with FC-19 through mediating health anxiety. Given the unpredictability of COVID-19, and that intolerance of uncertainty is considered a key component underlying anxiety disorders (e.g., Gentes & Ruscio, 2011; Morriss et al., 2016), we expect a mediational role of intolerance of uncertainty, so investigating the mediational role of intolerance of uncertainty in the association between FC-19 and health anxiety, is another aim of the current study.

1.4. The link between emotion regulation and health anxiety

In addition to potential role played by metacognitions and intolerance of uncertainty, emotion (dys)regulation may also impact on health anxiety (Görge, Hiller, & Witthöft, 2014). Emotion regulation refers to the strategies used to reduce, maintain, or increase one or more aspects of one's emotional experience and expression (Werner & Gross, 2010). The mediating role of cognitive emotion regulation strategies has also been confirmed in the relationship between intolerance of uncertainty and pathological worry (Pourhosein & Hodhodi, 2016). Furthermore, Bardeen and Fergus (2014) observed that emotion regulation difficulties provide a significant incremental contribution, in predicting health anxiety.

The findings of Xu and colleagues (2020) showed that emotion regulation (cognitive reappraisal) negatively moderated the association between perceived stress and anxiety symptoms in COVID-19 isolated people. In a further study by Ezazi Bojnourdi and colleagues (2020), cognitive emotion regulation strategies, health hardiness and death anxiety were found to explain over a third of COVID-19 anxiety changes.

A central aim of the current study is therefore to investigate the mediational role of emotion regulation in the relation between FC-19 and health anxiety.

1.5. Summary of the aims of the current study

Individuals with anxiety symptoms and high level of health anxiety tend to get reassurance about their health through frequent visits to hospitals and physicians (Asmundson & Taylor, 2020b). This behavior may cause hospitals to overcrowd and interfere the process of providing services to patients requiring instant intervention or treatment in the healthcare system. Therefore, understanding the relationship between FC-19 and health anxiety is important especially during the pandemic. Furthermore, recent research (e.g., Landi et al., 2020) has shown that having a family member infected with COVID-19 is a risk factor for both COVID-19 and psychological distress. Ying and colleagues (2020) reported that 33.7% of family members of health care workers experience anxiety. Because the close experience of this disease, and the observation of the physical and psychological damage brought about the disease, is undoubtedly accompanied by fear and anxiety, it would be important to shed more light on the health anxiety experienced by family members of patients suffering from COVID-19.

The overall aim of this study was therefore to investigate how FC-19 is linked to health anxiety through the three mediators discussed, and among families with COVID-19 infected family member. It was hypothesized that FC-19 may be linked to health anxiety directly and indirectly through metacognitions, intolerance of uncertainty and emotion regulation (see

Figure 1). In current study we also controlled for a series of socio-demographic factors including age, gender, employment status and risk factors including current health problems, older age, pregnancy, disability, and other reasons, that may affect health anxiety.

2. Method

2.1. Participants

The sample of the present study included 541 participants (F= 52.3%, mean age= 41.3±13.2 years; age range: 23-78 years). All participants, who completed a battery of questionnaires during November 2020, met the following inclusion criteria: (1) to be at least 18 years of age; (2) to reside in Tehran; (3) to have a main family member (mother/father, sister/brother, spouse, child) that has received a definitive diagnosis of COVID-19 through a Polymerase Chain Reaction (PCR) test and has been hospitalized in an Intensive Care Unit (ICU); (4) to have not been infected with COVID-19 or present any specific symptoms of COVID-19 during participation; and (5) to consent to participate. A large majority (84.1%) of the participants were educated at college level and employed (75.2%). Seventy-nine out of 541 participants had fully recovered from COVID-19 during participation. Over a third of the sample (39.0%) considered themselves to be at 'high-risk'. Of those who considered themselves to be at high-risk, 50.2% stated this was due to a health problem, 39.8% because of older age, 2.8% because of being pregnant, 1.9% because of disability, and 5.2% for non-defined reasons. Regarding the demographic features of people with COVID-19, it should also be noted that mean age of these patients was 53.8 years (SD=14.8 years) and majority of them (43%) were in recovery period. Table 1 presents additional data from study participants.

2.2. Measures

2.2.1. Socio-demographic factors and risk status: The socio-demographic factors in the study included age, gender, educational level, and employment status (employed/unemployed). Participants' risk status and its reason(s) were assessed by a worded as follows:

"Do you consider yourself to be at 'high-risk' to contract COVID-19?". "If yes, please provide a reason for stating you are at a high-risk from the following categories: current health problem, older age, pregnancy, disability, and non-defined reasons". Data on the participants' relationship with the patient, the patient's age, and the date of his/her infection were also collected. Participants were also asked to determine the physical condition of the patient (i.e., complete recovery, recovery period, active period of illness, death).

