

Moderating Effect of Education on the Impact of Vaccine Hesitancy on COVID-19 Vaccine Decision Regret

Haşim Çapar¹ , Ramazan Ayhan²

¹ Dicle University, Faculty of Economics and Administrative Sciences, Department of Health Management, Diyarbakır, Türkiye

² Dicle University, Institute of Social Sciences, Department of Health Management, Diyarbakır, Türkiye

ABSTRACT

Purpose: During the Covid-19 pandemic, herd immunity was accepted as an important strategy in the fight against the epidemic. However, vaccine decision regret emerged for various reasons. The aim of this research is to reveal the factors affecting vaccine decision regret in those who received the COVID-19 vaccine.

Methods: This research is a cross-sectional study conducted in Türkiye with 748 people who received at least three doses of Covid-19 vaccine. The study was conducted between 13.12.2024 and 3.3.2025 online with an analytical research model and a convenience sampling method was used. Demographic and health-related discrete variables and a decision regret scale were used as data collection tools. T-test, ANOVA and moderator effect analysis was performed with Jamovi.

Results: The findings show that demographic variables such as age, gender, marital status, education, employment status, and income level have significant effects on decision regret. It was found that education has a significant moderator role in the effect of vaccine hesitancy on vaccine regret.

Conclusion: It has been revealed that both demographic characteristics and attitudes towards Covid-19 affect vaccine decision regret at various levels, vaccine hesitancy increases vaccine regret, but this effect decreases with education.

Keywords: Vaccine, Decision Regret, Covid-19 Vaccine, Vaccine Regret, Education

ÖZET

Amaç: Covid-19 pandemisi sırasında, salgınla mücadelede sürü bağışıklığı önemli bir strateji olarak kabul edildi. Ancak, çeşitli nedenlerle aşı kararı pişmanlığı ortaya çıktı. Bu araştırmanın amacı, Covid-19 aşısı olan kişilerde aşı kararı pişmanlığını etkileyen faktörleri ortaya çıkarmaktır.

Yöntem: Bu araştırma, Türkiye’de en az üç doz Covid-19 aşısı olan 748 kişiyle yapılan kesitsel bir çalışmadır. Çalışma, 13.12.2024 ile 3.3.2025 tarihleri arasında çevrimiçi olarak, analitik araştırma modeli ve kolayda örnekleme yöntemi kullanılarak gerçekleştirilmiştir. Veri toplama araçları olarak demografik ve sağlıkla ilgili kesikli değişkenler ve karar pişmanlığı ölçeği kullanılmıştır. Jamovi ile T-testi, ANOVA ve moderatör etki analizi yapılmıştır.

Bulgular: Bulgular, yaş, cinsiyet, medeni durum, eğitim, istihdam durumu ve gelir düzeyi gibi demografik değişkenlerin karar pişmanlığı üzerinde önemli etkileri olduğunu göstermektedir. Eğitimin, aşı tereddüdünün aşı pişmanlığı üzerindeki etkisinde önemli bir moderatör rolü olduğu bulunmuştur.

Sonuç: Hem demografik özelliklerin hem de Covid-19’a yönelik tutumların aşı kararı pişmanlığını çeşitli düzeylerde etkilediği, aşı tereddüdünün aşı pişmanlığını artırdığı, ancak bu etkinin eğitim düzeyiyle azaldığı ortaya çıkmıştır.

Anahtar Kelimeler: Aşı, Karar Pişmanlığı, Covid-19 Aşısı, Aşı Pişmanlığı, Eğitim

Haşim ÇAPAR
0000-0001-7056-7879
Ramazan AYHAN
0009-0005-2215-3563

Correspondence: Haşim Çapar
Dicle University, Faculty of Economics and Administrative Sciences, Department of Health Management, Diyarbakır, Türkiye
Phone: +90 534 897 6081
E-mail: hasim.capar@dicle.edu.tr

Received: 01.01.2026

Accepted: 29.01.2026

Coronavirus is placing immense pressure on both local and global health systems, leading to a breakdown of existing healthcare infrastructure. This has made it imperative to implement personal protective health practices and mass vaccination programs in an accessible manner for all segments of the population to ensure individual survival (1). In times of crisis like Covid-19, the primary goal is to reduce mortality and morbidity rates. To achieve this goal, health policymakers are taking necessary actions to rapidly disseminate data-driven health messages, including accurate public information. However, this information dissemination has been complicated by an “information epidemic,” meaning an overload of information, including deliberate attempts to spread misinformation, stemming from the inherent uncertainty of the process and significantly shaping individuals’ attitudes towards vaccination. Vaccine regret regarding Covid-19 vaccines has emerged as a result of complex interactions between individuals’ experiences with side effects, social pressure, and the quality of health communication received during the crisis. Understanding the factors leading to Covid-19 vaccine regret is crucial for evidence-based health education practices, as it enables more resilient health communication strategies in future public health emergencies (2). Beyond the initial crisis management phase, several factors have been identified as reasons for vaccine decision regret among individuals who received the COVID-19 vaccine. International evidence-based medical data show that post-vaccination side effects (ranging from common mild symptoms like fever and fatigue to rare but serious complications like myocarditis or thrombosis) play a primary role in triggering the thought, “I wish I hadn’t been vaccinated.” (3). National studies in Türkiye also support this, showing that a significant proportion of healthcare workers and students experience regret, which is often linked to the physical experience of side effects or the perception that the risks of the vaccine were not fully transparent during administration. In addition to physiological consequences, social and psychological factors also significantly influence levels of regret. Many individuals reported feeling external pressure from workplace obligations, government restrictions, or social environments, which undermined their sense of autonomy in the decision-making process. This perceived lack of choice, combined with an “information epidemic” disseminating conflicting data about vaccine efficacy and long-term safety, intensifies the resulting uncertainty and emotional dissatisfaction. Furthermore, when vaccinated individuals later experience a severe case of Covid-19, the perception that the vaccine did not provide the expected protection often leads to high levels of decision regret.

