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ORIGINAL ARTICLE

Analysis of health communication research topics based on term clustering

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ABSTRACT

Objective. This study employed term clustering to analyze health communication research topics and to identify thematic groupings, scholarly impact, and term interconnectivity.

Methods. A systematic analysis was conducted using a Scopus dataset comprising terms related to health communication research, accompanied by spatial coordinates, cluster assignments, and impact metrics such as link strength, occurrences, and average citations. The methodology was structured in a way that enabled the presentation of four comprehensive analyses. The following four analyses were conducted: 1) topic cluster analysis to identify and label thematic groupings; 2) impact analysis to evaluate the scholarly influence of different terms using citation metrics; and 3) term connectivity analysis to visualize the network of relationships between terms. The data were processed in several steps, including cleaning and structuring the dataset, interpreting the clusters thematically, and creating a network graph using NetworkX and Matplotlib.

Results. The topic cluster analysis yielded seven discrete research clusters, each representing a primary area of focus. These included the following areas: *adolescent and youth health, behavioral interventions, advocacy and policy, global health, prevention, mental health,* and *digital communication*. The impact analysis evidenced the scholarly significance of key terms such as "behavior change," "advocacy," and "mental health," with robust citation metrics indicating their influence within the field. The connectivity analysis demonstrated a highly interconnected research landscape, with central nodes linking multiple thematic areas, emphasizing the field's multidisciplinary nature.

Conclusions. The field of health communication research is distinguished by a dynamic and evolving panorama that integrates behavioral science, policy influence, cultural competence, and modern technology. The study demonstrates that effective health communication strategies are inherently interdisciplinary, drawing on diverse insights to address a broad spectrum of public health challenges. The findings indicate that future research should continue to capitalize on these interrelated themes, emphasizing comprehensive and responsive communication strategies to address evolving societal needs and achieve meaningful health outcomes.

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1. INTRODUCTION

The field of health communication is undergoing rapid evolution, and it plays a crucial role in addressing the complex challenges that arise in the public health sector. There is a consensus among scholars and practitioners that effective health communication is vital for improving health outcomes, particularly in global crises such as the ongoing pandemic caused by the SARS-CoV-2 virus (de Las Heras-Pedrosa *et al.,* 2022). The necessity for transparent and efficacious communication is more pressing than ever, particularly in the context of misinformation and public health crises, which have brought to light significant deficiencies in current strategies (Lu *et al.,* 2023).

Recent research highlights the multidimensional nature of health communication, with digital platforms such as Reddit and other social media networks emerging as venues for health-related discourse. Britt, Franco, and Jones (2023) emphasize the methodological challenges and opportunities inherent to these platforms, suggesting that they can facilitate large-scale health studies while increasing the potential for the amplification of misinformation. Some research in the Arab world by Bardus, Kabakian-Khasholian, and Kanj (2024) reveals a significant yet uneven growth in health communication studies, with themes such as telemedicine and eHealth gaining prominence post-pandemic. The findings highlight the necessity of incorporating sociocultural contexts into developing efficacious health campaigns.

Moreover, health communication research has experienced a significant transition towards empirical studies, particularly emphasizing pressing issues such as vaccine hesitancy, mental health, and the deployment of eHealth solutions (Cao, Yang & Zhou, 2023). The intellectual structure of the field has expanded to integrate theories from communication, public health, and social sciences, thereby developing frameworks that provide a more comprehensive explanation of communication effectiveness (Makkizadeh & Ebrahimi, 2022). Despite these advances, shortcomings must be addressed, particularly in collaborative endeavors across regions and disciplines. This is evidenced by the paucity of research output in sub-Saharan Africa and parts of the Arab world (Mheidly & Fares, 2020).

The high production of literature on the topic has led to bibliometric exploration by many researchers. Bibliometrics is the quantitative and qualitative study of academic literature to reveal scientific publication patterns. The existing literature on bibliometric studies in health communication provides a comprehensive understanding of the research landscape across various contexts and regions. Mheidly and Fares (2020) underscore the insufficient contribution of low-income countries to global health communication research, underscoring the necessity for augmented investment, particularly in disease prevention initiatives such as HIV awareness. Bardus, Kabakian-Khasholian, and Kanj (2024) examine the landscape of health communication research, noting a recent proliferation of studies, particularly in telemedicine and eHealth. The findings of both studies indicate the need for a more comprehensive analysis to address regional health challenges effectively.

