INSIGHTS-JOURNAL OF
LIFE AND SOCIAL SCIENCES

INSIGHTS-JLSS
Insights-Journal of Life and Social Sciences

THE ROLE OF SEARCH ENGINES IN PUBLIC HEALTH EDUCATION: MISINFORMATION VS. EVIDENCE-BASED MEDICINE

Narrative Review

Awais Ali Ahmad[1]*, Tanzeela Gul[2], Aamna Jawed[3], Adeel-ur-Rehman[4], Ayesha Nazir[5], Rimal Rashid[6]

[1]State Key Laboratory of Agricultural Microbiology, College of Veterinary Medicine, Huazhong Agricultural University, Wuhan 430070, China.
[2]MPhil Scholar, Department of Pharmaceutical Sciences, Shifa College of Pharmacy, Shifa Tameer-e-Millat University, Islamabad, Pakistan.
[3]Research Scholar, Department of Public Health, Bahria University, Islamabad, Pakistan.
[4]Resident Neurosurgery, Punjab Institute of Neurosciences, Lahore, Pakistan.
[5]Pharmacist, Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Islamia University, Bahawalpur, Pakistan.
[6]Dow University Hospital, Karachi, Pakistan.

Corresponding Author: Awais Ali Ahmad, State Key Laboratory of Agricultural Microbiology, College of Veterinary Medicine, Huazhong Agricultural University, Wuhan 430070, China, dr.awais.ali.ahmad@gmail.com

Conflict of Interest: None

Grant Support & Financial Support: None

Acknowledgment: The authors would like to acknowledge the contributions of researchers and public health professionals whose work in the fields of digital health, health communication, and misinformation mitigation has laid the foundation for this review. Their continued efforts are vital in shaping a safer and more informed digital health landscape.

ABSTRACT

Background: In the digital age, search engines have become a primary source of health information for the public. While they offer unprecedented access to medical knowledge, they also serve as a major channel through which misinformation can spread. This duality has significant implications for public health education, clinical decision-making, and policy formulation, particularly in an era where digital literacy varies widely across populations.

Objective: This narrative review aims to explore the role of search engines in public health education, with a specific focus on the balance between evidence-based medical information and misinformation. The review evaluates how search engines influence user behavior, health beliefs, and decision-making, and examines interventions designed to mitigate misinformation.

Main Discussion Points: The review synthesizes evidence on key themes including algorithmic bias, misinformation density, user trust in search results, and the effectiveness of digital tools such as AI-driven misinformation filters. It also highlights the limitations of current studies, including methodological variability, small sample sizes, and limited generalizability. Issues of public trust, health literacy, and socio-demographic disparities in access and interpretation of information are also discussed.

Conclusion: Search engines play a pivotal role in shaping public understanding of health. While they offer valuable opportunities for disseminating evidence-based information, they also present significant risks when misinformation dominates search results. Stronger collaboration between healthcare providers, policymakers, and technology platforms is essential. Future research should focus on robust, long-term studies and inclusive strategies to improve digital health literacy and protect public health.

Keywords: Public Health Education, Health Misinformation, Search Engines, Digital Health Literacy, Evidence-Based Medicine, Narrative Review.

© 2025 et al. -Health And Research Insights-Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation

