



RESEARCH ARTICLE

The mediating role of cognitive flexibility in the relationship between metacognition and psychological health: A study in a non-clinical sample

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ABSTRACT

Objective: Metacognition is a concept that refers to the awareness and control of individuals' cognitive processes. In this regard, metacognitive processes may promote cognitive flexibility. The present study investigates the impact of metacognitions on adults' psychological health and the mediating role of cognitive flexibility through bootstrap analysis.

Method: The sample comprised of 212 university students. All volunteers had no history of psychiatric/neurological disorders and no use of medication affecting the central nervous system for the last six months. Participants were required to complete the Metacognitions Questionnaire-30, the General Health Questionnaire-12, and the Cognitive Flexibility Inventory via an online survey.

Results: According to the correlation analyses, cognitive flexibility was found to be negatively correlated with dysfunctional metacognition ($r=-0.227$, $p<0.01$) and poor psychological health ($r=-0.397$, $p<0.01$); dysfunctional metacognition was positively correlated with poor psychological health ($r=0.399$, $p<0.01$). We conducted mediation analyses via the bootstrapping method using a 95% confidence interval and 5000 bootstrap samples. The results showed that cognitive flexibility had a significant partial mediating role in the relationship between metacognition and psychological health [$R^2=0.26$, $F(2, 209)=36.38$, $p<0.001$].

Conclusion: The findings highlighted the importance of cognitive flexibility as an underlying mechanism through the relationship between metacognition and psychological health in a non-clinical sample. The results suggested the need to take "cognitive health" into account while attempting to promote "psychological health."

Keywords: Cognitive flexibility, metacognition, psychological health

INTRODUCTION

The term "metacognition" is characterized as psychological structures, processes, events, and the knowledge used to control, change, and interpret thoughts (1). In its simplest form, metacognition refers to "thinking about thinking" (2). It is also defined as a meta-system, which refers to being aware

of events and functions in the mind of the individual and intentionally directing these events and functions (3). Phrases such as "I can quickly recall the events", "I can control my thoughts", "I am aware of how my mind works while attempting to solve a problem", and "I can make reasonable preparations for the situation", provide information about metacognitions of individuals.

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By the late 1970s, the concept of metacognition was first coined by John Flavell. Flavell (4) characterized metacognition as information about one's cognitive methods and their related productions. Therefore, this term alludes awareness and thinking about an individual's cognitive processes and strategies. For instance, if an individual is aware that learning A is easier than learning B, and if the same individual thinks to ask someone to see whether C is correct, the individual engages in metacognition (5).

As in most of the other mental processes, metacognition does not constitute a unitary structure. Five subfactors are defined to identify metacognition (1,6). These factors are positive beliefs about worry, negative beliefs about the uncontrollability of thoughts and danger, lack of cognitive confidence, beliefs about the need to control thoughts, and cognitive self-consciousness (1). Positive beliefs express that worry helps with problem-solving and planning strategies; in this regard, positive beliefs include positive attitudes towards worry. Negative beliefs about the uncontrollability of thoughts and danger refer that worry is necessary and uncontrollable. Cognitive confidence indicates people's confidence about their attention and memory processes, whereas beliefs about the need to control thoughts are identified as the need to control negative beliefs that may lead to harmful consequences. The last factor, cognitive self-consciousness, implies constant efforts on one's thinking (7,8). Considering metacognition as a whole, it is noteworthy that many studies have highlighted a link between metacognitive dysfunction and psychological disorders (for a review, see Sun et al.'s meta-analytic review, 9). It has been shown that there are significant positive relationships between dysfunctional metacognitions and psychological disorders, such as generalized anxiety disorder (10), panic disorder (11), substance dependence (12), obsessive-compulsive disorder (13,14), post-traumatic stress disorder, (15) and schizophrenia (16). As the evidence accumulated, the link between individuals' metacognitions and psychological health status was intended to be the focus of current research in a non-clinical sample.