Likewise, in the context of the Arab world, Mheidly and Fares (2020) provide further insight into the limited research output, emphasizing the challenges that impede progress. Moreover, Lu *et al.* (2023) examine the doctor-patient relationship, investigating the impact of social media on communication and trust dynamics. Studies on online platforms also address this topic. Makkizadeh and Ebrahimi (2022) employed co-word analysis to identify relevant research themes, including the COVID-19 pandemic and vaccine hesitancy. This approach elucidates the intellectual structure of health communication. Cao, Yang, and Zhou (2023) delineate health risk perception and communication, emphasizing the preeminence of the United States in research output and recent shifts toward empirical studies on issues like social media and mental health. De

Las Heras-Pedrosa *et al.* (2022) examine the rise in health communication research during the pandemic. They trace evolving themes throughout the pandemic, identifying shortcomings and potential avenues for future inquiry. Meanwhile, Feeley *et al.* (2010) examine citation patterns, demonstrating the pivotal function of the Health Communication journal in connecting communication and health-related research and offering suggestions to enhance its influence. These studies reveal a multifaceted and evolving field marked by regional disparities and the need for improved collaboration and methodological precision.

In this study, we aim to contribute to this body of literature by exploring emerging health communication trends. We will focus on analyzing the field using the term clustering technique.

2. MATERIALS AND METHODS

2.1. Search Strategy and Methodological Approach

We used the Scopus database to extract the sample of articles for topic identification. We used the following search, which was based on accurately and comprehensively retrieving most of the indexed literature on the topic:

> TITLE("health communication") AND PUBYEAR > 1952 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE,"ar") OR LIMIT-TO (DOCTYPE,"ch") OR LIMIT-TO (DOCTYPE,"re") OR LIMIT-TO (DOCTYPE,"cp") OR LIMIT-TO (DOCTYPE,"cr"))

The topic cluster analysis employed a systematic and methodologically rigorous approach to dissecting and interpreting themes within health communication research. The entire process was designed to yield results structured into three distinct analyses: topic cluster analysis, impact analysis, and term connectivity. This comprehensive analysis aimed to elucidate the multifaceted dimensions of the research landscape in health communication from a sample of 1638 documents indexed in Scopus.

The preliminary stage entailed a comprehensive examination of the data set, encompassing an in-depth analysis of the terms, their respective spatial coordinates (x and y), cluster assignments, and a range of impact metrics, including link strength, occurrences, and average citations. The dataset was pre-defined with clusters; each term was linked to a specific cluster based on thematic relevance. The clustering approach was likely based on a term co-occurrence analysis, which determined the frequency with which terms appeared together within research contexts, thereby revealing their thematic associations. Moreover, network analysis proved invaluable in elucidating the strength and configuration of the interconnections between terms, thereby facilitating the identification of discrete research clusters.

The methodology was developed to address each analysis area systematically. Thematic groupings of terms were identified using a topic cluster analysis, with each cluster subsequently labeled based on the joint research themes. For example, clusters comprising terms such as "adolescent," "risk behavior," and "sexual health" were classified under the heading of *Adolescent* or *Risk Behavior* and so on. Subsequently, the clusters were assigned descriptive labels highlighting major research themes. The impact analysis section evaluated the scholarly influence of various terms. This entailed an examination of citation metrics to ascertain which topics had the most significant academic impact. The analysis identified terms with high average citation counts, thereby illustrating the extent to which influential research areas have shaped the field. The analysis also considered terms of significant scholarly importance despite having a lower frequency, thus providing a more nuanced understanding of the research landscape's most impactful elements. A term connectivity analysis employed a network graph to illustrate the interconnections between disparate research themes and terms. Each term was represented as a node, with the node size reflecting the term's total link strength. The edges between nodes indicated the existence of relationships, with the weights representing the strength of these connections. The network visualization facilitated an understanding of the density and complexity of relationships, demonstrating the interdisciplinary nature of health communication research.

