Ann Med Res

Current issue list available at Ann Med Res

Annals of Medical Research

journal page: annalsmedres.org

The role of cognitive flexibility in the relationship between pregnancy risk perceptions and vaccine hesitancy in expectant mothers

Hatice Tekbas[a,*], Yasar Barut[a], Emre Demirtas[a], Soner Cankaya[b]

[a]Ondokuz Mayıs University, Faculty of Health Sciences, Department of Child Development, Samsun, Türkiye
[b]Ondokuz Mayıs University, Yaşar Doğu Faculty of Sports Sciences, Samsun, Türkiye
*Corresponding author: haticeboztekbas@gmail.com (Hatice Tekbas)

MAIN POINTS

- The study included 204 volunteer pregnant women living in Samsun; the average age was 29.5 years, and most were university graduates and middle-income.
- Cognitive flexibility scores were significantly higher among university and postgraduate graduates than among primary school graduates.
- A trend toward higher cognitive flexibility scores with increasing income was observed.
- Vaccine hesitancy varied by employment status; self-employed individuals, in particular, were more hesitant. Pregnant women employed in the public sector have the highest perceived risk.
- Cognitive flexibility did not significantly moderate the relationship between risk perception and vaccine hesitancy.

Cite this article as: Tekbas H, Barut Y, Demirtas E, Cankaya S. The role of cognitive flexibility in the relationship between pregnancy risk perceptions and vaccine hesitancy in expectant mothers. *Ann Med Res*. 2026;33(7):318–325. doi: 10.5455/annalsmedres.2025.09.262.

ABSTRACT

Aim: Vaccine hesitancy has emerged as a significant public health problem in recent years. The aim of this study was to examine the moderating role of cognitive flexibility in the relationship between pregnant women's risk perceptions and vaccine hesitancy.

Materials and Methods: The study employed a relational screening model. The study population consisted of pregnant women. The sample included 204 participants who were randomly selected and consented to participate. Data were collected using a Personal Information Form, the Vaccine Hesitancy Scale, the Pregnancy Risk Perception Scale, and the Cognitive Flexibility Scale. Data analysis was conducted using SPSS v26 and Hayes' PROCESS Macro Model 1.

Results: The sample's mean age was 29.5 years; most participants had at least a university degree and reported middle-income status, while a majority lived in nuclear families. Participants with university or postgraduate education had higher cognitive flexibility scores than those with primary education. A marginal trend suggested greater cognitive flexibility among participants with higher incomes. Employment status significantly influenced vaccine hesitancy: self-employed women demonstrated higher hesitancy than those who were unemployed, and public-sector employees exhibited the highest levels of risk perception. A moderate positive correlation was observed between cognitive flexibility and vaccine hesitancy. A moderation analysis confirmed that cognitive flexibility did not significantly moderate the relationship between pregnancy risk perception and vaccine hesitancy. The overall model explained 7.8% of the variance in vaccine hesitancy, but was not statistically significant.

Conclusion: The findings underscore the complexity of vaccine hesitancy, indicating that cognitive processes alone may be insufficient to predict vaccination attitudes during pregnancy. Expanding such research to a national scale and integrating qualitative insights could enrich interpretations of how personal and contextual variables jointly shape vaccine hesitancy during pregnancy, ultimately supporting targeted interventions to promote maternal and fetal health.

Keywords: Vaccine hesitancy, Risk perception in pregnancy, Cognitive flexibility, Expectant mothers

Received: Sep 17, 2025 **Accepted:** Feb 02, 2026 **Available Online:** Jul 24, 2026

INTRODUCTION

The World Health Organization (WHO) defines vaccine hesitancy as a behavioral pattern resulting from multiple, interacting factors, such as distrust, complacency toward vaccines, and access problems, and emphasizes that these drivers rarely act alone [1]. The SAGE Vaccine Hesitancy Working Group concluded that vaccine hesitancy refers to delay in or refusal to accept vaccination despite the availability of immunization services [2]. Recently, reluctance and refusal to be vaccinated have increased significantly, both globally and in Türkiye. Social opposition to vaccination in Türkiye has increased markedly. According to a study, only 183 families refused vaccination in 2011, whereas this number reached 23,600 as of 2017 [3]. This trajectory underscores the urgency of addressing the interwoven social, cognitive, and structural determinants that shape vaccination decisions.

In her research titled COVID-19 vaccine hesitancy in pregnant women: a systematic review and meta-analysis, conducted by Oashe Bhattacharya [4], she examined studies that reported quantitative data on COVID-19 vaccine acceptance across countries and regions and found that acceptance levels were low among pregnant women. This situation threatens efforts to maintain and improve the effectiveness of immunity policies. As Hobson-West notes, "vaccination is just one of many decisions faced by parents." Other daily concerns related to child health and nutrition may take precedence at certain times or influence willingness to be vaccinated [5]. There is an urgent need for future research to address priority-setting for health behavior change before, during, and after pregnancy [6].

