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Evaluating the Impact of Risk Communication as A Disaster Preventive and Mitigatory Strategy During the Covid-19 Outbreak in Zimbabwe (2019-2023)

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ABSTRACT

During the COVID-19 pandemic, declared in March 2020, global governments enacted measures like lockdowns. However, the importance of risk perception and communication in promoting health behaviors was underestimated, leading to significant consequences. This study, using a mixed-methods approach with 2290 survey participants, 8 focus groups, and interviews, tested three hypotheses: the effect of risk communication on risk perception (H1), its use in pandemic mitigation (H2), and its positive correlation with protective actions (H3). It examined how risk communication influences behaviors, morbidity, and mortality, and its adjustment for different social groups. Theoretical frameworks used included the Risk Communication Model, Protection Motivation Theory, and the Health Belief Model. Findings affirmed the hypotheses, showing risk communication's pivotal role in changing perceptions and behaviors. It is vital for community engagement, behavior modification, and reducing morbidity and mortality. The study also revealed that risk communication was underused until the pandemic's second wave, underscoring the need for governments to enhance efforts and reach remote areas. In addition to pharmaceutical interventions, lockdowns, and quarantines, the study indicated that risk communication and risk perception are crucial for raising community participation, altering behavior, reducing morbidity and death, and encouraging protective actions. To successfully alter risk perception during disasters as the pandemic and laws evolve, the study recommends the need to tailor risk communication to the needs of various social groups. Governments should focus on risk communication, adapt strategies for diverse groups, and provide specific information for successful risk perception management during crises.

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Introduction

Effective community participation is essential to alter risk perceptions and behaviors to mitigate future health emergencies such as the coronavirus 2019 (COVID-19) pandemic. Timely risk communication plays a crucial role in curbing the spread by influencing public responses. COVID-19 spread globally despite the implementation of non-pharmaceutical interventions (NPIs) such as quarantines [1]. People and economies significantly suffered as a complex international public health emergency emerged with dire consequences. As advanced economies struggled, Zimbabwe initially watched from the sidelines as its preparatory plan was announced pre-emptively [2]. However, low-risk awareness and inadequate early communications implied that authorities saw little threat. This contrasted with the gravity of outbreaks observed internationally, including in nations with stronger healthcare systems [3].

Stricter NPIs were eventually implemented nationally, including school/gathering closures and lockdowns. However, policies proved inadequate without complementary risk communication strategies to encourage positive behaviors [4]. Countries successfully utilizing two-way risk messaging witnessed the curbing of transmissions [5,6]. Many countries encountered second waves despite initial responses, indicating persistent problems [3]. Mortality remained lower where stricter restrictions endured (Iran, China, Britain and Australia). This stresses the need for coordinated, enduring policy packages which integrate evidence-based public health programs with culturally sensitive communication planning. As outbreaks evolve rapidly, strategic policy reviews and adaptation become vital to sustaining gains across health, economic, and social impacts.

Literature Review

The role of risk communication is increasingly recognized as pivotal in managing public health emergencies, such as pandemics. Several studies have examined how risk communication influences risk perceptions and protective health behaviors. Malecki et al. analysed outbreak responses across 10 countries and discovered that risk communication significantly impacted virus transmission rates by informing the public and countering misinformation [7]. Chu et al. conducted a systematic review and meta-analysis of 172 research studies investigating non-pharmaceutical interventions for curbing infectious disease spread [8]. Their analysis identified risk communication as one of the most impactful approaches. The authors examined optimal physical distancing, face mask

usage, and eye protection to prevent coronavirus transmission according to data from 21 World Health Organization (WHO) and COVID-19 sources across 16 nations and six continents. No randomized controlled trials were identified, with 44 comparative healthcare and community-based studies included involving over 25,697 patients [9]. However, there remains a gap in understanding the nuanced mechanisms for this influence across different socio-economic contexts, further, they did not expose the impact of information access, a gap this study will fill.