2.2. Data Processing Procedures

The data processing procedures were meticulously planned and executed to ensure that the data was in an optimal format for analysis. The initial dataset was found to contain extraneous information, which was subsequently removed. The numerical data, including coordinates, link strengths, and occurrence counts, were converted to the appropriate data types to ensure the accuracy of subsequent calculations and visualizations. Once the data had been cleaned, the clusters were analyzed to ascertain the themes they represented. The topic cluster analysis identified the key terms in each cluster, while frequency and impact metrics were employed to determine the prominence and scholarly influence of these terms. The term connectivity network graph was constructed using the NetworkX library. Node size was determined by total link strength, and edges were drawn to represent connections within and between clusters. The spring layout algorithm positioned nodes by their relationships, creating a transparent and visually organized network. The graph, made using the Matplotlib plotting library, provided a comprehensive visual representation of the research landscape. A significant aspect of the analysis was the qualitative examination of each cluster, which involved identifying and interpreting research themes. This analysis revealed the interconnectivity of health communication research, demonstrating how disparate topics mutually inform one another. The impact analysis employed citation metrics to highlight the academic significance of specific terms.

3. RESULTS AND DISCUSSION

3.1. Topic Cluster Analysis

The topic cluster analysis reveals a structured organization of terms within health communication research, segmented into seven distinct clusters (see Figure 1 and Appendix 1). Each cluster represents a thematic grouping of related concepts, thereby illustrating the diverse focus areas within the field of study. The initial cluster is centered on the topic of *"adolescent and youth health communication,"* which features terms such as "adolescent," "adolescents," "youth," "peer influence," "sexual health," and "risk behavior." This cluster highlights the crucial objective of improving health outcomes

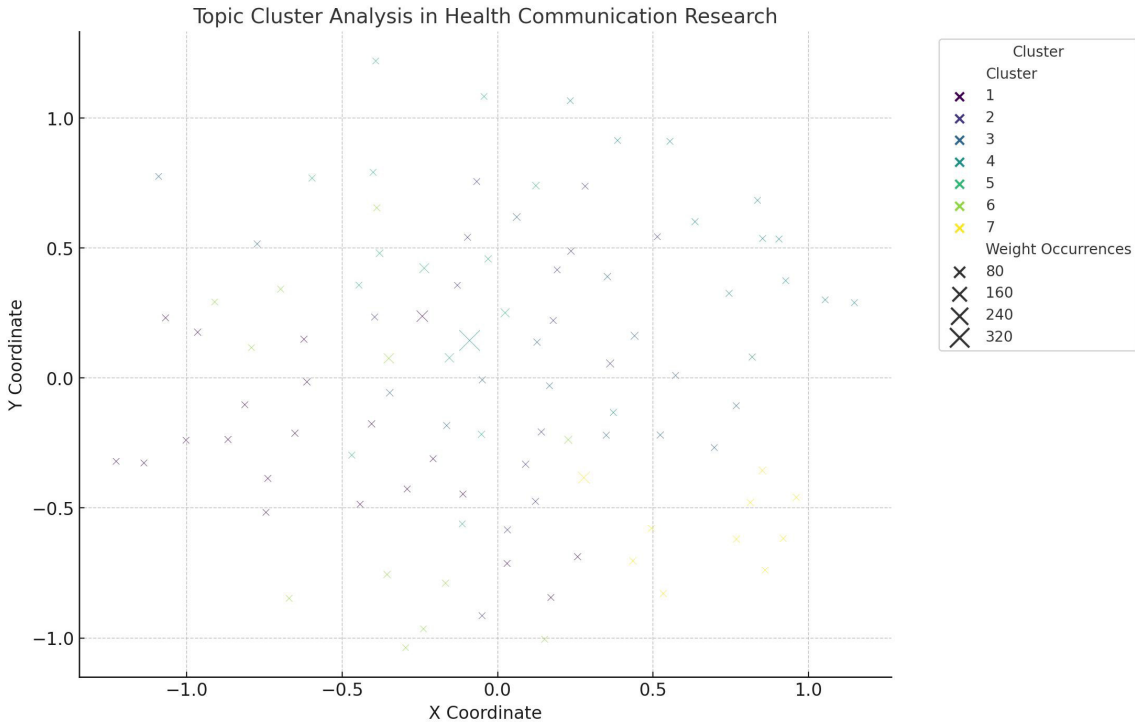

Figure 1. Topic cluster analysis in health communication research.

among younger populations by implementing targeted communication strategies. The prominence of terms related to risk behaviors and sexual health education highlights the critical need to address the unique challenges facing adolescents and ensure that health messages are tailored to resonate with youth. The second cluster, named *"behavioral interventions and communication strategies,"* is anchored by terms such as "behavior change," "intervention strategies," "health campaigns," "motivation," and "self-efficacy." This area of research is concerned with investigating effective health interventions designed to facilitate behavioral change. This area of research examines the potential impact of motivational techniques, self-efficacy theories, and pervasive health campaigns on individual and community health behaviors. The prominence of these terms reflects a fundamental aspect of health communication: the application of behavioral science to enhance health outcomes.