Integrating these evidence-based factors is essential for understanding the complexity of health behaviors and developing more nuanced health education strategies that address both clinical realities and psychological needs (4).

At the peak of the Covid-19 health crisis, the primary goal of both health authorities and individuals rested on a single priority: survival. In such high-risk environments, the rapid implementation of health communication for health promotion purposes is essential to guide public behavior. However, this period was characterized by a massive “information epidemic,” a chaotic flow of information where data-driven health messages were often overshadowed by contradictory narratives and misinformation. In this context, vaccine hesitancy emerged not merely as a personal preference, but as a result of the struggle to access and process reliable, evidence-based data amidst the noise of the information epidemic. The most critical health promotion strategy in such crises is to ensure that individuals can access and internalize data-driven, evidence-based health messages. When this access is compromised, uncertainty prevails, leading to higher levels of vaccine hesitancy and, consequently, an increased risk of post-decision regret. Therefore, examining the role of education in this process is vital, as education represents one of the key determinants of an individual’s ability to filter misinformation and maintain trust in public health interventions (5).

Considering the course of the Covid-19, vaccines developed within the framework of different technologies and techniques have become an important turning point in terms of public health. Vaccines developed within the framework of platforms and technologies, especially mRNA technology, have played a major role in reducing the spread of infection, hospitalizations and mortality rates (6). Thanks to the widespread use of vaccines, steps have been taken to return to normal life in many countries, and the pressure on health systems has been relieved. However, as with every medical intervention, it has been observed that Covid-19 vaccines can cause short-term side effects (such as fever, fatigue, muscle pain) in some individuals, and very rarely, serious side effects have been reported (7). In light of all this data, evaluations made by scientific authorities have revealed that the benefits of vaccines far outweigh their risks, and in this context, herd immunity has been accepted as an important strategy in the fight against the Covid-19 pandemic, which is considered a global health problem. However, vaccine hesitancy and anti-vaccine sentiment have emerged due to vaccine hesitancy, incomplete information about the vaccine, misinformation,

insecurity, psychological factors and similar environmental factors (8). In particular, the use of vaccines has been at the center of global health policies during the Covid-19 pandemic, and scientific studies have shown that the developed vaccines have significant effects in reducing the spread of infection, reducing hospitalization rates and preventing deaths (9). Uncertainty and lack of information in decision-making processes regarding vaccination have led some individuals to experience decision regret (10). In individuals who were vaccinated, although rare, negative health experiences triggered the thought of "I wish I hadn't had it"; in individuals who chose not to be vaccinated, "I wish I had" regret was experienced after experiencing severe illness or losing loved ones (11). This situation shows that health-related decisions are shaped not only by rational information but also by emotional, cultural, and social factors. In this context, decision regret is considered as a psychological outcome of the internal evaluations that individuals experience after the decision (12).

The Covid-19 pandemic has profoundly affected global health systems, significantly changing the health behaviors of societies and the health-related decision-making processes of individuals, and in this process, the rapid development and implementation of Covid-19 vaccines played a critical role in controlling the pandemic (13). However, discussions on the effectiveness and safety of vaccines have affected individuals' decisions to get vaccinated and their emotional reactions to these decisions, and in particular, the existence of individuals who regret getting vaccinated stands out as an important issue in terms of health behaviors and public health policies. In this context, decisional regret, which is also the main focus of this study, is defined as the state in which individuals are dissatisfied with the results of their past decisions and wish they had made a different choice. In the field of health, especially in preventive interventions such as vaccination, decisional regret can affect individuals' future health behaviors and trust in health services. Therefore, understanding the reasons for and factors affecting decision regret regarding COVID-19 vaccines stands out as an important element in developing public health strategies. When considered from a general perspective, it is seen that there are many different factors affecting decision regret, and among these factors, risk perception, level of trust, social influence and trust in information sources stand out. The accuracy of the information obtained about the vaccine, how the information is accessed and the individual's past health experiences significantly determine the level of regret that occurs after the decision. In addition, media content, social discourses and the communication style of

health authorities also affect how the individual evaluates his/her decision. It has been stated in various studies that these factors interact with each other and that decision regret should be examined as a social phenomenon as well as an individual one (14).

In particular, studies have shown that side effects experienced after vaccination are an important factor in individuals experiencing decision regret. In a study conducted by Luo et al. (15) on healthcare workers in China, it was found that individuals who experienced side effects after vaccination regretted their vaccination decisions more and that this regret reduced their willingness to pay for a booster dose. Similarly, in another study conducted on nursing and midwifery students in Türkiye, it was determined that 96.3% of the participants were vaccinated against Covid-19, but 50% regretted getting vaccinated (16).