Across all pregnancies, a complication that could threaten the health of the mother or the fetus may occur in approximately 5 to 20 per 100 pregnancies. When pregnancies in Turkey were examined, it was determined that 31.1% and 60.5% of births were risky [7]. Accurately understanding the perception of risk during pregnancy is essential determinant of how women utilize health services, their motivation to seek care, and their decision-making processes regarding childbirth [8,9]. In a study using self-reports from Australian individuals on whether they had received the 2019 influenza vaccine, researchers examined the impact of perceived disease severity on vaccination behavior. Participants were asked, on a scale from 0 to 10, "If you had the flu, how severe would you expect it to be?". 31% anticipated a mild flu, 44% moderate, and 25% severe. Those who perceived influenza as more serious were significantly more likely to be vaccinated than those perceiving moderate severity, while no significant difference emerged between mild and moderate groups [10]. These results reveal that risk perception can be a determinant of vaccination behavior and that higher perceived risk encourages preventive action.

Individual risk perception is a multilayered structure that describes how individuals perceive environmental risks and is directly related to the individual's past experiences, cultural background, and cognitive-perceptual style. Societal norms and value systems can influence which risks are prioritized, while cognitive characteristics, such as cognitive flexibility, attentional processes, and information-processing capacity, play an important role in determining how risk-related information is interpreted and which behavioral responses it elicits. Cognitive flexibility is the capacity to adapt logical strategies and develop alternative solutions to unexpected or complex situations [11]. This ability facilitates coping with uncertainty, supports evaluation of alternative information sources, and fosters development of flexible strategies. Therefore, The relationship between vaccine hesitancy and risk perception depends on how an individual interprets health risks and the attitude that individual develops toward those risks. In this theoretical framework, cognitive flexibility may play a moderating role in the relationship between risk perception and vaccine hesitancy. However, empirical research addressing cognitive flexibility as a mediator or moderator in this context is quite limited, and in Türkiye, studies that jointly examine vaccine hesitancy, risk perception and cognitive flexibility, especially among pregnant women, are not reported in the literature review. This gap reveals the need for comprehensive, model-based research to clarify not only direct relationships but also how cognitive flexibility shapes ambivalence in vaccination decisions.

The main purpose of this study is to evaluate the effect of perceived risk situations experienced by expectant mothers during pregnancy on vaccine hesitancy and to empirically examine the moderating role of cognitive flexibility in this relationship. To this end, answers were sought to the following subquestions:

1. What are the vaccine hesitancy levels of expectant mothers?
2. What are the risk perception levels of expectant mothers during pregnancy?
3. What are the cognitive flexibility levels of expectant mothers?
4. Is there a significant relationship between risk perception and vaccine hesitancy during pregnancy?
5. Does cognitive flexibility moderate the relationship between risk perception and vaccine hesitancy during pregnancy?

MATERIALS AND METHODS

Research model

The relational screening model, one of the screening research models designed to reveal the current status of a particular subject or population, was used in the study. The relational screening model is used to examine the existing or assumed levels of relationship among two or more variables [12].

Sample

This research was approved by the Ondokuz Mayıs University Social and Human Sciences Research Ethics Committee (decision number 2025-424, dated March 28, 2025). The study population comprises pregnant individuals residing in Samsun. The sample group was composed of 204 participants who applied to the Obstetrics and Gynecology Outpatient Clinic of Ondokuz Mayıs University Hospital and voluntarily agreed to take part in the study. These participants were selected through convenience sampling. Convenience sampling was preferred because it allowed practical and timely access to pregnant individuals who regularly visited the outpatient clinic during the data collection period. The sample size for this study was determined in accordance with established

https://doi.org/10.5455/annalsmedres.2025.09.262

Table 1. Demographic information of the study group.

	N	Min.	Max	Mean	SD
Age	204	19.00	41.00	29.50	4.78
Marriage Age	204	14.00	38.00	24.23	3.91
				N	%
Educational Status		Primary education		39	19.1
		High school		65	31.9
		University		93	45.6
		Postgraduate		7	3.4
		Total		204	100.0
Financial Income		Low		25	12.3
		Middle		169	82.8
		High		10	4.9
		Total		204	100.0
Employment Status		Not working		136	66.7
		Public personnel		30	14.7
		Private sector employee		34	16.7
		Private sector own business		4	2.0
		Total		204	100.0
Family Structure		Nuclear family		186	91.2
		Extended family		18	8.8
		Total		204	100.0

Table 2. Statistical information regarding the data collection tool.