2.2.2. Fear of COVID-19 Scale (FCV-19S): This self-report measure was developed by Ahorsu and colleagues (2020) to assess FC-19 among the general population. The FCV-19S consists of 7 items (e.g., "I am most afraid of coronavirus-19") rated on a 5-point Likert scale from 1 ("strongly disagree") to 5 ("strongly agree"). The total score ranges from 7 to 35, with higher scores reflecting higher levels of fear of COVID-19. The FCV-19S has been shown to possess robust psychometric properties, including internal consistency (Cronbach's alpha= 0.82), composite reliability (0.88), test-retest reliability (ICC= 0.72), and concurrent validity (Ahorsu et al., 2020). Alizadehfard and Alipour (2020) have also reported good internal consistency (Cronbach's alpha = 0.86). Cronbach's alpha in the current study was 0.84.

2.2.3. Short Health Anxiety Inventory (SHAI): This self-report measure was developed by Salkovskis and colleagues (2002) to assess features of health anxiety over the last 6 months. The SHAI consists of 18 items split into two factors: illness likelihood (14 items. e.g., "A. I do not worry about my health, B. I occasionally worry about my health, C. I spend much of my time worrying about my health, D. I spend most of my time worrying about my health"), and negative consequences of illness (4 items. e.g., "A. A serious illness would ruin some aspects of my life, B. A serious illness would ruin many aspects of my life, C. A serious illness would ruin almost every aspect of my life, D. A serious illness would ruin every aspect of my life"). The SHAI is scored on a multiple-choice type structure (each item has four statements) ranging between 0-3. The total score ranges from 0 to 54, with higher scores

reflecting higher levels of health anxiety. The Persian form of the SHAI has demonstrated good reliability and validity in two validation studies (Nargesi et al., 2017; Panahi et al., 2010). The Cronbach's alpha in the current study was 0.86.

2.2.4. Metacognitions Questionnaire-30 (MCQ-30): This self-report measure was developed by Wells & Cartwright-Hatton (2004) to assess metacognitions. The MCQ-30 consists of 30 items split into five factors: (i) positive beliefs about worry (e.g., “Worrying helps me to get things sorted out in my mind”); (ii) negative beliefs about thoughts concerning uncontrollability and danger (e.g., “My worrying could make me go mad”); (iii) cognitive confidence (e.g., “I have little confidence in my memory for words and names”); (iv) beliefs about the need to control thoughts (e.g., “I should be in control of my thoughts all of the time”); and (v) cognitive self-consciousness (e.g., “I am constantly aware of my thinking”). The MCQ-30 is scored on a 4-point Likert scale (“Do not agree” to “Agree very much”). The total score ranges from 30 to 120, with higher scores reflecting higher levels of maladaptive metacognitions. The MCQ-30 has demonstrated good internal consistency and convergent validity and has acceptable test-retest reliability (Spada, Mohiyeddini & Wells, 2008; Wells & Cartwright-Hatton, 2004). The Persian MCQ-30 was used in present study. This measure has been shown to have very good internal consistency (Cronbach's alpha = 0.91), test-retest reliability (ICC = 0.73), and acceptable validity (Shirinzadeh et al., 2009). The Cronbach's alpha in the current study was 0.91.

2.2.5. Intolerance of Uncertainty Scale (IUS-12): This self-report measure was developed by Carleton, Norton, and Asmundson (2007) to assess an individual's propensity to find uncertain situations unpleasant. The IUS-12 consists of 12 items split into two factors: prospective anxiety with 7 items (e.g., “Unforeseen events upset me greatly”) and inhibitory anxiety with 5 items (e.g., “The smallest doubt can stop me from acting”). The IUS-12 is scored on a 5-point Likert scale (“Not at all characteristic of me” to “Entirely characteristic of me”).

The total score ranges from 12 to 60, with higher scores reflecting higher levels of intolerance of uncertainty. Besharat (2010) reported good reliability (Cronbach's alpha = 0.89) and acceptable validity (convergent and discriminant and) for the Persian IUS-12. The Cronbach's alpha in the current study was 0.90.

