



Investigation of personal variables, technology usage, vaccine-related variables, social media-specific epistemological beliefs, media literacy, social impact strategies variables affecting vaccine hesitancy beliefs in the Covid-19 pandemic

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Received: 13 December 2022 / Accepted: 24 February 2023 / Published online: 14 March 2023
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Abstract

Aim In this study, personal variables, technology use cases, vaccine-related variables, social media-specific epistemological beliefs, media literacy, and social influence strategies were examined as predictors of Covid-19 vaccination hesitancy (VH) beliefs.

Subject and methods The prediction design research model is used to detect the predictors of the dependent variable. The study group consists of 378 participants. Five different scales were used together with the self-description form as a data collection tool.

Results According to the results of the research, individuals who have positive perceptions about the safety of Covid-19 vaccines and who have received the Covid-19 vaccine have lower anti-vaccine beliefs. It is another situation that prevents the opposition to vaccination of those who research the source of information on social media. As a result, age, education and income level, social media usage experience, media literacy, and social influence strategies were not effective on the participants' anti-vaccine beliefs.

Conclusion According to the findings of the study, positive perceptions about the safety of Covid-19 vaccines, being vaccinated against Covid-19, and researching a source of information on social media variables seem to be effective in laying the foundations for constructive interventions such as using anti-vaccine beliefs to guide, reduce or eliminate negative beliefs about vaccines.

Keywords Vaccine hesitancy · Personal variables · Technology use cases · Vaccine-related variables · Social media-specific epistemological beliefs · Social impact strategies

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Introduction

Vaccine hesitancy (VH) is a term that expresses reluctance or refusal to accept vaccination services despite the availability of vaccination services (MacDonald and Sage Working Group on Vaccine Hesitancy 2015). VH has ancient roots, but its importance in the context of combating COVID-19 has become evident. Salali and Uysal (2022) stated that developing an effective vaccine during the COVID-19 process is not sufficient to prevent the epidemic, and that enough people should be vaccinated for widespread immunity. The importance of COVID-19 VH is better understood when considering the intensity of conspiracy theories spreading in many environments related to COVID-19. VH negatively affects the individual and the whole society due to the need for high coverage to ensure herd immunity (Padhi and Almohaithef 2020). Therefore, it seems critical to investigate the influencing factors related to the acceptance of the COVID-19 vaccine.

VH is multidimensional and varies according to individual characteristics, perceptions of the perceived efficacy or benefits of vaccines, the context in which information was obtained, and the ability to differentiate misinformation and misperceptions from various digital technologies such as social media with adequate literacy skills (Dib et al. 2022; Saied et al. 2021; Rosenthal and Cummings 2021; Schiavo 2020; Su et al. 2021). To also be prepared for future pandemics, increasing the acceptance of new vaccines and understanding the context influencing adoption is critical. In order to correctly understand the factors affecting VH in the context of COVID-19, the effect on VH of personal variables, technology use cases, vaccine-related variables, social media-specific epistemological beliefs, media literacy, and social impact strategies were examined.

Conceptual framework

Theoretical framework

Recent research draws on some behavioral theories to explain COVID-19 VH behavior and develop appropriate intervention methods against VH (e.g., AlSaeed and Rabbani 2021; Hohmeier et al. 2021; Martinelli and Veltri 2021; Xiao and Wong. 2020). Prominent theories are the theory of planned behavior (TPB), theory of reasoned Action (TRA) (Fishbein and Ajzen 2011), health belief model (HBM) (Becker 1974), and social cognitive theory (SCT) (Bandura 1986, 1989). This research adopted SCT to comprehensively address the components that cause VH.

According to SCT, human behavior can be explained by the triple and reciprocal causality of personal factors, behavior, and environment (Bandura 1986, 1989). According to Bandura, human behavior is influenced by both personal and environmental factors. In addition, SCT emphasized that cognitions, defined as interpreting events, shape people's behavior (Bandura 1986, 2001). In this context, VH behavior is also affected by several environmental factors, both individual and external (AlSaeed and Rabbani 2021). Personal factors affecting VH discussed in the literature are as follows: demographic variables such as age, gender, education level, income level, and ethnicity (Allington et al. 2021), fear of injections, religious beliefs (Pugliese-Garcia et al. 2021), conspiracy beliefs (Allington et al. 2021; Jennings et al. 2021), lower perceived severity of COVID-19 (Schwarzingler et al. 2021), and not believing in the efficacy and safety of vaccines (MacDonald and Sage Working Group on Vaccine Hesitancy 2015). Social–environmental factors affecting VH are the use of social media (Jennings et al. 2021; Reno et al. 2021), institutional websites (Reno et al. 2021), educational messages, and effective interventions to improve vaccination uptake (Li et al. 2021), distrust of health services and health professionals, and policymakers who decide on necessary vaccines (Allington et al. 2021; MacDonald and Sage Working Group on Vaccine Hesitancy 2015).

In the end, considering the studies in the literature and SCT, in this study, personal factors determining VH beliefs were demographic variables (age, income level, education level), and vaccine-related variables (Covid-19 vaccination status, perception of Covid-19 vaccine reliability), while environmental factors are defined as technology usage status (social media usage experience, technology usage competence), social media-specific epistemological beliefs (source of knowledge, justification for knowing), media literacy, and social influence strategies.

