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The effects of health fatalism and cyberchondria on parents' childhood vaccine hesitancy

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Abstract

Background Vaccine hesitancy is a major public health problem on a global scale, where individual choices directly affect public health and increase the risk of re-spread of infectious diseases. In particular, parental indecision about childhood vaccinations leads to weakened community immunity, placing a serious burden on health systems. Today, the ease of access to digital information has led to increased health concerns and individuals develop cyberchondria behaviors in the process of online information seeking. At the same time, individuals' fatalistic beliefs about health may also affect their vaccination decisions. This study evaluates the effects of religious health fatalism and cyberchondria on parents' hesitancy regarding childhood vaccinations.

Methods This descriptive and cross-sectional study was conducted with 535 parents of children aged 0–5 who visited a healthcare institution in Turkey between March and August 2024. Data were collected using a Personal Information Form, the Religious Health Fatalism Scale, the Vaccine Hesitancy Scale, and the Cyberchondria Severity Scale Short Form. Data analysis was performed using SPSS 27.0 and the Hayes PROCESS program.

Results In this study, a significant positive relationship was found between vaccine hesitancy and religious health fatalism ($\beta = 0.274, p < .001$) and cyberchondria ($\beta = 0.193, p < .001$). In hierarchical regression, religious health fatalism ($\beta = 0.298$) and cyberchondria ($\beta = 0.200$) significantly predicted vaccine hesitancy and together explained 12.7% of the variance. Demographic variables did not contribute significantly to the model ($p > .05$). In the moderation analysis, cyberchondria was found to play a role in strengthening the relationship between religious health fatalism and vaccine hesitancy ($\beta = 0.088, p = .011$).

Conclusions This study has revealed that health-related fatalistic beliefs and levels of cyberchondria may be associated with parents' vaccine hesitancy. The findings suggest that vaccine hesitancy may be influenced not only by a lack of information but also by individuals' belief systems and health-related concerns in the digital environment.

Keywords Cyberchondria, Health fatalism, Parents, Vaccine hesitancy

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Background

Vaccines are widely regarded as one of the most significant public health achievements of the 20th century. They play a crucial role in preventing the transmission of infectious diseases [1]. However, this success is being undermined by vaccine hesitancy, which is a growing global challenge. Defined as delaying or refusing vaccines despite their availability, vaccine hesitancy is now recognized as a significant public health threat worldwide [2, 3]. There is evidence of the prevalence of vaccine hesitancy. For example, refusal rates for measles, mumps, rubella, varicella, and influenza vaccines reached 15%, while delay rates reached 27% in the US. In Europe, these rates vary from 9% to 42%, depending on the country. In Turkey, the overall hesitancy rate is reported to be 13.7% [4–7]. A direct threat to herd immunity is posed by this widespread hesitancy, and it has been identified as one of ten threats to global health [8], making research into its underlying determinants a critical public health priority [9, 10].

To understand vaccine hesitancy, one must examine its complex and multifaceted determinants, which are shaped by a combination of sociocultural and digital factors. The literature categorizes these influential factors into several key areas: level of knowledge; perceived risk/benefit balance; religious beliefs; and the roles of the media and healthcare workers [4, 11–14]. Religious beliefs are among the most important factors shaping attitudes toward vaccination [15]. Religious health fatalism, the belief that one's health depends entirely on God's will, can encourage a submissive attitude, leading to vaccine refusal or delay [16–18]. This is particularly observed in some conservative Muslim communities, where religious affiliation is associated with lower vaccination rates and has contributed to outbreaks of preventable diseases such as polio and measles in countries like Afghanistan and Pakistan [19, 20].

In the modern era, the digital information environment has emerged as a powerful factor influencing parents' decisions about their children's vaccinations. As more people turn to the internet and social media for advice about vaccines [21, 22], they often encounter misinformation, which creates a global public health problem [23–25]. One of the negative consequences of searching for information online is a condition known as 'cyberchondria'. Cyberchondria involves the excessive, repetitive and uncontrollable behaviour of searching for health information online in an attempt to alleviate concerns about one's health. Paradoxically, the information sought increases anxiety rather than alleviating it. Cyberchondria is conceptualised as a multidimensional, syndrome-like structure characterised by a behavioural pattern, negative emotional states (such as distress and anxiety), disruption to daily activities and often a search

for reassurance [26]. For parents, this behavior can be a significant source of anxiety regarding childhood vaccinations [27]. Research shows that many parents turn to the internet to learn about vaccines [25]. Even if they do not trust these platforms, it has been found that people who obtain information about vaccines from these platforms are significantly more likely to be vaccine hesitant or to change their minds [28]. In this context, studies have revealed a positive correlation between cyberchondria and vaccine hesitancy [28, 29]. The positive relationship between cyberchondria and vaccine hesitancy can be explained by the pathological nature of this behaviour. The excessive, anxiety-driven online search behaviour characteristic of cyberchondria exposes individuals to negative content about vaccine risks via selective cognitive biases. This leads them to disregard scientific evidence, ultimately fuelling vaccine hesitancy through increased risk perception and distrust [27, 30, 31]. This digital anxiety cycle can further reinforce vaccine hesitancy when interacting with factors such as religious fatalism and a tendency to believe conspiracy theories [32]. Cyberchondria exposes individuals to negative, anxiety-provoking information about vaccine risks, while religious health fatalism interprets this information as a 'divine sign' or 'part of destiny'. The combination of these two processes can create a mutually reinforcing interaction that deepens vaccine hesitancy.

