



Digital strategies intervention and impact in promoting health education and making health decisions among individuals

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Abstract

Objectives: To assess the influence of digital strategies on individual behaviour, considerations, and decisions regarding health issues. To evaluate the impact of digital advertisements on the decision to receive vaccines, take the COVID-19 vaccination as a case report.

Methodology: A structured 5-axes questionnaire was distributed through a Google form and completed by 351 participants. The investigated variables were information, “discomfort, anxiety, and fear,” motivation, reference groups, and the decision to take the vaccine. The reliability analysis was carried out to assess the internal consistency of the study elements. Multicollinearity and multiple regression analyses were utilized to evaluate the research hypothesis.

Results: A positive correlation and robust internal consistency between the variables were confirmed. The overall Cronbach's alpha (α) is 0.93, indicating a solid association between the variables and the consistency of the measuring scale. The information, emotion, motivation, and reference group have a moderate level of importance with average mean values of 3.61, 3.74, 3.55, and 3.88, respectively. The correlation of the decision to take the vaccine with the information and the emotion variables was the highest (Pearson's correlation of 0.675 and 0.676, respectively). The motivation and reference groups showed lower associations (Pearson's correlation of 0.558 and 0.496). The results of the multiple linear regression analysis ($\alpha \leq 0.05$) confirm the hypothesis by demonstrating that the independent variables significantly influenced the decision to take the vaccine. The F-value (98.26) and significance level ($p < 0.00$) provide further validation of the model. **Conclusion:** Information and emotional concerns significantly impact health decision-making, while motivation and reference groups have a considerable role. It is a warranty of expanding digital strategies to improve health literacy and equity.

Keywords

digital advertisement, digital strategies, health education, vaccines

Introduction

Throughout life and in a variety of contexts, health education is a continuous, dynamic, complex, and structured process of teaching and learning that takes place (Pueyo-Garrigues et al. 2019). It entails a cooperative relationship between patients and medical professionals with the goal of enabling people to start making healthy lifestyle choices on their own for improved health results. It aims to improve people's knowledge, skills, attitudes, and beliefs about their health needs and behaviors within a positive health framework (Rincón et al. 2021). It takes into account both internal and external variables that influence people's health status (Pueyo-Garrigues et al. 2019).

Several limitations are to be encountered in delivering reliable and accurate health-related information. Communicating with a variety of populations from different educational backgrounds, languages, and varying degrees of health literacy is a big task to achieve (Berkman et al. 2011; Al-Suhaimat et al. 2024). The diverse requirements among individuals spotlight the warranty of proper medical communication between the patients and the healthcare staff (Liu et al. 2020; Tuan et al. 2024). Skillful conveyance is much needed to enable individuals to acquire and understand health information and improve health literacy (CDC 2023).

Having inadequate health knowledge has a negative impact on health status, medication adherence, the efficacy of health sector services, the health economy, and health disparities (Nutbeam 2021). Several studies have emphasized the role of raising acquired health knowledge among individuals in cutting costs and addressing challenges related to non-communicable diseases (Benziger et al. 2016; Liu et al. 2020). It is worth mentioning that health literacy is not limited to the known skills of reading and writing; the concept is extended to include the ability to navigate digital sources (Tuan et al. 2024).

Unfortunately, the massive increase and assorted sources of information through digital channels, such as social media and some dubious websites, have an increasing risk of delivering misinformation and complicating the health status of the affected patients (Jabbour et al. 2023). Moreover, cultural beliefs have considerable influences on individual practice of seeking medical and health-related advice and even treatments (Al-Yateem et al. 2023).

To ensure effective health literacy, patients, families, healthcare providers, and staff must communicate clearly and mutually comprehend it. Culture and health literacy both have a significant impact on the content and outcomes of healthcare interactions, necessitating a communication strategy that is sensitive to different cultural perspectives (Institute of Medicine (US) Committee on Health Literacy et al. 2004; Brooks et al. 2019). In addition, limited access to healthcare services and technology, particularly in underserved communities, impedes the dissemination of health-related information (Yu and Meng 2022).

The internet availability has made it attainable for medical professionals to stay up to date with scientific advances and has given patients and their families a platform to support one another and share health information (Ho and Ye

2024). Nevertheless, social media has also developed into a source of inaccurate health information, endangering public health because of how simple it is to create and share such information, which can cause confusion and lead to impulsive choices (Le et al. 2023). For example, much of the global population first learned about the SARS-CoV-2 and COVID-19 outbreak through web searches, particularly in the early months of the pandemic from January 2020 to June 30 of the same year, as awareness grew after the initial wave (Lu et al. 2020; Akpan et al. 2021; Al-Samydai et al. 2021).