Previous literature has extensively documented factors contributing to Covid-19 vaccine hesitancy, such as concerns about side effects, distrust of authorities, and the impact of misinformation. Studies by Luo et al. (15) highlighted that post-vaccination regret is often linked to negative experiences and social pressure. However, much of the current research focuses on direct associations. This study stands out by exploring the regulatory role of education and offers a more nuanced perspective on how cognitive resources can mitigate emotional dissatisfaction stemming from complex health decisions during an "information epidemic."

In light of these challenges, vaccine hesitancy should be evaluated within the framework of an evidence-based approach to health education implementation. Rather than viewing hesitancy as a static stance, this approach addresses it as a dynamic health literacy problem influenced by the quality of accessible information and the individual's cognitive processing capacity. Understanding the impact of hesitancy on post-decision emotional states such as regret is crucial for designing effective health promotion strategies. The aim of this research is not to validate vaccine hesitancy, but to analyze it as a significant psychological antecedent of decision regret in a high-pressure public health context. By exploring the regulatory role of education, this study aims to demonstrate how evidence-based health education can empower individuals to navigate more effectively in an "information epidemic," thereby reducing the intensity of regret. Consequently, the hypothesis is based on a health management perspective that prioritizes data-driven communication and long-term health behavior

sustainability. Through this design, the study aims to provide health authorities with insights into how to implement proactive health education that demonstrates a protective effect against emotional dissatisfaction stemming from complex medical decisions.

Material and Methods

Research Type and Model

Since the research was conducted in a certain period of time, it is a cross-sectional type, which is one of the analytical research types. This research was designed as a causal comparative model since it reveals the causal relationship between variables.

Study Setting and Time

This cross-sectional study was conducted with online survey in Türkiye between December 13, 2024 and March 3, 2025 with individuals who voluntarily accepted to participate in the study.

Study Population, Sampling and Sample Size

The sample group for this study consists of 28,237,424 people in Türkiye who have received at least three doses of the Covid-19 vaccine, according to statistics provided by the Covid-19 Vaccine Information Platform of the Ministry of Health of the Republic of Türkiye (17). Considering the difficulty of reaching the entire population of the study and the cost it will create, a sample selection method was used in this study. In this context, the study was conducted with 748 people who accepted to participate in the study online using the convenience sampling method. Data were collected from seven different regions of Türkiye to ensure the necessary participant heterogeneity in the study.

The sample size for this study was determined using a power analysis to ensure sufficient statistical significance and to minimize Type II errors. Given the analytical nature of the research and the use of moderator effect analysis, the minimum required sample size was calculated based on a medium effect size ($f^2 = 0.15$), a significance level (α) of 0.05, and a power ($1-\beta$) of 0.95. The calculation indicated that a minimum of 600 participants was necessary; however, the study reached a total of 748 participants to further empower the statistical significance of the results and to account for potential data quality variations in online surveys. This sample size provides a robust basis for conducting complex analyses, such as the moderating role of education, with high confidence levels. All statistical

procedures, including the moderator effect and simple slope estimations, were performed using Jamovi Version 2.4. This software, powered by the R ecosystem, was specifically chosen for its precision in handling advanced mediation and moderation models, thereby ensuring the mathematical integrity of the findings (18,19).

Measurement Tools and Measurement Procedures

In this study, a survey form was used as a data collection tool. The survey form consisted of demographic information questions, health status and vaccine attitudes questions, and the Covid-19 decision regret scale.

Demographic information questions: These questions created by the researchers included age, gender, marital status, employment, education and income.

Health status and vaccine attitudes questions: These questions created by the researchers included getting a required vaccination, vaccine hesitancy, chronic disease, getting Covid-19, Covid-19 vaccine type, reason for vaccination, vaccine adverse effect belief, how the vaccine affects life and loss of life due to Covid-19 (20).

Decision regret scale: The Decision Regret Scale (DRS) is a self-report scale developed to measure the level of regret experienced by individuals after receiving healthcare services. The scale was developed in Canada by Brehaut et al (21) and is frequently used to measure regret after decisions regarding healthcare services. The Turkish adaptation and validity-reliability study was conducted by Telatar et al. (22) and the Turkish version of the scale was accepted as a valid and reliable tool in assessing regret after healthcare services. The DRS is a short scale consisting of a single factor and five items. Each item is answered with a 5-point Likert-type scale; It is scored between 1 = "strongly agree" and 5 = "strongly disagree". Since the second and fourth items contain negative expressions, these items are reverse coded; then the following formula is used for all item scores: $(\text{Answer} - 1) \times 25$ is calculated for each item, and the average is obtained by taking the sum of the five items. The scores obtained vary between 0 and 100; low scores indicate low regret levels, and high scores indicate high regret levels. In the validity study conducted with the Turkish form of the scale, it was determined that the model fit indices ($\chi^2/df = 1.3$, RMSEA = 0.069, GFI = 0.943) regarding the confirmatory factor analysis were at a sufficient level. The Cronbach alpha coefficient for the internal consistency of the scale was found to be 0.868; and the test-retest correlation was at a very high level of 0.945.

Statistical Analysis

For statistical analyses, t-test, ANOVA and moderator effect analysis were conducted. Frequency and percentage values were reported for discrete variables of the study, mean and standard deviation for descriptive findings, and estimate and standard error values for moderator effect (23). A 5% margin of error was accepted for these analyses. For the assumption of normality, skewness and kurtosis values for the variables were reported, and values between -1.5 and 1.5 were considered normal (24). Analyses were performed with Jamovi Version 2.4 (18,19).