The third cluster, *"health policy and advocacy communication,"* features terms such as "advocacy," "policy change," "community engagement," "public health initiatives," and "grassroots movements." This cluster highlights the potential of communication strategies to influence health policy and empower communities. The research in this area elucidates the role of advocacy in propelling systemic change and emphasizes the significance of community engagement in shaping public health initiatives. The interconnectivity of these terms demonstrates the value of communication in mobilizing populations and informing policy decisions to promote enhanced health outcomes.

The fourth cluster, *"global health communication and equity,"* is concerned with developing cultural competence and reducing health disparities. The terms "Africa," "global health," "cultural competence," "language barriers," and "health disparities" are included in the analysis. This area of research addresses the global dimensions of health communication, particularly emphasizing the importance of delivering effective health messages across a range of cultural contexts. The terms indicate a pronounced focus on overcoming obstacles to healthcare access and developing culturally responsive communication strategies to enhance health equity on a global scale.

The fifth cluster, *"preventive health communication and risk management,"* comprises terms such as "prevention," "screening programs," "vaccination," "risk communication," and "public awareness." This cluster emphasizes the proactive nature of health communication, focusing on preventive measures and public education. This research area aims to increase awareness of health risks and encourage adopting preventive practices, such as vaccination and regular health screenings. The emphasis on risk communication underscores the necessity of effectively informing the public about potential health threats and providing guidance on managing these risks.

The sixth cluster, *"mental health communication and support strategies,"* encompasses terms such as "mental health," "stigma reduction," "counseling," "workplace wellness," and "emotional support." This area of research examines the potential of communication to address mental health challenges, reduce stigma, and foster emotional well-being. The emphasis on stigma reduction and workplace wellness reflects a holistic approach to mental health, emphasizing the role of supportive environments and effective counseling in promoting overall well-being.

The final cluster, named *"digital health communication and technology,"* encompasses terms such as "digital communication," "social media," "engagement," "misinformation," and "telemedicine." This cluster illustrates the growing influence of technology on health communication. The objective of research in this area is to ascertain how digital platforms can be utilized to engage with the public, disseminate accurate health information, and combat the spread of misinformation. The appearance of "telemedicine" illustrates the convergence of healthcare and digital communication, particularly in light of the growing reliance on virtual healthcare solutions in recent years.

3.2. Impact Analysis

The scatter plot demonstrates which topics have significantly influenced the research landscape, as indicated by higher average citation counts (See Figure 2 and Appendix 1). Terms that are both highly prevalent and have a high average citation count are likely to represent

areas of significant influence and extensive research within the field of health communication. Clusters offer further insight into whether specific thematic groups are associated with more impactful research. The impact analysis provides a more detailed and nuanced perspective on the topics within health communication research that have exerted the most significant influence on the scholarly landscape. It does so by employing citation metrics in addition to the frequency of occurrences. One of the most frequently cited terms is "behavior change," which has maintained a robust presence in the scholarly literature. This term, pivotal in numerous health communication studies, has an impressive average citation count of 58.4. The high citation rate indicates that research on behavior change is pervasive and foundational, contributing critical insights and practical models referenced extensively in the academic community. The prominence of "behavior change" on the map indicates that this topic is intricately linked with numerous other clusters, underscoring its pivotal role in developing communication strategies that promote healthier lifestyles and prevent disease.