Several countries leveraged risk communication strategies successfully during the COVID-19 pandemic. In Southeast Asia and Central Africa, Singapore, South Korea, and Rwanda widely disseminated consistent, fact-based messaging using diverse platforms [10]. These nations provided near real-time guidance to the public through press briefings, websites, social media, and community engagement tools. Comprehensive risk communication approaches were observed as capable of boosting the understanding of risks and recommended behaviors among populations. Similarly, Malaysia harnessed its digital governance infrastructure established under initiatives outlined by Abdul et al., to share COVID-19 updates and directives nationwide. Yet, these authors seem to primarily focus on high-income countries or regions with robust digital infrastructure. The present study aims to bridge this gap by examining the effectiveness of risk communication strategies in a lower-income, high-diversity setting like Zimbabwe. It seeks to understand how communication-related barriers can be overcome to enhance public cooperation and emergency preparedness. The goal is to provide novel insights into the interplay between risk communication, access to information and factors like public trust, health system capacities, and socio-economic challenges, which have been less explored in the context of African nations.

Risk communication has been vital for mitigating the widespread health, social, and economic impacts of the COVID-19 pandemic globally. However, some regions struggled more than others with containment efforts partly because of inadequate public cooperation stemming from poor risk communication [4]. Scholarly views differ on factors influencing outbreak outcomes. While risk communication is emphasized as shaping risk perceptions and adherence to guidelines, others maintain that the success of communication strategies depends on pre-existing public trust in authorities and resources or capacities within health systems [11,12]. Case studies of African nations have also highlighted gaps in risk communication exacerbating outbreaks on the continent. A study by Agyeman, Laar and Ofori-Asenso argues that effective communication of crisis and risk information is particularly important in developing regions like Africa, where diversity and poverty present additional challenges to coordinated pandemic responses [12]. While countries have adopted various approaches, the authors note that building credibility and transparency through trustworthy messaging remains vital given the fragile health infrastructures and pre-existing disease burdens. This study seeks to provide insights into communication-related barriers faced in Zimbabwe and how overcoming such challenges could strengthen future emergency preparedness and management.

There is even more scholarly divergence regarding the influence ofrisk communication on other contextual factors. Several studies emphasize its impact on enhancing risk perceptions and adherence to recommended precautions. For example, Ning et al. found that on average 71% of respondents embraced protective behaviors associated with accurate knowledge, perceiving high severity, strong negative emotions, good health, high attention to government media, and trust in such sources. Women and older groups also demonstrated a greater likelihood of adopting precautions [13]. However, Karasne et al. revealed that pharmacists' disease awareness, risk perception, and reliance on media influences are shaped by demographic and information exposure factors [14]. Others contend that the success of communication relies on pre-existing capacities like robust healthcare systems, stable infrastructure, adequate resourcing, and high societal trust in authorities as highlighted by Samuel et al. [15]. Recent research underlines that pandemic models require integrated policy, community resilience, and infrastructure programming alongside optimized risk communication to drive outcomes, as discussed in Lal et al. [16]. This ongoing debate reflects risk communication's complex interdependence on wider determinants, with neither broadly prioritized over others as sole determinants of outbreak impacts. This study will contribute to the discourse on the relative influence of risk communication compared to other contextual factors.

Risk Communication Model

This model focuses on the processes of receiving, understanding, and acting on warnings [17]. This model was instrumental in analysing the evolution of Zimbabwe's crisis communication and assessing the effectiveness of different communication stages. The model's emphasis on message framing and the credibility of messengers is crucial for evaluating how these elements contribute to the formation of RPs, and the motivation to engage in protective behaviors [18].

Mediation and Moderation in the Theoretical Framework

The integration of these models facilitates the examination of potential mediation and moderation relationships within the study. For instance, the HBM and PMT allow the exploration of how trust in information sources (a potential mediator) can influence the relationship between risk communication and protective behaviors. Similarly, demographic factors like rural-urban differences (potential moderators) can affect the strength or direction of these relationships. The chosen models thus provide a bedrock upon which to understand the multifaceted nature of risk communication and its effects on public health outcomes.