2.2.6. Emotion Regulation Questionnaire (ERQ): This self-report measure was developed by Gross and John (2003) to assess emotion regulation. The ERQ consists of 10 items rated on a 7-point scale which have two opposing dimensions. Six items measure the degree of cognitive reappraisal (e.g., “I control my emotions by changing the way I think about the situation I’m in”) and 4 items measure the degree of expressive suppression (e.g., “When I am feeling negative emotions, I make sure not to express them”). The total score ranges from 10 to 70, with higher scores reflecting greater use of the specific emotion regulation strategy. In the current study emotion regulation was measured using the Persian version of the ERQ. The original version of the ERQ had a Cronbach's alpha of 0.79 for reappraisal and 0.73 for suppression. Test–retest reliability across 3 months was 0.69 for both scales. Ghasempur, ElBeigi, and Hasanzade (2012) reported good reliability (Cronbach's alpha = 0.71) for the Persian ERQ. The Cronbach's alpha in the current study was 0.78.

2.3. Procedure

The present study was conducted between October 30th 2020 and November 24th 2020 when Iran was in the third wave of the COVID-19 outbreak. We referred to the archives of the admissions departments of nine Tehran hospitals and accessed the list of patients who had received a definitive diagnosis of COVID-19 through a PCR test and had been hospitalized. Some patients were admitted to an ICU at the time and we randomly invited their families to participate in the study. Others were discharged from the hospital close to the time of the data collection period of the current study, and we randomly contacted their families and invited them to participate. It should be noted that if the patient's family were eligible to participate

(see eligibility criteria in section 2.1), and provided consent, only one member (someone who volunteered) of the family was selected to participate in the study. All participants were informed of the study aims. After answering questions about the aims of the research (see section 2.2), participants were assured that all their data would remain confidential. Participants were also informed that they could discontinue taking part in the research at any time. The current study was conducted in accordance with the Helsinki Declaration as revised 1989.

2.4. Data analyses

First, bivariate correlation analyses were conducted in order to test the associations between the variables included in the study. Second, the pattern of relationships specified by our proposed theoretical model (see Figure 1) was examined through path analysis. The package Lavaan (Rosseel, 2012) of the software R (R Development Core Team, 2014) and a single observed score for each construct included in the model were used. Specifically, the covariance matrix of the observed variable was analyzed with the robust maximum likelihood method estimator (MLR; Satorra & Bentler, 1994). The bootstrap approach (1000 bootstrap samples) was used to test for mediation. To evaluate the goodness of fit of the model, several indices of fit for structural equation models were employed, such as χ^2 , the Comparative Fit Index (CFI; good fit: ≥ 0.90), the Tucker–Lewis Index (TLI; good fit: ≥ 0.90), the Root Mean Square Error of Approximation (RMSEA; good fit: ≤ 0.06), the Standardized Root Mean Square Residual (SRMR; good fit: ≤ 0.08), the explained variance of each endogenous variable (R^2), and the total coefficient of determination (TCD; varies from 0 to 1 and the closer to 1, the better the fit of the model; Bollen, 1989; Jöreskog & Sörbom, 1996). In the tested model, FC-19 was the independent variable, health anxiety was the dependent variable, whereas the five metacognitions subscales, intolerance of uncertainty, and the two emotion regulation subscales were the mediators. Participants' age, gender, employment status, and risk status were considered as control variables for the dependent variable (see Figure 1).

3. Results

3.1. Preliminary analysis

Mean scores, standard deviations, skewness, kurtosis, and bivariate correlations between the variables included in the study are presented in Table 2. None of the indices of univariate skewness and kurtosis were non-normally distributed so as to preclude the planned analyses (Tabachnick & Fidell, 2013). As shown in Table 2, the lack of multicollinearity between variables was confirmed ($r < 0.85$; Kline, 2015). As can be seen in Table 2, the bivariate correlation analyses revealed that FC-19 was positively correlated with all subscales of the mediators, except for one of the metacognitions' subscales (cognitive self-consciousness). In addition, all subscales of the mediator variables were significantly positively correlated with health anxiety. Moreover, the strongest positive correlations were found between intolerance of uncertainty with FC-19 ($r = 0.48$) and negative beliefs about thoughts concerning uncontrollability and danger with health anxiety ($r = 0.45$). The mean scores on the two variables (i.e., FC-19 and health anxiety) across four groups (participants whose relative was completely recovered, participants whose relative was in the recovery period, participants whose relative was in the active period of infection, and participants whose relative had died) were compared in pairs and no difference was observed (Table 3).

3.2. Path analyses and test of mediation

A first version of the conceptual model (see Figure 1) was tested including all the variables of interest. However, several path coefficients were not significant at the $p < 0.05$ level and were removed step by step: The path between FC-19 and cognitive self-consciousness; the path between cognitive self-consciousness and health anxiety; the path between cognitive reappraisal and health anxiety; the path between employment status and age (as sociodemographic variables) with health anxiety.

