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Relationships between health anxiety, intolerance of uncertainty, rumination and self-compassion: A structural equation and latent profile analysis

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Abstract

The aim of this study is to examine the relationships between health anxiety, intolerance of uncertainty, rumination, and self-compassion through structural equation modeling (SEM) and latent profile analysis (LPA). The study group consists of 471 participants (296 female and 175 male) between the ages of 18 and 75 who were reached by convenience sampling method. Data were collected using the Health Anxiety Inventory (HAI), the Intolerance of Uncertainty Scale Short Form (IUS), the Ruminative Thought Style Scale (RTS), and the Self-compassion Scale (SCS). SPSS AMOS was used for the SEM analysis and MPLUS for the LPA analysis. The SEM results indicate that intolerance of uncertainty was positively associated with health anxiety and negatively associated with self-compassion, while rumination was negatively associated with self-compassion but not directly associated with health anxiety. The mediating role of self-compassion was significant in the relationship between both intolerance of uncertainty and rumination with health anxiety, highlighting the protective role of self-compassion against anxiety. The LPA revealed two latent profiles within the study group. The first latent profile, labeled "lower health anxiety symptoms and higher self-compassion," included participants with lower levels of health anxiety, intolerance of uncertainty, and rumination, but higher levels of self-compassion. The second latent profile, "higher health anxiety symptoms and lower self-compassion," comprised individuals with higher levels of health anxiety, intolerance of uncertainty, and rumination, and lower levels of self-compassion. These findings emphasize the importance of self-compassion and effective cognitive coping strategies in mitigating health anxiety, suggesting targeted interventions to enhance self-compassion and manage cognitive processes could be beneficial.

Keywords: Health anxiety, intolerance of uncertainty, rumination, self-compassion

Sağlık kaygısı, belirsizliğe tahammülsüzlük, ruminasyon ve öz-şefkat arasındaki ilişkiler: Bir yapısal eşitlik ve örtük profil analizi

Öz

Çalışmanın amacı, sağlık kaygısı, belirsizliğe tahammülsüzlük, ruminasyon ve öz-şefkat arasındaki ilişkileri yapısal eşitlik modellemesi (YEM) ve örtük profil analizi (LPA) yoluyla incelemektir. Çalışma grubu, uygun örnekleme yöntemiyle ulaşılan 18-75 yaş aralığındaki 471 katılımcıdan oluşmaktadır. Veriler Sağlık Anksiyetesi Envanteri, Belirsizliğe Tahammülsüzlük Ölçeği Kısa Formu, Ruminatif Düşünce Tarzı Ölçeği ve Öz Şefkat Ölçeği kullanılarak toplanmıştır. YEM sonuçları, belirsizliğe tahammülsüzlüğün sağlık kaygısı ile pozitif, öz-şefkat ile negatif ilişkili olduğunu; ruminasyonun ise öz-şefkat ile negatif ilişkili olduğunu ancak sağlık kaygısı ile doğrudan ilişkili olmadığını göstermiştir. Hem belirsizliğe tahammülsüzlük hem de ruminasyon ile sağlık kaygısı arasındaki ilişkide öz-şefkatin aracı rolünün anlamlı olması, öz-şefkatin kaygıya karşı koruyucu rolünü vurgulamaktadır. LPA, çalışma grubu içinde iki örtük profil ortaya çıkarmıştır. "Daha düşük sağlık kaygısı semptomları ve daha yüksek öz-şefkat" olarak etiketlenen ilk örtük profil, daha düşük sağlık kaygısı, belirsizliğe tahammülsüzlük ve ruminasyon seviyelerine sahip, ancak daha yüksek öz-şefkat seviyelerine sahip katılımcıları içermektedir. İkinci örtük profil olan "daha yüksek sağlık kaygısı semptomları ve daha düşük öz-şefkat" ise daha yüksek sağlık kaygısı, belirsizliğe tahammülsüzlük ve ruminasyon düzeylerine ve daha düşük öz-şefkat düzeylerine sahip bireylerden oluşmaktadır. Bulgular, sağlık kaygısının azaltılmasında öz-şefkatin ve etkili bilişsel başa çıkma stratejilerinin önemini vurgulamakta ve öz-şefkati artırmaya ve bilişsel süreçleri yönetmeye yönelik müdahalelerin faydalı olabileceğini düşündürmektedir.

Anahtar Kelimeler: *Belirsizliğe tahammülsüzlük, ruminasyon, sağlık kaygısı, öz-şefkat*

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INTRODUCTION

Health anxiety, which refers to the worry that a bodily sensation or a change in the body indicates a serious disease, is a type of anxiety that can be experienced by almost everyone at some point in people's lives (Abramowitz et al., 2002; Asmundson & Fergus, 2019). The fact that health anxiety is a type of anxiety that can be experienced by anyone at any time of life makes health anxiety a matter of degree (mild to severe), as in other types of anxiety. Therefore, health anxiety can be adaptive or maladaptive. In mild forms, health anxiety is adaptive and acts as a driving force behind seeking the right medical care and steering clear of unhealthy situations. In these cases, the health anxiety is transient, and the medical help and feedback have a mitigating effect on the health anxiety. In severe forms, health anxiety is maladaptive, persistent, and medical help and feedback do not alleviate the health anxiety (Warwick & Salkovskis, 2001; Taylor, 2004; Kraemer et al., 2016). According to Warwick & Salkovskis (2001), the difference between adaptive to maladaptive forms of health anxiety derives from the processes that maintain anxiety in the maladaptive form. The cognitive-behavioral model of health anxiety, which attempts to explain health anxiety and has received the greatest empirical support to date, states that the maintaining factors are dysfunctional beliefs and behaviors. In the severe form of health anxiety, individuals interpret vague bodily sensations or changes in a catastrophizing way in the framework of beliefs about illness. Catastrophizing increase physiological arousal, which in turn triggers avoidance and safety behaviors. Avoidance and safety behaviors maintain dysfunctional interpretation by causing excessive preoccupation with bodily sensations and changes (Warwick & Salkovskis, 2001; Asmundson & Fergus, 2019). In other words, individuals who experience severe health anxiety exaggerate the possibility of having a disease and the negative consequences that may be associated with the disease and pay excessive attention to bodily sensations. Within this context, catastrophic health assessments serve as the primary trigger, making it essential to analyze them for a deeper comprehension of the characteristics of anxiety of health (Abramowitz et al., 2002; Fergus & Valentiner, 2011; Asmundson & Fergus, 2019). Therefore, we investigated intolerance of uncertainty, rumination and their relationships with health anxiety, as well as the contribution of self-compassion to these relationships in this study.