	Number of Items	Item Load Ranges	Explained Variance	Cronbach Alpha	KMO	p-value	Skewness		Kurtosis	
							Statistics	SE	Statistics	SE
Vaccine Hesitancy Scale	10	0.36-0.86	67.75%	0.84	0.88	<0.001	-0.56	0.17	-0.2	0.34
Cognitive Flexibility Scale	12	0.25-0.61	51.12%	0.70	0.74	<0.001	0.22	0.17	-0.28	0.34
Risk Perception Scale in Pregnancy	9	0.31-0.68	55.71%	0.82	0.77	<0.001	0.18	0.17	-0.82	0.34

methodological recommendations in the literature. According to Tavşancıl, the minimum sample size in scale-based research should be at least five times the total number of items [13]. Given that the measurement tools used in this study included 31 items, the minimum sample size was calculated to be 155, with an additional allowance of approximately 10% to account for potential data loss or exclusions. Furthermore, Aiken and West emphasize that moderation analyses often require larger samples, typically 200 or more participants, because of the generally low statistical power associated with interaction effects [14]. Therefore, conducting the analysis with 204 participants meets both the item-based sample-size criterion and the recommended methodological standard for moderation analysis.

Table 1 below shows descriptive statistics for the demographic characteristics of the study group.

Data collection tools and processes

The study used a researcher-prepared personal information form and three different scales as data collection tools.

Personal information form

It consists of questions aimed at obtaining the participants' descriptive information, such as age, age at marriage, education level, income, employment status, and family structure.

Cognitive flexibility scale

The Cognitive Flexibility Scale, developed by Martin and Rubin, consists of 12 items and a single dimension [15]. BEÖ is a 6-point Likert-type measurement tool, with responses ranging from 1 "strongly disagree" to 6 "strongly agree." In this study, the measurement tool had an internal consistency coefficient (α) of 0.80 and a test-retest reliability coefficient of 0.83. In the reliability study conducted by Martin and Anderson [16], the internal consistency of the BES was reported as 0.72, 0.73, and 0.81. The positive and significant correlation between CFS scores and self-efficacy scores for communication skills and related behaviors, together with findings that individuals form positive friendships as their cognitive flexibility increases, also support the criterion-related validity of the CFS [15]. The scores obtainable from the measurement tool, in which items 2, 3, 6, and 10 are reverse-scored, range from 10 to 60. Increased scores indicate a high level of cognitive flexibility. In another study, Maltby et al. [17] reported

https://doi.org/10.5455/annalsmedres.2025.09.262

an internal consistency coefficient for the BÖ of 0.92 [18].

Risk perception scale in pregnancy

The scale was developed by Heaman and Gupton [19] to assess perceived risk during pregnancy, and its Turkish reliability and validity were evaluated by Evcili and Dağlar [20]. The scale comprises nine items: five relate to pregnant women's risk perception towards their babies, and four relate to pregnant women's risk perception towards themselves. The scale includes the response options "no risk" and "extremely high risk" for each item. These statements are marked on a 0-10 cm linear scale according to pregnant women's risk perceptions. The total scale score is calculated by dividing the sum of all item scores by nine. Scores on the GRA scale range from 0 to 10. An increase in the score on the scale is interpreted as an increased risk perception among pregnant women regarding themselves and their babies. The Cronbach's Alpha coefficient of the scale was found to be 0.84. In this study, the coefficient was found to be highly reliable (0.90).

Vaccine hesitancy scale

The Turkish validity and reliability analysis of the vaccine hesitancy scale developed by Larson et al. [21] was conducted by Aslan et al. [22]. In this study, the WHO Vaccine Hesitancy Scale, adapted to Turkish culture by Aslan et al. [22] and shown to be usable by Turkish parents, was administered in Turkish. Responses to this 10-item, 5-point Likert-type scale range from "Strongly agree" to "Strongly disagree". While questions 5, 9, and 10 on the scale are negatively worded, all other questions are positively worded. Higher scores for positive statements are associated with lower vaccine hesitancy, whereas higher scores for negative statements are associated with higher vaccine hesitancy. Therefore, responses 5, 9, and 10 were reverse-coded. Therefore, as the total score on the scale increases, the level of vaccine hesitancy decreases. There is no cut-off point that distinguishes those who are hesitant from those who are not.

Statistical analysis

Data from study participants collected using "Vaccine Hesitancy", "Cognitive Flexibility", and "Risk Perception in Pregnancy" instruments were analyzed using IBM SPSS Statistics version 26.0 [23] and Hayes PROCESS model macros. A total of 220 participant responses were transferred to the analysis program. Before analysis, outlier and extreme-value analyses were conducted on the dataset, and participants who negatively impacted the dataset's reliability were excluded from the study. In the statistical evaluation of the data, the assumption of normality was first examined using the Kolmogorov-Smirnov and Shapiro-Wilk tests ($P > 0.05$) and by calculating skewness and kurtosis coefficients: skewness = 0.39 ± 0.17 for age and −0.44 ± 0.34 for marriage age; kurtosis = 0.52 ± 0.17 for age and 1.19 ± 0.34 for marriage age. After removing 11 outlier responses and 5 extreme responses from the data set, the analysis proceeded the responses of 204 participants. Table 2. below provides statistical information regarding the validity and reliability of the data collection tools in the current study.