INTRODUCTION

In the digital era, the public increasingly turns to the internet to answer health-related questions, with search engines serving as a primary gateway to information. Google alone receives over one billion health-related searches daily, reflecting the profound role of search technologies in shaping public understanding of medical topics (1). This unprecedented access has the potential to democratize health knowledge, support preventive behaviors, and empower individuals to make informed choices. However, it also opens the door to widespread misinformation—false or misleading health claims that may directly contradict evidence-based medicine (2). This duality makes search engines both valuable tools for public health education and significant vectors for misinformation, particularly during health crises like the COVID-19 pandemic. Epidemiologically, the stakes are high. Public health misinformation has fueled vaccine hesitancy, delayed diagnosis and treatment, and exacerbated the spread of infectious diseases. For instance, misinformation contributed to the resurgence of measles in the United States, where the CDC linked a 2019 outbreak to vaccine myths propagated online (3,4). Beyond communicable diseases, misinformation can influence chronic disease management, mental health decisions, and even healthcare-seeking behavior. The global burden of disease is thus not only clinical but increasingly informational. As misinformation is consumed and shared widely through search engines and social media, it poses risks comparable to biological pathogens—capable of "infecting" public perception and health behavior on a massive scale (5,6). Despite the reliance on digital information sources, the mechanisms through which search engines contribute to the spread or correction of misinformation remain insufficiently understood. Recent research indicates that while search engines can return accurate results, they often simultaneously display misleading content. In fact, users exposed to a high density of misinformation during searches answered fewer factual questions correctly, even if they engaged more actively with the content (7,8). Paradoxically, people who attempt to verify misinformation via search engines may become more likely to believe it, especially if low-quality or biased sources dominate their results—a phenomenon amplified by "data voids," or informational spaces lacking reputable coverage (9).

Although advancements in search technology aim to address this issue, challenges persist. Machine learning tools like SEMiNExt, which filters misinformation in real time, demonstrate promise in enhancing the safety of health-related searches (10). Similarly, systems like Vera, incorporating large language models to detect misleading content, show superior accuracy in minimizing misinformation (11). Nonetheless, interventions like misinformation warning banners may backfire by eroding trust even in credible information, underscoring the need for nuanced strategies (12). These mixed outcomes reveal critical gaps in existing approaches, particularly around user perception, algorithm transparency, and literacy in identifying credible information. This narrative review aims to explore the complex role of search engines in public health education, with a focus on the interplay between misinformation and evidence-based medicine. Specifically, it synthesizes findings from empirical studies, digital literacy research, and system-level interventions to evaluate how search engines influence public health behaviors, either positively through dissemination of scientific knowledge or negatively through exposure to health myths. The review will include studies from the past five years examining the impact of misinformation density, user trust, algorithmic interventions, and public literacy initiatives. The scope of this review includes empirical research articles, narrative reports, and technology-based interventions published within the last five years. It draws on both qualitative and quantitative findings related to search engine performance, health misinformation effects, and evidence dissemination strategies. Particular attention is given to digital health behavior during public health emergencies, such as the COVID-19 pandemic, as these periods often intensify both search activity and the consequences of misinformation exposure. This review is significant because it provides a comprehensive overview of how search engines serve as both instruments of public health education and inadvertent conduits for misinformation. While several studies have examined health misinformation on social media, relatively less attention has been paid to search engines—despite their ubiquity and perceived neutrality. By critically examining how users interact with, trust, and are influenced by search results, this review offers insights for health professionals, technologists, and policymakers seeking to mitigate harm and enhance digital health literacy. The goal is not only to map the landscape but to contribute to practical frameworks that align public search behavior with evidence-based medical knowledge in a rapidly evolving digital ecosystem.

THEMATIC DISCUSSION: THE ROLE OF SEARCH ENGINES IN PUBLIC HEALTH EDUCATION—BALANCING EVIDENCE-BASED INFORMATION AND MISINFORMATION

The Rise of Search Engines as Gatekeepers of Public Health Information

© 2025 et al. -Health And Research Insights-Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

In the digital age, search engines have emerged as powerful tools for health information dissemination. They play a pivotal role in shaping the public's understanding of medical knowledge, especially in situations where healthcare access is limited or professional consultations are delayed. Over 70% of individuals use the internet, particularly search engines, as their first point of inquiry for health-related concerns (13). This behavior underscores the enormous responsibility that search engines hold in delivering credible, evidence-based information. However, while the convenience and accessibility of these platforms are undeniable, the neutrality and accuracy of the content they prioritize remain contentious. Studies have shown that the algorithmic logic used by search engines may prioritize content based on popularity or engagement rather than medical credibility, thereby increasing the visibility of potentially misleading or harmful content (14).