Therefore, a final version of the model was evaluated to see how it fits the data (see Figure 2). In this final model, all path coefficients were significant at least at the $p < 0.05$ level. In this model, FC-19 was associated to health anxiety through intolerance of uncertainty, four metacognitions subscales (positive beliefs about worry, negative beliefs about thoughts concerning uncontrollability and danger, cognitive confidence, and beliefs about the need to control thoughts), and one of the emotion regulation subscales (expressive suppression). The direct link between the FC-19 and health anxiety was not significant ($\beta = 0.04$). With respect to the control variables gender ($\beta = 0.13$) and risk status ($\beta = 0.26$) were linked to health anxiety.

Along with the direct paths, standardized bootstrapping estimates (iteration number = 1000) of the indirect effects (mediating effects) revealed six significant indirect paths at the 5% level (see Table 4); that is their 95% confidence intervals did not include the zero value. As shown in Figure 2, four metacognitions, one subscale of emotion regulation (expressive suppression) and intolerance of uncertainty played a full mediating role in the relationship between FC-19 and health anxiety. Specifically, the strongest indirect links were found between FC-19 and health anxiety through negative beliefs about thought concerning uncontrollability and danger ($\beta = 0.534$, $SE = 0.021$, 95%, $CI [0.493-0.603]$, $p < 0.001$) and intolerance of uncertainty ($\beta = 0.394$, $SE = 0.030$, 95% $CI [0.344-0.446]$, $p < 0.001$).

The squared multiple correlations for the endogenous variables indicated that the final model accounted for 71% for health anxiety. Finally, the fit indices of model ($\chi^2 = 283.19$, $p < 0.001$; $CFI = 0.99$, $TLI = 0.99$, $RMSEA = 0.029$, $SRMR = 0.032$) and the total amount variance explained by the model ($TCD = 0.79$) confirmed an excellent fit of the measurement model. In terms of effect size, $TCD = 0.79$ corresponds to a correlation of $r = 0.90$ (which is large effect size according to the Cohen's [Cohen, 1988] traditional criteria).

4. Discussion

The aim of our study was to investigate the link between FC-19 and health anxiety, through the three mediators: metacognitions, intolerance of uncertainty, and emotion regulation. The current study included individuals whose first degree relatives have been recently hospitalized with a COVID-19 diagnosis. We advanced a model that integrates emotional, cognitive, and metacognitive components to elucidate correlated factors of health anxiety among participants with COVID-19 infected first degree relatives. The conceptual model (See Figure 1) was supported, in that the association between FC-19 and health anxiety was confirmed through a series of indirect routes (mediators), controlling for gender and risk status.

4.1. The link between FC-19 and health anxiety

In the current study, FC-19 was found to be correlated with health anxiety, however, contrary to our prediction, it had no direct link with health anxiety. The findings therefore confirmed the full mediation of metacognitions, intolerance of uncertainty, and expressive suppression in the association between FC-19 and health anxiety. These findings align themselves to those of Schweda and colleagues (2021) who observed that the presence of a risk of COVID-19 increases FC-19, but not generalized anxiety responses. In another study, Hetkamp and colleagues (2020) observed that although the FC-19 increased significantly at the beginning of the pandemic, after 6 weeks and with the removal of restrictions, it decreased to its initial level (the level at the beginning of the study), while generalized anxiety remained elevated over time. Furthermore, other studies have reported a positive correlation between FC-19 and worry, anxiety, and health anxiety, and between worry and health anxiety (Mertens et al., 2020; Wu et al., 2020). It would therefore appear that although fear, as a central emotion, occurs in response to life-threatening events like the recent pandemic (Barlow, 2000; Schimmenti et al., 2020), it need not result in pathological anxiety responses (such as health anxiety). The

question (central to our research endeavour) is what could contribute to the escalation of FC-19 into pathological responses?