Link between Risk Communication and Perception

Schmälzle, Renner, and Schupp confirm a relationship between risk communication and risk perception, with the latter enabling protective actions [19]. Other studies also demonstrate risk communication's influence on shaping risk perception [20-22]. Schmälzle, Renner, and Schupp further credit risk perception as a prerequisite for implementing protective measures [19]. While cultural views or misunderstandings of danger could expose populations, involvement in risk decision-making requires comprehending different risk perceptions [23]. Theoretical risk communication models are commonly applied across fields due to the complexity of how humans interpret probabilistic risk data [24]. For example, public risk perception significantly depends on message framing, communicators, and channels [25].

However, cross-cultural variation leads to systematic discrepancies in risk perception determining crisis responses over objective danger [25]. Early in disease outbreaks, media serves as the primary risk communication source impacting initial risk cognition [26]. Trust enables organizations and the media to simplify uncertainty [26,27]. Challenges facing risk perception projects include correctly understanding public perceptions for effective messaging and balancing sufficient concern without causing undue anxiety [21,28]. Addressing this bi-directional relationship

between risk communication and perception could better enable mitigating events through two hypotheses:
H1: RC influences risk perception during pandemics.
H2: RC and RP have mitigatory and preventive capacity during pandemics.

Risk Communication and Risk Mitigation

The purpose of risk communication is to enable informed decision-making that decreases hazard impacts like disease [29]. The aim of risk communication is for those at risk to make choices that reduce their vulnerability and protect others from threats [29]. Timely information allows preventive and mitigating actions. Modern risk communication activities change behaviors and attitudes [30]. Crisis communication poses the greatest challenges during pandemics [31].

Risk communication can raise awareness, and knowledge and alter the behaviors/attitudes of stakeholders including the exposed, specialists, decision-makers, the public, and the media [9]. Comprehending stakeholder opinions, concerns, abilities, and routines is integral to effectively preventing and mitigating risks through communication [9]. Early identification and handling of misinformation are also important for risk management according to WHO [9]. Understanding diverse stakeholder perspectives facilitates the tailoring of messages to drive well-informed, appropriate responses. When communication addresses information needs and challenges while building understanding across demographics, it can transform risk perception and actions [9]. However, unchallenged misinformation threatens effective communication. This emphasizes the importance of bidirectional dialogue to build consensus, align crisis response, and handle rumours. Such strategies, when underpinned by deep engagement with populations, inform the third hypothesis:
H3: There is a significant positive relationship between risk communication and protective/preventive behaviors.

Research Methods

Study Design and Sampling

The study employed a convergent parallel mixed methods design which enabled the simultaneous collection of both quantitative and qualitative data to analyse the impact of risk communication during the COVID-19 outbreak in Zimbabwe. For the qualitative part, 25 key informant interviews were conducted with health officials, policymakers and community leaders who were selected via purposive sampling to gather diverse perspectives about the risk communication strategies in place. The selection criteria were related to their roles in health communication during the period under study, willingness to participate and ability to provide informed consent. An additional 25 participants who had recovered from COVID-19 were interviewed using a semi-structured interview format to capture their in-depth personal experiences and responses to public health messaging. These participants were selected based on confirmed COVID-19 diagnosis, recovery status, and consent to share their experiences.

Survey Development and Administration

An online questionnaire was developed with initial items generated from a literature review and consultations with experts from epidemiology, communication studies and sociology. The questionnaire was translated into the 16 recognized Zimbabwean languages by certified translators to ensure cultural relevance and comprehension [32,33]. Back-translation methods were implemented to maintain the integrity of the survey content. A pilot test was conducted with 100 participants before distributing the questionnaires to refine questions for clarity and to establish construct validity and internal consistency using a Cronbach's alpha target of 0.7 or above, indicating acceptable reliability. The final survey was administered remotely to 2500 adults using KoboToolbox, selected for its secure data transmission, storage and data analysis features. The platform had a robust data management system that facilitated real-time monitoring of survey responses and data quality. The survey achieved an overall response rate of 91.6% (n = 2290). Participants for the survey were chosen via a stratified random sampling method to ensure representation across different demographics like age, gender and geographic location.