In light of the proven vital role of childhood vaccinations in public health, the emergence of vaccine hesitancy as a global threat is alarming. This threat is fuelled by misinformation on digital information platforms and social media, which is having an increasingly significant influence on parents' decisions about vaccination. While the individual roles of religious fatalism, health fatalism and cyberchondria in vaccine hesitancy have been proven, there is a critical gap in our understanding of how these constructs interact with each other. There is a lack of literature examining these two variables together and investigating how they interact to shape parental decisions. This study aims to address this issue by examining the combined effect of these two powerful factors on parental decisions regarding vaccines, which are widely advocated by public health authorities. By examining the individual and combined effects of these psychological and digital factors, this research aims to provide a more nuanced understanding of the driving forces behind vaccine hesitancy, thereby contributing to the development of more effective public health interventions.

Hypotheses

H1: Health fatalism is positively and significantly associated with vaccine hesitancy.

H2: Cyberchondria is positively and significantly associated with vaccine hesitancy.

H3: Cyberchondria moderates the relationship between health fatalism and vaccine hesitancy.

Methods

Study design and participants

This descriptive and correlational study was conducted with parents living in Van province, located in eastern Turkey, between March and August 2024. The study examined parents visiting the Family Medicine Clinic affiliated with Van Yüzüncü Yıl University Dursun Odabaş Medical Center, a tertiary healthcare facility. The study population consisted of parents residing in the same province and having children aged 0–5 years. The formula ($n = t^2 \cdot p \cdot q / d^2$) was used to calculate the minimum number of individuals required for the study sample, giving a result of at least 384. This calculation was performed with a 95% confidence interval ($d = 0.05$), $t = 1.96$, $p = .5$, and $q = 0.5$. While the information was being collected, the answers from the people taking part were included in the information analysis based on the rules for being in the study, and the study was finished with 535 people taking part. A post hoc power analysis was performed using the G*Power 3.1 statistical package in line with the results obtained from these 535 participants. The analysis revealed that the power of the study was 99%, with a medium effect size at the 95% confidence level. The STROBE guidelines were used to report this research paper [33]. Participants were individuals with children aged 0–5, internet access and literacy skills, aged 18 or over, without any mental or physical disabilities, who voluntarily agreed to participate in the study. Those who did not meet the inclusion criteria or who did not agree to participate were excluded.

Data collection

The data for this study was collected through face-to-face surveys between March and August 2024. After the participants were informed about the purpose and scope of the study, their voluntary participation was ensured. After informed consent was obtained, the participants completed the questionnaire under the supervision of the researchers. This method allowed for the clarification of possible uncertainties that the participants may have had about the items, thus improving the quality and integrity of the data. Each survey took an average of 7–10 min.

Questionnaire introduction

Personal information form

The demographic characteristics form consists of a total of nine items, including gender, marital status, education level, income status, whether news about childhood vaccinations on social media causes hesitation about

vaccination, the source of information about childhood vaccinations, the age of the parents, the age of the child, and the average daily internet usage time.

Religious Health Fatalism Scale (RHFS)

The RHFS, developed by Franklin et al., is used to assess individuals' beliefs about the futility of preventive health behaviours. The scale consists of 17 items in total. It has three subdimensions: divine foresight, destined planning and helplessness [18]. Bobov and Çapık (2020) conducted a study to examine the validity and reliability of the Turkish adaptation of the scale. The Turkish version of the scale contains 17 items, one of which is 'If I pray only to God for my health, He will heal me'. It was concluded that the scale has a unidimensional structure. It is a 5-point Likert scale, with responses ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The factor loadings of the items range from 0.47 to 0.77. The Cronbach's alpha coefficient of the scale is 0.91. Scores obtained from the scale can range from 17 to 85. An increase in the scale score indicates an increase in health fatalism attitude [34]. The Cronbach's alpha value of the scale was found to be .93 in this study.

Vaccine Hesitation Scale (VHS)

The VHS, developed by Larson et al., was designed to evaluate individuals' attitudes towards, and concerns about, vaccination [35]. Shapiro et al. revealed that the scale has construct and criterion validity in identifying parents who hesitate to receive a vaccination [36]. Dilcen et al. conducted the Turkish adaptation of the scale and its validity-reliability study. The Turkish version of the scale consists of nine items, such as 'New vaccines carry more risk than old vaccines' (sample item). The scale consists of two sub-dimensions. These are lack of trust and risk. Items 1, 2, 3, 4, 6 and 7 are included in the lack of trust dimension, while items 5, 8 and 9 are included in the risk dimension. The scale has a five-point Likert-type rating ranging from "strongly disagree" to "strongly agree". The overall Cronbach's alpha coefficient of the scale was found to be 0.80 [37]. The scale's Cronbach's alpha value was found to be .75 in this study.