4.2. The mediating role of metacognitions in the relationship between FC-19 and health anxiety

The present study revealed a mediational role of metacognitions (positive beliefs about worry, negative beliefs about thoughts concerning uncontrollability and danger, cognitive confidence and beliefs about the need to control thoughts) in the link between FC-19 and health anxiety. This path confirms the proposed mechanisms of transmission between the fear response relating to COVID-19 and the escalation of health anxiety. Massoni (2014) suggested that internal processes such as anxiety, can bring to the activation of metacognitions. In other words, it is possible to argue that high levels of bodily, interpersonal, cognitive, and behavioral aspects of FC-19 can activate metacognitions related to the danger of negative thoughts (e.g., about illness) and the need to control these thoughts through worrying. According to the metacognitive model of psychopathology (Wells, 2000), metacognitions have a central role in the activation and maintenance of forms of maladaptive coping (e.g., worry, rumination and thought suppression) that will exacerbate underlying distress. According to this model, a trigger (in our case FC-19) may lead to the activation of positive metacognitions and associated forms of maladaptive coping (e.g. worry). If these forms of maladaptive forms of coping persist negative metacognitions (i.e., beliefs about the uncontrollability and dangers of thoughts and coping) can become activated resulting in escalations of anxiety and self-focused attention (Wells, 1995; 2004; 2009). In other words, the presence of metacognitions may be ‘escalating’ FC-19 into a fully-fledged anxiety response likely to exacerbate distress and maintain fears relating to COVID-19 in consciousness (Nikčević et al., 2021; Nikčević & Spada, 2020) but also generalise the anxiety response to other health triggers.

It is notable that the strongest indirect links were observed between FC-19 and health anxiety through negative beliefs about thoughts concerning uncontrollability and danger. In line with this finding Bailey and Wells (2013) and Melli and colleagues (2018) have shown that this particular metacognition predicts health anxiety. According to Melli and colleagues (2016) metacognitions about uncontrollability and interference of illness thoughts can predict health anxiety after controlling for anxiety, depression, anxiety sensitivity and health-related dysfunctional beliefs. Bailey and Wells (2015) argue that negative metacognitions make individuals sensitive to control their reactions to misinterpretations of any cues and symptom.

4.3. The mediating role of intolerance of uncertainty in the relationship between FC-19 and health anxiety

Consistent with the findings from Satici, Saricali et al. (2020) and Mertens et al. (2020), FC-19 was found to be positively correlated with intolerance of uncertainty. Barlow (2000) stated that fear focuses on present and imminent threats, so with regards to COVID-19, fear is an adaptive response to a potential threat for humanity. But the question that arises here is how this natural fear persists in the current situation and becomes an extreme. In fact, high intolerance of uncertainty in facing to the FC-19 appears is likely to be associated with the activation of worry as a form of coping (e.g., Buhr & Dugas, 2002; 2006; 2009; Dugas, Freeston, & Ladouceur, 1997). Individuals with high intolerance of uncertainty, will have an increased attentional focus and tendency to misinterpret stimuli that are ambiguous (Francis, Dugas, & Ricard, 2016). This is likely to explain the ‘transmission’ of the FC-19 to health anxiety through intolerance of uncertainty. In support of this view, and in alignment with previous research, intolerance of uncertainty was also found to be positively correlated with health anxiety (Tull et al, 2020; Wright et al., 2016). This entails that individuals with high levels of intolerance of uncertainty (a factor closely linked to pathological worry) are more likely to be focusing on their physical health (Bakioğlu et al., 2020; Fergus & Bardeen, 2013),

including bodily cues (especially those are related to COVID-19). In turn this may lead to cycles of checking of body symptoms in an attempt at finding potential health threatening symptoms, leading to health anxiety (Dugas, Schwartz, & Francis, 2004; Tull et al., 2020).

4.4. The mediating role of emotion regulation in the relationship between FC-19 and health anxiety

In contrast with cognitive reappraisal, expressive suppression was found to be a mediator in the association between FC-19 and health anxiety. Fear is a strong emotion that affects individuals' emotional responses and emotion regulation. Our findings are consistent with studies showing a correlation between emotion dysregulation and health anxiety. Gørgen et al. (2014) found a relationship between the expressive suppression subdimension of emotion regulation and behavioral and cognitive dimensions of health anxiety, while they found no relation (except for the perceptual dimension) between the cognitive reappraisal subdimension of emotion regulation and dimensions of health anxiety. In line with their study, our results (related to health anxiety) confirmed this assumption: that the adoption of maladaptive emotion regulation strategies is more important to psychopathology than the absence of adaptive regulation. According to Gross and John (2003) suppression includes actively inhibiting and hiding the manifestation of an emotional experience. Emotion dysregulation (suppression) weakens the individual's ability to manage negative emotions and also intensifies fear and anxiety. In the current pandemic, suppression could increase health related concerns and lead to health anxiety. In brief, individuals with high levels of FC-19 are more likely to suppress their emotions, which in turn may impact health anxiety levels.