Intolerance of uncertainty, rumination and health anxiety

Worry is an important cognitive process in the cognitive model of health anxiety (Warwick & Salkovskis, 2001). One of the prominent factors in the worry is intolerance of uncertainty. The incapacity of a person to endure a negative response caused by a deficiency of

substantial, crucial, or adequate information and maintained by the sense of uncertainty that accompanies it is known as intolerance of uncertainty. Individuals with high intolerance of uncertainty tend to view vague circumstances as more perilous than low intolerance of uncertainty. Anxiety and worry can become chronic due to behavioral (avoidance and safety-seeking behavior) and emotional (increased anxiety and stress) effects of an increased perception of threat (Carleton et al., 2007; Carleton, 2016).

The tolerance of catastrophic health evaluations varies from person to person. Intolerance of uncertainty may explain this variation because uncertainty is recognized as a significant source of stress and a major precursor to anxiety (Warwick & Salkovskis, 2001). Health anxiety may be more common in people who are not able to handle uncertainty about catastrophic health evaluations (Fergus & Valentiner, 2011). Abramowitz et al. (2002) suggested that catastrophic health evaluations and health anxiety are related, and one of the factors explaining this relationship is intolerance of uncertainty. Individuals suffering from high levels of health anxiety frequently seek greater certainty about the underlying causes of their symptoms (Abramowitz & Braddock, 2008). Evidence from research suggests that a greater intolerance of uncertainty is associated with increased health anxiety. (e.g. Abramowitz et al., 2007; Fergus & Valentiner, 2011; Partovi Pirooz et al. 2022; Satıcı et al., 2022).

Another cognitive process related to health anxiety is rumination. Rumination, an important predictor of mental health problems, is a structure explained by different models. According to the Reaction Styles Theory (RST), which is one of these models, rumination means that the person is excessively preoccupied with the reasons, results and signs of negative mood and constantly thinks about them. This model explains rumination in the concept of cognitive vulnerability of depression. Apart from this model, there are also models that address rumination in different contexts. One of these is the Self-Regulatory Executive Function (S-REF), which considers rumination in the self-regulation context and considers it as a subset of anxiety. Rumination is regarded by S-REF as a significant metacognitive process that exacerbates the issue by impairing attention, emotion, and cognitive regulation abilities. Rumination's detrimental effects on effective coping can be considered one of the commonalities among various models. Coping strategies are classified as either emotion- or problem-focused in the literature (Smith & Alloy, 2009). Rumination is a passive and emotion-focused coping style. For these reasons, rumination is not functional and does not contribute to problem solving. Conversely, it results in avoidance and the suppression of negative emotions, which makes them harder to process and more persistent (McLaughlin & Nolen-Hoeksema,

2011; Odou & Brinker, 2014). Evidence from research suggests that a greater rumination is associated with increased health anxiety. (Marcus et al., 2008; Wolfradt et al., 2014; Partovi Pirooz et al. 2022; Satıcı et al., 2022) In this context, rumination is an important empirical diagnostic criterion for health anxiety. (Fink et al., 2004). Rumination has a similar effect on health anxiety as worry does and could increase health concerns by exacerbating perceptions of vulnerability (Marcus et al., 2008). Repetitive thinking may also lead to an increase in physiological arousal and harmless sensations and symptoms can be mistakenly considered health threats (Abramowitz & Braddock, 2008).

The emotional avoidance and emotion suppression functions of rumination also affect autobiographical memory. Rumination inhibits the retrieval of specific autobiographical memories and recall more general and superficial memories are recalled. Thus, the individual's mind becomes preoccupied with a narrow range of thoughts about anxiety. This prevents access to the detailed and positive memories necessary to cope with the problematic thoughts and feelings and causes the anxiety to persist (Sansom-Daly et al., 2014) In other words, the effect of created by rumination may prevents effective problem solving and makes it difficult to cope with anxiety. For instance, Sansom-Daly et al. (2014, 2016) found that ruminative thinking may lead to more frequent recall of illness-related memories, creating a cycle by preventing coping with future health problems by making realistic plans, which may lead to persistent health anxiety. Muse et al. (2010) also state that people who experience intrusive health-related memories may frequently engage in rumination as an avoidant behavior.

Self-compassion and health anxiety

Self-compassion is defined by (Neff, 2003) as being receptive to experiencing pain, easing it, and igniting a desire to heal oneself with kindness, all while touching one's pain without escaping it or breaking away from it. Put differently, self-compassion refers to an attitude that includes being open to emotions and accepting them (Odou & Brinker, 2014). According to Neff (2003), three components comprise self-compassion. These are self-kindness, common humanity, and mindfulness. While a tendency to treat oneself with understanding and care as opposed to judging oneself harshly is known as self-kindness, common humanity refers rather than feeling alone, accepting that unpleasant experiences are a necessary part of being human. Mindfulness, which is the third element of self-compassion, involves balancing awareness of unpleasant feelings and thoughts as opposed to running away, repressing, or becoming overtaken by them emotionally. These aspects of self-compassion promote psychological well-being and provide a buffer against the onset of mental health

problems (Neff, 2003; Raes, 2010). Neff and Dahm (2015) assert that self-compassion significantly contributes to the processes of emotional regulation and the development of effective coping strategies. Furthermore, self-compassion reduces stress and facilitates problem-solving and the search for social support.

A significant body of research has established a clear link between self-compassion and disorders related to anxiety. Changing one's self-perception and practicing self-compassion during difficult times can help reduce anxiety (Neff, 2003; Raes, 2010). Research on health anxiety have mostly focused on the effect of mindfulness, a dimension of self-compassion, on health anxiety. Kraemer et al. (2016) assert that a negative correlation exists between mindfulness and health anxiety. In addition, controlled experimental studies show that mindfulness-based cognitive therapy practices have a therapeutic effect on severe health anxiety (e.g. Lovas & Barsky, 2010).

Self-compassion has the potential to mitigate health anxiety by addressing the negative impacts of rumination and intolerance of uncertainty. As mentioned above, intolerance of uncertainty and rumination are important cognitive processes that influence health anxiety. Being kind and compassionate toward oneself during uncertain times is self-compassion's sign (Neff, 2003). Self-compassion may have a reducing effect on intolerance of uncertainty because it tends to reduce avoidance behavior while strengthening positive reappraisal and proactive coping behavior (Neff, 2003; Neff & Dahm, 2015). Studies show that intolerance of uncertainty and self-compassion predict health anxiety both directly and indirectly (e.g. Deniz, 2021; Poluch et al., 2022).