Vaccine hesitancy beliefs

VH is defined as the delay in acceptance or rejection of the vaccine due to hesitancy to be vaccinated despite the availability of vaccination services and access to vaccines (MacDonald and Sage Working Group on VH 2015; Wiysonge et al. 2021). Individual views on vaccination ranges from complete acceptance to complete rejection, and vaccine-hesitant people fall somewhere in the middle of this range. In this respect, individuals who are hesitant about vaccination may accept some vaccines, but reject, delay, or doubt others (Dubé et al. 2015). However, people who are totally against the vaccine are known as “anti-vax” or “anti-vaxxers”; not all vaccine-hesitant people are “anti-vaccine” (Fisayo 2021).

Vaccination, which is accepted as one of the most successful public health interventions in the prevention of communicable diseases (Andre et al. 2008), is seen as one of

the most effective strategies to control the pandemic during the COVID-19 pandemic (Harapan et al. 2020). However, VH is a major source of risk both for those who delay or refuse vaccination and for wider society (Wysonge et al. 2021). Moreover, VH hinders campaigns to control COVID-19 (Allington et al. 2021) and poses a major threat to global health.

VH is a complex and context-specific problem (varying with time, place, and vaccines) (MacDonald & Sage Working Group on VH 2015). The extensive literature on the subject tries to identify the factors affecting VH. Dubé et al. (2015) identified factors influencing VH based on the available literature as contextual factors (communication and media, social norms, etc.), organizational factors (factors related to the accessibility and quality of vaccination services), and individual factors (attitudes and beliefs, sociodemographic characteristics, etc.). Similarly, Alamoodi et al. (2021) grouped the reasons for VH into three main areas based on the academic literature: (1) vaccine-related reasons, (2) reasons related to the health system, and (3) reasons arising from the social characteristics of the individual. In conclusion, the causes of VH are multidimensional and based on complex decision-making processes.

The role of personal variables in anti-vaccine beliefs

Anti-vaccination is not a new phenomenon; it has been seen in many pandemics in past years (Hussain et al. 2018). Even if anti-vaccine information or rumors have little persuasion, they can trigger anti-vaccine opposition by affecting a large part of the population (Curiel and Ramirez 2021). The anti-vaccine movement could further prolong the Covid-19 pandemic and increase health, economic, and social inequalities (Ransing et al. 2021). Megget (2020) indicated that anti-vaccination is spreading faster than the Covid-19 outbreak. Anti-vaccination develops and can be done depending on many factors. Economic difficulties and suspicious and harsh measures of governments are effective in the development of anti-vaccination (Megget 2020). According to a study, having a low income, not getting the flu vaccine in the past years, not trusting the Covid-19-related practices of the administrators in the country where they live, having a female gender, and living with children are effective against vaccination (Paul et al. 2021). Social media applications are very effective in spreading this opposition (Megget 2020). Even though there are few anti-vaccine than pro-vaccine individuals on social media (Yumru and Karakoç-Demirkaya 2021), the former share conspiracy theories more frequently, use emotional language more, and participate more in discussions about various aspects of the vaccine compared to pro-vaccine individuals (Curiel and Ramirez 2021).

The role of technology usage status in vaccine hesitancy beliefs

Progress in information and communication technologies (ICTs) has begun to shape the healthcare field more and more (Aceto et al. 2018). Nowadays, in addition to the significant support and benefits of ICT in the field of health (Aceto et al. 2018; Hohmeier et al. 2021; Li et al. 2021), it can also cause some harmful effects that will pose a threat to public health (e.g., Allington et al. 2021; Jennings et al. 2021; Puri et al. 2020). For example, VH is closely linked to the growing importance of the internet and the rise of ICT (Tafari et al. 2014). The internet and social media networks provide a base for the propaganda of the anti-vaccine movement and the spread of harmful and false information that can fuel VH (Faasse et al. 2016; Puri et al. 2020). Basch et al. (2017) analyzed the 87 most-watched videos in terms of content, author status, and view count in a study examining what kind of videos there are about vaccines on YouTube. Research results showed that 65% of these videos try to discourage viewers from getting vaccinated, 36.8% having no scientific evidence; however, only 5.6% were produced by government experts. In addition, studies conducted during the COVID-19 process report that there is a positive relationship between social media use and VH (Allington et al. 2021; Jennings et al. 2021; Reno et al. 2021). As a result, the available evidence suggests that exposure to anti-vaccine content via ICT can directly influence views on vaccination and trigger vaccine hesitations. In this regard, this research has addressed the role of technology use status (social media usage experience, technology usage competence, digital technology usage experience) in VH beliefs.

The role of vaccine-related variables in vaccine hesitancy beliefs

In this study, Covid-19 vaccination status, and perception of Covid-19 vaccine reliability variables, which may be effective in the formation of VH beliefs, were discussed based on the literature. Studies in the literature also highlight the role of vaccine trust in vaccine decisions (e.g., De Figueiredo et al. 2020; Murphy et al. 2021; Troiano and Nardi 2021). For example, De Figueiredo et al. (2020) mapped vaccine confidence in 149 countries between 2015 and 2019. Confidence in the importance of vaccines (rather than in their safety or efficacy) has the strongest association with vaccine intake compared to other determinants. Additionally, Troiano and Nardi (2021) found that one of the most highlighted reasons for rejecting the vaccine was concerns about the safety of the vaccine (thinking that a hastily produced vaccine is too dangerous, doubt about the source of the vaccine).