4.5. Limitations and directions for future research

Some limitations of our research should be considered, including the cross-sectional nature of the study which precludes inferences about causality. Data in the present study was gathered during the COVID-19 outbreak, which may vary depending on the course of pandemic, with

possible biases and cognitive misinterpretations heightened and lowered on the basis of numerous contextual factors. Future studies should replicate this study in contexts other than epidemics and pandemics so that we can draw more novel information and inference about the mediating nature of these variables. The present study also relies on the self-report measures, which may distort results. Another possible limitation of this study is its focus on a group of participants whose first degree relatives were infected with COVID-19. In addition, the presence of concurrent symptoms and psychological disorders was not assessed, which is an important factor that may reduce the generalization of the findings. Longitudinal studies, considering comorbid disorders, is a key direction for future research.

Our findings suggest important factors that may be targeted in reducing health anxiety. Metacognitive Therapy (Wells, 2009) may be employed to target metacognitions that drive the escalation of FC-19 into health anxiety. Associated interventions, such as attention training and detached mindfulness may help interrupt perseverative thinking patterns characteristic of health anxiety (e.g., worry, rumination, attention to threat). Cognitive-behavioral interventions that specifically focus on intolerance of uncertainty (Dugas et al., 2004) may also be beneficial in reducing the risk of health anxiety developing. Furthermore, since our findings have underlined the importance of expressive the suppression subdimension of emotion regulation, it seems that this component should targeted in treatment.

5. Conclusions

In the current study we presented a novel model linking FC-19 to health anxiety through the full mediation of metacognitions, intolerance of uncertainty, and expressive suppression. We did this controlling for gender and risk status. Despite the study limitations, we are confident that our findings can shed light on mechanisms key in the escalation of FC-19 to health anxiety. Our findings may be a foundation for future studies and the development of interventions aimed at limiting the escalation of health anxiety associated with COVID-19.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

Data availability statement

The data that supports the findings of this study are available from the corresponding author, upon request.

Table 1: Demographic features and additional data of the sample (n=541).

		N	%
Gender	Female	283	52.3
	Male	258	47.7
	Total	541	100.0
Educational level	Diploma	86	15.9
	Advanced Diploma	39	7.2
	Bachelor	239	44.2
	Master	113	20.9
	PhD	43	7.9
	Medical Science	21	3.9
Employment Status	Employed	407	75.2
	Unemployed	134	24.8
Risk Status	Yes	211	39.0
	No	330	61.0
Reasons	Older Age	84	39.8
	Health Problem	106	50.2
	Pregnancy	6	2.8
	Disability	4	1.9
	Non-defined reasons	11	5.2
Relative with Patient	Father	185	34.2
	Mother	167	30.9
	Brother/Sister	59	10.9
	Spouse	84	15.5
	Child	46	8.5
Data of Family Members with COVID-19			
Age (years)	53.8 (SD=14.8)		
Physical Condition	Complete Recovery	81	15.0
	Recovery Period	233	43.1
	Active Period of Illness	184	34.0
	Death	43	7.9

Table 2: Mean, standard deviations, skewness, kurtosis and zero order correlations between the study variables (n=541).

Variables	M	SD	Skewness	Kurtosis	1	2	3	4	5	6	7	8	9	10	11	12	13
1. FCV-19S	29.91	6.48	0.11	-0.14	1												
2. SHAI	29.74	6.13	-0.29	0.48	0.39**	1											
3. MCQ-30-POS	14.98	4.11	0.57	-0.89	0.29**	0.15**	1										
4. MCQ-30-NEG	15.32	4.91	0.62	0.57	0.34**	0.45**	0.23**	1									
5. MCQ-30-CC	12.89	4.87	-0.43	0.76	0.17**	0.42**	0.18**	0.29**	1								
6. MCQ-30-NC	17.65	5.07	0.49	-0.68	0.24**	0.39**	0.39**	0.43**	0.20**	1							
7. MCQ-30-CSC	19.01	5.71	0.48	-0.39	0.07	0.19**	0.21**	0.18**	0.23**	0.15*	1						
8. IUS-12	52.31	8.97	-0.39	0.33	0.48**	0.40**	0.17**	0.24**	0.04	0.19**	0.06	1					
9. ERQ-CRE	29.77	4.21	-0.19	-0.27	-0.38**	-0.13*	-0.18**	-0.29**	-0.08	-0.23**	-0.16**	-0.31**	1				
10. ERQ-ESU	11.58	3.02	0.68	-0.87	0.19**	0.39**	0.06	0.31**	0.15*	0.29**	0.23**	0.29**	-0.23**	1			
11. Age	41.3	13.2	-0.17	0.61	0.03	0.05	0.09	0.001	0.01	0.07	0.009	0.04	0.02	0.09	1		
12. Gender	-	-	-	-	0.09	0.16*	0.005	0.002	0.03	0.006	0.001	0.03	0.08	0.05	0.06	1	
13. Employment status	-	-	-	-	0.13*	0.03	0.002	0.06	0.008	0.003	0.04	0.006	0.001	0.009	0.03	0.05	1
14. Risk status	-	-	-	-	0.11*	0.21*	0.09	0.10*	0.04	0.001	0.02	0.003	0.01	0.02	0.13*	0.9	0.002