Rumination and self-compassion are negatively correlated (Neff, 2003; Raes, 2010). While self-compassion entails treating oneself with kindness and compassion (Neff, 2003), rumination is a coping mechanism for maladaptive emotional states in which the reaction to distress is an ongoing process of considering the signs, origins, and effects of the suffering that one is going through (Nolen-Hoeksema, 1991). Theoretically, rumination is unlikely to occur when self-compassion is present because the processes and ideas involved are completely different. Therefore, one protective tactic could be to work on developing self-compassion in people who tend to have a ruminative cognitive style (Odou & Brinker, 2014).

The current study

In this study, we have focused on two specific objectives that were identified in accordance with the data and insights derived from the literature. Our first objective was to

examine the relationships between health anxiety, intolerance of uncertainty, rumination and self-compassion with a structural model. In the model, rumination and intolerance of uncertainty are the predictive variables, health anxiety is the outcome variable, and self-compassion is the mediator variable. To our current knowledge, there have been no studies that have investigated how self-compassion mediates the relationships between rumination, intolerance of uncertainty, and health anxiety. Studies have mostly focused on mindfulness, a component of self-compassion (Kraemer et al., 2016). We believe that it is critical to investigate self-compassion's function in the relationship between rumination, intolerance of uncertainty, and health anxiety overall because self-compassion is a multidimensional structure (Neff, 2003). The results of this study will also support the cognitive model of health anxiety.

Our second objective is to identify the latent profiles in terms of study variables and to examine the psychological characteristics of latent profiles. In the existing studies, there are no studies that we know that examined latent profiles in health anxiety in terms of intolerance of uncertainty, rumination and self-compassion. Considering both the importance of intolerance of uncertainty and rumination in the cognitive model of health anxiety (Warwick & Salkovskis, 2001) and the protective and enhancing effect of self-compassion on mental health (Neff, 2003; Raes, 2010; Neff & Dahm, 2015), which has come to the fore with third wave cognitive behavioral therapy approaches, we believe that latent profile analysis will make an important contribution to the cognitive model of health anxiety. We also believe that determining the heterogeneity in psychological response patterns is critical to comprehending individual differences and thus to developing more specific prevention and treatment interventions for health anxiety. In this regard, we believe that this part of the study will be highly informative. Therefore, we first tested whether the study group consisted of homogenous subgroups based on scale scores. Second, using scale scores and demographic variables, we attempted to determine the psychological characteristics of these homogenous subgroups.

METHOD

Research model

In this study, correlational research design, one of the quantitative research designs, was used. Correlational research design is a research design that aims to examine the relationships between two or more variables without manipulating the variables and to make predictions based on the relationships (Fraenkel et al., 2012).

The study group

A total of 471 (296 female [62.80%] and 175 male [37.20%]) individuals aged 18-75 years (M = 38.04, SD = 13.02) were included in the study. Data were also collected from the participants regarding their education, history of COVID-19, and history of chronic diseases. The research group was recruited using the convenience sampling method. Convenient sampling is one of the non-random sampling methods in which researchers establish the sample by reaching the participants who are accessible in terms of time and cost (Fraenkel et al., 2012).

This research was conducted with the decision of Sivas Cumhuriyet University Educational Sciences Research Proposal Ethics Review Board dated 27.02.2023 and numbered E-50704946-100-269468.

Data collection tools

The health anxiety inventory

The Health Anxiety Inventory (HAI; Salkovskis et al., 2002) was developed to measure individuals' level of health anxiety. There are 18 items on the scale and two subscales with scores between 0 and 3. The first 14 items are included in the body of inventory measuring hypersensitivity to physical symptoms and anxiety. The last 4 items are related to the negative consequences of the illness. A high score on the scale indicates high health anxiety. Aydemir et al. (2013) adapted the scale to Turkish culture. The construct validity of the inventory was examined by exploratory factor analysis. As a result of the analysis, the two-factor structure of the scale was confirmed. The reliability of the inventory was examined using two different methods: the Cronbach α internal consistency coefficient and the test-retest method. Cronbach α internal consistency coefficient was 0.918 and the test-retest value was $r = 0.572$ ($p < 0.0001$; Aydemir et al., 2012). In this study, the Cronbach α internal consistency coefficient of the inventory was 0.848.

The short version of the intolerance of uncertainty scale

The Intolerance of Uncertainty Scale Short Form (IUS; Carleton et al., 2007) was developed to assess a person's level of intolerance of uncertainty. On a 5-point Likert-type scale, with 1 denoting not at all characteristic of me and 5 denoting entirely characteristic of me, participants rate 12 items. Higher scores indicate a greater intolerance of uncertainty. The scale consists of prospective anxiety and inhibitory anxiety subscales. Sarıçam et al. (2014) adapted the scale to Turkish culture. The construct validity of the scale was examined by exploratory and confirmatory factor analyses. Exploratory factor analysis confirmed the two-factor structure of the scale. According to the confirmatory factor analysis, the scale showed

good fit ($\chi 2$ = 147.20, df = 48; RMSEA = 0.073, CFI = 0.950, IFI = 0.950, GFI = 0.940, SRMR = 0.046). The Cronbach α internal consistency coefficient of the scale was 0.880 (Sarıçam et al., 2014). In this study, the Cronbach α internal consistency coefficient of the whole scale was 0.895.

The ruminative thought style questionnaire

The Ruminative Thought Style Scale (RTS; Brinker & Dozois, 2009) was developed to assess a person's level of rumination. Higher scores indicate higher levels of rumination. Participants answered 20 items on a 7-point Likert-type scale, with 1 representing "not at all descriptive of me" and 7 representing "describes me very well." The scale has a single-factor structure. Karatepe et al. (2013) adapted the scale to Turkish culture. The single-factor structure of the scale has also been confirmed in Turkish culture. The construct validity of the scale was examined by exploratory factor analysis. Exploratory factor analysis confirmed the single-factor structure of the scale. The Cronbach α internal consistency coefficient of the scale was 0.907 (Karatepe et al., 2013). In this study, the Cronbach α internal consistency coefficient of the scale was 0.953.