Cyberchondria Severity Scale Short Form (CSS-SF)

The CSS-SF was developed by McElroy et al. [38]. The scale was adapted into Turkish by Söyler et al. [39]. The Turkish version of the scale consists of 12 items such as 'I read different web pages about the same situation I perceive' (sample item). The scale consists of four subscales (extremism, anxiety, reassurance seeking and compulsion). The scale is a 5-point Likert scale (1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always). There are no propositions that need to be reverse scored. The scale is evaluated on a total score. The Cronbach's alpha internal

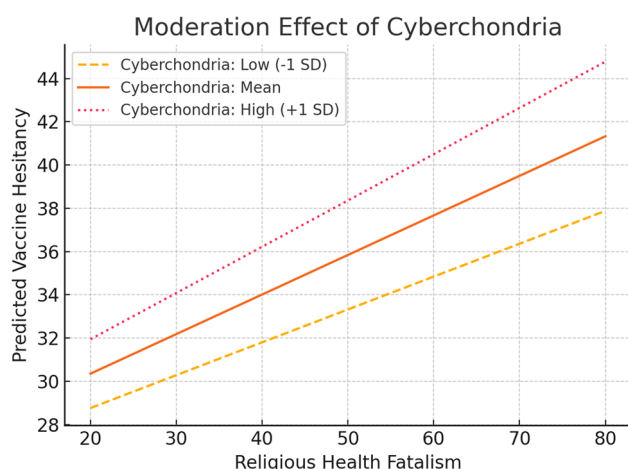


Fig. 1 The moderating role of cyberchondria in the relationship between religious health fatalism and vaccine hesitancy (simple slopes grafiği)

consistency of the scale is 0.86 [39]. The scale is scored on the total points. There are no reverse items. The maximum score that can be obtained from the scale is 60, the minimum score is 12, and the mean/median score is 36. We can classify 12–24 points as very low, 24–36 points as low, 36–48 points as moderate and 48–60 points as high cyberchondria severity [39]. In this study, the Cronbach's alpha value of the scale was found to be 0.90.

Statistical analysis

In this study, data were analyzed using SPSS 27.0 and PROCESS Macro programs. The normal distribution of data was evaluated based on skewness and kurtosis values ranging from -1.5 to $+1.5$ [40]. In this study, the skewness and kurtosis values of the scales are as follows: For the RHFS, skewness is -0.069 and kurtosis is -0.385 ; for the CSS-SF, skewness is -0.278 and kurtosis is -0.154 ; while for the VHS, skewness was -0.855 and kurtosis was 1.171 . Participants' demographic characteristics were presented using frequency and percentage distributions, while scale scores were presented using mean, standard deviation, and minimum-maximum values. Independent samples *t*-tests and one-way ANOVAs were used for group comparisons, and Tukey HSD tests were applied for significant differences. Relationships between variables were examined using Pearson correlation analysis. Before regression analysis, parametric assumptions were checked: normality of residuals (histogram and P-P plots), multicollinearity ($VIF < 10$), homogeneity of variance, and autocorrelation (Durbin-Watson ≈ 2) were ensured [41]. Hierarchical regression was performed to predict vaccine hesitancy: Model 1 included only religious fatalism, Model 2 added cyberchondria, and Model 3 included control variables created with dummies. The moderating effect of cyberchondria was tested using the mean-centered interaction term and visualized using a

Table 1 Parents' descriptive characteristics ($n = 535$)

Demographic characteristics		<i>n</i>	%
Gender	Male	196	36.6
	Female	339	63.4
Marital status	Married	513	95.9
	Single	22	4.1
Education status	Literate	46	8.6
	Primary school graduate	98	18.3
	Secondary school graduate	60	11.2
	High school graduate	119	22.2
Income status	University graduate	212	39.6
	Income is less than expenses	243	45.4
	Income equals expenses	235	43.9
	Income exceeds expenses	57	10.7
Have the news stories you've seen on social media about childhood vaccinations made you hesitant about vaccination?	Yes	317	59.3
	No	218	40.7
His go-to source of information about childhood vaccinations	Health Personnel	338	63.2
	Internet	104	19.4
	Neighbor relatives	43	8.0
	Other	50	9.3
M $\pm$ SD (Min–Max)			
Parent's Age (Years)		31.91 $\pm$ 6.29 (18–65)	
Child's age		2.91 $\pm$ 1.45 (1–5)	
Average daily internet usage time		2.84 $\pm$ 1.76 (1–10)	

M Mean, *SD* Standard Deviation

simple slope analysis (-1 SD, mean, $+1$ SD) (Fig. 1). Scale reliability was confirmed using Cronbach's alpha ($p < .05$ significant).

Results

In this study, 63.4% of the individuals were female, 95.9% were married, 39.6% were university graduates, 45.4% had an income less than their expenses, 59.3% were hesitant about vaccination because of news about childhood vaccines via social media, and 63.2% used health personnel as the source of information about childhood vaccines. The mean age of the individuals was 31.91 ± 6.29 years, the duration of daily internet use was 2.84 ± 1.76 , and the age of their children was 2.91 ± 1.45 years (Table 1).