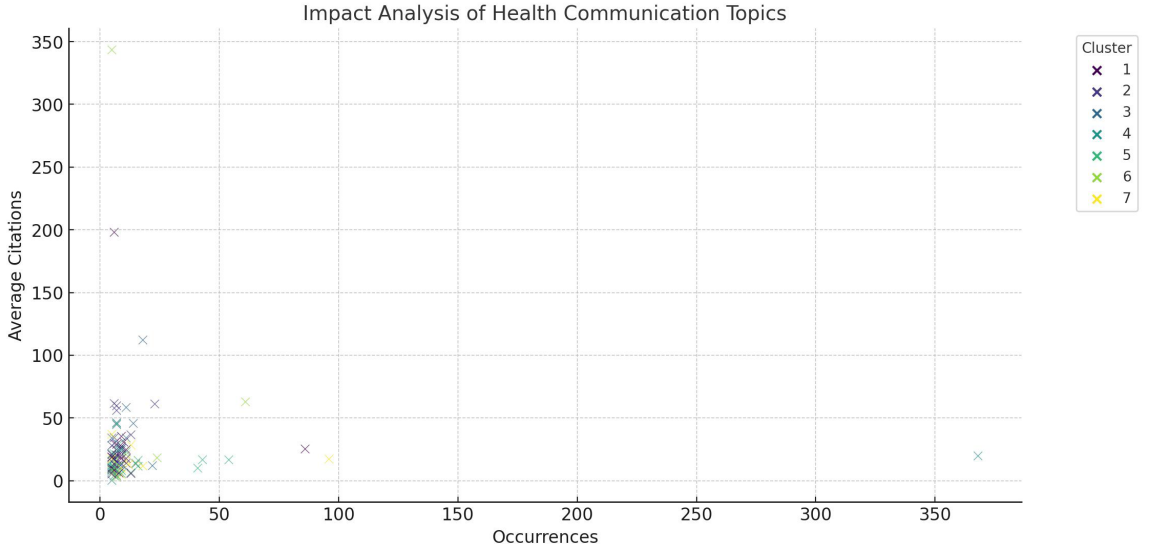

Figure 2. Impact analysis of health communication topics.

Another frequently cited term is "adolescent," with an average citation rate of 17.8. This term, in conjunction with "adolescents" (average citation rate: 16.2), demonstrates the profound influence of research on youth health. Despite a moderate frequency of occurrences, these terms command significant academic attention, underscoring the relevance of studies focused on adolescent well-being and health behavior. The appearance of these terms on the map demonstrates a substantial commitment to investigating how communication interventions can address the distinctive challenges younger populations face.

"Advocacy" is another term that, although not among the most frequent, has made a substantial impact, with an average citation rate of 7.0. The map's inclusion of this term signifies the paramount importance of research centered on health policy and community engagement. The study of advocacy is of great importance in understanding how communication can influence health policy, drive social change, and mobilize communities. The relatively high citation impact indicates that this research has substantially influenced the development of public health initiatives and the formulation of effective community outreach and policy influence strategies. It is also noteworthy that the term "Africa" (average citation rate: 4.8) has significantly impacted scholarship. Research in the field of global health, as indicated by the presence of the continent of Africa on the map, addresses critical health disparities and explores the application of culturally relevant communication strategies. The considerable academic attention devoted to these studies highlights the global relevance of health communication,

particularly in addressing inequities in healthcare access and outcomes. The appearance of this term on the map links it to discussions on international health interventions and the necessity for bespoke communication strategies in diverse cultural contexts.

A particularly impactful yet less frequent term is "behavioral interventions," which is likely to appear within the same cluster as "behavior change". Research in this area concerns evaluating and enhancing the efficacy of health communication strategies. This topic contributes to the understanding of designing effective interventions that lead to sustained behavior modification. While not the most frequently cited term, its appearance on the map highlights the practical application of communication research in real-world public health contexts.

The impact analysis reveals that while specific terms, such as "behavior change," are prevalent in terms of frequency and citations, others, including "advocacy" and "Africa," have made a notable impact on the scholarly landscape despite appearing less frequently. These highly cited terms highlight areas of research that have made substantial contributions to the field, influencing how health communication is studied and applied.

3.3. Term Connectivity Analysis

Figure 3 illustrates the strength of the interconnections between terms within health communication research. The magnitude of the points indicates the strength of the link between the terms, thereby suggesting that they represent central themes or are highly interconnected with other research topics. The clustering offers further insight into the thematic grouping of these terms.