The role of social media-specific epistemological beliefs in vaccine hesitancy beliefs

During the COVID-19 pandemic, information sharing about health continued to increase (Limaye et al. 2020; Pennycook et al. 2020). In this process, vaccination was one of the topics that were frequently shared on social media platforms (Hernandez et al. 2021; Muric et al. 2021). Groups who are hesitant about vaccines take an active part in social media, and share information about vaccines in a way that triggers anti-vaccination behavior (Ashkenazi et al. 2020). Anti-vaccine activists especially use platforms such as Twitter to share their views (Hernandez et al. 2021; Muric et al. 2021). Although most of the information shared about the vaccine has not undergone editorial review or has no scientific basis, such content can influence the public and increase VH (Alamoodi et al. 2021; Ashkenazi et al. 2020; Hernandez et al. 2021; Hohmeier et al. 2021; Puri et al. 2020).

Considering that there is a lot of misinformation about the COVID-19 vaccine on social media and that this misinformation increases VH (Limaye et al. 2020), the importance of people questioning the information they encounter on social media becomes evident. Social media users should approach the information in social media environments critically and look at the information they encounter with a rational lens (Yildiz-Durak and Saritepeci 2019). This approach is referred to in the literature as social media-specific epistemological beliefs. Social media-specific epistemological beliefs mean that social media users question the source of the information they encounter on social media platforms; the simplicity and precision of the information, reasoning about the information, and controlling other sources of information (Celik 2020). As a result, the fact that social media users question the source of the information they encounter and have epistemological beliefs including perceptions about the structure of information will play an important role in evaluating the false information on social media about vaccines.

The role of media literacy in vaccine hesitancy beliefs

Online areas such as social media platforms are the areas that play the most important role in the spread of misinformation (Allington et al. 2021; Xiao et al. 2021). Studies in the literature have shown that information-seeking on social media is positively associated with COVID-19 misperceptions and conspiracy beliefs (Allington et al. 2021; Su et al. 2021; Xiao et al. 2021). In this regard, one of the most effective ways to combat VH caused by misinformation and misperceptions is to provide individuals with

media literacy skills (e.g., Dib et al. 2022; Rosenthal and Cummings 2021; Schiavo 2020; Su et al. 2021; Xiao et al. 2021). Media literacy is defined as the ability to access, analyze, evaluate, and communicate messages in various forms (Aufderheide 1993). Media literacy includes many components such as digital literacy, information literacy, and news literacy (Xiao et al. 2021). People with high media literacy can critically consume, question, and analyze information, and better recognize fake news (Jones-Jang et al. 2021). Accordingly, in this study, it is expected that people with a high level of media literacy will be less affected by the misinformation in the media about the vaccine and will have lower VH belief.

The role of social influence strategies in vaccine-hesitancy beliefs

Social influence is of great importance in explaining the behavior of individuals in many contexts (Kim and Hollingshead 2015). Especially with the emergence of the internet and social media recently, the role of social influence continues to increase both in people's daily lives and in the change in their beliefs, attitudes, and behaviors (Oyibo and Vassileva 2019; Saritepeci 2020). The development of Web 2.0 tools that facilitate personal and interpersonal social interactions and enable the production and consumption of certain content have led to an increase in social influence sources (Kim and Hollingshead 2015). Information in online environments exerts social influence on people, enabling people to adjust their attitudes and risk perceptions according to perceived norms (Giese et al. 2020). However, the fact that individuals are affected by the flow of information in online or offline social environments depends on the level of their sensitivity to social influence. Sensitivity to social influence means the level of the tendency of individuals to regulate their behavior, and change or adapt their point of view within the framework of the behaviors of others and their perspectives on events or situations as a result of their social interactions (Moussaid et al. 2013; Saritepeci 2020).

Considering that the time people spend in front of the screen has increased during the pandemic (Gökçearsan et al. 2023; Jahja et al. 2021; Şimşir Gökcalp et al. 2022; Yıldız Durak 2018), and they have started to spend more time on social media platforms (Kaya 2020; Yıldız Durak 2019; 2020), it is not unreasonable to suggest that they are frequently exposed to social influence in online environments. As mentioned before, widespread misinformation on social media causes a social impact on people, fueling VH (Xiao et al. 2021). However, studies have revealed that one of the main determinants of people's decision to get vaccinated is the social impact (Abbas et al. 2018; Griffith et al. 2021;

Oldeweme et al. 2021). Accordingly, this study is thought to be useful to consider sensitivity to social influence in understanding the causes of VH beliefs.

Method

In this study, personal variables, technology use cases, vaccine-related variables, social media-specific epistemological beliefs, media literacy, and social influence strategies were examined as predictors of Covid-19 VH beliefs. The prediction design research model was used to detect the predictors of the dependent variable. The hypotheses concerning the