The self-compassion scale

The Self-Compassion Scale (SCS; Neff, 2003) was developed to evaluate a person's level of self-compassion. On a 5-point Likert-type scale, participants rated 26 items, with 1 denoting "almost never" and 7 denoting "almost always". Higher scores correspond to higher levels of self-compassion. The scale consists of subscales of self-kindness, self-judgment, common humanity, isolation, mindfulness and overidentification. Akın et al. (2007) adapted the scale to Turkish culture. The construct validity of the scale was examined by exploratory and confirmatory factor analyses. Exploratory factor analysis confirmed the six-factor structure of the scale. According to the confirmatory factor analysis, the scale showed good fit ($\chi 2$ = 779,01, df = 264, p = 0.000; RMSEA = 0.056, NFI = 0.950 CFI = 0.970, IFI = 0.970, RFI = 0.940, GFI = 0.910, SRMR = 0.059). The internal consistency coefficients of the scale were 0.77 for self-kindness subscale, 0.72 for self-judgment, 0.72 for common humanity, 0.80 for isolation, 0.74 for mindfulness, and 0.74 for overidentification. (Akın et al., 2014). In this study, the Cronbach α internal consistency coefficient of the whole scale was 0.927.

Data collection process

Prior to the study, the Sivas Cumhuriyet University Educational Sciences Research Proposal Ethics Review Board gave its approval. The study was also conducted in accordance

with the 1964 Helsinki Declaration and its later amendments. After ethical approval, the scales were converted into online forms and sent to the participants. Participants completed the forms in 15-20 minutes. Informed consent was acquired prior to taking part in the study.

Data analysis

The data set was analyzed in four stages. The data set was first checked for missing values, univariate and multivariate outliers, univariate and multivariate normality, linearity, homogeneity of variance and multicollinearity assumptions prior to data analysis. Secondly, relationships between variables were examined using Pearson's correlation.

In the third stage, the model fit of the previously proposed structural model consisting of intolerance of uncertainty, rumination, self-compassion, and health anxiety variables were tested using structural equation modeling (SEM) by SPSS AMOS. The model fit was evaluated by means of the chi-square statistic, RMSEA, CFI, TLI and SRMR (Hu & Bentler, 1999). Gender, age, COVID-19 status and chronic disease status of the participants and their immediate family were included as control variables. The significance of the mediation effect was examined with the bootstrap method, and 10000 resamples were made. The confidence interval (CI) was set at 95%, and confidence intervals not approaching zero were considered to indicate statistical significance.

In the final and fourth stage, latent profile analysis (LPA) was conducted by MPLUS. The aim of LPA is to determine the optimal number of profiles. Initially, several models were evaluated to determine the optimal number of profiles based on scale scores. One-, two- and three-profiles were analyzed respectively, and the optimal number of profiles was determined by comparing the models. Bayesian Information Criteria (BIC), Lo-Mendell-Rubin adjusted likelihood ratio test (LMR LRT) and Vuong-Lo-Mendell-Rubin likelihood ratio test (VLMR LRT) were used for model comparison to determine the number of profiles (Lo et al., 2001; Wang & Wang, 2020). Following the determination of the optimal number of profiles, the psychological characteristics of the profiles were analyzed using line graph prepared with the standard scores of the scale scores, independent samples t-test and regression analysis. In addition, the differences between the latent profiles in terms of demographic variables (gender, age, Covid-19 status, chronic disease status of participants and chronic disease status of immediate family members of participants) were analyzed by 3-step regression analysis.

FINDINGS

Preliminary analysis

No missing data were found in the missing data analysis. To determine the univariate extreme values, the variables' z standard scores were computed, and one data outside the ±3.29 (Tabachnick & Fidell, 2014) range were excluded from the analysis. To determine the multivariate extreme values, the Mahalanobis distance was calculated, and one data outside the critical value were excluded from the analysis. After removing univariate and multivariate outliers from the dataset, the number of participants was 469. Descriptive statistics and correlation coefficients are presented Table 1.

Table 1. Descriptive statistics and correlation analysis

	1	2	3	4
1. Health anxiety	-			
2. Intolerance of uncertainty	0.377**	-		
3. Rumination	0.346**	0.611**	-	
4. Self-compassion	-0.374**	-0.420**	-0.587**	-
Mean	15.055	37.859	92.130	83.977
Standard deviation	7.017	9.49	25.363	17.536
Skewness	0.663	-0.153	-0.216	-0.220
Kurtosis	0.497	-0.395	-0.598	0.028
Cronbach alpha	0.848	0.895	0.953	0.927
McDonald's omega	0.850	0.897	0.955	0.928
VIF	1.251	1.684	2.027	1.610
Tolerance	0.799	0.594	0.493	0.621

** = $p < 0.01$

To test the univariate normality of the data, the kurtosis and skewness values of the variables were examined. The kurtosis values ranged from -0.598 to 0.497, and the skewness values varied between -0.220 and 0.663. The variables are assumed to have a univariate normal distribution. These values are within the range of ±1.5 (Tabachnick & Fidell, 2014). To test the multivariate normality of the data, Mardia's multivariate skewness ($\hat{\gamma}$1,p = 101.990, p = 5.538) and kurtosis ($\hat{\gamma}$1,p = 0.849, p = 0.396) values were examined and it was determined that the data were not multivariate normal distribution. The Durbin Watson coefficient for the multicollinearity problem was calculated as 1.986. Additionally, variance inflation values (VIFs) were found to be between 1.251 and 2.027; tolerance values were found to be between 0.493 and 0.799. The values found were within the recommended limits, and it was accepted that there was no multicollinearity problem between the variables (Tabachnick & Fidell, 2014).

Health anxiety was positively correlated with intolerance of uncertainty (r = 0.377, p<0.01) and rumination (r = 0.346, p<0.01) and negatively associated with self-compassion (r = -0.374, p<0.01). Intolerance of uncertainty was positively correlated with rumination (r =

0.611, p<0.01) and negatively associated with self-compassion (r = -0.420, p<0.01). Additionally, rumination was negatively correlated with self-compassion (r = -0.587, p<0.01).

Structural model analysis of health anxiety

In the structural model we proposed based on the literature, intolerance of uncertainty and rumination are predictor variables, health anxiety is the outcome variable, and self-compassion is the mediating variable. The structural model is presented in Figure 1. Model fit and modification indices of the proposed model were examined. According to the final model fit indices, the model was found to be a good fit with the data ($\chi^2_{(6)}$ = 1.80 p = .94, CFI = 1.00, TLI = 1.00, SRMR = .011, RMSEA = 0.00, p = 0.996, 90% CI = 0.00 to 0.01).