The average score for parents on the RHFS was 52.12 ± 15.01 , the average score on the CSS-SF was 33.56 ± 9.77 , and the average score on the VHS was 30.62 ± 4.99 (Table 2).

The mean total scores of participants on the RHFS showed significant differences in terms of certain demographic variables. A statistically significant difference was found in the analysis based on educational level ($p = .001$) ($p < .05$). The Tukey HSD test revealed that the religious health fatalism scores of university graduates

Table 2 Parents' total scale scores and minimum-maximum values ($n = 535$)

	M $\pm$ SD	Min-Max	Skewness	Kurtosis
RHFS	52.12 $\pm$ 15.01	17–85	−0.069	−0.385
CSS-SF	33.56 $\pm$ 9.77	12–60	−0.278	−0.154
VHS	30.62 $\pm$ 4.99	10–44	−0.855	1.171

M Mean, SD standard deviation

were significantly lower than those of individuals with other levels of education. These results suggest that people with a university education tend to report lower levels of health fatalism than those with a lower level of education. Similarly, a notable difference was found in terms of monthly income ($p = .030$) ($p < .05$). According to the Tukey HSD test results, the fatalism scores of participants whose income exceeded their expenses were significantly lower than those of individuals whose income was less than their expenses. This suggests that people who are more economically well off are less likely to exhibit religious health fatalism than those who are less well off. On the other hand, no significant difference was observed in religious health fatalism scores based on gender, marital status, the extent to which news encountered on social media regarding childhood vaccinations

created vaccine hesitancy, and the source of information consulted regarding childhood vaccinations ($p > .05$) (Table 3).

The mean total scores of participants on the CSS-SF showed significant differences according to certain variables. In the analysis conducted to determine whether news about childhood vaccinations encountered on social media caused vaccine hesitancy, a significant difference was found ($p = .001$) ($p < .05$). Individuals who reported experiencing vaccine hesitancy scored higher than those who did not on the scale designed to measure cyberchondria. This finding suggests that individuals who experience distrust toward vaccines are more likely to engage in excessive online research related to health. Additionally, a significant difference was found based on the information source consulted regarding childhood vaccinations ($p = .002$) ($p < .05$). The results of the Tukey HSD test showed that there was a difference in scores between people who saw healthcare professionals and people who got their information from the internet. People who got their information from the internet scored significantly higher on the cyberchondria scale. This finding suggests that seeking information from internet sources may increase cyberchondria. In contrast, no statistically significant differences in average cyberchondria

Table 3 Comparison of RHFS, CSS-SF, and VHS scores according to parents' socio-demographic characteristics ($n = 535$)

Characteristics		RHFS		CSS-SF		VHS	
		M $\pm$ SD		M $\pm$ SD		M $\pm$ SD	
Gender ^a	Female	51.92 $\pm$ 14.49	$t = 0.410$	34.11 $\pm$ 9.63	$t = -1.716$	30.65 $\pm$ 4.41	$t = -0.081$
	Male	52.47 $\pm$ 15.90	$p = .682$	32.61 $\pm$ 9.97	$p = .087$	30.61 $\pm$ 5.30	$p = .935$
Marital Status ^a	Married	51.89 $\pm$ 14.76	$t = -1.345$	33.54 $\pm$ 9.76	$t = -0.258$	30.63 $\pm$ 4.97	$t = 0.168$
	Single	57.59 $\pm$ 19.63	$p = .192$	34.09 $\pm$ 10.29	$p = .797$	30.45 $\pm$ 5.51	$p = .867$
Educational Status ^b	Literate ^a	57.10 $\pm$ 16.67	$F = 12.181$	32.15 $\pm$ 11.79	$F = 1.926$	31.39 $\pm$ 4.89	$F = 1.292$
	Primary school graduate ^b	57.57 $\pm$ 14.95	$p = .001$	32.85 $\pm$ 10.38	$p = .105$	30.37 $\pm$ 5.06	$p = .272$
	Secondary school graduate ^c	54.78 $\pm$ 13.15	Tukey HSD $e < a, b, c, d$	36.66 $\pm$ 10.44		31.10 $\pm$ 4.75	
	High school graduate ^d	53.42 $\pm$ 14.76		33.57 $\pm$ 9.52		29.86 $\pm$ 5.70	
	University graduate ^e	47.05 $\pm$ 13.77		33.31 $\pm$ 8.82		30.87 $\pm$ 4.59	
Income Level ^b	Income is less than expenses ^a	53.19 $\pm$ 15.85	$F = 3.533$	33.36 $\pm$ 10.30	$F = 0.360$	30.60 $\pm$ 5.21	$F = 0.102$
	Income equals expenses ^b	52.18 $\pm$ 14.40	$p = .030$	33.93 $\pm$ 9.54	$p = .698$	30.58 $\pm$ 4.86	$p = .903$
	Income exceeds expenses ^c	47.35 $\pm$ 12.93	Tukey HSD $c < a$	32.87 $\pm$ 8.43		30.91 $\pm$ 4.61	
Have the news stories you've seen on social media about childhood vaccinations made you hesitant about vaccination?	Yes	52.26 $\pm$ 15.46	$t = 0.258$	34.82 $\pm$ 9.47	$t = 3.632$	29.58 $\pm$ 5.10	$t =$
	No	51.92 $\pm$ 14.35	$p = .796$	31.73 $\pm$ 9.93	$p = .001^*$	32.14 $\pm$ 4.42	-5.994 $p = .001^*$
His go-to source of information about childhood vaccinations ^b	Health Personnel ^a	51.48 $\pm$ 15.15	$F = 1.492$	32.44 $\pm$ 9.68	$F = 4.839$	31.51 $\pm$ 4.86	$F = 2.418$
	Internet ^b	52.64 $\pm$ 15.66	$p = .216$	35.98 $\pm$ 10.24	$p = .002$	29.62 $\pm$ 4.77	$p = .065$
	Neighbor relatives ^c	56.51 $\pm$ 9.45		36.32 $\pm$ 9.02	Tukey HSD $a < b$	31.00 $\pm$ 4.58	
	Other ^d	51.64 $\pm$ 16.21		33.72 $\pm$ 8.88		29.94 $\pm$ 6.28	