Table 2 indicates that the Vaccine Hesitancy Scale (10 items; loadings. 0.36–0.86) explains 67.75% of variance with high internal consistency (α =0.84; KMO = 0.88; $p<0.001$), the Cognitive Flexibility Scale (12 items; loadings. 0.25–0.61) explains 51.12% (α = 0.70; KMO=0.74; $p<0.001$), and the Pregnancy Risk Perception Scale (9 items; loadings. 0.31–0.68) explains 55.71% (α=0.82; KMO=0.77; $p<0.001$). Skewness/kurtosis values (Vaccine Hesitancy: −0.56/−0.20; Cognitive Flexibility: 0.22/−0.28; Risk Perception: 0.18/−0.82) fall well within Kline's thresholds (±3, ±10), supporting approximate normality [24]. Following George and Mallery, α values between 0.70–0.90 evidence acceptable–good reliability [25]. Independent-samples t tests were applied to dichotomous groupings, one-way ANOVA to multigroup comparisons, and Pearson correlations to examine associations among instruments. Following significant ANOVA results, Bonferroni post hoc tests were conducted to identify pairwise group differences. Effect sizes were interpreted via η^2 with [26]. 0.01, 0.06, and $\geq$0.14 denoting small, medium, and large effects, respectively. Moderation was tested using Hayes PROCESS Model 1 to evaluate whether the association between X (pregnancy risk perception) and Y (vaccine hesitancy) varies by W (cognitive flexibility) [27].

This study tests the effect of pregnancy risk perception (X) on vaccine hesitancy (Y) and examines the moderating role of cognitive flexibility (W) within the framework of Hayes PROCESS Model 1, with X, W, and X×W terms included in the model. Statistical significance of the effects was tested using multiple linear regression.

RESULTS

This section presents findings from statistical analyses examining the moderating role of cognitive flexibility in the relationship between vaccine hesitancy and risk perception during pregnancy.

Examination of Table 3 indicates that education level did not yield significant group differences in vaccine hesitancy ($F=0.765$, $p=0.515$, $\eta^2=0.011$) or pregnancy risk perception ($F=0.492$, $p=0.688$, $\eta^2=0.007$; $F=2.777$, $p=0.052$, $\eta^2=0.040$, with university (M=55.36 ±7.78) and postgraduate (M=57.57±5.85) participants scoring higher than primary-school graduates (M=51.94±7.48). Financial income showed no significant effects on hesitancy ($F=1.365$, $p=0.258$, $\eta^2=0.013$) or risk perception ($F=0.700$, $p=0.498$, $\eta^2=0.006$), whereas flexibility in the high-income group yielded ($F=2.384$, $p=0.095$, $\eta^2=0.023$; high M=58.10±4.01 vs. low M=52.04±7.88). Employment status mattered: vaccine hesitancy varied significantly ($F=2.776$, $p=0.042$, $\eta^2=0.040$), with self-employed individuals reporting higher hesitancy (M=45.25±2.21) than unemployed peers

https://doi.org/10.5455/annalsmedres.2025.09.262

Table 3. Comparison of participants' vaccine hesitancy, cognitive flexibility, and risk perception levels during pregnancy according to their socio-demographic characteristics.

	Vaccine Hesitancy					Cognitive Flexibility					Risk Perception in Pregnancy				
Variables	N	Mean±SD	Test (F/t)	η2	p-value	N	Mean±SD	Test (F/t)	η2	p-value	N	Mean±SD	Test (F/t)	η2	p-value
Educational Status															
Primary Education	39	36.35±7.12				39	51.94±7.48				39	3.41±1.87			
High School	65	35.06±6.89	0.765	0.011	0.515	65	53.24±7.03	2.777	0.040	0.052	65	3.33±1.80	0.492	0.007	0.688
University	93	36.84±7.71				93	55.36±7.78				93	3.68±1.94			
Postgraduate	7	36.14±7.90				7	57.57±5.85				7	3.58±1.68			
Material Income															
Low	25	33.92±7.46				25	52.04±7.88				25	3.44±1.63			
Medium	169	36.50±7.30	1.365	0.013	0.258	169	54.18±7.57	2.384	0.023	0.095	169	3.49±1.91	0.700	0.006	0.498
High	10	35.90±7.47				10	58.10±4.01				10	4.20±1.72			
Working Status															
Unemployed	136	36.04±6.98				136	53.59±7.39				136	3.56±1.84			
Public Employee	30	37.16±7.51	2.776	0.040	0.042	30	56.43±8.84	1.184	0.017	0.317	30	4.26±2.00	4.159	0.059	0.007
Private Sector	34	34.67±8.30				34	54.02±7.09				34	2.66±1.65			
Self-Employed	4	45.25±2.21				4	55.00±2.30				4	3.61±1.19			
Family Structure															
Nuclear	186	36.44±7.33	1.754	0.015	0.081	186	54.33±7.70	1.38	0.009	0.169	186	3.56±1.89	1.004	0.005	0.317
Extended	18	33.27±7.01				18	51.77±5.02				18	3.09±1.57			

Table 4. Pearson correlation analysis results.