Ethic Statement

The ethics committee approval required for this study was received from Dicle University Social and Human Sciences Ethics Committee with approval number 802036 dated 30.10.2024. An informed consent form written in Turkish was distributed to the participants to sign. Participants in this study were 18 years of age and older. Therefore, informed and signed consent forms were collected from study participants. All processes in this study were conducted in accordance with the Declaration of Helsinki, and all necessary precautions were taken to prevent any potential ethical violations.

Results

When the descriptive results of the decision regret scale and the findings of the normality assumptions regarding the normality assumption are examined, it is seen that the average decision regret score of the participants regarding Covid-19 vaccines is 73.33 ± 14.22 and this variable varies between the minimum 30 and maximum 100 values. The skewness value reported for normality was -0.24 and the kurtosis value was -0.25. The skewness and kurtosis values between -1.5 and +1.5 indicate that the data are normally distributed and parametric tests can be applied (25).

It was determined that the majority of the participants were 36 and over, female, single, employed, high school graduates, and had more income than expenses. It was reported that the majority of the participants had received the necessary vaccinations, did not have vaccine hesitancy, did not have a chronic disease, had Covid-19, had the BioNTech-Pfizer vaccine, were vaccinated to protect themselves from the disease, believed that Covid-19 vaccines had side effects, that the vaccines had a positive effect on their lives, and did not experience any losses due to Covid-19 (Table 1).

Table 1. Participant Demographic, Health Status and Attitudes Towards Vaccination Results		
Factors	N	%
Age		
18-25	181	24
26-35	176	23
36-45	177	24
46 and above	214	29
Gender		
Female	393	53
Male	355	47
Marital Status		
Single	442	59
Married	306	41
Employment		
Working	486	65
Not Working	262	35
Education		
Primary and Secondary School	149	20
High School	296	40
Undergraduate and Associate Degree	227	30
Postgraduate	76	10
Income		
Income is more than expenses	385	52
Income and expenses are equal	205	27
Income is less than expenses	158	21
Getting a required vaccination		
Yes	502	67
No	246	33
Vaccine Hesitancy		
Yes	550	74
No	198	27
Chronic Disease		
Yes	95	13
No	653	87
Getting Covid-19		
Yes, positive test	359	48
No	223	30
I don't know, I haven't been tested	166	22
Reason for vaccination		
Avoiding disease	312	42
Protecting loved ones	218	29
Getting rid of peer pressure	152	20
Other	66	9
Vaccine Adverse Effect Belief		
Yes	488	65
No	260	35
How the Vaccine Affects Life		
Positive	334	45
Negative	216	29
Neutral	198	27
Loss of due to Covid-19		
Yes	104	14
No	644	86

The t-test and ANOVA results showed that demographic variables such as age, gender, marital status, education, employment and income created a significant difference in Covid-19 vaccine decision regret ($p < 0.05$). In addition, it was determined that health-related variables such as vaccine hesitancy, anti-vaccine, loss due to Covid-19,

chronic disease, and the reason for vaccination significantly differentiated the Covid-19 vaccine decision regret ($p < 0.05$). On the other hand, variables such as having a necessary vaccine and belief that the vaccine will have side effects did not lead to a significant difference ($p > 0.05$) (Table 2).

Table 2. T-Test and ANOVA Analysis Results

Variables		Mean	Sd	t/F	p	Differences
Gender	Female	62.6	9.48	35.8	<.001***	
	Male	85.2	7.59			
Employment	Working	65.4	10.3	32.4	<.001***	
	Not Working	88.1	6.60			
Marital Status	Single	64.0	9.75	35.4	<.001***	
	Married	86.9	6.88			
Getting a required vaccination	Yes	73.5	14.3	0.41	0.680	
	No	73.0	14.1			
Vaccine Hesitancy	Yes	90.7	5.50	29.5	<.001***	
	No	67.1	10.8			
Chronic Disease	Yes	76.9	13.7	2.66	<.001***	
	No	72.8	14.2			
Income	My income is higher than my expenses	62.3	9.40	1099	<.001***	(1)<(2) (3)
	My income is equal to my expenses	79.5	3.55			
	My income is lower than my expenses	92.2	5.24			
Anti Vaccine	Yes	92.4	5.16	25.3	<.001***	
	No	68.4	11.4			
Vaccine Adverse Effect Belief	Yes	73.3	13.8	0.02	0.881	
	No	73.4	15.0			
Loss of due to Covid-19	Yes	49.7	6.68	24.5	<.001***	
	No	77.2	11.1			
Age	18-25	54.6	7.73			
	26-35	68.3	3.01	1210	<.001***	(1)<(2) (3) (4)
	36-45	77.4	2.51			
	46 and above	90.0	5.93			
Education	Primary and Secondary School	52.8	7.31			
	High School	69.7	4.56	1680	<.001***	(1)<(2) (3) (4)
	Undergraduate and Associate Degree	83.8	4.07			
	Postgraduate	96.5	3.74			
Reason for vaccination	Avoiding disease	59.9	8.74			
	Protecting loved ones	74.4	2.79	16.10	<.001***	(1)<(2) (3) (4)
	Getting rid of peer pressure	84.5	4.05			
	Other	97.5	2.94			

Note: * $p < .05$, ** $p < .01$, *** $p < .001$; t= Independent Sample t-test, F=One-Way ANOVA, Sd=Standard Deviation

Table 3 shows the effect of Covid-19 vaccine hesitancy on Covid-19 vaccine decision regret and the moderator effect of education on this effect. When Table 3 is examined, it shows that Covid-19 vaccine hesitancy has a strong and statistically significant positive effect on Covid-19 vaccine

decision regret and that education has a moderator role in this effect. In fact, it is seen that the effect of vaccine hesitancy on vaccine decision regret decreases as the level of education increases.