M Mean, SD Standard Deviation

* $p < .05$. Advanced analysis: Tukey HSD

^at: Independent Sample T-test

^bF: One-way ANOVA

scores were found based on gender, marital status, education level, or income ($p > .05$) (Table 3).

The total mean score on the VHS showed a significant difference depending on whether news about childhood vaccines encountered on social media caused hesitancy ($p = .001$) ($p < .05$). It was found that the average vaccine hesitancy scores of individuals who stated that news on social media caused vaccine hesitancy were lower than the scores of individuals who stated that they were not affected by such news. However, no statistically meaningful differences in vaccine hesitancy scores were found based on variables such as gender, marital status, educational attainment, income, and the source of information regarding childhood vaccinations ($p > .05$) (Table 3).

According to the Pearson correlation analysis results presented in Table 4, there were statistically significant positive weak and moderate correlations between RHFS and the CSS-SF ($r = .182$, $p = .001$) and vaccine hesitancy ($r = .298$, $p = .001$). Similarly, a statistically significant positive weak relationship was found between cyberchondria and vaccine hesitancy ($r = .247$, $p = .001$). When demographic variables were examined, a moderate positive relationship was found between parental age and child age ($r = .300$, $p = .001$). On the other hand, average daily internet usage time was only found to have a weak positive relationship with cyberchondria ($r = .140$, $p = .001$). No significant relationship was found between other demographic variables (parental age, child age, and internet usage time) and RHFS, CSS-SF, and VHS ($p > .05$) (Table 4).

When analyzing the results of hierarchical regression models created to determine the effects of religious health fatalism, cyberchondria, and dummy variables on vaccine hesitancy, the 95% confidence interval for the B coefficient is as follows:

Model 1 included only the RHFS variable. This model was found to be statistically significant and explained 8.9% of the total variance in the vaccine hesitancy variable ($R^2 = 0.089$; Adjusted $R^2 =$

0.087; F change = 51.759, $\Delta R^2 = 0.089$, $p < .001$). The religious health fatalism variable shows a significant and positive relationship with vaccine hesitancy ($\beta = 0.298$, $p < .001$). This finding indicates that as individuals' fatalistic health beliefs increase, their levels of vaccine hesitancy also increase (Table 5). In Model 2, the variable of CSS-SF was added to RHFS. The variance explained by Model 2 increased to 12.7% ($R^2 = 0.127$; Adjusted $R^2 = 0.124$, ΔR^2), and the addition of cyberchondria to the model resulted in a significant increase in variance ($\Delta R^2 = 0.039$; F change = 23.475; $p < .001$). In this model, both religious health fatalism ($\beta = 0.261$, $p < .001$) and cyberchondria ($\beta = 0.200$, $p < .001$) are significantly and positively associated with vaccine hesitancy. The results indicate that not only fatalistic beliefs but also excessive and anxiety-based internet searches related to health are associated with vaccine hesitancy (Table 5).

In Model 3, in addition to the variables of RHFS and CSS-SF, some demographic characteristics were included in the model as control variables (gender, marital status, educational status, income status, parental age, child's age, and daily internet usage time). The proportion of variance explained in this model increased to 15.1%, but the adjusted R^2 is only 12.9% ($R^2 = 0.151$; Adjusted $R^2 = 0.129$; $\Delta R^2 = 0.024$). However, the addition of control variables did not result in a statistically significant increase in variance in the model (F change = 1.314; $p > .05$). Furthermore, none of the control variables in this model had a statistically significant effect on vaccine hesitancy ($p > .05$). Nevertheless, the variables of religious health fatalism ($\beta = 0.300$, $p < .001$) and cyberchondria ($\beta = 0.202$, $p < .001$) retained their significance. These findings indicate that levels of religious health fatalism and cyberchondria are associated with vaccine hesitancy, independent of demographic characteristics (Table 5).