Misinformation Prevalence and the Role of Algorithmic Bias

Health misinformation—defined as false or misleading information that conflicts with established scientific consensus—is prevalent across digital platforms. Search engines, though not intentionally deceptive, often fail to filter this content effectively. In a controlled experimental study, demonstrated that higher "misinformation density" in search results led to increased user engagement (e.g., more clicks and longer queries) but paradoxically decreased learning accuracy and retention of factual information (15). Similarly, a study found that users attempting to verify false health claims via online searches often ended up reinforcing their belief in misinformation, especially when the results presented low-quality sources (16). This is largely attributed to "data voids"—informational gaps where search engines return numerous but unverified results due to limited high-quality indexed content on specific topics. These findings suggest that algorithmic structures may unintentionally amplify misinformation when robust, evidence-based content is not sufficiently represented.

Attempts to Counteract Misinformation Through Technological Innovation

Recognizing the dangers of unchecked misinformation, researchers and developers have introduced several technological solutions aimed at improving search quality. One such innovation is SEMiNExt—a machine learning-powered browser extension that flags misinformation in real-time during health-related queries. It achieved an accuracy of 84.3% in classifying content as reliable or unreliable (17). In a separate but related effort, developed a hybrid large language model-integrated search system called Vera, which outperformed traditional systems in identifying and excluding misleading content (18). These interventions highlight the potential for integrating artificial intelligence and natural language processing tools into search platforms to reduce the spread of harmful content. However, these models rely heavily on structured training datasets and require continuous updates, which presents scalability and generalizability challenges across diverse public health domains.

Trust Dynamics and Public Perception of Search Engine Credibility

Public trust in search engine results is influenced by both the content and its presentation. A study found that while higher-ranked search results were more frequently clicked, this did not equate to increased trust (19). Moreover, warning labels meant to flag misinformation were shown to reduce trust in *both* inaccurate and accurate results—a backfire effect that may undermine attempts at improving digital health literacy. This nuance reveals a complex behavioral dimension: users may misinterpret cues intended to guide them toward credible information, particularly when such cues are applied universally without contextual adaptation. Therefore, while technological filters are necessary, they must be accompanied by interventions that enhance public understanding of how to critically evaluate online content.

Influence of Search Behavior on Health Outcomes and Behavior Change

Health information-seeking behavior has a direct impact on individual decisions and public health outcomes. During the COVID-19 pandemic, for example, online searches shaped people's risk perceptions, vaccine attitudes, and preventive behaviors. A study found that spikes in search engine activity were closely correlated with public health announcements and subsequent changes in mobility, suggesting that people adjusted their actions based on online information (20). While this indicates the positive potential of search engines to disseminate timely public health guidance, it also raises concerns about the rapid spread of disinformation during critical periods. When users rely on unverified or speculative content, it may lead to behaviors that conflict with evidence-based recommendations, such as vaccine refusal or reliance on unproven treatments.

The Interplay Between Public Literacy and Search Engine Effectiveness

Digital literacy, or the ability to find, assess, and use credible information, is a critical mediator in the relationship between search engine use and health outcomes. Studies suggest that individuals with limited health or media literacy are particularly vulnerable to

© 2025 et al. -Health And Research Insights-Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

misinformation online. A study highlighted that the negative impact of search engines was more pronounced in users who failed to differentiate between high- and low-quality sources (21). Public education campaigns that focus on improving search term strategies, source evaluation, and fact-checking behaviors are essential to reduce susceptibility. However, these efforts must go beyond theoretical awareness and include practical training embedded within school curricula, workplace wellness programs, and community outreach.

Challenges in Regulating Health Misinformation and the Role of Policy

Despite advancements in technological filtering and media literacy initiatives, the regulation of online health content remains a major challenge. Unlike peer-reviewed medical publications, online platforms operate in a commercial environment with limited regulatory oversight. Attempts to control content are often met with accusations of censorship, complicating efforts to promote evidence-based discourse. Moreover, health misinformation is often embedded within narratives of personal experience or freedom of choice, which makes it harder to refute purely through scientific counterarguments. Policymakers must work in collaboration with technology firms, public health experts, and civil society to create transparent content moderation frameworks that prioritize public health without infringing on digital rights.