Table 3. Moderating Role of Education in the Effect of Vaccine Hesitancy on Vaccine Regret Estimates Results						
	Estimate	SE	95% Confidence Interval		Z	p
			Lower	Upper		
Vaccine Hesitancy	8.10	0.519	7.09	9.16	15.61	<.001
Education	12.70	0.288	12.13	13.26	44.05	<.001
Vaccine Hesitancy * Education	-4.46	0.597	-5.68	-3.30	-7.46	<.001

Table 4 and Figure 1 show the simple slope parameter results of the moderator analysis. Accordingly, it is seen that vaccine hesitancy affects vaccine decision regret at a

low level at high education levels, and vaccine hesitancy affects vaccine decision regret at a high level at low education levels.

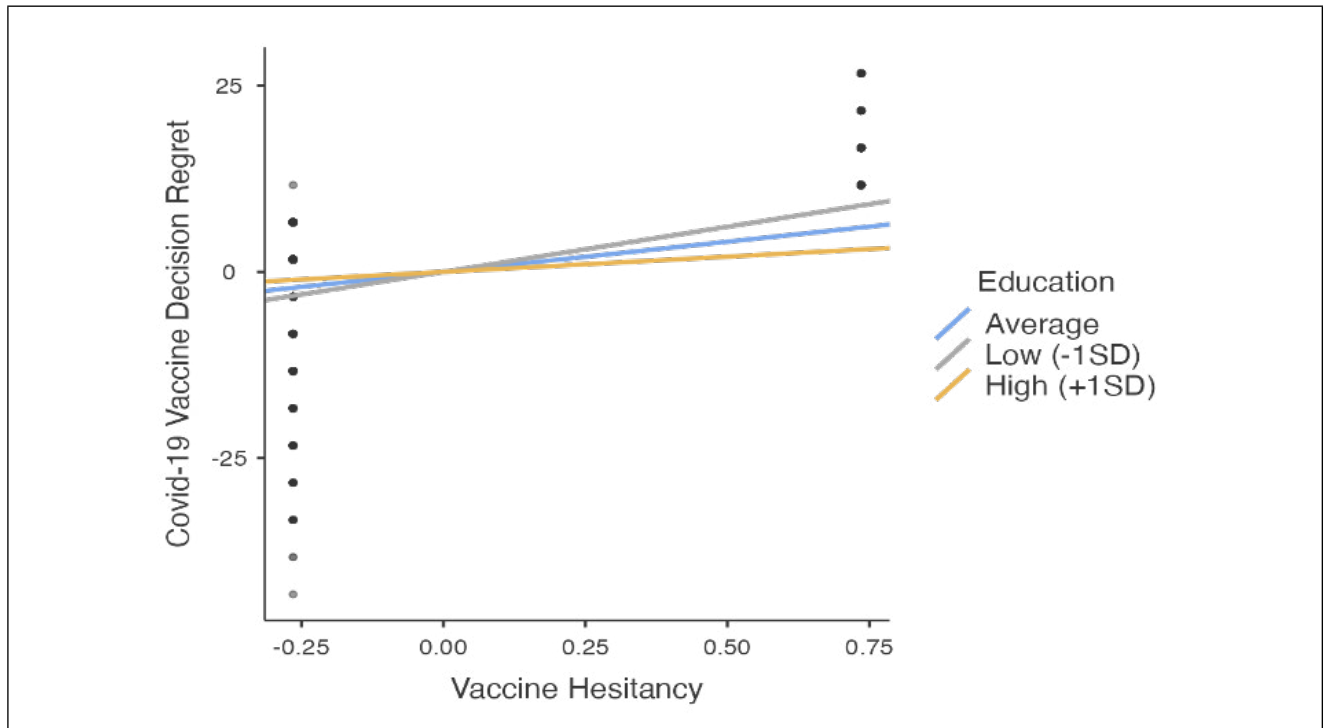


Figure 1: Simple Slope Plot of Moderating Role of Education in the Effect of Vaccine Hesitancy on Vaccine Regret

Table 4. Simple Slope Estimation Results						
	Estimate	SE	95% Confidence Interval		Z	p
			Lower	Upper		
Average	8.10	0.532	7.05	9.16	15.24	<.001
Low (-1SD)	12.13	0.995	10.15	14.16	12.18	<.001
High (+1SD)	4.08	0.418	3.23	4.89	9.78	<.001

Note: Shows the effect of the predictor (Vaccine Hesitancy) on the dependent variable (Covid-19 Vaccine Decision Regret) at different levels of the moderator (Education)

Discussion

This study was conducted to evaluate the complex relationship between vaccine hesitancy and decision regret during the Covid-19 pandemic, with a specific focus on the moderating role of education. In a global health crisis where survival was the primary objective, understanding the psychological outcomes of mass vaccination programs is essential for developing resilient health promotion strategies. Within an environment frequently disrupted by an 'infodemic,' this research aims to provide an evidence-based perspective on how individual cognitive resources, represented by education levels, can mitigate the emotional burden of high-stakes medical decisions.