In the literature, "psychological health" is suggested as one of the variables related to metacognition (17). Here, psychological health status broadly indicates whether individuals are in psychological/psychiatric distress or not (18). Besides, the scores obtained from the General Health Questionnaire-12 are primarily used to screen

psychopathological conditions of individuals such as depression, anxiety, and alexithymia (18-20). Studies on psychological health and metacognition were usually conducted with individuals with certain psychological disorders such as internet addiction (17) and substance use (21). Nevertheless, the relatively clear direction of the relationship between metacognitive processes, which is thought to have an essential role in psychopathology, and psychological health, indicates that increments in psychological pathology are mostly linked to metacognitive dysfunction (13,22,23). Specifically, participants who have dysfunctional metacognitions are reported to have poor psychological health (17,21).

Metacognition is a system that consists of intentionally orienting one's mental processes (3,4). Hence, cognitive flexibility, which is characterized as an ability to change cognitions in challenging situations (24,25), is thought to be linked to metacognition. There are three aspects of cognitive flexibility: the propensity to view difficult situations as controllable, the ability to consider multiple interpretations of human actions and events in life, and the ability to create alternatives to difficult situations (24). Cognitively flexible individuals are suggested to be more resilient to challenging situations, while cognitively rigid people may have a predisposition to respond more pathologically to these situations (24,26).

There are only a limited number of studies on the relationship between cognitive flexibility and psychopathologies (27-30). Individuals with psychological disorders, such as obsessive-compulsive personality disorder (27), panic disorder (28), depression (29), and attention deficit hyperactivity disorder (30), are reported to be cognitively less flexible than individuals without any psychological disorders. As more work is needed to demonstrate the importance of cognitive flexibility on psychological health, it would be of special interest to the mediating role of cognitive flexibility in the present study.

In summary, when all these variables are reviewed holistically the relationships among metacognition, psychological health, and cognitive flexibility are taken into account, this study aimed to examine the relationship between the functionality of metacognitive processes and psychological health status and to test the mediating role of cognitive flexibility in this relationship. No previous research has investigated the roles of these variables on psychological health. In the light of reported literature, the following hypotheses were formed:

H1: Dysfunctional metacognitions will negatively predict cognitive flexibility.

H2: Cognitive flexibility will negatively predict poor psychological health.

H3: Dysfunctional metacognitions will positively predict poor psychological health.

H4: Cognitive flexibility is expected to mediate the effects of dysfunctional metacognitions on poor psychological health.

METHOD

Participants

Participants were recruited based on some inclusion criteria. Participants who were university students and between the ages of 18 and 24 were included in the study. On the other hand, participants who reported that they had been diagnosed with a psychiatric/neurological disorder in the last six months and participants who chose to take psychological/pharmacological treatments at the time of the data collection were excluded from the study. Besides, to compute the minimum sample size required for conducting the mediation analysis to test the model hypothesized in the current study, G*Power 3.1.9.7 software was used. The minimum sample size was determined to be 208 participants with the test power ($1-\beta$) of 0.80, α value of 0.05, and effect size of 0.03 (31).

Accordingly, a total of 212 university students studying various faculties of universities in the spring term of the 2018-2019 academic year participated in the current study. The sample of the study consisted of 140 females and 72 males aged between 18 and 24 (Mean=21.94, Standard Deviation=1.42). These are the participants who reported no history of psychiatric/neurological or psychological disorders. The data were collected between April 2019 and November 2019 via an online self-report survey system, Qualtrics, using a convenience sampling method. Participants participated in the study voluntarily. Besides, participants from Çankaya University were given additional course credit. At the beginning of the survey, informed consent was obtained from each participant, and the participants were recommended to fill out the survey at a specified time.

Instruments

Demographic Information Form

Within the scope of this study, the relevant literature was searched to identify the socio-demographic features considered to be related to the main variables. The aim

was to detect potential variables that could affect psychological health. As a result of the search, a demographic information form was created by the researchers. It included the questions about marital status, occupational status, economic status, chronological age, gender, cumulative grade point average, and any psychiatric/neurological disorder treatments in the last six months.