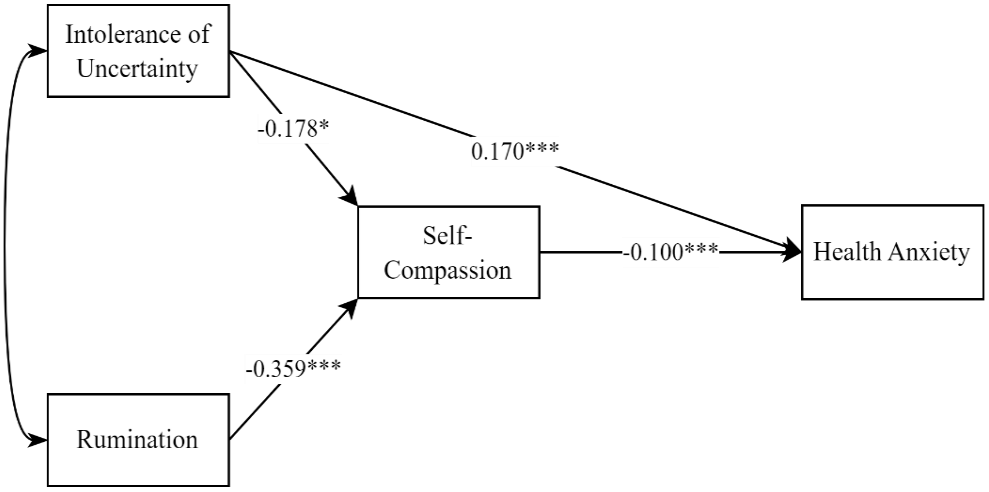

Figure 1. Final model results

Note: Values shown are unstandardized coefficients. $^{*}p$<0.05, $^{***}p$<0.001

According to the model analysis, intolerance of uncertainty is negatively associated with self-compassion (β = -0.178, p<0.05) and positively associated with health anxiety (β = 0.457, p<0.001). Rumination is negatively associated with self-compassion (β = -0.359, p<0.001). There is no significant relationship between rumination and health anxiety. Self-compassion is negatively associated with health anxiety (β = -0.100, p<0.001). Finally, the indirect effects were examined. Mediation analysis showed that the mediation effect of self-compassion for intolerance of uncertainty (indirect effect β = 0.018, 95% CI = 0.003 to 0.033) and rumination (indirect effect β = 0.036, 95% CI = 0.024 to 0.049) was significant. The outcomes also indicate that the indirect effects of intolerance of uncertainty and rumination are significant.

Latent profile analysis of health anxiety

It was determined that the model fit was good, LPA was performed to determine homogenous subgroups of the study group. One-, two- and three-class models were analyzed

to determine the optimal number of profiles, respectively. Table 2 shows that the one-class model has the worst model fit (BIC = 15016.434) compared to the other models. Although the BIC values of the two-class (BIC = 14654.537) and three-class (BIC = 14571.873) models are quite close to each other, the LMR (p=0.171) and VLMR (p=0.164) values of the three-class model are not significant. The findings indicate that the two-class model has better model fit than the three-class model. The entropy value of the two-class model is 0.727, which indicates a medium to high level of entropy (Wang & Wang, 2020). Furthermore, in the two-class model, the average classification membership probabilities are 0.91 (n = 239, class size 50.2%) for the first latent class and 0.93 (n = 230, class size 49.8%) for the second latent class. These values exceed the recommended lower limit (0.70). According to the findings, it was concluded that there were two latent profiles within the study group in terms of health anxiety, intolerance of uncertainty, rumination and self-compassion.

Table 2. Model fit indices of latent profile analysis

Model	BIC	LMR (p)	VLMR (p)	Class assignment probability (class size)	Entropy
1 class	15016.434	-	-	-	-
2 classes	**14654.537**	**380.284 (0.000)**	**392.650 (0.000)**	**0.91(51%) / 0.93(49%)**	**0.727**
3 classes	14571.873	109.845 (0.171)	113.417 (0.164)	0.90(18%) / 0.86(50%) / 0.89(32%)	0.739

Note. Bold text indicates the best model selected.

After the number of profiles was determined, the psychological characteristics of the latent profiles were examined in terms of study variables. For this purpose, the mean and standard deviation values of the health anxiety, intolerance of uncertainty, rumination and self-compassion variables were analyzed. In addition, z standard scores of the variables were calculated and presented as a line graph in Figure 2. Figure 2 demonstrates that the latent profiles differ from each other according to the standardized scores. Latent profile 1 (LP1) consists of participants with lower levels of health anxiety, intolerance of uncertainty, rumination and higher levels of self-compassion. Therefore, LP1 was labelled "*lower health anxiety symptoms and higher self-compassion*". Latent profile 2 (LP2) consists of participants with higher levels of health anxiety, intolerance of uncertainty, rumination and lower levels of self-compassion. Therefore, LP2 was labelled as "*higher health anxiety symptoms and lower self-compassion*".