The governments and different public health agencies faced challenges in swiftly disseminating accurate information about the coronavirus outbreak through the Internet and the World Wide Web during the early stages of the pandemic, which created a void that was quickly filled by misinformation and conspiracy theories on various online platforms such as social media, blogs, news outlets, and websites (Roozenbeek et al. 2020; Akpan et al. 2021). These misinformation campaigns undermined public trust in official health guidance and fueled skepticism toward recommended public health safety measures like mask-wearing, social distancing, and vaccination (Akpan et al. 2021).

Uncertainty and doubt regarding vaccination is a time-hallowed challenge that negatively affects immunizing children and adults (Kaufman et al. 2018). Vaccination hesitancy during the pandemic was a powerful example of the role of digital advertising and its effect on making decisions among the folk. Professionals have faced big challenges in overcoming deception and misleading information through digital channels (Evans and French 2021). Strategies have been developed worldwide to debunk the myths and to help hand in vaccination acceptance at both the individual and community levels (Kaufman et al. 2018).

Digital advertising is encouraged to be used by professionals to advocate for evidence-based practices and deliver accurate health information (Fitzpatrick 2023). For example, the United States has organized a professional campaign through social media platforms by publishing medical videos to increase awareness towards COVID-19 vaccinations among the communities (Bardus et al. 2023). In the digital era, collaboration between healthcare providers and scientific and social researchers with the digital platform is essential to thwarting incorrect practices and health-related myths and ensuring delivering trustworthy information (Merchant et al. 2019; Pennycook et al. 2020).

The broad aim of the current research is to assess the influence of digital advertising on individuals' behaviour, considerations, thoughts, and decisions related to health issues, specifically to evaluate the impact of social media platforms on entities' decision to receive COVID-19 vaccines.

Methodology

The study approach

This study relied on both the descriptive and analytical approaches and covered five axes, starting by collecting information: discomfort, anxiety, and fear; motivator; ref-

Table 1. The five axes of the study approach regarding the impact of the digital advertisements on COVID-19 vaccinations by folk.

Information	Discomfort, anxiety, and fear	Motivators	Reference Groups	Decision
Recall of the vaccine details from digital advertising	Unwelcome the vaccine information in digital ads	Advertisement impact on motivating vaccine uptake	Influence of digital ads in motivating family members to educate on vaccine	Behavior influence of digital ad-disseminated vaccine information
Information provision in digital ads on the significance of vaccination	Disquieting vaccine information in digital ads	Engagement with informative vaccine digital ad content	Motivation from digital ads for family members to receive vaccine	Encouragement from digital ads for vaccine uptake
Encouragement from digital ads to consider vaccination	Fear-inducing vaccine information in digital ads	Encouragement from digital ads to receive the vaccine	Digital ad impact on colleagues' vaccine motivation	Perception of fear and anxiety instilled by digital ads regarding vaccine
Persuasive quality of vaccine information in digital ads	Doubtful information about vaccine efficacy in digital ads	Captivating digital ads encouraging vaccine acceptance	Promotion of peer education on vaccine via digital ads	Motivation from digital ads for vaccine acceptance
Sufficiency of digital ad information regarding vaccine queries	Potential discomfort or concern arising from vaccine-related digital ad content	Social media influencer-driven encouragement for vaccine uptake	Persuasion effect of digital ad comments from friends and celebrities on social media	Role of digital ads in shaping vaccine opinions
Presence of unreliable sources in digital ad information on vaccine	–	Digital advertising motivation to educate on vaccine reception	–	Influence of digital advertising as a primary factor in vaccine decision-making

erence groups; and decision to take the vaccine. Table 1 demonstrates the five axes of the study approach.

Data collection

The structured 5-axes questionnaire was distributed in a Google form to the target population through social media applications.

The study adopted the descriptive analysis method following and modified after published data (Hajleh et al. 2021; Shudifat et al. 2024). A computer-generated randomized sampling strategy was employed, resulting in 351 responses being collected. The population for the study consisted of adults aged 18 years and older who have access to digital devices and use digital platforms for health-related information. A sampling frame was created using a database of individuals who had consented to participate in online health-related research. This database included potential participants meeting the inclusion criteria.