Measures

The sections of the survey assessed public awareness of COVID-19 symptoms, transmission and preventive measures, social media usage patterns in seeking COVID-19 information, community satisfaction with the communication efforts of local authorities, reliability of information sources, and clarity and consistency of received information. Participants' protective/preventive behaviors, risk communication (RC) engagement, and risk perception (RP) were measured using Likert scales. A risk information diversity score (see Table 1) was calculated based on various media sources accessed by participants to determine the breadth of their information exposure.

Table 1: Information Diversity Scale

Medium	Score
Electronic media	4
Newspaper	3
Social media	2
Hear from others	1

The Risk Diversity Score was conceptualized based on the premise that access to a variety of sources can lead to a more informed decision-making. The scoring system was based on the hypothesis that individuals with a higher diversity score (closer to 10) have access to a wider range of perspectives and information, which could influence their risk perception and engagement in preventative behaviors. This is grounded in the Diffusions of Innovation theory, which suggests that diverse communication channels can enhance the spread of fresh ideas and practices [34]. The conceptualization and calculation of the Risk Diversity Score represent an innovative approach to assessing information exposure and its potential impact on risk perception and engagement in preventive behaviors. Grounded in the Diffusions of Innovation theory, this scoring system acknowledges the importance of diverse communication channels in fostering informed decision-making and behavior change, this is supported by Chen [34,35].

Data Processing Procedures and Analysis

Statistical analyses were conducted using IBM SPSS Version 22 and R Studio 4.3.3 for the multiple-group SEM modeling. Chi-square testing was used to determine correlations between RC, changes in risk perception, and the adoption of behavioral measures. The significance level was set at 0.05. The causal relationships between the dependent variable (behavioral change) and independent variables (diversity of communication and risk perception) were examined using path analysis.

Ethics

Ethical considerations were paramount throughout the study. Approval was granted by the Midlands State University Research Ethics Committee, Faculty of Arts and Humanities. All participants were informed about the research objectives, procedures, potential

risks, and benefits, and provided informed verbal consent. Moreover, participants were assured of their right to withdraw from the study at any time without repercussions. Documentation of the consent process is maintained and can be provided upon request.

Conceptual Framework

A framework (see Figure1) examined the 3 hypotheses relating to RC, RP, and protective/preventive behaviors

Figure 1: Framework of Analysis

Source: Author (2024)

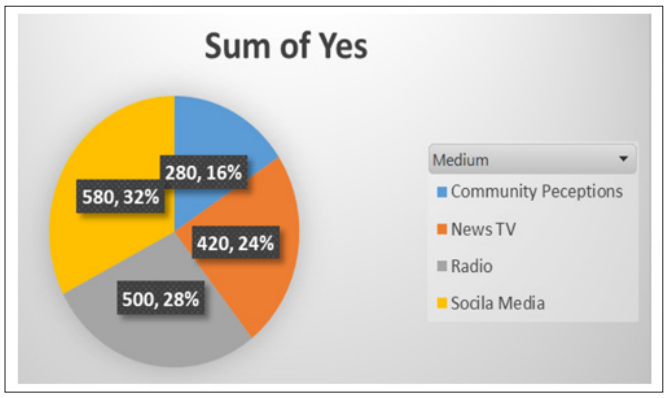

Figure 2: Effectiveness of Communication Medium in Changing Risk Perceptions and Behaviors

Source: Author (2024)

Respondents were asked on whether the medium of communication was believable and able to make them change their risk perceptions and behaviors during the second wave using yes and no. Respondents were expected to change their perceptions and behaviors. The response was positive (see Figure 2). It emerged that 73.6% of the 2290 respondents who responded to the questionnaire reported having changed their perception after they got educated through risk communication on various mediums, while 22.2 % highlighted that they did not change their perception based on what the news channels or the social media channelled out. 32% seemed to believe that social media was trustworthy as compared to trusting the National TV information. Radio channels managed to change perception better than Television and this could be due to its reach and the use of community radio stations.