Variables		2	3	4	5
1. Age	r p	0.398** p<0.01	0.046 p>0.05	0.009 p>0.05	0.117 p>0.05
2. Age of Marriage	r p		0.188** p<0.01	0.142* p<0.05	0.147* p<0.05
3. Vaccine Hesitancy	r p			0.271** p<0.01	-0.004 p>0.05
4. Cognitive Flexibility	r p				0.069 p>0.05
5. Pregnancy Risk Perception	r p	- -	- -	- -	- -

N=204, p<0.05=*, p<0.01**

Table 5. Moderation analysis results (Hayes PROCESS Model 1).

Dependent Variable: Vaccine Hesitancy	B (β)	SE	t-value	p-value	95% Lower Limit	95% Upper Limit
Constant	28.623	7.180	3.99	<0.001	14.465	42.781
Risk Perception in Pregnancy (X)	-1.824	1.755	-1.04	0.300	-5.284	1.636
Cognitive Flexibility (W)	0.145	0.130	1.12	0.266	-0.112	0.402
Interaction (X × W)	0.032	0.032	1.00	0.317	-0.031	0.094

(M=36.04±6.98), and pregnancy risk perception differed across sectors (F=4.159, p=0.007, η^2=0.059), peaking among public personnel (M=4.26±2.00) and lowest in private employees (M=2.66±1.65), Cognitive flexibility is not affected by employment status (F=1.184, p=0.317, η^2=0.017). Finally, family structure produced no statistically significant differences in vaccine hesitancy (F=1.754, p=0.081, η^2=0.015), cognitive flexibility (F=1.380, p=0.169, η^2=0.009), or pregnancy risk perception (F=1.004, p=0.317, η^2=0.005).

Examination of Table 4 revealed a significant positive relationship between age and age of marriage (r=0.398, p<0.01). Age at marriage was found to be slightly positively correlated with vaccine hesitancy (r=0.188, p<0.01), cognitive flexibility

https://doi.org/10.5455/annalsmedres.2025.09.262

(r=0.142, p<0.05), and pregnancy risk perception (r=0.147, p<0.05). A moderate, positive correlation was observed between vaccine hesitancy and cognitive flexibility (r=0.271, p<0.01). The relationships between other variables are not statistically significant (p>0.05).

Table 5 shows the results of the moderation analysis. In the Hayes PROCESS Model 1 moderation test, we examined pregnancy risk perception (X), cognitive flexibility (W), and their interaction (X×W) as predictors of vaccine hesitancy (Y). The model was statistically significant overall (F(3, 200) = 6.31, p=0.004), explaining 7.8% of the variance (R^2 = 0.078). Risk perception during pregnancy negatively, but non-significantly, predicted hesitancy (B=−1.824, SE=1.755, t=−1.04, p=0.300, 95% CI [−5.284, 1.636]); cognitive flexibility showed a small, non-significant positive association (B=0.145, SE=0.130, t=1.12, p=0.266, 95% CI [−0.112, 0.402]); the interaction term did not indicate moderation (B=0.032, SE=0.032, t=1.00, p=0.317, 95% CI [−0.031, 0.094]).Despite the importance of the model, risk perception and cognitive flexibility do not explain the variations in vaccine hesitancy. This indicates that other factors may come into play in determining hesitancy, and that cognitive flexibility does not moderate the relationship between risk perception and hesitancy under current circumstances.

DISCUSSION

This study aimed to analyze the relationship between vaccine hesitancy and risk perception among pregnant individuals and to examine the moderating effect of cognitive flexibility on this relationship. Using Hayes' PROCESS Model 1, we tested the effects of pregnancy risk perception (X), cognitive flexibility (W), and their interaction (X×W) on vaccine hesitancy. Although the overall model was statistically significant, its explanatory power was low (R^2 = 0.078), suggesting that additional determinants of vaccine hesitancy were not included, such as health literacy, trust, and religious-spiritual orientations. The independent variable, pregnancy risk perception, negatively predicted vaccine hesitancy, but not significantly, consistent with findings that women's total risk perception scores during pregnancy tend to be low [28]. Cognitive flexibility did not significantly predict hesitancy, and the interaction term (Risk Perception × Cognitive Flexibility) did not yield a significant moderating effect. These results indicate a multifactorial structure in which cognitive flexibility may be related to hesitancy but does not alter the risk perception–hesitancy link in this sample.

By educational level, no significant differences emerged in vaccine hesitancy or pregnancy risk perception, indicating that attitudes cannot be explained solely by academic attainment and may instead be shaped by cognitive and sociocultural factors. This aligns with Sevinç et al. [29], who reported no relationship between education and vaccine hesitancy. Yet other evidence is mixed: Çetin and Söğüt [30], identified education as a factor, finding higher vaccine opposition among primary school graduates; Çınar et al. [31] observed that high school or higher education was associated with increased tetanus vaccination among pregnant women; and Afolabi et al. [32] concluded that lower education was associated with greater hesitancy toward hepatitis B vaccination. Regarding pregnancy risk perception, Gözüyeşil and Özertürk [7] determined that overall levels were low, with risk perception for self and baby peaking in the second trimester, a pattern congruent with our findings.