Structure validity and reliability

The survey underwent validation by experts before distribution. The reliability analysis tool was used to evaluate the internal consistency of the study criteria. A minimum acceptable level of the computed Cronbach's alpha (α) coefficient ≥ 0.60 is required to indicate consistency (Cronbach and Shavelson 2004; Taber 2018).

The questionnaire's development followed a two-step validation process:

- **Content Validity:** A panel of experts in public health and marketing reviewed the initial survey draft to ensure it comprehensively addressed all relevant aspects of digital strategies for promoting health education and decision-making. Their feedback led to revisions in question wording and domain structure.

- **Face Validity:** The same panel then evaluated whether the questions appeared to effectively measure the intended concepts, ensuring the language and format were suitable for the target audience.

Survey Question Scale and Scoring Method: Each domain in the survey contains a set of questions rated on a 5-point Likert scale (1 = Very Bad, 2 = Bad, 3 = Neutral, 4 = Good, 5 = Very Good). The raw score for each domain was calculated by summing the individual item scores within that domain, providing a quantitative measure for subsequent analysis.

Independent and dependent variables

In this study, the dependent variable is the "decision to take the COVID-19 vaccine," as we are investigating which factors influence this decision. The independent variables (predictors) include domains such as information, discomfort, anxiety and fear, motivation, and reference group. These factors were hypothesized to impact the decision to take the vaccine, which is why they are treated as independent variables in the regression analysis.

Scale Responses for Independent Variables:

Each independent variable (domain) was measured on a 5-point Likert scale, where participants rated their agreement or experience with statements related to each domain (e.g., 1 = Strongly Disagree to 5 = Strongly Agree).

Statistics

The statistical analysis was conducted using Statistical Package for Social Sciences (SPSS) version 23. These include mean and T-value measurements, multicollinearity tests, and multiple regression analysis. Values of $p \leq 0.05$ are considered significant.

Results

Reliability analysis

The correlation results showed a positive correlation and internal consistency between the variables under investigation as evidenced by the Cronbach's alpha (α) value exceeding the acceptable threshold of 0.6. These include the dependent variable (the decision to take the vaccine) and the independent variables of information, discomfort, anxiety and fear, motivation, and reference groups. The overall Cronbach's alpha (α) is 0.93, indicating a solid association between the variables and the consistency of the measuring scale.

Discomfort, anxiety, and fear recorded the highest value ($\alpha = 0.81$), while the reference group variable was the lowest ($\alpha = 0.60$). The results of the reliability analysis test of the tested variables are demonstrated in Table 2.

Mean and T-value analysis

The five axes of the structured survey were covered with multiple questions to measure every determined variable. Tables 3–7 were generated to analyze the importance of each studied variable by computing the mean, standard deviation, t-value, and the level of significance of its related questions.

Information

The information variable was assessed using six questions. Results indicated a moderate level of importance (average mean value of 3.61), which suggests that the information

presented in digital advertisements is adequate. The responses to each information question are analyzed, and the results are shown in Table 3.

Discomfort, anxiety, and fear

The "discomfort, anxiety, and fear" variable was assessed using five questions. Results indicated a moderate level of importance (average mean value of 3.74). The responses to each "discomfort, anxiety, and fear" question are analyzed, and the results are shown in Table 4.

Motivation

The motivation variable was assessed using six questions. Results indicated a moderate level of importance (average mean value of 3.55), which suggests that the importance of digital advertisements in motivating vaccine uptake is moderate. The responses to each motivation question are analyzed, and the results are shown in Table 5.

Reference group

The reference group variable was assessed using five questions. Results indicated a moderate level of importance (average mean value of 3.88), which suggests that the importance of the reference group in taking vaccine decisions is moderate. The responses to each reference group question are analyzed, and the results are shown in Table 6.

Table 2. Reliability analysis of the dependent and the independent variables using Cronbach's alpha coefficient.

Variable	Questions	Cronbach's alpha
Information	Q1–Q6	0.714
Discomfort Anxiety and Fear	Q7–Q11	0.808
Motivation	Q12–Q17	0.771
Reference Group	Q18–Q22	0.601
Decision to Take the Vaccine	Q23–Q29	0.766
All Items		0.926

Table 3. Mean and T-value analysis for information axis.

Question	Mean	Std. Deviation	t	Sig. (2-tailed)
Q1	3.7265	1.29145	54.060	0.000
Q2	3.7493	0.93799	74.887	0.000
Q3	3.5641	0.96556	69.155	0.000
Q4	3.6980	0.96804	71.569	0.000
Q5	3.8034	0.92495	77.039	0.000
Q6	3.0969	1.09897	52.795	0.000
h1	3.6064	0.66661	101.356	0.000

Table 4. Mean and T-value analysis for discomfort, anxiety, and fear axis.