The study discovered that the information source affected the effectiveness of risk communication messages during the COVID-19 pandemic. Participants were more inclined to adhere to non-pharmaceutical strategies and believe the information they obtained from trustworthy community leaders or healthcare providers. Participants were less inclined to adhere to non-pharmaceutical strategies and trust the information acquired from social media or unofficial sources. These findings underscore the importance of including reliable information sources in risk communication messaging during a pandemic. To provide the public with accurate and timely information, healthcare professionals and community leaders can be important sources of information. Healthcare practitioners and community leaders can foster adherence to non-pharmaceutical approaches by communicating clear, consistent messages that are in accordance with public health recommendations.

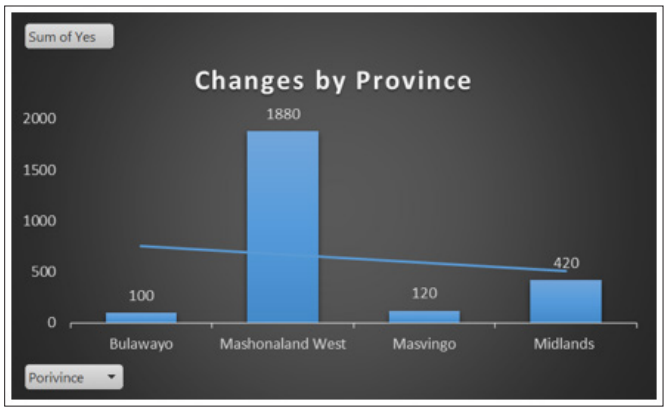

Figure 3: Bar Chart showing Percentage Change in Perception by Region

Source: Author (2024)

A survey comparison of perception change among Mashonaland West, Masvingo, Bulawayo, and Midlands provinces showed that Midlands scored higher in behavior change and risk perception, while Mashonaland West, Masvingo, and Bulawayo had more people who seemed to resist change (see Figure 3).

The Survey was followed up by interviews which revealed that some people perceived that they were not contagious, which again reflects resistance to changing how they perceived the contagious nature of COVID-19. Others emphasized that, despite the financial difficulties, they were responsible for supporting their families and were reluctant to be separated from them. There was a statistically significant ($p<0.05$) difference between the individuals who changed their perception and behavior and those who did not. Within the same framework, access to risk communication and geographic location were significantly correlated. The risk information diversity score indicates that people in urban regions have a variety of communication channels, which caused them to alter their behavior and perspectives. Therefore, the impact on risk perception and behavior modification increases with the diversity of communication modalities.

The foregoing assertion was tested using degrees of freedom (r-1) (c-1) and a significance threshold of $\alpha = 0.05$.

$$X^2_{critical}(2;\ 0.05)=5.99$$

At the 5% level of significance, there is sufficient data to draw the conclusion that a person's location affects their access to RC. Moreover, the degree of trust and the informational channel or medium being used influence how risk perceptions and behaviors are changed to mitigate it. In reacting to the epidemic, governments, medical associations, health organizations, businesses, and the general public encountered formidable challenges due to the harm caused by COVID-19 to the population and economic health.

Discussion of Research Findings

Given the prevalence of misinformation related to diseases, governments and health organizations must exercise caution when disseminating current evidence-based information to the public. The rate of case prevalence and the generation of COVID-19 virus variants could have been reduced by following nationalized WHO guidelines and recommendations as well as other endogenous national-level public health policies with the help of preventative behaviors stimulated by RC.

Data from the interviews further confirmed the findings of the survey by highlighting that people performed poorly on measures that called for behavioral change. For instance, people in urban regions behaved better than those in rural areas in terms of avoiding physical contact, but less so in terms of maintaining good hand hygiene and refraining from touching their eyes, nose, or mouth. Although both interventions required behavioral modification, social distancing had legal enforcement, which accounts for the high level of adherence in urban areas while enforcement was patchy in rural regions at the time the pandemic began, because there was no strict enforcement of the guidelines and serious policing. The aforementioned is additionally backed by several academic works. Walters-Salas's study titled, "The Challenge of Patient Adherence," demonstrates that non-adherence is common, particularly when advice calls for behavioral changes [36]. People must adhere to prescribed measures during a pandemic, even if they are not legally required. This can be achieved by using an efficient and effective RC.