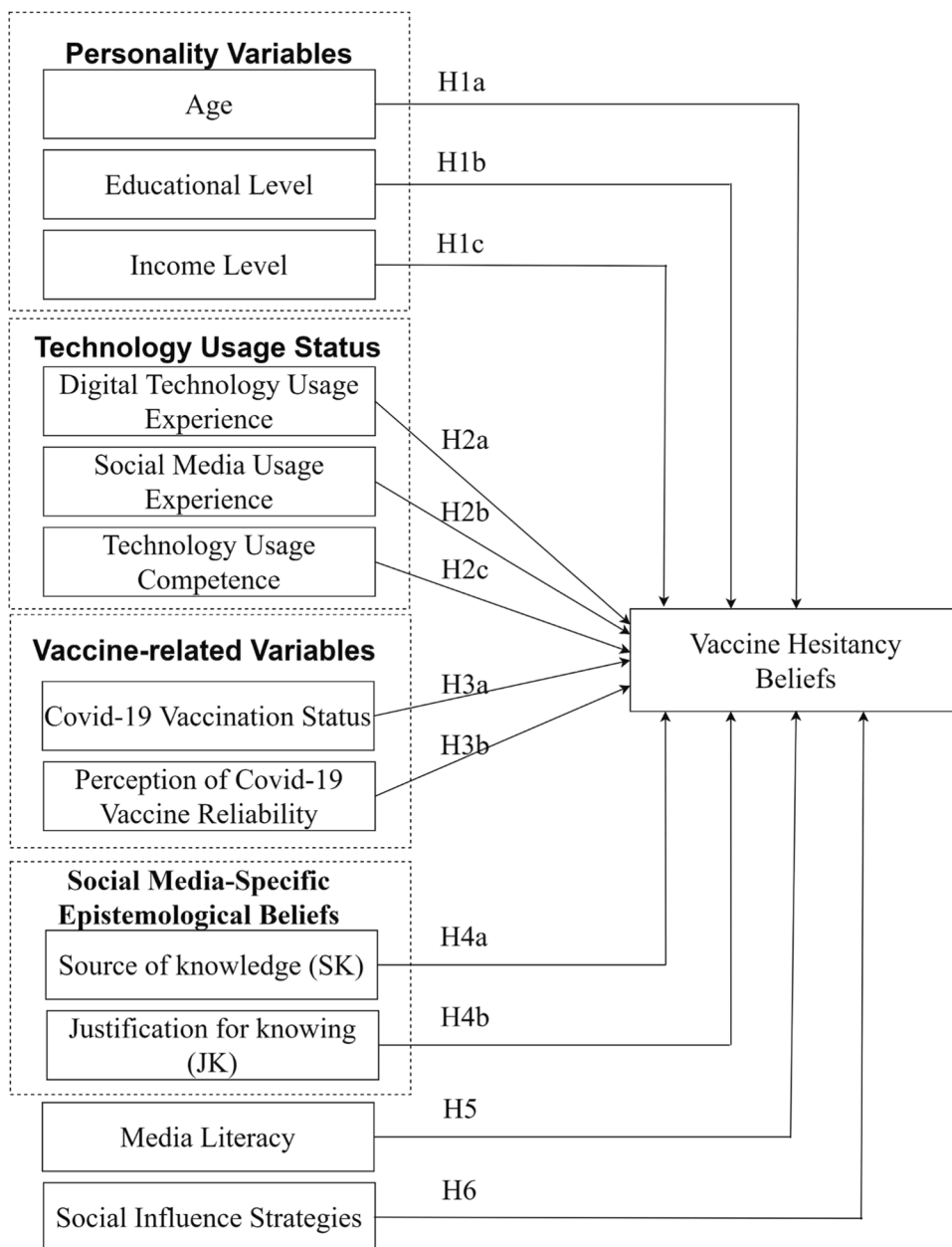
predictive relationships between the variables of the study are presented in Fig. 1.

Data collection tools

Self-description form

The self-description form consists of three parts. In the first part, there are seven items related to demographic information (gender, age, education level, etc.). In the second part, there are three items (Covid-19 vaccine status, etc.) related to exposure to Covid-19 and vaccination status. In the last

Fig. 1 The research model



section, five items (daily social media usage time, etc.) related to technology usage status and habits are included.

Vaccine hesitancy belief

The scale developed by Kılıncarslan et al. (2020) includes a four-factor, 21-item long-form, and three-factor, 12-item short form. The short form was used in this study. The scale is a 5-point Likert scale. Among the short-form factors, “benefits and protective value of vaccines” has three items, “vaccine repugnance” has five items, and “solutions for non-vaccination” has three items.

Social media-specific epistemological beliefs

The scale developed by Celik (2020) consists of three factors and 15 items. Scale factors are “simplicity and certainty of social media-based knowledge (SCK)”, “source of knowledge (SK)” and “justification for knowing (JK)”. There are five items in each factor. The scale is a 5-point Likert scale. In this study, the scale factors SK and JK were used.

Media literacy

The new media literacy scale developed by Koc and Barut (2016) consists of four factors and 35 items. Scale factors are functional consumption (seven items), critical consumption (11 items), functional prosumption (seven items) and critical prosumption (ten items). The scale is a 5-point Likert scale. In this study, critical consumption and critical prosumption factors were used.

Social influence strategies (SIS)

The social influence strategies inventory created by Oyibo and Vassileva (2019) has three factors and 14 items. Social learning (five items) and social comparison (six items) dimensions are two factors of the five-factor “the persuadability inventory” scale developed by Busch et al. (2013). The social proof factor (three items) was taken from the “susceptibility to persuasive strategies” scale of Kaptein et al. (2012). The scale was adapted into Turkish by Sarıtepeci (2020). The inventory, which was adapted differently from the original scale, includes two factors and nine items. There are six items in the “social learning - social proof” factor and three items in

the “social comparison” factor. The scale is a 5-point Likert scale (1: I totally disagree to 5: I totally agree).