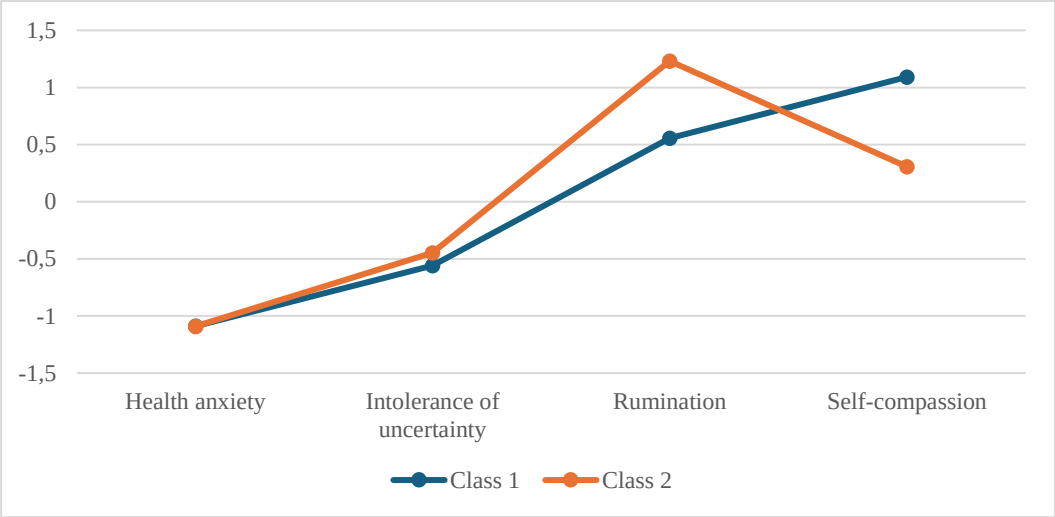

Figure 2. Standardized mean scores of two-classes latent profiles

The independent sample t test was used to analyze whether there was a significant difference between the latent profiles in terms of health anxiety, intolerance of uncertainty, rumination and self-compassion. The results of the analysis indicated that participants in LP1 (M = 12.02, SD = 5.04) showed significantly lower levels of health anxiety than participants in LP2 (M = 18.21, SD = 7.38), t = -10.654, p<0.001. Participants in LP1 (M = 31.95, SD = 7.82) showed significantly lower levels of intolerance of uncertainty than participants in LP2 (M = 44.00, SD = 6.94), t = -17.609, p<0.001. Participants in LP1 (M = 73.44, SD = 18.14) showed significantly lower levels of rumination than participants in LP2 (M = 111.55, SD = 15.06), t = -27.700, p<0.001. Finally, participants in LP1 (M = 94.42, SD = 12.91) showed significantly higher levels of self-compassion than participants in LP2 (M = 73.12, SD = 14.31), t = 16.904, p<0.001.

Table 3. Posterior profile membership probabilities regression analysis results by latent profiles

	Latent profile 1 (n = 239, 50.2%) (Lower health anxiety symptoms and higher self-compassion)				**Latent profile 2 (n = 230, 49.8%) (Higher health anxiety symptoms and lower self-compassion)**			
	R^2	β	t	p	R^2	β	t	p
Health anxiety	0.251	-0.501	-12.496	<0.001	0.251	0.501	12.496	<0.001
Intolerance of uncertainty	0.488	-0.699	-21.118	<0.001	0.488	0.699	21.118	<0.001
Rumination	0.669	-0.818	-30.746	<0.001	0.669	0.818	30.746	<0.001
Self-compassion	0.466	0.682	20.177	<0.001	0.466	-0.682	-20.177	<0.001

The psychological characteristics of the latent profiles were also analyzed by regression analysis. The relationships between the posterior profile membership probabilities of the latent profiles and the research variables were regressed. In the analysis, posterior profile membership probabilities were dependent variables, and health anxiety, intolerance of uncertainty, rumination and self-compassion were independent variables. Posterior profile membership

probabilities regression analysis results are presented in Table 3. The regression analysis results for LP1 showed that posterior profile membership probabilities were negatively associated with health anxiety (β = -0.501, p<0.001), intolerance of uncertainty (β = -0.699, p<0.001), and rumination (β = -0.818, p<0.001), but positively associated with self-compassion (β = 0.682, p<0.001). As a result, participants in LP1 were less likely to experience health anxiety, intolerance of uncertainty and rumination, and more likely to show self-compassion.

Regression analysis results for LP2 showed that posterior profile membership probabilities were positively associated with health anxiety (β = 0.501, p<0.001), intolerance of uncertainty (β = 0.699, p<0.001) and rumination (β = 0.818, p<0.001), but negatively associated with self-compassion (β = -0.682, p< 0.001). As a result, unlike LP1, participants in LP2 were more likely to experience health anxiety, intolerance of uncertainty and rumination, and less likely to show self-compassion.

Table 4. The demographic features of the identified latent profiles

	Latent profile 1(*n* = 239, 50.2%) (Lower health anxiety symptoms and higher self-compassion)		**Latent Profile 2 (*n* = 230, 49.8%) (Higher health anxiety symptoms and lower self-compassion)**	
Variables	**M**	**SD**	**M**	**SD**
Age	40.67	13.07	35.46	12.43
	N	%	N	%
Gender				
Female	126	52.70	170	73.90
Male	113	47.30	60	26.10
COVID-19				
Yes	119	49.80	118	51.30
No	120	50.20	112	48.70
Chronic disease of participants				
Yes	34	14.20	50	21.70
No	205	85.80	180	78.30
Chronic disease of immediate family members				
Yes	143	59.80	153	66.50
No	96	40.20	77	33.50

Finally, the variability in the latent profiles according to demographic variables (gender, age, Covid-19, chronic disease status of the participants and chronic disease status of the immediate family member of the participants) were analyzed by 3-stage regression analysis. Multinomial logistic regression analysis indicated that gender and age significantly differentiated the profiles. Female participants were significantly more likely to belong to LP1 compared to male participants (β = 1.008, [OR] = 2.741, p<0.001). Similarly, increasing age was associated with a higher likelihood of belonging to LP1 (β = 0.047, [OR] = 1.049, p<0.001). Participants with their own chronic disease were also more likely to belong to LP1 (β = 1.167, [OR] = 3.211, p<0.001). However, COVID-19 infection status (β = 0.228, [OR] = 1.257,

p=0.360) and having an immediate family member with a chronic disease (β = 0.044, [OR] = 1.045, *p*=0.868) did not significantly differentiate the profiles. The demographic features of the identified latent profiles are presented in Table 4.

DISCUSSION AND CONCLUSION

Structural model of health anxiety

Health anxiety is a significant problem that negatively affects individuals' well-being. In this study, the relationships between health anxiety, intolerance of uncertainty, rumination and self-compassion were investigated to shed light on the mechanism underlying health anxiety. In this regard, we tested a structural model in which intolerance of uncertainty and rumination were predictive variables, health anxiety was the outcome variable, and self-compassion was the mediating variable.

The study results suggest that intolerance of uncertainty is positively and directly associated with health anxiety. This result is consistent with research results indicating that intolerance of uncertainty increases health anxiety (Warwick & Salkovskis, 2001; Abramowitz & Braddock, 2008; Fergus & Valentiner, 2011; Partovi Pirooz et al. 2022; Satıcı et al., 2022). The perception of uncertainty can lead individuals to think that their health is at potential risk. Individuals who are unable to tolerate uncertainty and believe that they have lost control may experience increased stress and perceive more threats. This may increase their concerns about their health (Abramowitz et al., 2007; Fergus & Valentiner, 2011).