Question	Mean	Std. Deviation	t	Sig. (2-tailed)
Q7	3.6752	0.91803	75.003	0.000
Q8	3.6752	0.93346	73.763	0.000
Q9	3.7094	0.88537	78.493	0.000
Q10	3.6923	0.97507	70.944	0.000
Q11	3.9544	0.86730	85.422	0.000
h2	3.7413	0.68908	101.720	0.000

Table 5. Mean and T-value analysis for motivation axis.

Question	Mean	Std. Deviation	t	Sig. (2-tailed)
Q12	3.8319	1.00155	71.680	0.000
Q13	3.6695	0.93146	73.807	0.000
Q14	3.5869	1.01009	66.529	0.000
Q15	3.3476	1.01924	61.533	0.000
Q16	3.5185	0.99374	66.335	0.000
Q17	3.3675	0.94656	63.00	0.00
h3	3.5537	–	–	–

Decision to take the vaccine

The “decision to take the vaccine” variable was assessed using seven questions. Results indicated a moderate level of importance (average mean value of 3.84). The responses to each “decision to take the vaccine” question are analyzed, and the results are shown in Table 7.

Multicollinearity assessment

Correlation analysis was performed to evaluate the multicollinearity between the independent variables, aiming for values of ≤ 0.9 . The correlation was considered significant at a level of 0.01 (2-tailed). The correlation of the decision to take the vaccine with the “discomfort, anxiety, and fear” variable was the highest (0.676), while the reference group was the lowest (0.496). Table 8 shows the Pearson’s correlation values between all the selected variables at a significant level of 0.01.

Multiple regression analysis

Multiple linear regression was conducted to test the main hypothesis at a significance level of $\alpha \leq 0.05$. The obtained results confirm the main hypothesis by demonstrating that the independent variables significantly influenced the decision to take the vaccine. The F-value (98.26) and significance level ($p < 0.00$) provide further validation of the model. However, all correlations remain within acceptable limits, suggesting minimal multicollinearity issues. Detailed statistics of the multiple regression analysis are shown in Table 9.

A histogram and a normal probability-probability (P-P) plot were generated to explicate the distribution pattern of the regression standardized residuals for the dependent variable in the multiple regression analysis. The dependent variable was previously defined as “decision to take the vaccine” and denoted with h5. The normal P-P plot elucidates the observed cumulative probability of the standardized residuals versus the expected cumulative probability under a normal distribution for the dependent variable. The graphs are shown in Figs 1, 2.

Regarding the histogram, the residuals are roughly normally distributed, as evidenced by their close alignment to the superimposed normal distribution curve. The residuals have a mean near zero ($-7.09E-15$) and a standard deviation close to one (0.99), indicating that the model’s assumptions are met.

Fig. 1 demonstrates a roughly normal distribution of the residuals, which verified their close alignment to the superimposed normal distribution curve. The statistical mean

was close to zero ($-7.09E-15$) with a standard deviation of almost 1 (0.99). These values endorse that the model’s assumptions are satisfied. Moreover, the normal P-P plot demonstrated the close alignment of the points along the diagonal line, which suggests that the residuals round about normal distribution. The results support the assumption of normality in the regression model and further validate the model’s findings regarding the influence of the tested independent variables on the decision to take the vaccine.

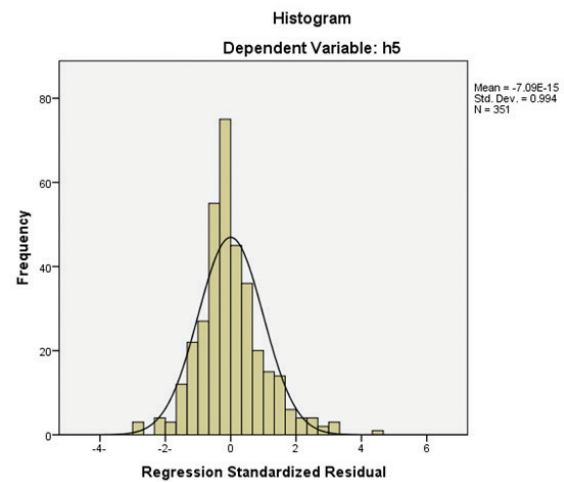


Figure 1. Histogram of regression standardized residuals for the dependent variable “decision to take the COVID-19 vaccine.”