Data analysis

Analysis of the data was carried out with structural equation modeling. SmartPLS 3 program was used in the analysis. In partial least squares–structural equation modeling (PLS–SEM), first the measurement model and then the structural model are tested. The measurement model was tested to prove the reliability and validity of the structural model. Internal consistency, and convergent and discriminant validity were examined. In order to test the relationships in the structural model, the path coefficients between the structures were examined.

There are several reasons for choosing PLS-SEM in this study. First, PLS-SEM is less sensitive to violation of the normality assumption. It can be used for complex models with many structures and factors (Hair et al. 2017). In addition, the current study focused on predicting anti-vaccine beliefs and has a complex model. In this context, PLS-SEM was considered a suitable method for this study.

Findings

Participants

The study group consisted of a total of 378 participants, 81% of whom were women and 19% were men. The ages of the participants vary between the ages of 18–54, with an average of 22.81. All of the participants are high school graduates; 88% of them are undergoing undergraduate education or are graduates, while 7% of them are undergoing postgraduate education or are postgraduates. In addition, 87% of the participants are single.

Participants have an average of 10 years of digital technology use and 7.77 years of social media user experience. In addition, participants use digital technological tools for an average of 3.94 hours per day and spend 2.85 hours in social media environments. When the participants’ exposure to Covid-19 was examined, 29% of them were exposed to at least one of the Covid-19 variants. When the answers regarding the safety of Covid-19 vaccines are examined, 48.4% of the participants express hesitations about the safety of Covid-19 vaccines, while 39.9% find the vaccines safe. In addition, 7.4% of the participants do not find Covid-19 vaccines reliable, and 4.2% do not find vaccines reliable in general, including childhood vaccines. When the vaccination status was examined, 66% of the participants had been vaccinated with a double dose of BioNTech, 19% with a double

dose of Sinovac, 9% with at least one dose, and only 6% were not vaccinated.

Testing measurement model

Before testing the supposed model, the measurement model was examined first. Items with factor loadings of 0.50 and below were excluded from the model. All remaining items have factor loadings above the threshold value. Related findings are presented in Table 1.

For internal consistency reliability, composite reliability (CR), rho_A, and Cronbach's alpha coefficients were evaluated. According to Hair et al. (2017), the recommended limit value for composite reliability, Cronbach's alpha, and rho_A is 0.70. A threshold of 0.50 is recommended for average variance extracted (AVE) values, and values obtained in the current research are above this threshold. Thus, convergent validity is achieved. When Table 1 is examined, all structures have values above the threshold value. Therefore, it was assumed that the constructs in the study were reliable and had sufficient internal consistency.

Fornell and Larcker's (1981) criteria and heterotrait–monotrait ratios (HTMT) were used to assess discriminant validity.

According to Table 2, all pairwise correlations between structures have lower values than the diagonal values of the AVE. This indicates that discriminant validity has been achieved. Heterotrait–monotrait (HTMT) correlation ratio method was also applied for discriminant validity. HTMT values should be less than 0.85, and a threshold value of 0.90 is acceptable if the latent variables theoretically measure similar structures (Henseler et al. 2015). According to Table 3, all HTMT values were found below 0.85.

Discriminant validity was provided according to Fornell and Larcker's criteria and HTMT values. As a result, the measurement model produced sufficient reliability and validity values that the structural model was suitable for testing.

Structural model

To test the statistical significance of the path coefficients, it was carried out with 1000 sub-samples. Table 4 presents the results of the Fig. 2 structural model.

In the structural model, R^2 was calculated as 0.571, indicating that the putative model with research variables

Table 1 Factor loadings and construct reliability and validity

Variables	Items	Factor loadings	Construct reliability and validity			
			Cronbach's alpha	rho_A	Composite reliability	Average variance extracted (AVE)
Anti-vaccination beliefs	AB1	0.809	0.897	0.900	0.924	0.709
	AB2	0.882				
	AB3	0.809				
	AB4	0.879				
	AB5	0.827				
Media literacy	ML1	0.809	0.920	1.000	0.932	0.633
	ML2	0.760				
	ML3	0.790				
	ML4	0.806				
	ML5	0.852				
	ML6	0.800				
	ML7	0.791				
	ML8	0.757				
JK	JK1	0.818	0.866	0.899	0.909	0.714
	JK2	0.769				
	JK3	0.905				
	JK4	0.882				
SK	SK1	0.832	0.756	0.756	0.818	0.692
	SK1	0.832				
SIS	SED1	0.719	0.701	0.725	0.832	0.624
	SED2	0.806				
	SED3	0.840				

Table 2 Discriminant validity results — Fornell and Larcker's (1981) criteria

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	1.000												
2. Anti-vaccination beliefs	-0.070	0.842											
3. Covid-19 vaccination status	-0.081	-0.343	1.000										
4. Digital technology usage experience	0.541	0.010	-0.037	1.000									
5. Educational level	-0.165	-0.007	0.069	0.003	1.000								
6. Income level	0.126	-0.001	0.045	0.141	0.026	1.000							
7. JK	0.005	-0.078	-0.009	0.024	-0.025	-0.108	0.845						
8. Media literacy	-0.002	-0.100	0.019	0.063	0.020	-0.050	0.552	0.796					
9. Perception of Covid-19 vaccine reliability	0.077	-0.724	0.319	0.035	0.004	0.023	0.042	0.051	1.000				
10. SIS	-0.100	0.175	-0.106	0.009	0.017	0.004	0.036	0.070	-0.118	0.790			
11. SK	0.029	-0.234	0.115	-0.020	-0.016	0.001	0.154	0.131	0.109	-0.316	0.832		
12. Social media usage experience	0.530	-0.010	-0.014	0.709	-0.038	0.041	-0.080	0.049	0.064	-0.062	0.028	1.000	
13. Technology usage competence	0.084	-0.093	0.038	0.288	0.032	0.009	0.137	0.224	0.074	0.025	-0.048	0.295	1.000

explained 57% of the variance in anti-vaccine beliefs. R^2 value can be described as an important, moderate, and weak model. In this study, the power of the model to predict anti-vaccine beliefs is moderate.