Table 4 Relationships between RHFS, CSS-SF, VHS, and continuous demographic variables ($n = 535$)

	1	2	3	4	5	6
RHFS	1					
CSS-SF	$r = .182$ $p = .001$	1				
VHS	$r = .298$ $p = .001$	$r = .247$ $p = .001$	1			
Parent's Age (Years)	$r = .014$ $p = .746$	$r = -.033$ $p = .450$	$r = .015$ $p = .735$	1		
Child's age	$r = -.054$ $p = .209$	$r = -.067$ $p = .120$	$r = -.029$ $p = .506$	$r = .300$ $p = .001$	1	
Average daily internet usage time	$r = .074$ $p = .086$	$r = .140$ $p = .001$	$r = .004$ $p = .934$	$r = .068$ $p = .115$	$r = -.043$ $p = .324$	1

r: Pearson correlation

Table 5 Hierarchical regression analysis of the relationships between religious healthfatalism, cyberchondria severity scale short form, and control variables with vaccine hesitancy ($n = 535$)

Predictive Variables		VHS (Dependent variable)					95.0% Confidence Interval for B		Collinearity Statistics		Durbin-Watson
		B	SD	β	t	p*					
Model 1							Lower Bound	Upper Bound	Tolerance	VIF	
	(Constant)	25.470	.746		34.125	.000	24.003	26.936			
	RHFS	.099	.014	.298	7.194	.000	.072	.126	1.000	1.000	
	R: .289, R ² /Adjusted R ² : .089/.087, Δ R ² : .089, F Change: 51.759										1.707
Model 2											
	(Constant)	22.677	.931		24.358	.000	20.848	24.506			
	RHFS	.087	.014	.261	6.340	.000	.060	.114	.967	1.034	
	CSS-SF	.102	.021	.200	4.845	.000	.061	.143	.967	1.034	
	R: .356, R ² /Adjusted R ² : .127/.124, Δ R ² : .039, F Change: 23.475										1.707
Model 3											
	(Constant)	21.791	1.718		12.686	.000	18.416	25.165			
	RHFS	.100	.014	.300	6.878	.000	.071	.128	.859	1.164	
	CSS-SF	.103	.022	.202	4.799	.000	.061	.145	.920	1.087	
	Female	-.037	.469	-.004	-.079	.937	-.958	.884	.796	1.257	
	Single	-.814	1.023	-.032	-.795	.427	-2.824	1.197	.983	1.017	
	Literate	.528	.926	.030	.570	.569	-1.292	2.348	.602	1.661	
	Primary school graduate	-.630	.782	-.049	-.805	.421	-2.166	.907	.443	2.255	
	High school graduate	-.759	.755	-.063	-1.005	.315	-2.243	.724	.412	2.430	
	University graduate	.813	.710	.080	1.145	.253	-.582	2.207	.337	2.969	
	Income is less than expenses	.128	.431	.013	.298	.766	-.719	.976	.880	1.136	
	Income exceeds expenses	.572	.703	.035	.813	.416	-.809	1.953	.863	1.159	
	Parent's Age	.008	.036	.010	.214	.831	-.062	.078	.806	1.241	
	Child's age	.034	.148	.010	.233	.816	-.257	.326	.877	1.140	
	Average daily internet usage time	-.110	.119	-.039	-.919	.358	-.344	.125	.919	1.088	
	R: .388, R ² /Adjusted R ² : .151/.129, Δ R ² : .024, F Change: 1.314										1.753

*Hierarchical Regression Analysis

Table 6 Moderation analysis of cyberchondria on the relationship between religious health fatalism and vaccine hesitancy ($n = 535$)

Predictive Variable	B	SE	β (Beta)	t	p-value	95% CI (Lower–Upper)
(Constant)	23.781	0.712		33.40	0.001	22.38–25.18
RHFS	0.090	0.014	0.274	6.43	0.001	0.063–0.117
CSS-SF	0.097	0.020	0.193	4.85	0.001	0.058–0.136
RHFS * CSS-SF	0.0031	0.0012	0.088	2.56	0.011	0.0007–0.0055
Model Summary	R ² = 0.138, Adjusted R ² = 0.133, Δ R ² = 0.011 (vs. Model 2), F(3, 531) = 28.2, $p < .001$.					

The results of the moderation analysis (Table 6) show that cyberchondria significantly affects the relationship between religious health fatalism and vaccine hesitancy ($B = 0.0031$, $p = .011$). This finding indicates that as the level of cyberchondria increases, the effect of fatalism on vaccine hesitancy becomes stronger. The simple slope graph presented in Fig. 1 also visually supports this interaction; in individuals with high levels of cyberchondria, the effect of fatalism on vaccine hesitancy is significantly greater. In contrast, this relationship is quite weak at low cyberchondria levels. When both statistical analysis and visual presentation are considered together, it is concluded that cyberchondria functions as a meaningful moderator in this relationship and that the two

psychological variables can jointly increase vaccine hesitancy (Table 6; Fig. 1).