The study results suggest that intolerance of uncertainty is negatively and directly related to self-compassion and this result is consistent with the literature (Neff, 2003; Deniz, 2021; Poluch et al., 2022). Considering the distinct mechanisms underlying self-compassion and intolerance of uncertainty, this relationship is expected. Intolerance of uncertainty increases the perception of threat and triggers a search for absolute certainty. This situation increases the use of dysfunctional coping methods (e.g. overthinking, avoidance, and safety-seeking behaviors), causing excessive preoccupation with uncertainty and increased anxiety. In other words, intolerance of uncertainty plays a role in perpetuating and aggravating the problem rather than solving it (Carleton, 2016). Self-compassion, on the contrary, involves being open to and accepting emotions. It increases individuals' abilities to effectively cope with difficulties and stressful situations and plays a problem-mitigating role (Odou & Brinker, 2014; Neff & Dahm, 2015). In summary, it can be said that a higher level of intolerance of uncertainty may mean a lower level of self-compassion and vice versa.

The study results suggest that there is no direct significant relationship between rumination and health anxiety. Other research findings (e.g. Marcus et al., 2008; Wolfradt et al., 2014; Partovi Pirooz et al. 2022; Satıcı et al., 2022) do not align with this outcome. This result suggests that rumination and health anxiety have a complicated relationship, and that various mediators and mediator variables influence this relationship. The cultural and psychological characteristics of the study group and the setting and period of time in which the study was conducted could also have contributed to this outcome.

The study results suggest that rumination is negatively and directly related to self-compassion and this result is consistent with the literature (e.g. Neff, 2003; Odou & Brinker, 2014). The fact that rumination and self-compassion have distinct mechanisms helps to explain this finding. Rumination is an emotion-focused and passive coping strategy. Consequently, because it seeks to deal with negative emotion by repressing and avoiding it, it hinders effective problem-solving. The result is that the problem persists (Nolen-Hoeksema, 1991; Odou & Brinker, 2014). Self-compassion, as mentioned before, is based on accepting emotions, creating space for emotions, and being kind to oneself. Rumination's avoidance and suppression mechanisms are the opposite of this, which allows for effective problem-solving. In summary, a higher level of rumination may indicate a lower level of self-compassion and vice versa.

Finally, study findings showed that the mediating effect of self-compassion was significant in the relationship between intolerance of uncertainty and rumination and health anxiety. This finding is consistent with the literature and is expected. Researchers (Neff, 2003; Neff & Dahm, 2015) have reported that self-compassion is a significant protective factor against psychological problems. This protective feature of self-compassion isolates the negative effect of intolerance of uncertainty and rumination on health anxiety. In contrast to intolerance of uncertainty and rumination, self-compassion is characterized by being kind and understanding towards oneself when faced with difficulties. Individuals' acceptance of themselves and approach to compassion may increase positive emotions and thoughts and make them more resilient in the face of problems (Neff, 2003; Odou & Brinker, 2014). In other words, self-compassion reduces problems such as anxiety and depression by increasing individuals' ability to cope with negative thoughts. In summary, it can be concluded that when the level of self-compassion is low, the relationships between intolerance of uncertainty-health anxiety and rumination-health anxiety may become stronger, or vice versa.

Latent profile analysis of health anxiety

After testing the structural model we proposed regarding health anxiety, we performed LPA to identify homogeneous subgroups of the research group based on the relationships between study variables (health anxiety, intolerance of uncertainty, rumination and self-compassion). It revealed that the LPA research group consisted of 2 latent profiles. There were 239 (50.2%) participants in LP1 and 230 (49.8%) participants in LP2.

In the analyzes conducted to determine the psychological characteristics of latent profiles, it was observed that LP1, called "lower health anxiety symptoms and higher self-compassion", consisted of participants with lower levels of health anxiety, intolerance of uncertainty, rumination and higher levels of self-compassion. It can be concluded that the participants in this profile are more psychologically functional and resilient because the findings show that the participants in this profile have better coping and emotion regulation skills. The literature supports these findings. Neff (2003), for example, showed that self-compassion is linked to reduced levels of anxiety and depression. In addition, similar to Neff and Dahm (2015), Raes (2010) found that people with high levels of self-compassion were better able to cope with negative emotions and showed less rumination. These studies, which emphasize self-compassion as a protective factor against anxiety and related cognitive patterns, are consistent with the features of LP1. Given this, interventions aimed at preserve or improve self-compassion and flexible coping mechanisms may be beneficial for this profile.

LP2, on the other hand, is called "higher health anxiety symptoms and lower self-compassion" and is consisted of individuals who exhibit higher levels of self-compassion, intolerance for uncertainty, rumination, and lower levels of health anxiety. The group with higher levels of psychological dysfunction is represented by this profile. It can be concluded that participants in this profile have dysfunctional coping skills and more negative cognitive and emotional patterns. The literature supports these findings. Carleton (2016), for example, showed that a significant predictor of a number of anxiety disorders, including health anxiety, is an intolerance of uncertainty. Furthermore, research has indicated that rumination intensifies the symptoms of anxiety (McLaughlin & Nolen-Hoeksema, 2011).

The results of Neff (2003), Neff and Dahm (2015) and Raes (2010) indicate that self-compassion can act as a buffer against the negative effects of stress and anxiety, which is supported by the lower levels of self-compassion in LP2. In other words, the lower levels of self-compassion may explain the higher levels of stress and anxiety in LP2. In this regard,

reducing health anxiety and rumination and increasing self-compassion through cognitive-behavioral approaches should be the focus of interventions for this profile.