The current study aimed to reveal the determinants of regret in those who received Covid-19 vaccination and to investigate the moderating role of education in the effect of vaccine hesitancy on vaccine decision regret. The results showed that vaccine decision regret is affected by many different factors, and in particular, education has a moderating effect on the effect of vaccine hesitancy on vaccine decision regret, and this effect is statistically significant.

The results of the study in terms of education level reveal that as the participants' level of education increases, their decision regret levels decrease significantly. It was observed that the decision regret levels of individuals with postgraduate education were significantly lower than those with other levels of education. This finding is both consistent and different from the existing studies in the literature in terms of understanding the relationship between education level and decision regret. Some studies in the literature state that as the level of education increases, individuals have access to more information, and therefore tend to evaluate more alternatives in the decision process and experience higher levels of regret (9). This situation may be due to the habits of individuals with a high level of education to evaluate their decisions in a multifaceted and detailed manner. It is also stated that individuals with a high level of education generally have higher expectations and that regret increases when the decisions taken do not meet these high expectations. On the other hand, some studies suggest that individuals with higher levels of education generally have a greater sense of self-efficacy in decision-making processes, which may have a decreasing effect on regret levels. Income level significantly differentiates decision regret. According

to the findings, it is seen that as income level decreases, decision regret level increases significantly. When this finding is examined in the literature, it is emphasized that individuals who are economically disadvantaged generally experience higher levels of stress and uncertainty in decision-making processes. Limited economic resources increase the perception of risk regarding the outcomes of decisions and as a result, it may cause the feeling of regret to intensify. In addition, the fact that individuals with lower income levels have more limited access to sufficient information during decision-making may increase the uncertainty regarding the outcomes of their decisions and thus increase decision regret levels. In contrast, it is stated that individuals with higher income levels can make more flexible and comfortable decisions because they have a larger resource pool, and therefore their anxiety and regret levels regarding the consequences of their decisions are lower (26). This situation forms the basis of the negative relationship between income level and decision regret and is consistent with the results of the current study. When the findings are examined specifically in terms of Covid-19, low-income groups experienced the greatest negative impact during the Covid-19 period, both economically and socially, and this situation negatively affected decision regret (6).

Individuals with Covid-19 vaccine hesitancy were found to have a high probability of experiencing Covid-19 vaccine decision regret. However, it was observed that this probability decreased when interacted with education. This decrease in the effect of vaccine hesitancy on vaccine decision regret shows that education is an important moderator in this effect. This finding can be said that education is an important phenomenon in reducing vaccine decision regret and the effect of vaccine hesitancy. In fact, a study suggests that Covid-19 vaccine decision regret is a common situation experienced after Covid-19 vaccination and that this situation is caused by a complex structure such as various demographics, vaccine attitudes and vaccine hesitancy (27). In the context of the current finding and the findings supporting it, it can be stated that education has a moderating effect on the effect of vaccine hesitancy on vaccine regret, that education provides individuals with the ability to cope with vaccine hesitancy, and that it enables individuals to conduct more comprehensive information research before vaccination, to benefit from different sources in a critical sense, thus facilitating the management of complex emotions, and therefore acting as a buffer in reducing the severity of decision regret (28).

The moderating effect of education on the effect of vaccine derivatives on vaccine decision regret suggests that health policies and interventions to be put forward for vaccine decision regret should include strategies that not only address the lack of information but also help individuals manage the emotions and attitudes that affect vaccine decision regret. For example, clearly stating post-vaccination expectations and possible mild side effects may allow individuals to evaluate their painful experiences in a more realistic framework (29).

To our knowledge, this is the first study to investigate the moderating effect of education on the effect of vaccine hesitancy on vaccine decision regret. In particular, the fact that data were collected from participants from seven regions of Türkiye with different income levels reveals that the results can be generalized to a heterogeneous population. The fact that the data were collected with an online survey form and that this survey collected data based on individual statements may not have been as objective as desired. However, the use of a control variable in the survey reduced this bias. It is recommended that similar studies be conducted on different populations on the subject and that the results of these studies be reported.

Our findings demonstrate that higher levels of education significantly reduce the positive impact of vaccine hesitancy on decision regret; this aligns with self-efficacy theories found in the general decision-making literature. This result differs from studies suggesting that higher education leads to more questioning and potential regret (30). In our context, education likely facilitated access to data-driven health messages and allowed individuals to contextualize side effects within a "survival" framework. This interpretation suggests that education served as a protective shield against the negative psychological consequences of the COVID-19 information epidemic.

One of the most important limitations of this study is that the research group's health literacy was not directly assessed from their own perspective. In a health crisis, the ability to access evidence-based medicine and translate this knowledge into intuitive behavioral change is essential. Although education level was used as a proxy for cognitive resources, the lack of a specific health literacy scale prevents a deeper understanding of how participants navigated the "infodemic". Literature suggests that health literacy is a critical determinant of vaccine acceptance, and its absence in the measurement

model may limit the interpretation of how information was utilized for decision-making.