Table 2: Adherence to Non Pharmaceutical Strategies by Percentage of Participants Who Followed Recommended Guidelines

Message type	Percentage of participants who adhered to non-pharmaceutical strategies
Healthcare professionals	80%
Trusted community leaders	75%
Government	60%
Social media	40%
Informal sources	30%

Table 2 presents the adherence rates to non-pharmaceutical strategies among participants, segmented by the type of message received. The data indicates that communications from healthcare experts and credible community leaders were most effective, with adherence rates of 80% and 75%, respectively. In contrast, government-issued messages saw a lower compliance rate of 60%. Messages disseminated through informal channels and social media were least effective, with adherence rates of only 40% and 30%, respectively. This disparity highlights the critical role of trustworthy information sources in risk communication during a pandemic. Clear and consistent messaging from healthcare professionals and community leaders, aligned with public health guidelines, has been shown to promote adherence to non-pharmaceutical measures. However, information from unofficial sources, such as social media, may lack credibility and even propagate misinformation.

Our findings echo those of Latkin et al. who initially reported high trust levels in information from state health departments, the CDC, and academic institutions like Johns Hopkins University [37]. This trust correlates with the higher adherence rates we observed in response to messages from healthcare authorities and community leaders. The subsequent decline in trust identified by Latkin et al., particularly towards the CDC and the White House, mirrors the reduced adherence to government messages noted in our study. These observations suggest that public trust in the source of information is paramount for ensuring compliance with health guidelines. Moreover, Latkin et al.'s identification of political affiliation, educational attainment, and COVID-19 skepticism as determinants of trust in information sources provides further insight [37]. These factors may also influence the varying adherence levels observed in our research. In light of this, we recommend that future risk communication strategies be tailored to account for these variables. Through engaging trusted sources and customizing messages to bridge political and educational gaps, it is possible to enhance adherence to non-pharmaceutical interventions and better manage public health crises.

Figure 4 highlights the value of utilizing reliable information sources for disseminating risk communication information during a pandemic. Healthcare practitioners and community leaders can foster adherence to non-pharmaceutical approaches by communicating clear, consistent messages that are in line with public health recommendations. Messages from unofficial sources like social media, however, may not be as trustworthy and may even spread false information.

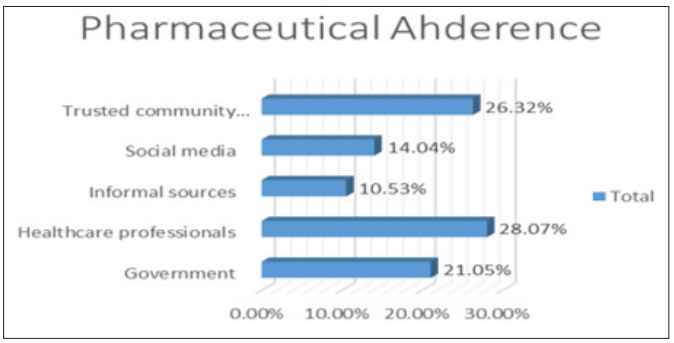

Figure 4: Bar Chart Showing Percentage Change in Perception by Message Type

Source: Author (2024)

The WHO guidelines, which advised people to practice hygiene and physical contact precautions, were encouraged by the Zimbabwean government, as it was determined that droplets and aerosols are the primary means of transmission for coronavirus. The vaccination was initiated; however because of false information and myths (conspiracy theories) regarding its safety, herd immunity was a challenge to achieve hence the need for proper RC. Through RC, it is necessary to emphasize the significance of non-pharmaceutical interventions such as social distancing, using protective gear like face masks, and other hygiene practices in containing the coronavirus [9]. The findings of this study align with data from a 2020 pan-European survey which examined the efficiency and effectiveness of the WHO's risk communication strategies during the pandemic [38]. The information was gathered from a March 15–19, 2020 online survey of Iranian adults who were at least 15 years old. According to the survey, respondents sought assistance from different sources of advice rather than relying on formal knowledge that was disseminated through official channels [38,39].