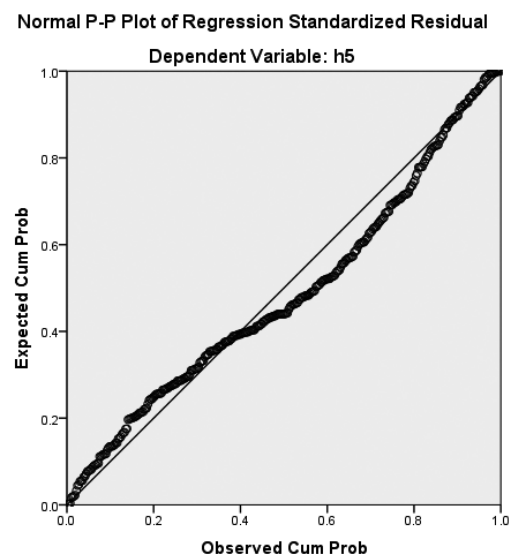


Figure 2. Normal P-P plot of regression standardized residuals for the dependent variable “decision to take the COVID-19 vaccine.”

Table 6. Mean and T-value analysis for reference group axis.

Question	Mean	Std. Deviation	t	Sig. (2-tailed)
Q18	3.4103	1.07028	59.696	0.000
Q19	3.9402	0.90355	81.699	0.000
Q20	4.1852	0.87008	90.118	0.000
Q21	4.1538	1.05518	73.753	0.000
Q22	3.7123	0.94708	73.435	0.000
h4	3.8803	0.59640	121.894	0.000

Table 7. Mean and T-value analysis for the decision to take the vaccine axis.

Question	Mean	Std. Deviation	t	Sig. (2-tailed)
Q23	3.6325	0.92519	73.558	0.000
Q24	3.9316	0.84576	87.092	0.000
Q25	4.0342	0.84446	89.502	0.000
Q26	3.4473	1.09385	59.044	0.000
Q27	3.8974	0.87881	83.088	0.000
Q28	4.0028	0.81591	91.914	0.000
Q29	3.9174	0.69817	105.121	0.000
h5	3.8376	0.56669	126.874	0.000

Table 8. Correlations (Pearson's correlation) among independent variables of 0.9 or less (n = 351).

Variables	h1	h2	h3	h4	h5
h1 (Information)	1.00	0.736**	0.730**	0.723**	0.675**
h2 (Discomfort Anxiety)	0.736**	1.00	0.769**	0.686**	0.676**
h3 (Motivation)	0.730**	0.769**	1.00	0.731**	0.558**
h4 (Reference Group)	0.723**	0.686**	0.731**	1.00	0.496**
h5 (Decision to Take Vaccine)	0.675**	0.676**	0.558**	0.496**	1.00

**Correlation is significant at the 0.01 level (2-tailed).

Sig. (2-tailed) = 0.00

sample size (N) = 351

Table 9. Multiple regression analysis of factors influencing the decision to take the COVID-19 vaccine.

Dependent Variable	R	R2	F	Sig	Independent Variable	B	T	Sig*
Decision to take the vaccine	0.73	0.53	98.26	0.00	Information	0.38	7.24	0.00
					Discomfort Anxiety and Fear	0.37	7.00	0.00
					Motivation	0.25	-0.45	0.65
					Reference Group	0.11	-1.90	0.06

The analysis includes correlation coefficient (R), coefficient of determination (R²), F-value (F), and significance level (Sig) for the overall model. It also details the unstandardized coefficients (B), t-values (T), and significance levels (Sig*) for each independent variable: information, discomfort, anxiety and fear, motivation, and reference group.

Discussion

The study was structured and designed to weigh up the impact of digital advertising on individuals' perceptions and decisions about vaccination, taking the COVID-19 vaccine as a case study. The study output shed light on the influence of multiple variables on the decision to get vaccinated. These variables are information, discomfort, anxiety and fear, motivation, and reference group. The statistical analysis of the study's elements ensures the findings' robustness and reliability and highlights the significant role of digital advertising in shaping vaccination behaviour.

The practice of using social media and digital advertising in vaccine promotion has been explored previously. Health organizations face challenges with various impediments to using social media platforms. These include fast-paced technology evolution, limitations of reliable and

trustable sources, and measuring the impact because of insufficient pieces of evidence that link the digital advertisement with the behaviour changes (Steffens et al. 2020).