Discussion

Vaccine hesitancy is a current issue that has been frequently discussed in recent years and there are many studies in the literature. However, no study has examined the interaction of psychological and behavioral factors such as religious health fatalism and cyberchondria, especially in parents' hesitancy towards childhood vaccines. Examining the effect of these two concepts together on vaccine hesitancy is important to understand how both the submissive attitudes stemming from religious beliefs and the intensive and often unreliable health information obtained from the internet interact in individuals'

health-related decision-making processes. This study aims to examine the effects of religious health fatalism and cyberchondria on parents' hesitancy towards childhood vaccinations. The findings are discussed within the framework of the literature and specific contributions to the field are presented.

This study, it was determined that hesitancy toward childhood vaccines increased as health fatalism increased. The relationship between health fatalism and vaccine hesitancy is a complex interaction of psychological, social and informational factors. Religious health fatalism, defined as the belief that health outcomes are predetermined and largely beyond individual control, may significantly influence parents' attitudes toward vaccines. As health fatalism increases, parents may perceive vaccination as unnecessary, leading to increased hesitancy about childhood vaccinations. This phenomenon is supported by several studies exploring the psychological underpinnings of vaccine hesitancy and the broader social context in which these beliefs are formed. Research shows that parents' attitudes toward vaccines are strongly influenced by their perceptions of health risks and the efficacy of vaccines. For example, Kurt et al. reported that distrust of the medical profession and the belief that children are vulnerable to adverse vaccine effects are important determinants of vaccine hesitancy among parents [42]. This mistrust may stem from a fatalistic perspective in which parents feel powerless in influencing their children's health outcomes, leading them to question the necessity and safety of vaccines. Similarly, Akhrani et al. emphasized that conspiracy beliefs about vaccines contribute to parental hesitancy, suggesting that when parents feel that they have no control over their health decisions, they may resort to alternative means that support their fears [43]. From a Health Belief Model (HBM) perspective, vaccination behavior is determined by perceptions of susceptibility and severity of vaccine-preventable diseases (VPDs), as well as perceived benefits and barriers to vaccination. In this context, high levels of health fatalism can decrease perceived susceptibility and benefits while increasing perceived barriers, resulting in greater vaccine hesitancy. Alghamdi and Alghamdi reported that parents who perceive their children as susceptible to VPDs are more likely to vaccinate [44]. However, when health fatalism is high, this perception may decrease, resulting in a lack of urgency for vaccination. This is supported by Vonasek et al., who emphasized that caregivers' beliefs about the efficacy of vaccines are crucial in decision-making processes [45]. Moreover, the emotional and psychological dimensions of vaccine hesitancy are also important. Research by Fadhel suggested that anxiety and fear about health outcomes can lead to increased vaccine hesitancy, especially when parents feel overwhelmed by the complexity of health information

[46]. This emotional response may be compounded by fatalistic beliefs, as parents may feel that their efforts to protect their children through vaccination are futile in the face of perceived uncontrollable health risks.

The other finding of this study is that as cyberchondria increases, hesitancy toward childhood vaccines increases. The relationship between cyberchondria and vaccine hesitancy, especially in relation to childhood vaccinations, is becoming increasingly important in the context of the digital age, where health information is easily accessible online. This phenomenon can significantly influence parents' attitudes toward vaccinations, resulting in further hesitancy. Research suggests that individuals who experience high levels of cyberchondria are more likely to develop anxiety regarding health decisions, including vaccines. This is in line with the findings of Üzümlü et al., who reported a strong correlation between cyberchondria and various dimensions of vaccine hesitancy, including vaccine aversion and vaccine reluctance [47]. Emotional turmoil resulting from cyberchondria may distort parents' understanding of the benefits and risks associated with childhood vaccines, leading them to delay or refuse vaccinations. Furthermore, Akpınar et al. reported that individuals with severe cyberchondria often engage in compulsive online searches for health information, which may increase their anxiety and fear of health outcomes, including vaccine safety [48]. This compulsive behavior can create a feedback loop in which increased anxiety leads to increased searching, which in turn increases concerns about vaccines. This feedback loop is of particular concern in the context of childhood vaccinations, as parents may be influenced by conflicting information and negative discourse about vaccines. The interaction between cyberchondria and health anxiety is also important. Nadeem et al. reported that health anxiety is a strong predictor of cyberchondria, suggesting that people who are already anxious about health issues are more likely to engage in excessive online search [49]. This high state of anxiety may lead parents to perceive vaccines as more dangerous than they are, contributing to their hesitancy. Furthermore, Zolotareva's research revealed that cyberchondria may mediate the relationship between fear of illness and health-related behaviors, reinforcing the idea that increased fear and anxiety may lead to avoidance behaviors such as vaccine refusal [50]. Furthermore, the role of misinformation in shaping cyberchondria cannot be ignored. The internet is full of conflicting information about vaccines, which can further heighten the fears of parents already struggling with cyberchondria. For example, Bajcar and Babiak discussed how distorted self-perceptions and health anxiety can lead to irrational decision-making, often fueled by misleading online content [51]. This misinformation can create an environment where parents feel justified in their

hesitancy to vaccinate because they believe that they are protecting their children from perceived dangers. Moreover, the impact of social media on vaccine perceptions is profound. Studies have shown that social media can increase fears about vaccines, especially among those with high levels of cyberchondria. For example, Yam et al., reported that cyberchondria was positively associated with fear of COVID-19, which may similarly apply to fears about childhood vaccines [52]. As parents encounter negative narratives about vaccines on social media, their cyberchondria may lead them to internalize these fears, leading to increased hesitancy.