A significant effect of education on cognitive flexibility was observed: Participants with university and postgraduate education scored higher than primary school graduates, consistent with Oral and Kolburan [33]. No significant differences in vaccine hesitancy or pregnancy risk perception were observed across levels of financial income. Prior work links lower education and income to higher anxiety, which may complicate information-seeking and communication with health services [34]. In our data, cognitive flexibility exhibited a marginal income gradient, with higher scores in the upper-income group, whereas Saadi [35] reported no statistically significant association; this discrepancy may reflect our study population or its relatively high socioeconomic setting.

Employment status was important. Self-employed individuals exhibited significantly higher vaccine hesitancy than the unemployed; we found no directly comparable results in the literature, and this pattern may stem from broader interpersonal networks and greater exposure to heterogeneous opinions among the self-employed. Risk perception differed by sector: it was highest among public-sector employees and lower among private-sector employees, plausibly linked to occupational risk profiles such as stress, chemical exposures, sharps injuries, hepatitis B, and violence-related injuries [36]. Cognitive flexibility did not differ by employment status. Family structure (nuclear vs. extended) was not associated with significant differences in vaccine hesitancy, cognitive flexibility, or risk perception, and we found no studies assessing these variables jointly.

Age and age at marriage were positively correlated, and age at marriage was slightly positively correlated with vaccine hesitancy, cognitive flexibility, and risk perception. Prior findings are nuanced: Oral and Kolburan [33] noted high cognitive flexibility at ages 26–35, whereas Altunkol [37] and Dağgeçcen Başsu [38] reported no significant age–flexibility link, and Xia et al. [39] found that cognitive flexibility decreases in older adults. We observed a moderately positive, statistically significant relationship between vaccine hesitancy and cognitive flexibility. Sevinç et al. [29] reported a negative correlation between age and vaccine hesitancy. Importantly, participants with lower cognitive flexibility have been shown to endorse more personal, but not external, barriers to vaccination [40], emphasizing that vaccine hesitancy is multidimensional and that different mechanisms may underlie personal versus structural influences. Overall, our results highlight limited moderation by cognitive flexibility and underscore the need

https://doi.org/10.5455/annalsmedres.2025.09.262

for holistic models integrating cognitive, sociocultural, and structural determinants.

CONCLUSION

Findings indicate a moderately positive and statistically significant association between vaccine hesitancy and cognitive flexibility, whereas relationships among the remaining constructs were not significant. Within the Hayes PROCESS Model 1 framework, pregnancy risk perception (X), cognitive flexibility (W), and their interaction (X×W) were entered as predictors of vaccine hesitancy. The model was statistically significant overall (R^2 = 0.078), explaining 7.8% of the variance; however, neither X, W, nor X×W reached significance. These results imply that pregnancy risk perception does not directly predict vaccine hesitancy, that cognitive flexibility alone is not a sufficient determinant of vaccine hesitancy, and that cognitive flexibility does not moderate the link between pregnancy risk perception and vaccine hesitancy. The study is limited to Samsun Province, which constrains generalizability; therefore, multi-site sampling across Türkiye is warranted. Future research should complement these quantitative findings with qualitative inquiry and develop integrative models that test additional psychosocial determinants, such as information literacy, health anxiety, trust, and conspiracy beliefs, as potential mediators or moderators. Including pregnant women, their spouses/partners, healthcare professionals, and recent mothers could yield a more comprehensive map of societal perspectives and vaccination decision-making dynamics. Pregnant women participating in the study were not asked whether they had been vaccinated , which constituted a limitation. Another important limitation of this study is that no questions were asked regarding the differential diagnosis of vaccine rejection in expectant mothers.

Ethics Committee Approval: The research was approved by the Ondokuz Mayıs University Social and Human Sciences Research Ethics Committee (decision number 2025-424, dated March 28, 2025).

Informed Consent: Participants were informed about the purpose of the study, their voluntary consent was obtained after explaining the study's potential contributions to women's health and the scientific literature. The study was completed face-to-face, with the understanding that the data would be used only for scientific purposes.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The authors declare that there are no conflicts of interest.

Author Contributions: Conception: HT; Design: ED; Supervision: YB; Fundings: SÇ; Materials: ED; Data Collection and/or Processing: HT; Analysis and/or Interpretation: SÇ; Literature Review: ED; Writing: HT; Critical Review: YB.

Financial Disclosure: The authors declare that the study received no funding.

Artificial Intelligence Disclosure: During the preparation of this article, ChatGPT (GPT-5.2 version), an AI-based tool developed by OpenAI, was used only for limited purposes: language editing, improving academic English expressions, translation, and enhancing text fluency. AI support was not used in the creation of the scientific content of the article, data analysis, interpretation of results, or the development of original academic contributions. All linguistic adjustments and expressions suggested by artificial intelligence have been carefully reviewed and verified by the authors, and the authors assume full academic and ethical responsibility for the final text. All scientific content, data, analyses, and interpretations in the article belong to the authors. In the use of artificial intelligence tools, the ethical guidelines on the use of artificial intelligence published by the Council of Higher Education (YÖK) have been taken into consideration; and actions have been taken in accordance with the principles of transparency, accountability, and scientific integrity. The artificial intelligence system is not listed as an author in any way, and the responsibility for the study rests entirely with the authors.