Metacognitions Questionnaire-30 (MCQ-30)

The MCQ-30 was first developed by Wells and Cartwright-Hatton (1). The questionnaire consists of five subscales: positive beliefs about worry, negative beliefs about the uncontrollability of thoughts and danger, lack of cognitive confidence, beliefs about the need to control thoughts, and cognitive self-consciousness. Responses to each item on the MCQ-30 are on a 4-point Likert scale, from 1="do not agree" to 4="strongly agree." MCQ-30 scores range from 30 to 120 points with higher scores indicating more dysfunctional metacognitions. The Turkish adaptation, validity, and reliability study of this questionnaire was conducted by Tosun and Irak (7). In their research, Tosun and Irak (7) reported that the Cronbach's alpha internal consistency reliability coefficient of the scale was 0.86; test-retest correlation coefficients were between 0.40 and 0.94 for scale items and between 0.70 and 0.85 for subscales.

Cognitive Flexibility Inventory (CFI)

The CFI was developed by Dennis and Vander Wal (24) to measure cognitive flexibility with two subscales: alternatives and control. The alternatives subscale measures the ability to perceive several alternative explanations for difficult situations and to generate several solutions for events, while the control subscale measures the tendency to perceive difficult situations as controllable. The inventory consists of 20 items. Each item was evaluated on a 5-point Likert scale, from 1="strongly disagree" to 5="strongly agree". The total scores from CFI vary between 20 and 100. The Turkish adaptation, validity, and reliability study was conducted by Gülüm and Dağ (32). Internal consistency reliability coefficients were found to be 0.90 for the entire scale, 0.89 for the alternatives subscale, and 0.85 for the control subscale.

General Health Questionnaire-12 (GHQ-12)

The GHQ-12 is generally used to detect general psychopathological levels and psychiatric cases in community screenings (19). Also, in research, it has

been widely used to assess the “psychological health” of individuals (33,34). The GHQ has 12, 28, 30, and 60-item forms, and the 12-item version was developed by Goldberg and Williams (35). Scores obtained from the GHQ-12 range from 0 to 12, with higher scores indicating a greater tendency for psychological/psychiatric disorders. Each item has four choices (e.g., “not at all, no more than usual, rather more than usual, much more than usual”). The GHQ-12 consists of questions about individuals’ psychological/psychiatric complaints in the last couple of weeks and about their psychological health in general. When participants choose one of the first two choices while answering the items, they get 0 points. On the other hand, they get 1 point for the other two choices. The Turkish validity and reliability study was conducted by Kılıç (19), and the test reliability coefficient was found as 0.78.

Procedure

Before the study was conducted, the research ethics committee approval was obtained from the Ethical Committee of Cankaya University (IRB: 04.04.2019 - 80281877-050.99). The online survey consisted of the informed consent form, the demographic information form, the MCQ-30, the CFI, and the GHQ-12. First, the survey was prepared, then distributed by the researchers. For this, the link of the survey was given to university students and it was also shared on social media. Participants were informed about the aim of this study through the informed consent form, and they could withdraw from the survey at any time. Participants were asked to answer all items on the same page before proceeding to the next page. Hence, it was guaranteed that there was no missing data. Participants who completed the survey items were thanked, and the survey was automatically closed. The survey took approximately 20 minutes to complete.