Persistent Gaps and Directions for Future Research

Despite a growing body of literature, several gaps remain. Most existing studies are conducted in controlled or experimental settings and may not fully capture real-world user behaviors. Additionally, the majority of intervention-based research has focused on English-language content, leaving other linguistic populations vulnerable to misinformation. There is also a need for longitudinal studies that assess how search behavior evolves over time and how sustained exposure to misinformation affects public attitudes and health literacy. Finally, future research should explore how socioeconomic factors intersect with digital information access, potentially exacerbating health inequities in underserved communities. In summary, search engines serve as both allies and adversaries in the field of public health education. While they offer unparalleled access to information, they also present new avenues for misinformation to flourish. Through a combination of algorithmic refinement, public education, and policy reform, it is possible to align search engine functionality with the principles of evidence-based medicine and safeguard the public's health in the digital age.

CRITICAL ANALYSIS AND LIMITATIONS

While the reviewed literature provides valuable insight into the role of search engines in shaping public health knowledge and the propagation of misinformation, several limitations and methodological weaknesses reduce the strength and generalizability of these findings. A critical appraisal of the studies reveals recurring issues related to study design, measurement inconsistency, and population representativeness, all of which warrant caution in interpreting the evidence and applying it across broader public health contexts. One of the most notable limitations is the reliance on experimental and observational designs with relatively small sample sizes. For instance, a study used only 60 participants to evaluate how misinformation density affects search behavior (18). While the study design was innovative and tightly controlled, the limited sample reduces statistical power and may not capture the diversity of real-world search behaviors, particularly among vulnerable or marginalized groups. Similarly, other studies, employed online experiments with restricted participant pools, which can limit external validity (19). Without large-scale, real-world observational data or longitudinal follow-ups, it remains unclear whether these experimental trends translate into meaningful public health outcomes over time. A significant issue in this field is the predominance of non-randomized, unblinded designs, which introduces potential performance and detection bias. Studies used survey-based and trace data methodologies, but lacked control groups or blinding mechanisms. This may have influenced participant behavior or introduced observer bias during data collection (20). Moreover, many studies assess user perception and behavior in artificial or simulated search environments, potentially misrepresenting how users interact with search engines under natural conditions, particularly in urgent or emotionally charged situations like disease outbreaks.

Methodological bias is further compounded by the heterogeneity of outcome measures used across the reviewed literature. Some studies focused on behavioral indicators, such as query length or click frequency (21), while others emphasized cognitive outcomes like belief change or trust in information (22). This variability hampers meaningful cross-comparison and synthesis. The lack of standardized metrics for evaluating misinformation exposure, comprehension, and behavioral outcomes creates interpretive inconsistencies, especially when trying to determine the public health significance of the results. Publication bias also appears to be a concern. Most studies that report significant or novel findings—such as the success of AI-based misinformation filtering systems (22,23)—are widely cited, while negative or inconclusive studies are largely absent. This selective reporting may overstate the effectiveness of interventions

© 2025 et al. -Health And Research Insights-Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

and create an overly optimistic view of the current technological landscape. For example, few studies have critically evaluated the long-term usability or cost-effectiveness of browser extensions like SEMiNExt in real-world settings. Additionally, interventions that failed to improve user trust or reduce misinformation spread are underreported, creating an evidence gap around potential harms or limitations of digital solutions.