REFERENCES

1. Troiano G, Nardi A. Vaccine hesitancy in the era of COVID-19. *Public Health.* 2021;194:245–51. doi: 10.1016/j.puhe.2021.02.025.
2. MacDonald NE. Vaccine hesitancy: Definition, scope and determinants. *Vaccine.* 2015;33(34):4161–4. doi: 10.1016/j.vaccine.2015.04.036.
3. Türk Eczacılar Birliği. 6. Bölge Samsun Eczacı Odası, "Aşı Reddi Geleceğimizi Tehdit Ediyor" Basın Açıklaması [Internet]. 2019 [cited 2025 Apr 9]. Available from: https://www.samsuneczacio-dasi.org.tr/haber-26475.
4. Bhattacharya O, Siddiquea BN, Shetty A, Afroz A, Billah B. COVID-19 vaccine hesitancy among pregnant women: a systematic review and meta-analysis. *BMJ Open.* 2022;12(8):e061477. doi: 10.1136/bmjopen-2022-061477.
5. Hobson-West P. Understanding vaccination resistance: moving beyond risk. *Health Risk Soc.* 2003;5(3):273–83. doi: 10.1080/1369857031000160697 8.
6. Olander EK, Smith DM, Darwin Z. Health behaviour and pregnancy: a time for change. *J Reprod Infant Psychol.* 2018;36(1):1–3. doi: 10.1080/02646838.2018.1408965.
7. Gözüyeşil E, Özertürk Ö. Gebelikte risk algısı ve etkileyen faktörlerin belirlenmesi; Trimesterler arası karşılaştırma. *Adnan Menderes Univ Sağlık Bil Fak Derg.* 2022;6(3):467–77. doi: 10.46237/amusbfd.1035974.
8. Atkinson SJ, Farias MF. Perceptions of risk during pregnancy amongst urban women in northeast Brazil. *Soc Sci Med.* 1995;41(11):1577–86. doi: 10.1016/0277-9536(95)00021-X.
9. Suplee PD, Dawley K, Bloch JR. Tailoring peripartum nursing care for women of advanced maternal age. *J Obstet Gynecol Neonatal Nurs.* 2007;36(6):616–23. doi: 10.1111/j.1552-6909.2007.00197.x.
10. Trent MJ, Salmon DA, MacIntyre CR. Using the health belief model to identify barriers to seasonal influenza vaccination among Australian adults in 2019. *Influenza Other Respir Viruses.* 2021;15(5):678–87. doi: 10.1111/irv.12843.
11. Cañas J, Quesada J, Antolí A, Fajardo I. Cognitive flexibility and adaptability to environmental changes in dynamic complex problem-solving tasks. *Ergonomics.* 2003;46(5):482–501. doi: 10.1080/0014013031000061640.
12. Karasar N. Bilimsel araştırma yöntemi: kavramlar, ilkeler, teknikler. Ankara: Nobel Yayın Dağıtım; 2007.
13. Tavşancıl E. Tutumların ölçülmesi ve SPSS ile veri analizi. Ankara: Nobel Akademik Yayıncılık; 2010.
14. Aiken LS, West SG. Multiple Regression: Testing and Interpreting Interactions. *Sage* (1991).