Statistical Analyses

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) 23.0. The significance level was determined as 0.05 in all analyses. Before the data analyses, first, the Kurtosis and Skewness values of the research variables were examined. The values fell within the specified range of ± 1.5 , and the normality assumption was observed to be met (36). Then, extreme values were determined by calculating distance values regarding Mahalanobis, Cook, and Leverage parameters. One participant with extreme values based on two of these three parameters was excluded from the dataset. Thus, 238 young adults who had no extreme

Table 1: Descriptive statistics of demographical information of participants

Variables	Frequency	Percentage (%)
Gender		
Female	140	66
Male	72	34
Occupational status		
Full-time	4	1.9
Part-time	6	2.8
Unemployed	9	4.3
Student	190	89.6
Other	3	1.4
Economic status		
Low	24	11.3
Medium	169	79.7
High	19	9
Living conditions		
Alone	19	9
With family	144	67.9
With roommate	24	11.3
With partner	3	1.4
Other	22	10.4
Marital status		
Married	1	0.5
Single	127	59.9
In a relationship	84	39.6
Grade		
Preparatory	6	2.8
1 st grade	29	13.7
2 nd grade	34	16.1
3 rd grade	56	26.4
4 th grade	69	32.5
Other	18	8.5

N=212.

values were determined. Afterwards, 26 participants were excluded from this study since they stated that they had been treated for a psychiatric/neurological disorder in the last six months. As a result, all analyses were carried out with 212 participants. First, independent sample t-tests were performed to examine potential gender effects on the main variables of this study, which were metacognition, psychological health, and cognitive flexibility, and no significant gender effects were found on any main variable (all $p > 0.05$). Primarily, Pearson product-moment correlation analysis was conducted to determine the bivariate

Table 2: Correlations among chronological age, cumGPA, and variables of interest

Variables	M	SD	Min.	Max.	1	2	3	4	5
1. Chronological age	21.94	1.42	18	24	1	0.146*	-0.112	0.127	0.051
2. cumGPA	2.63	0.81	0.0	4.0		1	0.025	0.094	-0.024
3. MCQ-30	74.11	11.56	45	103			1	-0.227**	0.399**
4. CFI	77.33	10.50	51	100				1	-0.397**
5. GHQ-12	3.99	3.35	0	11					1

*: $p < 0.05$; **: $p < 0.01$; cumGPA: Cumulative grand point average; MCQ-30: Metacognitions Questionnaire-30; CFI: Cognitive Flexibility Inventory; GHQ-12: General Health Questionnaire-12; SD: Standard deviation; Min.: Minimum; Max.: Maximum.

relationships among chronological age, cumGPA, and the main variables of this study. Preacher and Hayes (37) suggested that three criteria should be met for a significant mediation model. First, there should be a significant correlation between the predictor variable and the mediator. Second, when the effect of the predictor variable is controlled, there should be a significant correlation between the mediator and the outcome variable. Third, the indirect effect of the predictor variable on the outcome variable should be significant. Accordingly, in the current study, the mediating role of cognitive flexibility (i.e., mediator) in the relationship between metacognition (i.e., predictor variable) and psychological health (i.e., outcome variable) was tested by a mediation model 4 with the bootstrap bias-corrected confidence interval (BC 95% CI) method through regression-based PROCESS Macro for SPSS, instead of Baron and Kenny's criteria, as suggested by Hayes (38). Besides, since it is recommended for small to moderate samples and suggested as a powerful approach in mediation analyses (39), the Bootstrap estimation approach proposed by Preacher and Hayes (37) with 5000 samples was used to check the significance of the indirect effect.