Generalizability is another key issue. Many reviewed studies are concentrated in Western, English-speaking populations, with little representation from non-English-speaking regions or low-resource settings where health literacy and internet infrastructure differ significantly. This raises questions about the applicability of findings across global populations. For instance, the cognitive and behavioral effects of misinformation warnings may not operate similarly across cultures, given varying trust in institutions and health systems. Studies analyze region-specific responses to health communication, do not account for socioeconomic or racial disparities in information access, which are critical factors in health equity (23,24). Lastly, there is a lack of longitudinal research capturing how prolonged exposure to health misinformation via search engines affects knowledge retention, behavior change, or health outcomes over time. The existing evidence largely focuses on short-term interactions and fails to evaluate whether technological interventions produce lasting improvements in public health literacy or decision-making. This limits the ability to assess causality and long-term impact—two essential aspects of designing effective public health education strategies in the digital environment. In sum, while the current literature offers important insights into how search engines shape public health discourse and behavior, several methodological and structural limitations hinder its robustness. Addressing these gaps through larger, more representative, and methodologically rigorous studies will be vital to developing reliable, scalable interventions that promote evidence-based medicine in the face of digital misinformation.

IMPLICATIONS AND FUTURE DIRECTIONS

The synthesis of current literature on the role of search engines in public health education underscores critical implications for clinical practice, health policy, and future research. As search engines increasingly serve as the public's first point of contact with health information, clinicians must recognize their patients' exposure to both accurate medical guidance and harmful misinformation. Understanding the digital sources patients consult can enhance physician–patient communication, improve shared decision-making, and help clinicians preemptively address false beliefs during consultations. For instance, clinicians should be equipped with strategies to counteract misinformation that patients may have encountered online, particularly regarding vaccination, chronic disease management, or alternative therapies. Incorporating brief assessments of digital health literacy into clinical encounters could guide tailored education, helping patients navigate search results more critically and rely on credible sources. At the policy level, the findings point to an urgent need for regulatory frameworks that ensure health-related search engine content aligns with evidence-based guidelines. Public health authorities should collaborate with technology companies to embed credibility indicators and source authentication tools into search algorithms. Systems like SEMiNExt and large language model–driven platforms such as Vera show promise in reducing exposure to misleading content by filtering and flagging misinformation in real time (25). However, such innovations require policy oversight to ensure transparency, equitable access, and protection against unintended consequences like reduced trust in accurate information, which has been documented with generic warning banners (26). Developing formal guidelines for search engine accountability in health communication, analogous to standards used in pharmaceutical advertising—could be a pivotal step in safeguarding public health.

Despite the growing body of research, several questions remain unanswered. There is a paucity of evidence evaluating the long-term behavioral and health impacts of misinformation encountered through search engines. While studies have shown that search results can influence belief formation and decision-making in the short term (27), little is known about how this exposure evolves over time or interacts with repeated search behavior. Additionally, few studies have addressed the digital health information-seeking patterns of vulnerable populations, including non-English speakers, older adults, and individuals with low health literacy, whose risk of misinformation exposure may be disproportionately high. Understanding how these groups interpret and apply online health content is essential for building inclusive interventions. Future research must adopt more robust and ecologically valid study designs to address these limitations. Large-scale longitudinal cohort studies that track search behaviors, health outcomes, and misinformation exposure over time would provide valuable insight into causal relationships and long-term effects. Moreover, randomized controlled trials evaluating digital literacy interventions—such as teaching patients how to identify credible search results or integrate search training into public health campaigns—are needed to establish evidence-based approaches to combating misinformation. Implementation science methods could also assess the scalability and real-world impact of tools like misinformation notifier extensions or AI-enhanced search platforms across diverse healthcare systems and populations. Additionally, future studies should standardize outcome measures to enable more meaningful cross-study comparisons, particularly regarding behavior change, trust in health systems, and clinical decision-making.

© 2025 et al. -Health And Research Insights-Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

In conclusion, the reviewed literature highlights both the potential and the perils of search engines as tools for public health education. While they offer unprecedented access to medical knowledge, they also serve as conduits for misinformation that can misguide public behavior and undermine evidence-based care. Addressing this dichotomy requires a multifaceted approach—one that integrates clinical vigilance, regulatory innovation, and high-quality, inclusive research. Bridging the gap between digital health access and digital health accuracy is not only a research imperative but also a clinical and societal necessity.