Another salient finding of this study is that cyberchondria plays a moderating role in fortifying the relationship between religious health fatalism and vaccine hesitancy ($\beta = 0.088$, $p = .011$). Although this moderation effect is statistically significant, its magnitude is relatively small. However, given that parents frequently access online health information in the digital age, even a small effect may be significant at the societal level. The literature supports this. For example, Bajcar and Babiak (2021) noted that health anxiety causes individuals to constantly seek online verification, thereby reinforcing existing fears [51]. Similarly, Nadeem et al. (2022) reported that individuals with high levels of cyberchondria may experience weakened critical thinking skills when encountering online misinformation and may be more likely to believe content that confirms their existing concerns [49]. In this context, a parent with a fatalistic worldview may see anti-vaccine content online as information that validates their perspective, which can further lead to increased vaccine hesitancy. Cyberchondria can function as both a source of information and a regulatory mechanism that reinforces the negative effects of fatalistic beliefs. From a Health Belief Model perspective, this moderating effect may amplify perceived barriers and reduce perceived benefits of vaccination among fatalistic parents, further influencing their decision-making. These findings underscore the importance of considering digital health behaviors alongside psychological factors when addressing parental vaccine hesitancy. However, due to the cross-sectional design of the study, the causal relationship between the variables cannot be definitively determined. While the findings indicate an association between the variables, it is not possible to determine whether fatalism leads to hesitancy or whether hesitancy reinforces fatalism.

Limitations

This study has certain limitations. Firstly, the research was conducted using convenience sampling in a single province in eastern Turkey, which may restrict the applicability of the findings to parents residing in different regions or possessing different sociodemographic characteristics. Future studies conducted in different regions

and using multicentre and community-based sampling will increase the external validity of the findings. Furthermore, the cross-sectional design of the study does not permit the establishment of causality between variables. Since data were collected at a single point in time, it is not possible to determine the direction of relationships between religious health fatalism, cyberchondria and vaccine hesitancy. The fact that the data were collected through face-to-face and self-report surveys carries the risk of social desirability bias and subjective response bias. Additionally, although demographic variables were incorporated into the model, they were not found to significantly impact vaccine hesitancy. However, unmeasured cultural, cognitive, or contextual factors may influence this relationship. While the moderating effect of cyberchondria was statistically significant, its effect size was limited, indicating that online health concerns alone do not determine vaccine hesitancy.

Conclusion

In this study, the effects of religious health fatalism and cyberchondria on vaccine hesitancy were examined using hierarchical regression and moderation analyses. The findings revealed that religious health fatalism ($\beta = 0.274$, $p < .001$) and cyberchondria ($\beta = 0.193$, $p < .001$) significantly predicted vaccine hesitancy. Moderation analysis revealed that the effect of religious fatalism on vaccine hesitancy strengthened as cyberchondria levels increased ($\beta = 0.088$, $p = .011$). This relationship was particularly pronounced in individuals with high levels of cyberchondria, as confirmed by simple slope analysis. The fact that demographic variables did not contribute significantly to the model ($p > .05$) suggests that the effects of the main variables are independent of these factors. Correlation analyses showed that religious fatalism and cyberchondria ($r = .182$, $p < .001$) were positively associated with vaccine hesitancy ($r = .298$ and $r = .247$, respectively, $p < .001$). The study emphasizes the importance of interventions aimed at reducing vaccine hesitancy, particularly among individuals exposed to health information from social media and with high levels of religious fatalism. Future studies may employ qualitative methods or subgroup analyses with larger sample sizes to investigate the indirect and subtle effects of demographic factors, such as socioeconomic status, educational attainment, and number of children, on vaccine hesitancy.

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Authors' contributions

Y.S: Writing – original draft, Visualization, Validation, Supervision, Investigation M.Y. & M.A.A: Software, Resources, Project administration,

Methodology, Formal analysis D.K.S. & S.S.: Investigation, Funding acquisition, Data curation, Conceptualization S.S. & M.F.Y.: Data curation, Conceptualization Y.S., M.Y., M.F.Y., D.K.S., M.A.A., N.Ç., & S.S.: All authors reviewed and approved the manuscript.

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Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by Muş Alparslan University Scientific Research and Publication Ethics Committee (Date and Number: 06.02.2024–129962). After ethical approval, institutional permission (Date and Number: 19.03.2024–499183) was obtained from the institution where the study would be conducted. The participants were given detailed information about the purpose of the study, the methods used and the implementation process; it was clearly stated that participation was completely voluntary and did not involve any risk. Both written and verbal informed consent was obtained from all participants. During the study, the ethical principles of the Declaration of Helsinki were followed, and maximum care was taken to protect the rights of the participants.

Consent for publication

Not applicable.

Competing interests

The authors declare that there are no competing interests to disclose. There are no financial or personal relationships that could inappropriately influence or bias the work reported in this manuscript.

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