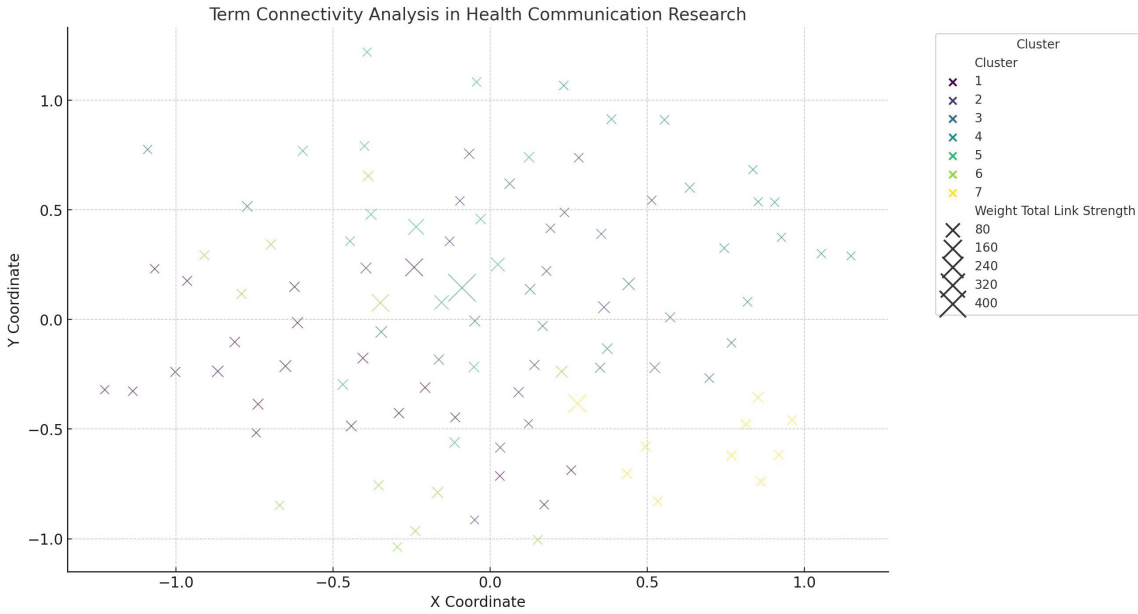

Figure 3. Term connectivity analysis in health communication research.

In addition to the frequently discussed terms such as "behavior change" and "adolescent," other significant terms emerge with meaningful linkages that shape the field. To illustrate, the term "advocacy" remains well-connected. However, there are also crucial linkages to terms such as "policy" and "community health," which reflect a more expansive research agenda oriented towards systemic transformation and community-level interventions. The link between "advocacy" and "policy" indicates a focus within the research domain on the utilization of health communication strategies to influence decision-makers, promote health equity, and drive legislative change. Furthermore, the link to "community health" highlights initiatives to engage with local communities and implement strategies for health communication from the grassroots level to empower communities to influence their health outcomes.

The term "prevention" is of crucial importance, with significant interconnectivity, directly linking to terms such as "disease control," "risk communication," and "screening programs." The prominence of "prevention" as a highly connected term underscores the proactive character of health communication, which is focused on strategies designed to prevent the onset of health problems. The connection to "risk communication" suggests investigating optimal strategies for disseminating information and educating the public about potential health hazards, including infectious diseases and lifestyle-related illnesses. This interconnection is essential in crisis communication and public health preparedness, where disseminating timely and compelling messaging can mitigate the impact of health emergencies.

The term "health literacy" is a prominent feature on the map and is closely associated with other key concepts, including "education," "accessibility," and "patient empowerment." These connections indicate a need for research to ensure individuals possess the requisite knowledge and understanding to make informed health decisions. The interconnection between "health literacy" and "education" highlights the significance of educational initiatives in augmenting public comprehension of health-related matters. The term "accessibility" indicates a need for research on overcoming the barriers that prevent people from accessing reliable health information, which is crucial for marginalized and vulnerable populations. Furthermore, the connection with "patient empowerment" highlights the importance of equipping individuals with the necessary skills and confidence to take an active role in their healthcare.

"Mental health" is another pivotal term with extensive interconnections. This links to topics such as "stigma reduction," "counseling services," and "workplace wellness," indicating an integrated approach to addressing mental health issues through communication. The connection to "stigma reduction" suggests a necessity for research into how communication can be utilized to modify societal attitudes toward mental health, thereby creating a more supportive and understanding environment. The references to "counseling services" underscore the significance of communication in providing mental health assistance, whether through conventional channels or digital platforms. The link to "workplace wellness" illustrates an emerging awareness of the imperative to advance mental health in professional settings. This necessitates implementing communication techniques that facilitate a harmonious work-life equilibrium and enhance the well-being of employees.