CONCLUSION

This narrative review highlights the dual role of search engines as both facilitators of public health education and conduits for the dissemination of misinformation. While search engines provide rapid access to vast health-related information, they also expose users to inaccurate, misleading, or even harmful content that may conflict with evidence-based medical guidelines. Key findings demonstrate that misinformation density, algorithmic bias, and user trust dynamics significantly influence health behaviors and beliefs, with vulnerable populations being particularly at risk. Technological interventions such as AI-based filters and misinformation notifier tools show promise but are not yet universally implemented or validated across diverse populations. Overall, the existing literature offers valuable insights but remains limited by small sample sizes, short-term study designs, and variability in outcome measures, making the strength of evidence moderate at best. Clinicians should proactively address online misinformation during consultations and support patients in developing critical appraisal skills. Researchers are urged to design large-scale, longitudinal studies that evaluate the long-term behavioral and health outcomes of digital health information-seeking. A concerted effort is needed to integrate clinical, technological, and policy-driven approaches that safeguard public health in the evolving digital landscape.

AUTHOR CONTRIBUTION

Author	Contribution
Awais Ali Ahmad*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Tanzeela Gul	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Aamna Jawed	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Adeel-ur-Rehman	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ayesha Nazir	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Rimal Rashid	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

REFERENCES

1. Bauder L, Giangobbe K, Asgary R. Barriers and Gaps in Effective Health Communication at Both Public Health and Healthcare Delivery Levels During Epidemics and Pandemics; Systematic Review. Disaster Med Public Health Prep. 2023;17:e395.
2. Ittefaq M. Climate Communication, Public Health, and Social Media: Examining the Role of Health Agencies in Addressing the Impacts of Climate Change on Human Health. J Health Commun. 2024;29(sup1):68-76.
3. Chou WS, Gaysynsky A, Vanderpool RC. The COVID-19 Misinfodemic: Moving Beyond Fact-Checking. Health Educ Behav. 2021;48(1):9-13.
4. Parveen S, Pereira AG, Garzon-Orjuela N, McHugh P, Surendran A, Vornhagen H, et al. COVID-19 Public Health Communication on X (Formerly Twitter): Cross-Sectional Study of Message Type, Sentiment, and Source. JMIR Form Res. 2025;9:e59687.

© 2025 et al. -Health And Research Insights-Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.