RESULTS

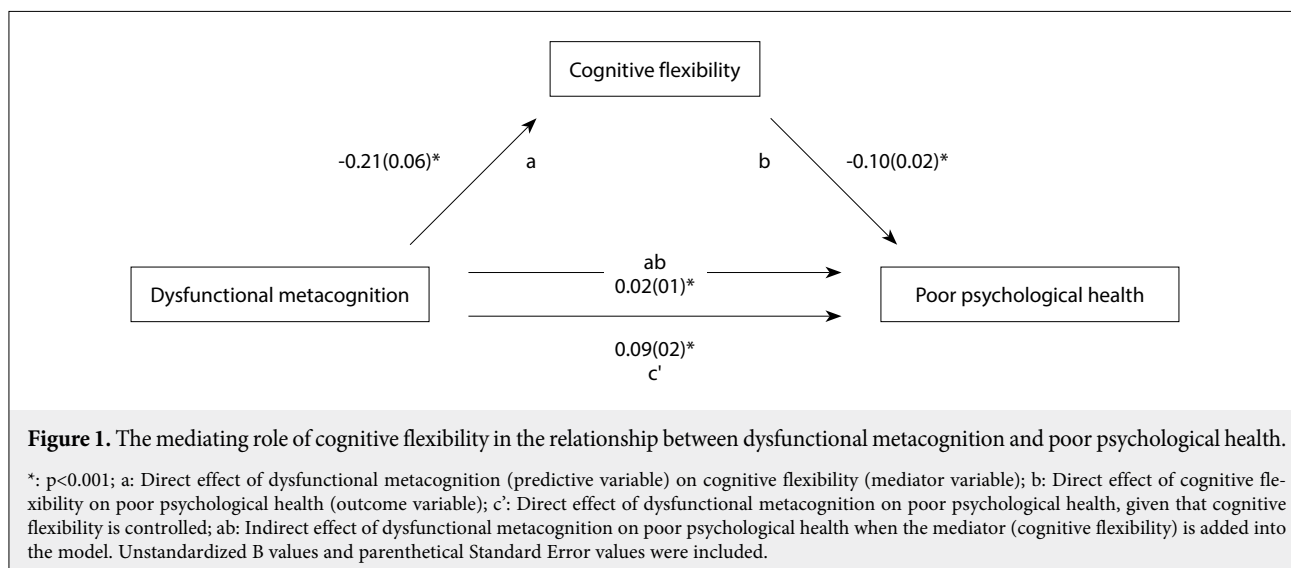
First, we calculated the values of descriptive statistics for the demographical variables. Descriptive statistics with frequencies and percentages of each demographical information obtained from participants are shown in Table 1.

Second, Pearson's correlation analysis was carried out to determine the relationships among chronological age, cumGPA, and total scores obtained from the MCQ-30, CFI, and GHQ-12. In addition to the results, the means, standard deviations, minimum and maximum values, and ranges of scores that participants from the MCQ-30, CFI, and GHQ-12 are presented in Table 2. There was a significant negative correlation

between dysfunctional metacognition and cognitive flexibility ($r = -0.227$, $p < 0.01$) and significant positive correlation between dysfunctional metacognition and poor psychological health ($r = 0.399$, $p < 0.01$). On the other hand, the results indicated a significant negative correlation between cognitive flexibility and poor psychological health ($r = -0.397$, $p < 0.01$).

Third, the single mediation analysis using the regression-based PROCESS Macro Model 4 for SPSS was conducted (38) to test whether cognitive flexibility had a mediating role in the relationship between dysfunctional metacognition and poor psychological health. In this model, metacognition was the predictor variable, psychological health was the outcome variable, and cognitive flexibility was the mediator variable. Figure 1 demonstrates the mediation model of the study and the path coefficients.

The results indicated that metacognition significantly negatively predicted cognitive flexibility ($B = -0.21$, $SE = 0.06$, $p < 0.001$, 95% CI = [-0.33, -0.09]). In other words, for each unit increase in dysfunctional metacognition, a 0.21 unit decrease in the cognitive flexibility of an individual was obtained, and this result supported H1. Similarly, cognitive flexibility significantly negatively predicted poor psychological health ($B = -0.10$, $SE = 0.02$, $p < 0.001$, 95% CI = [-0.14, -0.06]), supporting H2, as cognitive flexibility decreased, psychological health of an individual also decreased. Besides, the direct effect of metacognition on psychological health ($B = 0.09$, $SE = 0.02$, $p < 0.001$, 95% CI = [0.06, 0.13]) was found to be significant. This finding was in line with our prediction (H3), dysfunctional metacognition was positively associated with poor psychological health. To examine the indirect effect of metacognition, on psychological health through cognitive flexibility, a 5000-sample Bootstrap estimation approach with was conducted. The results revealed that the indirect effect of metacognition on poor psychological health was significant ($B = 0.02$, $SE = 0.01$, 95% CI = [0.01, 0.04]). Since both direct and indirect effects of metacognition on psychological



health were found to be significant, technically speaking, cognitive flexibility was a significant partial mediator supporting the H4. The mediation model explained 26% of the variance in psychological health [$R^2 = 0.26$, $F(2, 209) = 36.38$, $p < 0.001$].