The significance of the path coefficient was examined in Table 4 and Fig. 2. H1 assumes that personal variables are associated with anti-vaccination beliefs. The results showed that age had no significant effect on anti-vaccine beliefs (H1a–reject). Education and income level also do not have a significant effect on anti-vaccine beliefs (H1b, H1c–reject).

H2 assumes that the use of digital technologies (digital technology usage experience, social media usage experience, and technology usage competence) significantly predicts anti-vaccine beliefs. The results showed that the use of digital technologies did not significantly predict anti-vaccine beliefs; hence H2a, H2b, and H2c were rejected.

Vaccine-related variables in H3 are predicted to be associated with anti-vaccine beliefs. The results showed that Covid-19 vaccination status ($\beta = -0.113$, $t = 3.120$, $p < 0.001$) and perception of Covid-19 vaccine reliability ($\beta = -0.663$, $t = 22.008$, $p < 0.001$) were significantly associated with anti-vaccine beliefs. Therefore, H3a and H3b were accepted.

In H4, the relationship of the source of knowledge (SK) and justification for knowing (JK), which are sub-dimensions of social media-specific epistemological beliefs, with anti-vaccine beliefs was tested. Results showed that SC was significantly associated with anti-vaccination beliefs ($\beta = -0.132$, $t = 3.496$, $p < 0.001$); therefore H4a was accepted. H4b hypothesizes that JK is associated with anti-vaccine beliefs. Findings showed that JK was not significantly associated with anti-vaccine beliefs; therefore, H4b was rejected.

H5 assumes that media literacy significantly predicts anti-vaccine beliefs. The results showed that media literacy did not significantly predict anti-vaccine beliefs; therefore H5 is rejected.

In H6, social influence strategies are predicted to be significantly associated with beliefs. The results showed that social influence strategies did not have a significant effect on beliefs and therefore H6 was rejected.

Discussion

In this study, six hypotheses were determined and tested. In Hypothesis 1, it was assumed that personal variables were associated with anti-vaccination beliefs and the predictive effects of age, education, and income level were examined. As a result of the research, personal variables did not have a significant effect on anti-vaccine beliefs (H1a, H1b, H1c). On the other hand, an important proportion of the studies on vaccine acceptance report that the acceptance level of vaccines such as Covid-19 and flu is higher among men, those

Table 3 Discriminant validity results — heterotrait–monotrait ratio (HTMT)

	1	2	3	4	5	6	7	8	9	10	11	12
Age												
VH beliefs	0.075											
Covid-19 vaccination status	0.081	0.359										
Digital technology usage experience	0.541	0.056	0.037									
Educational level	0.165	0.017	0.069	0.003								
Income level	0.126	0.020	0.045	0.141	0.026							
JK	0.059	0.089	0.018	0.032	0.040	0.114						
Media literacy	0.057	0.096	0.027	0.064	0.041	0.064	0.612					
Perception of Covid-19 vaccine reliability	0.077	0.761	0.319	0.035	0.004	0.023	0.057	0.042				
SIS	0.124	0.217	0.117	0.014	0.095	0.058	0.134	0.124	0.134			
SK	0.039	0.330	0.154	0.044	0.076	0.042	0.220	0.168	0.147	0.509		
Social media usage experience	0.530	0.029	0.014	0.709	0.038	0.041	0.084	0.049	0.064	0.076	0.038	
Technology usage competence	0.084	0.099	0.038	0.288	0.032	0.009	0.137	0.246	0.074	0.040	0.064	0.295