Other studies using mixed analyses also corroborate the results of this investigation. To our knowledge, this is the first study that aims to determine the latent profiles of participants in terms of health anxiety, intolerance of uncertainty, rumination and self-compassion. However, there are latent class analysis studies in the literature that examine the variables that are the focus of this study independently. For instance, Yalçın et al. (2024) tested the Pandemic Health Anxiety Model (PHAM) in their study with the variables perceived vulnerability about diseases, cyberchondria severity, obsessive compulsive symptoms, sleep quality, depression, anxiety, stress, fear of covid-19, healthy anxiety and how many homogeneous groups the participants were divided into. As a result of the analysis, it was determined that the participant group consisted of 6 latent classes: risk-aversive healthy latent class, incautious healthy latent class, infection obsessions latent class, health anxiety latent class, negative affect latent class, and general psychopathology latent class. According to the findings, latent classes have an increasing pattern in terms of psychological symptoms, from latent class 1 to latent class 6. In other words, while latent class 1 shows fewer psychological symptoms in terms of study variables, latent class 6 shows more psychological symptoms. In the study conducted by Ullrich-French and Cox (2020) on self-compassion, three latent profiles were obtained: self-compassionate, uncompassionate, and average (moderate). When the psychological characteristics of the latent profiles were examined, it was determined that individuals in the uncompassionate profile had the highest levels of psychological inflexibility, depression and perceived stress. In contrast, the self-compassionate profile showed low levels of psychological inflexibility, depression, anxiety and perceived stress. In the study conducted by Boelen and Lenferink (2018) on intolerance of uncertainty, four latent classes were obtained: low intolerance of uncertainty, predominantly prospective intolerance of uncertainty, predominantly inhibitory intolerance of uncertainty, and high intolerance of uncertainty, respectively. When the psychological characteristics of the latent profiles are examined, worry, rumination, depressive symptoms, anxiety, obsessive-compulsive symptoms, social anxiety and separation anxiety increase from low intolerance of uncertainty to high intolerance of uncertainty, while mindfulness decreases. In the study conducted by Stephens (2016) on rumination, three latent classes were obtained: low, medium and high. The psychological characteristics of the latent classes were examined in terms of sadness, anger, depression and aggression variables, and it was determined that the severity of these variables increased from

the low rumination class to the high rumination class. In summary, other mixed analysis studies in the literature support the findings obtained from this study and reveal that variables such as health anxiety, intolerance of uncertainty, rumination and self-compassion are important indicators of significant differences between psychological profiles, as determined in this study.

Finally, in the analysis of variability in the latent profiles according to demographic variables (gender, age, Covid-19, chronic disease status of the participants and immediate family member of the participants), it was determined that the gender, age and chronic disease status of the participants were significantly related to the latent profile membership. It was determined that there was no significant relationship between the participants' Covid-19 status, the chronic disease status of their first-degree relatives, and their latent profile membership.

The analysis showed that females were more likely to be in Latent Profile 1 (LP1), which has lower health anxiety and higher self-compassion. This finding is contrary to studies in the literature reporting that women experience higher levels of anxiety (e.g. McLean et al., 2011). However, females in LP1 are more likely to be in this group, which may indicate that females have better coping mechanisms because of their higher psychological resilience and social support. Females seek out social support more frequently, for example, according to research by Tamres et al. (2002), which improves their psychological and coping skills. To further contribute to their placement in LP1, females might practice self-compassion more frequently, such as mindfulness and self-care.

The correlation between LP1 and older age suggests that age is a protective variable against health anxiety. Charles and Carstensen (2010) suggested that older adults focus more on emotionally meaningful goals, which improves emotional regulation and coping skills. In older people, this emphasis on positive experiences may result in reduced health anxiety and increased self-compassion. Furthermore, they are better able to manage stress and uncertainty due to their increased life experience and acquired coping mechanisms. These variables match the traits of LP1 in older adults.

The correlation between LP1 and chronic disease status of participants suggests that being ill can result in improved coping mechanisms and heightened self-compassion. According to Sirois et al. (2015), self-compassion is an important factor for coping with chronic disease. In addition, self-compassionate coping strategies can be developed by people with chronic diseases. The psychological distress caused by long-term medical conditions can be mitigated by practicing self-compassion. Furthermore, chronic disease may promote more self-care and

health-promoting behaviors, strengthening psychological resilience and lowering health anxiety. These results emphasize how crucial it is to support self-compassion and flexible coping mechanisms in people with long-term conditions to enhance psychological health.

Overall, these findings suggest that enhancing self-compassion and reducing intolerance of uncertainty and rumination may be crucial targets for interventions aimed at reducing health anxiety. The structural model analysis and distinct psychological profiles identified provide valuable insights for tailored therapeutic approaches. Understanding these associations and profiles can help clinicians develop more effective, personalized treatment plans for health anxiety.

Recommendations

The study is crucial that it is the first study, to our knowledge, examining the mediation of self-compassion in the relationships between rumination, intolerance of uncertainty, and health anxiety and latent profiles in health anxiety in terms of intolerance of uncertainty, rumination and self-compassion. However, the study has limitations.

This was a self-reported and cross-sectional study. Therefore, the reliability of the findings may be low. To overcome this, the relationships between intolerance of uncertainty, health anxiety, rumination and self-compassion can be examined through longitudinal studies. Second, the convenient sampling method was used to form the study group. This approach reduces the generalizability of the research results. Using a different sampling strategy and size, the relationships between the variables can be re-examined with people from different age groups and geographic locations. This study has shown that the relationship between health anxiety, intolerance of uncertainty and rumination is mediated by self-compassion. Potential mediating variables, such as health perception, anxiety sensitivity, body image, and quality of life, could be tested in future studies. This analysis also underscores the importance of self-compassion as a buffer against health anxiety and related cognitive processes. Given the significant relations in structural model and differences between the profiles, targeted interventions that focus on improving self-compassion, managing uncertainty, and reducing rumination could prove beneficial in mitigating health anxiety and improving overall psychological well-being. Finally, the lack of a direct significant relationship between rumination and health anxiety in this study may indicate complex relationships between these two variables. For this reason, investigating the relationships between these variables with different models and variables can contribute to the literature.

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KATKI ORANI ***CONTRIBUTION RATE***	**AÇIKLAMA** ***EXPLANATION***	**KATKIDA BULUNANLAR** ***CONTRIBUTORS***
Fikir ve Kavramsal Örgü *Idea or Notion*	Araştırma hipotezini veya fikrini oluşturmak *Form the research hypothesis or idea*	Kenan POLAT
Tasarım *Design*	Yöntem ve araştırma desenini tasarlamak *To design the method and research design.*	Kenan POLAT
Literatür Tarama *Literature Review*	Çalışma için gerekli literatürü taramak *Review the literature required for the study*	Kenan POLAT Çiğdem GÜLDEN Süleyman ÇİFÇİ
Veri Toplama ve İşleme *Data Collecting and Processing*	Verileri toplamak, düzenlemek ve raporlaştırmak *Collecting, organizing and reporting data*	Kenan POLAT Çiğdem GÜLDEN Süleyman ÇİFÇİ
Tartışma ve Yorum *Discussion and Commentary*	Elde edilen bulguların değerlendirilmesi *Evaluation of the obtained finding*	Kenan POLAT Çiğdem GÜLDEN Süleyman ÇİFÇİ

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