5. Wang B, Liang B, Chen Q, Wang S, Wang S, Huang Z, et al. COVID-19 Related Early Google Search Behavior and Health Communication in the United States: Panel Data Analysis on Health Measures. Int J Environ Res Public Health. 2023;20(4).
6. Ho SS, Chuah ASF, Ho VS, Rosenthal S, Kim HK, Soh SSH. Crisis and Emergency Risk Communication and Emotional Appeals in COVID-19 Public Health Messaging: Quantitative Content Analysis. J Med Internet Res. 2024;26:e56854.
7. Ceretti E, Covolo L, Cappellini F, Nanni A, Sorosina S, Beatini A, et al. Evaluating the Effectiveness of Internet-Based Communication for Public Health: Systematic Review. J Med Internet Res. 2022;24(9):e38541.
8. Moore JB, Harris JK, Hutti ET. 'Falsehood flies, and the truth comes limping after it': social media and public health. Curr Opin Psychiatry. 2021;34(5):485-90.
9. Berg SH, O'Hara JK, Shortt MT, Thune H, Brønnick KK, Lungu DA, et al. Health authorities' health risk communication with the public during pandemics: a rapid scoping review. BMC Public Health. 2021;21(1):1401.
10. Uddin J, Feng C, Xu J. Health Communication on the Internet: Promoting Public Health and Exploring Disparities in the Generative AI Era. J Med Internet Res. 2025;27:e66032.
11. Park A, Sayed F, Robinson P, Elopre L, Ge Y, Li S, et al. Health Information on Pre-Exposure Prophylaxis From Search Engines and Twitter: Readability Analysis. JMIR Public Health Surveill. 2023;9:e48630.
12. Valenti A, Mirabile M, Cannone E, Boccuni F, Dionisi P, Fortuna G, et al. The Impact of COVID-19 Pandemics on the Development of Health Risk Communication: Challenges and Opportunities. Int J Environ Res Public Health. 2022;20(1).
13. Horváth T, Csupor D, Győrffy Z, Varga Z. [Internet-based health communication opportunities (blogs, podcasts, video channels) and the social media]. Orv Hetil. 2022;163(4):132-9.
14. Nishikawa M, Yamanaka M, Shibanuma A, Kiriya J, Jimba M. Japanese health and safety information for overseas visitors: protocol for a randomized controlled trial. BMC Public Health. 2021;21(1):558.
15. Mheidly N, Fares J. Leveraging media and health communication strategies to overcome the COVID-19 infodemic. J Public Health Policy. 2020;41(4):410-20.
16. Howell EL, Brossard D. (Mis)informed about what? What it means to be a science-literate citizen in a digital world. Proc Natl Acad Sci U S A. 2021;118(15).
17. Edinger A, Valdez D, Walsh-Buhi E, Trueblood JS, Lorenzo-Luaces L, Rutter LA, et al. Misinformation and Public Health Messaging in the Early Stages of the Mpox Outbreak: Mapping the Twitter Narrative With Deep Learning. J Med Internet Res. 2023;25:e43841.
18. Kite J, Chan L, MacKay K, Corbett L, Reyes-Marcelino G, Nguyen B, et al. A Model of Social Media Effects in Public Health Communication Campaigns: Systematic Review. J Med Internet Res. 2023;25:e46345.
19. Zhang D, Hu H, Shi Z, Li B. Perceived Needs Versus Predisposing/Enabling Characteristics in Relation to Internet Cancer Information Seeking Among the US and Chinese Public: Comparative Survey Research. J Med Internet Res. 2021;23(1):e24733.
20. Joshi M, Gupta L. Preparing Infographics for Post-publication Promotion of Research on Social Media. J Korean Med Sci. 2021;36(5):e41.
21. Okuhara T, Ishikawa H, Ueno H, Okada H, Kato M, Kiuchi T. Readability assessment of vaccine information: A systematic review for addressing vaccine hesitancy. Patient Educ Couns. 2022;105(2):331-8.
22. Kalocsányiová E, Essex R, Poulter D. Risk and Health Communication during Covid-19: A Linguistic Landscape Analysis. Health Commun. 2023;38(6):1080-9.
23. Alhassan FM, AlDossary SA. The Saudi Ministry of Health's Twitter Communication Strategies and Public Engagement During the COVID-19 Pandemic: Content Analysis Study. JMIR Public Health Surveill. 2021;7(7):e27942.
24. Tawfik AM, Hayek N, Mahdy SSE, Elsherbiny NM, Salem MR, Taie AFH. Social and self-stigma during COVID-19 pandemic: Egyptians' perspectives. PLoS One. 2023;18(4):e0284582.
25. Yang S, Lee CJ, Beak J. Social Disparities in Online Health-Related Activities and Social Support: Findings from Health Information National Trends Survey. Health Commun. 2023;38(7):1293-304.
26. Chipidza W, Akbaripourdibazar E, Gwanzura T, Gatto NM. Topic Analysis of Traditional and Social Media News Coverage of the Early COVID-19 Pandemic and Implications for Public Health Communication. Disaster Med Public Health Prep. 2022;16(5):1881-8.
27. Ming WK, Huang F, Chen Q, Liang B, Jiao A, Liu T, et al. Understanding Health Communication Through Google Trends and News Coverage for COVID-19: Multinational Study in Eight Countries. JMIR Public Health Surveill. 2021;7(12):e26644.

© 2025 et al. -Health And Research Insights-Open access under CC BY License (Creative Commons). Freely distributable with appropriate citation.