Table 4 Structural model results

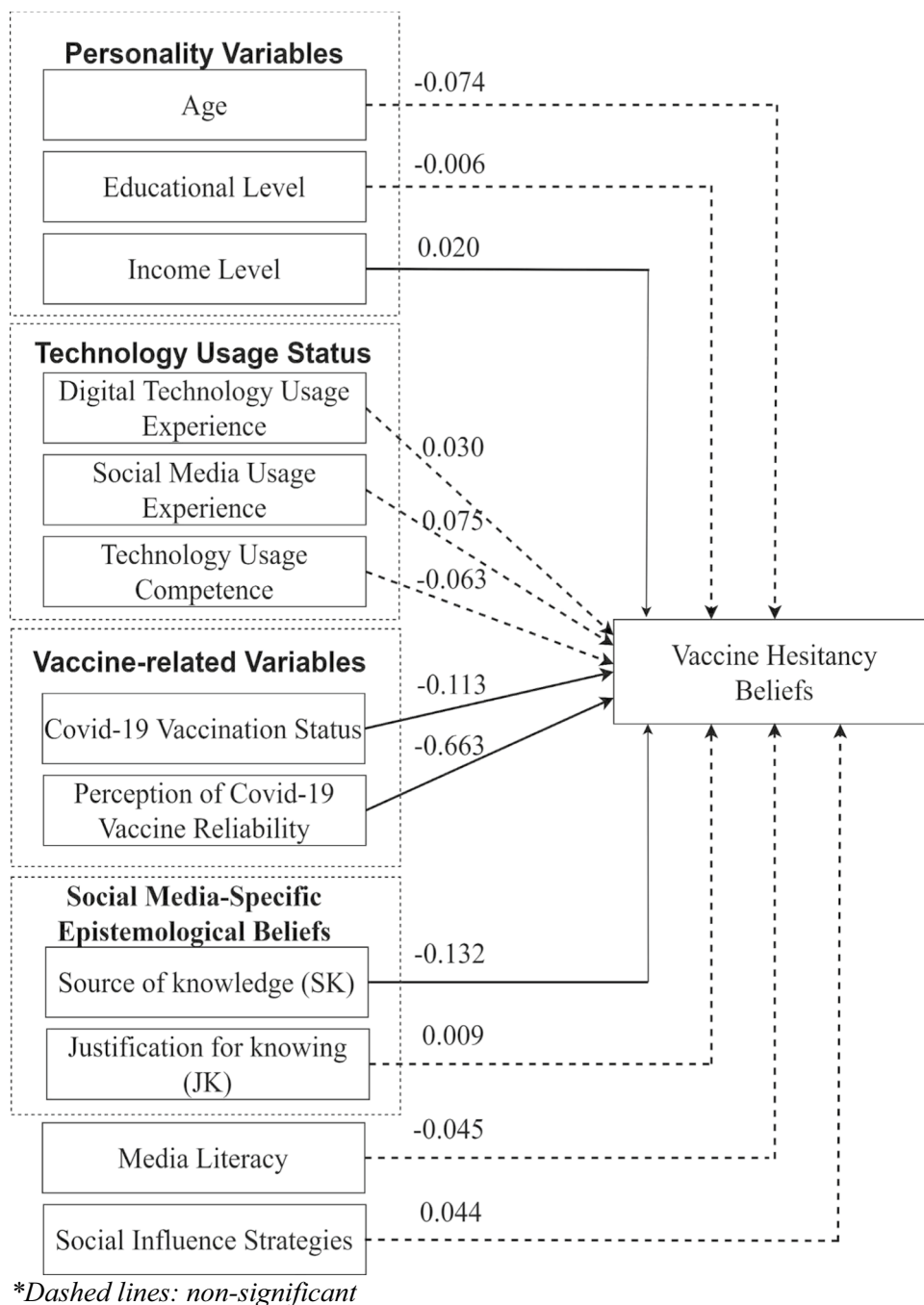
Hypothesis	Path	β	T	P	Accept/Reject
H1a	Age -> VH beliefs	-0.074	1.624	0.105	Reject
H1b	Educational level -> VH beliefs	-0.006	0.221	0.825	Reject
H1c	Income level -> VH beliefs	0.020	0.544	0.586	Reject
H2a	Digital technology usage experience -> VH beliefs	0.030	0.513	0.608	Reject
H2b	Social media usage experience -> VH beliefs	0.075	1.534	0.125	Reject
H2c	Technology usage competence -> VH beliefs	-0.063	1.653	0.099	Reject
H3a	Covid-19 vaccination status -> VH beliefs	-0.113	3.120	0.002	Accept
H3b	Perception of Covid-19 vaccine reliability -> VH beliefs	-0.663	22.008	0.000	Accept
H4a	Source of knowledge (SK) -> VH beliefs	-0.132	3.496	0.000	Accept
H4b	Justification for knowing (JK) -> VH beliefs	0.009	0.206	0.836	Reject
H5	Media literacy -> VH beliefs	-0.045	0.880	0.379	Reject
H6	Social influence strategies -> VH beliefs	0.044	1.156	0.248	Reject

who are relatively older, and those with a higher income level (Detoc et al. 2020; Fisher et al. 2020; Kreps et al. 2020; Kricorian et al. 2022; Kumar et al. 2016; Sallam 2021; Ward et al. 2020). The lower vaccination refusal status of male participants, which occurred in most of the relevant studies, contradicts our study findings. One of the important reasons for this difference is that the rate of male participants, which is one of the limitations of this study, remained at 20%. This situation makes it difficult to interpret the possible differences and similarities in the context of gender. Although various measures were developed (face-to-face data collection, sharing on different social media platforms, etc.) during the data collection process of the study, the number of male volunteer participants did not reach the expected level. It is thought that the difference in the literature in terms of the age variable is due to the low range between the ages of the participants and the relatively large part of the participant population consisting of participants aged 30 and below.

Especially in advanced ages and chronic diseases, the more serious course of Covid-19 can be considered as a situation that reduces vaccine rejection, with the effect of fear of Covid-19 in these age groups. In this context, the absence of participants from the advanced age group in this study revealed such a result. A significant number of studies reveal that vaccine rejection is more common in young people. The main reason for the limited participation in this study in older ages is that the use of social media in this age group is very limited in the country where the study was conducted.