Notes: M = Mean; SD = Standard Deviation; FCV-19S = Fear of COVID-19 Scale; SHAI = Short Health Anxiety Inventory; MCQ-30-POS = Metacognitions Questionnaire 30 – Positive Beliefs about Worry; MCQ-30-NEG = Metacognitions Questionnaire 30 – Negative Beliefs about Thoughts concerning Uncontrollability and Danger; MCQ-30-CC = Metacognitions Questionnaire 30 – Cognitive Confidence; MCQ-30-NC = Metacognitions Questionnaire 30 – Beliefs about the Need to Control Thoughts; MCQ-30-CSC = Metacognitions Questionnaire 30 – Cognitive Self-Consciousness; IUS-12 = Intolerance of Uncertainty Scale-12; ERQ-ESU = Emotion Regulation Questionnaire – Expressive Suppression; ERQ-CRE = Emotion Regulation Questionnaire – Cognitive Reappraisal; ** $p < 0.01$; * $p < 0.05$. Gender= 1: Male, 2: Female; Employment status= 1: Employed, 2: Unemployed; Risk status= 1: Yes, 2: No.

Table 3: Paired comparisons for fear of COVID-19 and health anxiety among four groups of participants.

Variables	Groups		Mean differences (I-J)	SD error	<i>p-value</i>
	(I)	(J)			
Fear of COVID-19	G1	G2	-0.63	0.012	0.757
		G3	-0.89	0.039	0.689
		G4	-1.02	0.095	0.212
	G2	G1	0.63	0.012	0.757
		G3	-0.78	0.017	0.709
		G4	-0.94	0.081	0.592
	G3	G1	0.89	0.039	0.689
		G2	0.78	0.017	0.709
		G4	-0.81	0.048	0.634
	G4	G1	1.02	0.095	0.212
		G2	0.94	0.081	0.592
		G3	0.81	0.048	0.634
Health Anxiety	G1	G2	-0.23	0.009	0.982
		G3	-0.31	0.011	0.823
		G4	-0.81	0.024	0.563
	G2	G1	0.23	0.009	0.982
		G3	-0.39	0.041	0.794
		G4	-0.79	0.037	0.551
	G3	G1	0.31	0.011	0.823
		G2	0.39	0.041	0.794
		G4	-0.27	0.023	0.864
	G4	G1	0.81	0.024	0.563
		G2	0.79	0.037	0.551
		G3	0.27	0.023	0.864

Notes: G1 = participants whose relative was completely recovered; G2 = participants whose relative was in the recovery period; G3 = participants whose relative was in the active period of infection; G4 = participants whose relative had died.

Table 4: Standardized bootstrapping estimates of the indirect effect (with 95% confidence interval) of the fear of COVID-19 (independent variable) on health anxiety (dependent variable) through the metacognitions, intolerance of uncertainty, and emotion regulation (mediator variables).

Independent Variable	Mediator Variable	Dependent Variable	Standard Coefficient	Standard Error	Confidence Intervals		p-value
					Lower	upper	
Fear of COVID-19		Health Anxiety	0.394	0.030	0.344	0.446	< 0.001
	IUS-12						
Fear of COVID-19		Health Anxiety	0.191	0.028	0.147	0.242	< 0.01
	MCQ-30-POS						
Fear of COVID-19		Health Anxiety	0.534	0.021	0.493	0.603	< 0.001
	MCQ-30-NEG						
Fear of COVID-19		Health Anxiety	0.332	0.031	0.311	0.389	< 0.001
	MCQ-30-CC						
Fear of COVID-19		Health Anxiety	0.245	0.016	0.179	0.292	< 0.001
	MCQ-30-NC						
Fear of COVID-19		Health Anxiety	0.274	0.020	0.249	0.323	< 0.001
	ERQ-ESU						

Notes: MCQ-30-POS = Metacognitions Questionnaire 30 – Positive Beliefs about Worry; MCQ-30-NEG = Metacognitions Questionnaire 30 – Negative Beliefs about Thoughts concerning Uncontrollability and Danger; MCQ-30-CC = Metacognitions Questionnaire 30 – Cognitive Confidence; MCQ-30-NC = Metacognitions Questionnaire 30 – Beliefs about the Need to Control Thoughts; IUS-12 = Intolerance of Uncertainty Scale-12; ERQ-ESU = Emotion Regulation Questionnaire – Expressive Suppression.