The current study revealed a positive and significant impact of the information provided by digital sources on making the vaccine decision. Thus, providing the public with essential and convincing information, well-written, and educational digital ads can increase vaccination rates effectively. The measured effect of the information variable was not unexpected. Previous studies emphasized the critical role of disseminating accurate information in public health campaigns and advised that misinformation can exert a significant negative impact on vaccine confidence and uptake (Wakefield et al. 2010; Jarrett et al. 2015; Paul et al. 2021).

The analyzed data revealed that the effect of "discomfort, anxiety, and fear" has a significant positive effect on making a decision, which indicates that people tend to take

preventive measures like getting vaccinated when they are emotionally impacted by the pandemic. Moreover, receiving specific advertising might allay their fears. This was consistent with published reports that underlined the role of emotional reactions on an individual's behaviors related to health issues (Tannenbaum et al. 2015; Nabi and Myrick 2019). Other published articles recommend public health authorities concentrate on addressing emotional responses, such as fear and anxiety, to encourage taking the vaccine decision (Hudson and Montelpare 2021; Roy et al. 2022).

Interestingly, intrinsic motivation did not account for a reliable factor affecting taking the vaccine decision, according to the obtained findings. It was reported that the role of motivation in health behaviors exhibits controversial effects, and other factors have more impact (Ryan and Deci 2000; Schmitz et al. 2022).

A comparable effect was measured for the reference group variable. The influence of the reference group was marginally non-significant, which weakened its weight compared to other variables, such as information and emotional reactions. This assumption was partially supported by literature that underlined the fluctuating effects of peer pressure and social norms on health behaviors (Cialdini and Goldstein 2004; Nolan et al. 2008). Recently, there has been a focus on the role of digital strategies and business intelligence in supporting well-informed decision-making in healthcare organizations (Alkhwaldi 2024).

The COVID-19 pandemic has provided a great opportunity to evaluate the readiness of the healthcare systems to manage and leverage health information technology and to establish the principle of strict regulations regarding it. For instance, the United Kingdom re-evaluated its digital health and care strategies; the UK has prioritized the reinforcement of health information technology to optimize the balance between top-down and bottom-up approaches. Moreover, it enhances interoperability, mounting the capacity for managing big data and boosting digital inclusivity. Matters of privacy and security concerns must be addressed as well (Sheikh et al. 2021).

A conceptual model was constructed by a study held in the USA to guide healthcare professionals in correcting health misinformation on digital platforms. Identifying and then correcting the faulty information could be performed by a double authentication process. The internal act of authentication includes checking the authors, cues, and topics. If needed, an added external act to inspect authors and their contents is recommended. When misinformation is detected on social media, professionals are encouraged to proceed to the act of correction (Bautista et al. 2021).

To sum up, information and emotional concerns have a significant impact on influencing the individual's decision to take vaccines. The provided information should be clear, accurate, comprehensive, and well-communicated to promote vaccination. Addressing feelings and emotional responses by healthcare specialists and authorities should endorse the vaccination decision. Even though the motivation and reference group did not prove to be significant, they ought to be taken into consideration because

they might have a stronger impact depending on the subject matter and the circumstances at hand.

The findings provide important gap-filling information for analyzing and de-shielding the factors influencing the vaccination decision among Jordanian societies. Moreover, addressing the importance of correctly utilizing digital platforms to deliver health information and acquire customers' feedback, particularly in the era of advanced technology.

Limitations and recommendation

The obtained output is to be considered in light of the encountered limitations. The generalizability of the results is limited by the restricted geographical location. The length of the questionnaire might hinder the respondents from completing the survey. Taking the current results as a guide and building a comprehensive study to get proportional responses from regional and international aspects might show a deeper insight into the effect of culture, religion, ethnicity, economic status, and background.

Conclusion

Digital marketing campaigns play crucial roles in public health initiatives and have a profound role in health education. The obtained findings confirm the association between addressing accurate health information, emotional influences, and making health decisions, such as vaccination, among individuals. The implication of digital strategies applies to other health issues, such as health literacy and equity. Collaboration between digital advertisers, researchers, and the healthcare sector is a warranty to combat misinformation and provide evidence-based health education.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statements

The authors declared that no clinical trials were used in the present study.

The authors declared that no experiments on humans or human tissues were performed for the present study.

The authors declared that no informed consent was obtained from the humans, donors or donors' representatives participating in the study.

The authors declared that no experiments on animals were performed for the present study.

The authors declared that no commercially available immortalised human and animal cell lines were used in the present study.

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Data availability

The supplementary data is available from the corresponding author after a reasonable request.

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