The use of digital technologies (digital technology usage experience, social media usage experience, and technology usage competence) predicted anti-vaccine beliefs, and three sub-hypotheses (H2a, H2b, and H2c) were rejected. Digital technologies, especially the internet and its components, are one of the most basic elements in following information flow during the epidemic period. This situation reveals the idea that as a result of the rapid spread of false information,

Fig. 2 The structural model



especially in the online environment, compared to the correct information, VH can be fed. It is a factor mentioned in various studies that the use of media such as social media and blogs as a source for vaccines and health-related information triggers or increases VH (Puri et al. 2020). Ahmed et al. (2018) reported that those who do not use Twitter are more likely to have the flu vaccine compared to those who do. However, unlike most studies (e.g., Puri et al. 2020), they stated that using Facebook and Twitter as a source of health information increased the probability of getting vaccinated.

This result is an indication that the purpose of using these environments is a much more important determinant than the experience in such environments.

Vaccine-related variables (vaccination status and perception of Covid-19 vaccine reliability) were assumed to be associated with anti-vaccine beliefs, and H3a and H3b were accepted. According to the results of the research, the effect of perception of Covid-19 vaccine reliability on VH is the most important variable. Numerous studies highlighted that trust in the vaccine is one of the most important components of

vaccine acceptance (Fares et al. 2021; Puri et al. 2020; Sallam 2021; Troiano and Nardi 2021). Fares et al. (2021) indicated that the two factors associated with VH that will negatively affect vaccine trust are (1) fear of the side-effects of Covid-19 vaccines, and (2) the belief that there are not enough clinical trials in the development process of vaccines.

The relationship between the source of knowledge (SK) and justification for knowing (JK), sub-dimensions of social media-specific epistemological beliefs, and anti-vaccine beliefs was tested, and the results showed that SK was significantly associated with anti-vaccine beliefs (H4a). SK level is a negative predictor of VH belief. In social media environments, where the reliability of shared information is one of the most important uncertainties (Atman-Uslu and Yildiz Durak 2022; Avcı and Yildiz Durak 2022; Osatuyi 2013), individuals need to display a cautious attitude toward the information source (Chiu et al. 2013). SK consists of items containing beliefs about the acceptance of information shared in social media environments (Atman-Uslu and Yildiz Durak 2022). A high score in the SC dimension indicates that information in these environments is approached with a skeptical and critical perspective (Celik 2020). In such a period, when anti-vaccination posts about Covid-19, flu, and childhood vaccines are frequently encountered on many platforms, especially on social media (Meleo-Erwin et al. 2017), the importance of questioning the SK becomes more important. The viral elements that arise from the negative effects of Covid-19 vaccines, whose source is unclear or that arise only from assumptions, may affect individuals' VH or vaccine opposition (Puri et al. 2020). This situation increases the importance of a questioning perspective towards the source of SK in social media environments.

It was assumed that media literacy significantly predicted anti-vaccine beliefs, and H5 was rejected. On the other hand, studies show that media literacy increases the probability of exhibiting recommended health behaviors such as vaccine acceptance (Austin et al. 2021; Dib et al. 2022; Kricorian et al. 2022). With regard to this difference, the way scientific information about Covid-19 is presented has a significant effect. Indeed, Kricorian et al. (2022) emphasize that a significant proportion of individuals have difficulty understanding the language used in sharing information and scientific data shared by institutions. Accordingly, although media literacy is important in terms of reaching accurate information, scientific literacy levels of individuals become more important beyond media literacy in terms of processing this information. At this point, the use of a much clearer, more understandable, and simple language in health-related information, especially on issues such as Covid-19 that emerge suddenly and are not known to the majority, can increase the probability of individuals exhibiting recommended health behaviors (such as vaccine acceptance) (Kricorian et al. 2022).

H6, which tested that social influence strategies were significantly associated with beliefs, was rejected. One of the determining factors of the behavior of individuals in any subject is social influence and the level of sensitivity of the individual to social influence (Kim and Hollingshead 2015; Saritepeci 2020). Numerous conspiracy theories and misinformation at different stages during the Covid-19 pandemic have gone viral through social media platforms (Facebook, Instagram, Telegram, Twitter, WhatsApp, etc.) (Vraga et al. 2022; Xiao et al. 2021). In such an information flow, it is well known that the information has important effects on the behavior and attitudes of individuals on any subject (health, choice, violence, etc.) (Bierwiazzonek et al. 2020; Lewandowsky et al. 2017). We predicted that the effects of these flows on the individual in the context of behavior and attitude are related to social influence strategies. The results showed that, contrary to our expectations, social influence strategies did not affect individuals' VH beliefs. This situation is thought to be related to the fact that only 6% of the participants were not vaccinated against Covid-19. Although 60% of the participants reported hesitation or distrust towards vaccines, the fact that a very important proportion of them has had at least one vaccine injection causes the relationship between social influence strategies and VH to be ambiguous. In this context, it is thought that future studies that will deal with the effect of social influence strategies on health-related behaviors and attitudes in different contexts will make this ambiguous relationship clearer.

Authors' contribution Hatice Yildiz Durak: conceptualization, methodology, analysis, investigation, resources, writing — original draft. Zeynep ŞİMŞİR GÖKALP: data collection, writing — review & editing. Mustafa SARITEPECİ: resources, writing — review & editing, Bülent DİLMAÇ: resources, writing — review & editing, Aykut DURAK: resources, writing — review & editing

Funding This study was not funded by any funding agencies or academic organizations.

Data availability The data that support the findings of this study are available from the corresponding author upon request.

Declarations

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent In addition, informed consent was obtained from all individual participants included in this study.

Research involving human participants and/or animals The data used was collected, ensuring that all credentials were anonymous.

Conflict of interest The authors declare that they have no conflict of interest.

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