Another limitation concerns the professional background of the participants. While the study included a diverse group of employed and unemployed individuals, a detailed sector-based grouping—specifically identifying those working in the healthcare sector—was not performed. Healthcare workers often have higher exposure to clinical data and different risk perceptions compared to other sectors, which could significantly influence decision regret. Future studies should incorporate both specific health literacy assessments and sector-specific analyses to provide a more descriptive and nuanced understanding of health-related behavioral changes during global crises.

Conclusion

These results show that getting vaccinated against Covid-19 is not only a decision about individual health; it is also a process that involves strong emotional and cognitive evaluations and education. A good understanding of the variables that affect this process is of great importance both in terms of public health practices and in developing effective communication strategies in crisis periods. In order to reduce decisional regret, developing special communication and information approaches for different segments of society will contribute to individuals managing their decision-making processes in a healthier way. The findings of the study show that decisional regret is not only an individual experience for individuals; it also reflects a collective emotional process affected by the social, economic and health contexts in which they are located. Therefore, approaches to preventing decisional regret should be based not only on the level of individual awareness, but also on information transparency, reliable health communication and supportive policy environments for the general public.

Based on the findings, the following concrete recommendations have been made:

Health policymakers and decision-makers should design and implement data-driven communication strategies and training programs using appropriate methods, particularly targeting groups with low levels of education, to reduce uncertainty and future regrets.

Health policymakers and decision-makers should prioritize improving health literacy to ensure long-term health promotion, enabling citizens to make effective decisions in an environment of misinformation and assisting them in their decision-making.

It is recommended that health policy-making authorities provide transparent information about the potential side effects of vaccines to manage individuals' expectations and reduce post-vaccination emotional dissatisfaction.

Declarations

Conflict of Interest

The authors have declared no conflicts of interest or financial support.

Funding

This study was conducted without any external funding.

Ethics Approval

The ethics committee approval required for this study was received from Dicle University Social and Human Sciences Ethics Committee with approval number 802036 dated 30.10.2024. An informed consent form written in Turkish was distributed to the participants to sign. Participants in this study were 18 years of age and older. Therefore, informed and signed consent forms were collected from study participants. All processes in this study were conducted in accordance with the Declaration of Helsinki, and all necessary precautions were taken to prevent any potential ethical violations.

Availability of Data and Material

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

Author's Contributions

All tasks related to the study, such as study design, data collection, data analysis, study supervision, manuscript writing, critical revisions for important intellectual content, were performed by HÇ and RA.

Acknowledgments

This study was produced from the master's thesis titled "Decision Regret and Influencing Factors Regarding Covid-19 Vaccines" written by Ramazan AYHAN under the supervision of Assoc. Prof. Dr. Haşim ÇAPAR and accepted in the Health Management Master's Program of Dicle University, Institute of Social Sciences.

References

1. Alilio M, Hariharan N, Lugten E, Garrison K, Bright R, Owembabazi W, et al. Strategies to Promote Health System Strengthening and Global Health Security at the Subnational Level in a World Changed by COVID-19. *Glob Health Sci Pract* [Internet]. 2022 Apr 28 [cited 2026 Jan 23];10(2):e2100478. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC9053150/>
2. Palmer A, Gorman S. Misinformation, trust, and health: The case for information environment as a major independent social determinant of health. *Soc Sci Med* [Internet]. 2025 Sept 1 [cited 2026 Jan 23];381:118272. Available from: <https://www.sciencedirect.com/science/article/pii/S0277953625006033>
3. Altman JD, Miner DS, Lee AA, Asay AE, Nielson BU, Rose AM, et al. Factors Affecting Vaccine Attitudes Influenced by the COVID-19 Pandemic. *Vaccines* [Internet]. 2023 Feb 23 [cited 2026 Jan 23];11(3):516. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC10057947/>
4. Azizoğlu F, Terzi B, Topçu Tarakçı N. The attitudes of healthcare professionals in Turkey toward the coronavirus vaccine. *Int Nurs Rev*. 2022 Dec;69(4):566–74.
5. Porat T, Nyrup R, Calvo RA, Paudyal P, Ford E. Public Health and Risk Communication During COVID-19-Enhancing Psychological Needs to Promote Sustainable Behavior Change. *Front Public Health*. 2020;8:573397.
6. Alper S, Bayrak F, Yilmaz O. Psychological correlates of COVID-19 conspiracy beliefs and preventive measures: Evidence from Turkey. *Curr Psychol*. 2021;40(11):5708–17.
7. Benham JL, Atabati O, Oxoby RJ, Murali M, Shaffer B, Sheikh H, et al. COVID-19 Vaccine-Related Attitudes and Beliefs in Canada: National Cross-sectional Survey and Cluster Analysis. *JMIR Public Health Surveill*. 2021 Dec 23;7(12):e30424.
8. Kalil I, Silveira SC, Pinheiro W, Kalil Á, Pereira JV, Azarias W, et al. Politics of fear in Brazil: Far-right conspiracy theories on COVID-19. *Glob Discourse* [Internet]. 2021 May 1 [cited 2026 Jan 23];11(3):409–25. Available from: <https://bristoluniversitypressdigital.com/view/journals/gd/11/3/article-p409.xml>
9. Eren H. The Relationship Between COVID-19 Awareness and Vaccine Hesitancy among University Students. *J Basic Clin Health Sci* [Internet]. 2022 May 31 [cited 2026 Jan 23];6(2):550–9. Available from: <https://dergipark.org.tr/en/pub/jbachs/article/1066123>
10. Paakkari L, Okan O. COVID-19: health literacy is an underestimated problem. *Lancet Public Health* [Internet]. 2020 May 1 [cited 2026 Jan 23];5(5):e249–50. Available from: <https://www.thelancet.com/journals/lanpub/article/PIIS2468-26672030086-4/fulltext>
11. Durmuş A, Akbolat M, Amarat M. COVID-19 Aşı Okuryazarlığı Ölçeği'nin Türkçe geçerlilik ve güvenilirliği. *Cukurova Med J* [Internet]. 2021 June 30 [cited 2026 Jan 23];46(2):732–41. Available from: <http://dergipark.org.tr/doi/10.17826/cumj.870432>