In sum, metacognition significantly predicted psychological health first, and its predictive effect significantly decreased in the presence of cognitive flexibility, yet remained significant. So, cognitive flexibility was a significant partial mediator in the relationship between metacognition and psychological health. Since the model contributed to 26% of the variance in psychological health, it helped us to understand one of the main factors that may affect the psychological health of young adults.

DISCUSSION

The main aim of the current study was to investigate the mediating role of cognitive flexibility in the relationship between metacognition and psychological health in a non-clinical sample. The correlational results indicated that dysfunctional metacognition appeared to be related to poor psychological health. The results also suggested that cognitive flexibility was negatively associated with both dysfunctional metacognition and poor psychological health. Moreover, the mediational results pointed out that dysfunctions in metacognition positively predicted poor psychological health. This finding suggested that individuals with dysfunctional metacognitions could be more likely to report lower psychological health. As generally agreed, higher scores from MCQ-30 indicate metacognitive dysfunction (7), and individuals

diagnosed with psychological disorders (e.g., obsessive-compulsive disorder, generalized anxiety disorder) are more likely to have dysfunctional metacognitions (7,29,40). Likewise, individuals with higher GHQ-12 scores may have a psychiatric/psychological disorder (18). These findings were in line with previous studies showing the predictive role of metacognitions on psychological health (17,41). For instance, in a research conducted with M.D. students, a significant positive correlation health was found between dysfunctional metacognition and poor psychological. It showed that metacognition was one of the influencing factors for psychological health (41). Hence, along with these previous findings, our findings supported the link between metacognition and psychological health.

Experts agree that cognitively healthy individuals are able to carry out tasks, have functional thoughts, memory and language processes, etc. (42). As metacognition refers to being aware of one's own cognition (7), individuals with functional metacognitive processes may be considered cognitively healthy. These explanations lead us to suggest that being able to generate multiple alternatives to difficult situations and to perceive these situations as controllable, which refers to cognitive flexibility, might be one of the components of cognitive health. Therefore, metacognitive processes and cognitive flexibility may be considered separate but interrelated components of "cognitive health". In the light of these explanations, metacognition and cognitive flexibility are thought to be linked. The result of this study was in the expected direction that dysfunctional metacognition negatively predicted cognitive flexibility. In other words, as the individuals' dysfunctional metacognitions increased, they could become

cognitively less flexible. Considering the reverse scoring of the MCQ-30, it can be inferred that people who have functional metacognitions are also cognitively flexible. Overall, these findings were in accordance with results reported by Oğuz et al. (28). Similarly, they found that healthy participants who were cognitively more flexible tended to engage in functional metacognitions.

The hypothesis that cognitive flexibility would predict lower psychological health was supported. To the best of our knowledge, limited research has investigated the relationship between cognitive flexibility and psychological health. While assessing psychological health, the GHQ-12 is often the preferred measure to detect a psychiatric/psychological disorder in individuals (41). Moreover, a study conducted with and without adult ADHD revealed that individuals with psychological disorders were less likely to be cognitively flexible (19). Therefore, cognitive flexibility and psychological health were predicted to be significantly associated in the current study. That is, cognitively flexible individuals might be expected to stay in strong psychological health. This crucial link has remained briefly addressed in prior research. As expected, we found that poor psychological health was predicted by cognitive flexibility. In other words, as CFI scores increased, GHQ-12 scores decreased. As MCQ-30, reverse scoring is required in the GHQ-12. Hereby, a negative correlation between cognitive flexibility and psychological health is presumable, consistent with those found in limited research (29,30).