https://doi.org/10.5455/annalsmedres.2025.09.262

15. Martin MM, Rubin RB. Development of a communication flexibility measure. *South J Commun.* 1994;59(2):171–8. doi: 10.1080/10417949409372934.
16. Martin MM, Anderson CM. The cognitive flexibility scale: Three validity studies. *Commun Rep*. 1998;11:1–9. doi: 10.1080/08934219809367680.
17. Maltby J, Day L, McCutcheon LE, Martin MM, Cayanus JL. Celebrity worship, cognitive flexibility, and social complexity. *Pers Individ Dif*. 2004;37(7):1475–82. doi: 10.1016/j.paid.2004.02.004.
18. Çelikkaleli Ö. Bilişsel esneklik ölçeği'nin geçerlik ve güvenirlik çalışmaları. *Egit Bil*. 2014;39(176):339–46. doi: 10.15390/EB.2014.3466.
19. Heaman MI, Gupton AL. Psychometric testing of the perception of pregnancy risk questionnaire. *Res Nurs Health.* 2009;32(5):493–503. doi: 10.1002/nur.20342.
20. Evcili F, Dağlar G. Gebelikte risk algısı ölçeği: Türkçe geçerlik ve güvenirlik çalışması. *Cukurova Med J.* 2019;44:211–22. doi: 10.17826/cumj.554151.
21. Larson HJ, Jarrett C, Schulz WS, et al. Measuring vaccine hesitancy: the development of a survey tool. *Vaccine.* 2015;33(34):4165–75. doi: 10.1016/j.vaccine.2015.04.037.
22. Aslan KT, Ay P, Kaş D, et al. Adaptation and validation of the Turkish version of the vaccine hesitancy 5 point Likert Scale. *Hum Vaccin Immunother.* 2021;17(12):5176–82. doi: 10.1080/21645515.2021.1953347.
23. Mehta CR, Patel NR. (2011). IBM SPSS exact tests. Armonk, NY: IBM Corporation, 23(12), 24.
24. Kline RB. Becoming a behavioral science researcher: A guide to producing research that matters. New York: *Guilford Press*. 2009.
25. George D, Mallery P. IBM SPSS statistics 29 step by step: A simple guide and reference. New York: *Routledge*. 2024. doi: 10.4324/9781032622156.
26. Cohen J. Eta-squared and partial eta-squared in fixed factor ANOVA designs. *Educ Psychol Meas.* 1973;33(1):107–12. doi: 10.1177/001316447303300111.
27. Hayes AF. Introduction to mediation, moderation, and conditional process analysis: a regression-based approach. New York: *Guilford Press.* 2018.
28. Bayrampour H, Heaman M, Duncan KA, Tough S. Advanced maternal age and risk perception: a qualitative study. *BMC Pregnancy Childbirth.* 2012;12:100. doi: 10.1186/1471-2393-12-100.
29. Sevinç K, Çiftçi M, Akyıldız R, Karaoğlan E. Dindarlık, dogmatizm, eğitim ve Covid-19 farkındalığı Covid-19 aşı tereddüdünün tahmin edicileri olarak: Türk Müslümanları üzerine nicel bir çalışma. *Hitit İlahiyat Derg.* 2023;1031–46. doi: 10.14395/hid.1333363.
30. Çetin K, Söğüt SC. The relationship between vaccine hesitancy and health literacy in pregnant women: a cross-sectional study. *BMC Womens Health.* 2024;24(1):361. doi: 10.1186/s12905-024-03148-2.
31. Çınar G, Akdemir-Kalkan İ, Yılmaz-Karadağ F, et al. Evaluation of the knowledge, attitudes and behaviors of pregnant women on tetanus vaccination. *Klimik J.* 2022;35(2):78-83. doi: 10.36519/kd.2022.4229.
32. Afolabi IB, Aremu AB, Maidoki LA, Atulomah NO. Predictors of hepatitis B virus infection vaccine hesitancy among pregnant women attending antenatal care at Lubaga Hospital, Kampala, Uganda. *Int J Womens Health.* 2022;14:1093–104. doi: 10.2147/IJWH.S378000.
33. Oral S, Kolburan ŞG. Çekişmeli boşanma sürecindeki bireylerin empatik eğilim düzeyleri ve bilişsel esneklik düzeylerinin bazı değişkenlere göre incelenmesi. *Yaşam Becerileri Psikol Derg.* 2019;3(6):165–78. doi: 10.31461/ybpd.607300.
34. Shui IM, Weintraub ES, Gust DA. Parents concerned about vaccine safety: Differences in race/ethnicity and attitudes. *Am J Prev Med.* 2006;31(3):244–51. doi: 10.1016/j.amepre.2006.04.006.
35. Saadi T. Tevekkül, kendini gerçekleştirme ve bilişsel esneklik ilişkisi üzerine bir araştırma [Master's thesis]. Bursa: Bursa Uludağ Üniversitesi Sosyal Bilimler Enstitüsü; 2024.
36. Yanık A, Kurul N. Sağlık çalışanlarının risk yönetimi algısı: hastanelerde bir uygulama. *Usaysad Derg.* 2020;6(2):287–302. Available from: https://dergipark.org.tr/tr/pub/usaysad/article/786752.
37. Altunkol F. Üniversite öğrencilerinin bilişsel esneklikleri ile algılanan stres düzeyleri arasındaki ilişkinin incelenmesi [Master's thesis]. Adana: Çukurova Üniversitesi Sosyal Bilimler Enstitüsü; 2011.
38. Dağgeçen Başsu A. Öğretmenlerin bazı demografik özelliklerine göre bilişsel esneklik düzeyleri ile öğrencilerinin bilişsel esneklik düzeylerinin incelenmesi [Master's thesis]. Mersin: Çağ Üniversitesi Sosyal Bilimler Enstitüsü; 2016.
39. Xia H, Li T, Hou Y, Liu Z, Chen A. Age-related decline in cognitive flexibility and inadequate preparation: evidence from task-state network analysis. *Geroscience.* 2024;46(6):5939–53. doi: 10.1007/s11357-024-01135-x.
40. Gomes-Ng S, Wood JK, Cowie S. Cognitive flexibility predicts attitudes towards vaccination: evidence from a New Zealand sample. *BMC Psychol.* 2024;12(1):550. doi: 10.1186/s40359-024-02048-2.