The terms "digital communication" and "social media" are also closely interrelated, underscoring the transition towards contemporary communication platforms in public health messaging. The term "digital communication" is associated with other key concepts such as "engagement," "misinformation," and "telemedicine," indicating a growing body of research exploring the opportunities and challenges presented by digital health technologies. The link to "engagement" reflects studies on the most effective methods for capturing and maintaining public interest in health messages delivered through digital media. The link to "misinformation" indicates an increasing concern about disseminating false health information online and the necessity for strategies to address this issue. The term "telemedicine" illustrates the convergence of health communication with technology, particularly in the growing reliance on virtual healthcare solutions.

Another term worthy of note is "cultural competence," which is linked to "ethnic disparities," "language barriers," and "community partnerships." These interconnections highlight the imperative of modifying health communication strategies to align with diverse cultural contexts, optimizing health outcomes for heterogeneous population groups. The concept of "cultural competence" is frequently the subject of research, which has demonstrated that understanding and respecting cultural variations can enhance the efficacy of health messages, particularly in multicultural societies. The link to "community partnerships" highlights the importance of working with local leaders and organizations to develop culturally appropriate and effective health messages in collaboration. Meanwhile, the concept of "health equity" is a significant aspect of this field of study, with connections to related terms such as "socioeconomic status," "universal healthcare," and "barriers to care." This indicates a focus on reducing health disparities and ensuring equitable

access to health resources for all individuals. The link to "socioeconomic status" indicates research into the influence of economic factors on health outcomes and the capacity of communication to address these disparities. The term "universal healthcare" suggests that studies are being conducted on the role of health communication in advocating for policies that provide equitable healthcare coverage.

4. CONCLUSION

Our study on health communication reveals a complex and interconnected field comprising many interlinked thematic clusters. The integration of behavioral science, policy influence, cultural competence, and modern technology underscores a field that is both adaptable and comprehensive. Through strategic and multidisciplinary approaches, it addresses a wide range of public health challenges.

The terms "behavior change," "advocacy," and "mental health" are not only central to the field of health communication but also highly influential, as evidenced by their high rates of citation. The network of connections between these terms illustrates the complexity and breadth of health communication research, emphasizing the necessity of a holistic approach to understanding the field. It is recommended that future research continue to build on these interconnected themes, leveraging technological advancements and addressing global health disparities. The findings emphasize the necessity for effective health communication to be comprehensive, drawing on a range of insights to develop effective strategies across different demographics and cultural contexts.

Conflict of interests

The authors declare that there are no conflicts of interest.

Contribution statement

Conceptualization, formal analysis, investigation, and methodology: Elsa Carmen Oscuvilca Tapia, Fredy Ruperto Bermejo Sánchez

Software, supervision: Efraín Ademar Estrada Choque, Miriam Milagros Noreña Lucho, Fredy Ruperto Bermejo Sánchez.

Writing - review & editing: Elsa Carmen Oscuvilca Tapia, Miriam Milagros Noreña Lucho.

Statement of data consent

The data generated during the development of this study has been included in the manuscript. ●

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APPENDIX

Appendix 1. Frequency and citation of top five terms per cluster.

Term	Cluster	Frequency	Citations
covid-19	1	86	25.2
prevention		13	5.6
social marketing		11	24.7
vaccination		11	17.7
coronavirus		10	30.8
internet	2	23	61.1
health communications		13	36.5
knowledge		11	13.9
hiv		10	11.8
sexual health communication		9	20.2
health education	3	22	11.9
persuasion		18	112.1
health information		15	13.4
health disparities		14	45.6
behavior change		11	58.3
health communication	4	368	19.7
diabetes		9	24.3
mental health		9	8.1
hiv/aids		8	11.2
primary care		8	24.5
public health	5	54	16.6
health promotion		43	16.6
health literacy		41	10
public health communication		16	16.1
risk communication		16	11.5
social media	6	61	62.8
health		24	18.2
e-health		15	14.1
healthcare		11	20.8
digital health		8	11.8
communication	7	96	17.1
sexual health		18	11.5
cancer		13	28.4
parents		12	12.8
adolescents		11	16.1