The current study also found that dysfunctions in metacognition predicted poor psychological health, and cognitive flexibility was a significant partial mediator in this relationship. In other words, when cognitive flexibility was incorporated into the relationship between metacognition and psychological health, the strength of this relation increased. This mediation model explained 26% of the variance in psychological health. As hypothesized, dysfunctional metacognitions predicted poor psychological health through cognitive flexibility. Cognitive flexibility had a predictive role on psychological health, contributing to reducing the possibility of detecting a psychological case in self-administered screenings. Since cognitive flexibility is characterized as an ability, this ability might be developed and maintained over time. These findings are consistent with previously reported and limited research revealing that low cognitive flexibility might lead to poor psychological health (43,44). As a result, improving the ability to be cognitively flexible can prevent individuals from having poor psychological

health. Moreover, while previous studies have highlighted the strong association between metacognitive dysfunctions and poor psychological health in various psychopathologies (9), our findings have shown the pattern in a non-clinical sample. Hence, it can be pointed out that metacognition and cognitive flexibility might be relevant factors linked to psychological health.

Although the present study achieved its purpose, it has some limitations. The design of the current study was cross-sectional. Cross-sectional studies, by their nature, only provide information for only one-time points and do not provide cause and effect relationships. In this case, there are limitations to performing a mediation analysis on cross-sectional data. Although there might be no such mediation effect in the general population, our findings might have revealed support for a significant mediator (40). Therefore, a longitudinal study is recommended to determine the cause-and-effect relationship for future studies. In addition, a further longitudinal study has the advantage of being able to assess the long-term changes in metacognition and cognitive flexibility that are considered essential components of “cognitive health”. In this sense, it is possible to analyze the effects of such changes that occur in a certain time period on psychological health. The sample of our study consisted of university students aged between 18 and 24 years old. This period refers to the “late adolescence/young adulthood” period among the developmental stages (45). It is recommended to carry out further studies covering middle and late adulthood and investigating the change in psychological health across developmental periods. Besides, the gender inequivalence of the sample might be considered as another limitation. Approximately 2/3 of the participants in the current study were female (140 females and 72 males). Women report lower levels of psychological health than men on self-reported measures (46). Therefore, such disparities in the sample might be the constraints on the generalizability of the results. In further studies, “cognitive health” might also be measured using standardized neuropsychological tests to evaluate these variables more objectively, and the proposed model might also be tested employing neuropsychological tests. In this research, we tested the mediating role of cognitive flexibility in the relationship between metacognition and psychological health. Future studies should examine the mediating role of other possible variables, which have the potentials to affect “cognitive health” and psychological health. Additionally, exploring the mediating role of cognitive

flexibility in the relationship between metacognition and psychological health in a clinical sample may be an exciting topic for future research.

In conclusion, the present study sheds light on the knowledge regarding the roles of metacognition and cognitive flexibility, which are suggested as components of “cognitive health” on psychological health among young adults. Furthermore, it is essential to highlight that studying the cognitive components of health can be useful to understand human health. Individuals with functional metacognitions and higher cognitive flexibility may remain in better psychological health. Therefore, this study contributes to research on psychological health, in particular, “cognitive health”. Since the proposed model has not been tested among young adults previously in the relevant literature, this study may make an essential contribution to this field. The findings emphasize the importance of cognitive interventions to foster cognitive health, since these interventions may be used to improve psychological health in the population.

Contribution Categories		Author Initials
Category 1	Concept/Design	H.K., Ö.A.
	Data acquisition	Ö.A.
	Data analysis/Interpretation	H.K., Ö.A.
Category 2	Drafting manuscript	Ö.A.
	Critical revision of manuscript	H.K.
Category 3	Final approval and accountability	H.K., Ö.A.
Other	Technical or material support	H.K., Ö.A.
	Supervision	H.K.

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