12. Budiyantri RT, Ganggi RIP, Murni M. Barrier Factors Related to COVID-19 Vaccine Literacy in Developing Countries: A Traditional Literature Review. E3S Web Conf [Internet]. 2021 [cited 2026 Jan 23];317:03018. Available from: https://www.e3s-conferences.org/articles/e3sconf/abs/2021/93/e3sconf_icenis2021_03018/e3sconf_icenis2021_03018.html
13. World Health Organization. Vaccines and immunization [Internet]. 2023 [cited 2026 Jan 23]. Available from: <https://www.who.int/health-topics/vaccines-and-immunization>
14. Keaveney SM, Huber F, Herrmann A. A model of buyer regret: Selected prepurchase and postpurchase antecedents with consequences for the brand and the channel. J Bus Res [Internet]. 2007 Dec 1 [cited 2026 Jan 23];60(12):1207–15. Available from: <https://www.sciencedirect.com/science/article/pii/S0148296307001282>
15. Luo C, Jiang W, Chen HX, Tung TH. Post-vaccination adverse reactions, decision regret, and willingness to pay for the booster dose of COVID-19 vaccine among healthcare workers: A mediation analysis. Hum Vaccines Immunother. 2022 Nov 30;18(6):2146964.
16. Çapar H, Çınar F. Vaccine Hesitancy Scale in Pandemics: Turkish Validity and Reliability Study. Gevher Nesibe J IESDR [Internet]. 2021 May 25 [cited 2026 Jan 23];6(12):40–5. Available from: <https://gevhernesibedergisi.com/index.php/gnj/article/view/106>
17. Türkiye Cumhuriyeti Sağlık Bakanlığı. Covid-19 Aşısı Bilgilendirme Platformu [Internet]. 2026. Available from: <https://covid19asi.saglik.gov.tr/>.
18. R Core Team. R: A Language and environment for statistical computing. [Internet]. 2022. Available from: <https://cran.r-project.org>.
19. The Jamovi Project. jamovi [Internet]. 2023. Available from: <https://www.jamovi.org>.
20. Larson HJ, Jarrett C, Eckersberger E, Smith DMD, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007-2012. Vaccine. 2014 Apr 17;32(19):2150–9.
21. Brehaut JC, O'Connor AM, Wood TJ, Hack TF, Siminoff L, Gordon E, et al. Validation of a decision regret scale. Med Decis Mak Int J Soc Med Decis Mak. 2003;23(4):281–92.
22. Telatar TG, Ozel CS, Turgut A, Kınlı Ö. Turkish version methodological validation study of the Decision Regret Scale. Ethiop J Health Dev [Internet]. 2021 Nov 25 [cited 2026 Jan 23];35(4). Available from: <https://ejhd.org/index.php/ejhd/article/view/5313>
23. Galluci M. jAMM: jamovi Advanced Mediation Models. [jamovi module]. [Internet]. 2020. Available from: <https://jamovi-amm.github.io/>.
24. Adawi M, Bragazzi NL, Argumosa-Villar L, Boada-Grau J, Vigil-Colet A, Yildirim C, et al. Translation and Validation of the Nomophobia Questionnaire in the Italian Language: Exploratory Factor Analysis. JMIR MHealth UHealth. 2018 Jan 22;6(1):e24.
25. Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate data analysis. 7th ed. Pearson; 2009.
26. Diener E, Biswas-Diener R. Will Money Increase Subjective Well-Being?: A Literature Review and Guide to Needed Research. Soc Indic Res [Internet]. 2002 [cited 2026 Jan 23];57(2):119–69. Available from: <https://www.jstor.org/stable/27526987>
27. Tayhan A, Bozhan Tayhan E, Şahin Büyük D. Nursing and Midwifery Students' COVID-19 Vaccine Regrets and Future Vaccination Intentions: A Mixed Methods Study. Nurs Health Sci. 2025 Mar;27(1):e70039.
28. Göl İ, Açıkgöz S. Does Health Literacy Affect Vaccine Hesitation? Turk J Fam Med Prim Care [Internet]. 2025 Mar 7 [cited 2026 Jan 23];19(1):23–31. Available from: <https://dergipark.org.tr/en/pub/tjfmprc/article/1474170>
29. Wong JC, Yang JZ. Misinformation, Anticipated Regret, and Vaccine-Related Behaviors. J Health Commun. 2022 Sept 2;27(9):644–53.
30. Brera A, Arrigoni C, Belloni S, Conte G, Magon A, Arcidiacono MA, et al. Decision Regret and Vaccine Hesitancy among Nursing Students and Registered Nurses in Italy: Insights from Structural Equation Modeling. Vaccines. 2024 Sept 14;12:1054.