Figure 1: Proposed conceptual model for the relationship between fear of COVID-19 and health anxiety.

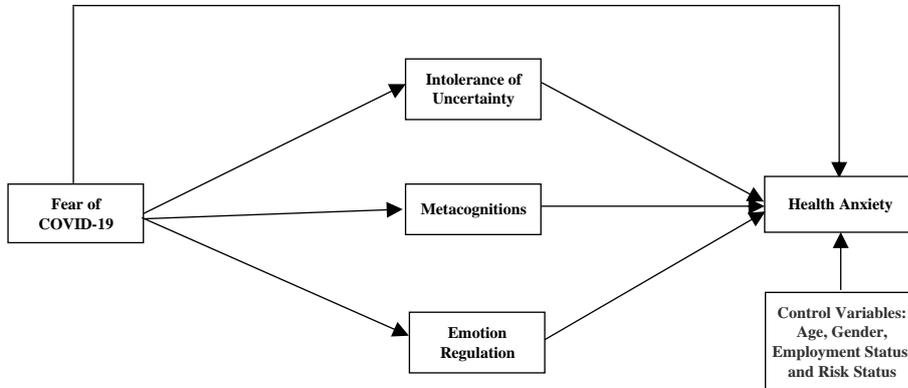
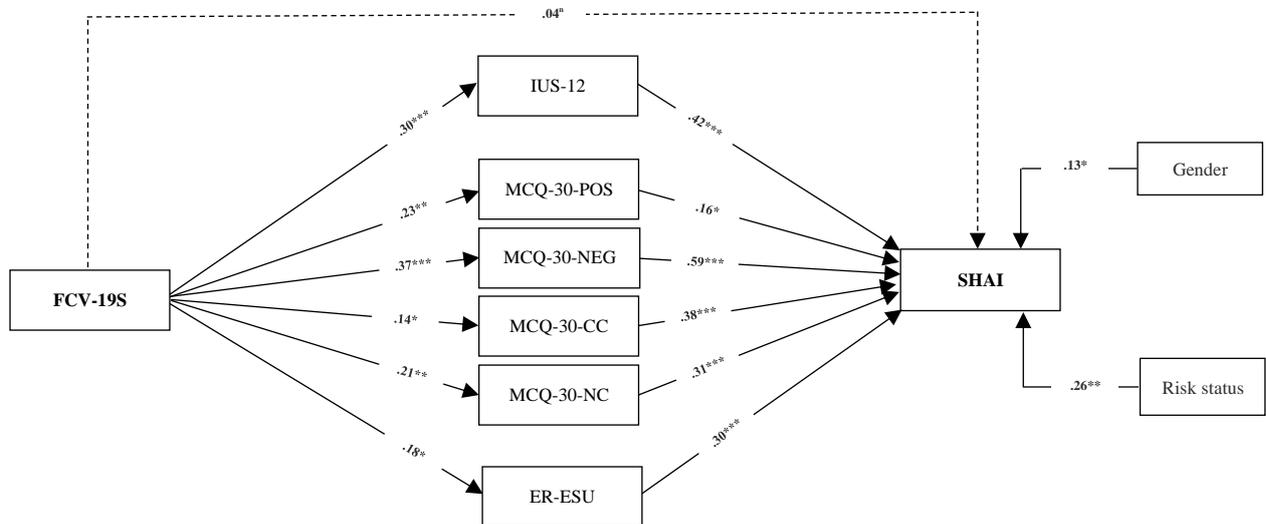


Figure 2: Final model of the direct and indirect impacts of fear of COVID-19 (independent variable) on health anxiety (dependent variable) through metacognitions, intolerance of uncertainty, and emotion regulation (mediator variables).



Notes: FCV-19S= Fear of COVID-19 Scale; SHAI= Short Health Anxiety Inventory; MCQ-30-POS= Metacognitions Questionnaire 30–Positive Beliefs about Worry; MCQ-30-NEG= Metacognitions Questionnaire 30–Negative Beliefs about Thoughts concerning Uncontrollability and Danger; MCQ-30-CC= Metacognitions Questionnaire 30 – Cognitive Confidence; MCQ-30-NC= Metacognitions Questionnaire 30– Beliefs about the Need to Control Thoughts; IUS-12= Intolerance of Uncertainty Scale-12; ERQ-ESU = Emotion Regulation Questionnaire– Expressive Suppression; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ⁿ no significance.

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