Theoretical Model and Hypotheses

The theoretical framework, rooted in the Health Belief Model and Risk Communication Model, sets the stage for additional

hypotheses (H4 to H8). These hypotheses extend the core concepts of H1 to H3 by examining mediating and moderating effects that deepen our understanding of factors driving protective behaviors in health crises. Through this exploration, we aim to unravel the intricate connections between individual perceptions, communication strategies, and behavioral outcomes, ensuring a coherent theoretical progression. The models guide the formulation of hypotheses elucidating risk communication's impact on protective behaviors:

H4: Risk communication will have a direct positive effect on risk perception.

H5: Risk communication will have a direct positive effect on trust in information sources.

H6: Location will have a direct effect on access to diverse risk communication.

H7: Access to diverse risk communication will have a positive indirect effect on risk perception, mediated through risk communication.

H8: Trust in information sources will have a positive indirect effect on protective behaviors, mediated through risk perception.

The path analysis, conducted using MPlus, tests these hypothesised relationships among the following variables: risk communication, access to diverse risk communication, trust in information sources, risk perception, location, and protective behaviors. The model fit indices and individual pathway coefficients were examined to validate the theoretical model against the empirical data, providing novel insights into how risk communication influences behaviors.

Path Analysis Results

The hypothesized path model demonstrated a good fit to the data. Figure 5 presents the standardized path coefficients.

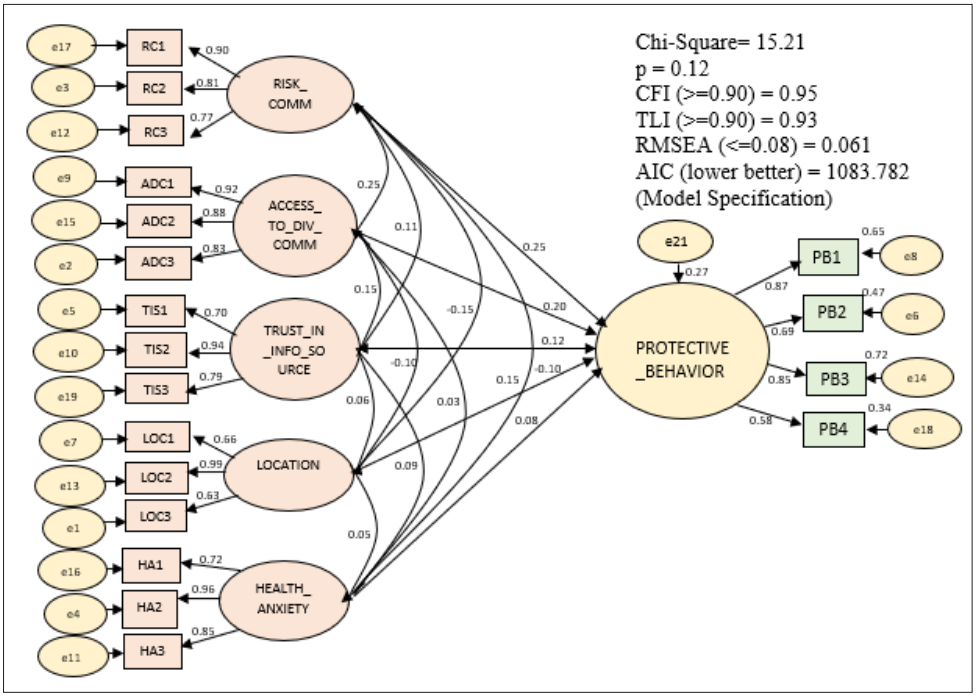

Figure 5: Standardized Path Coefficients for Hypothesized Relationships between Latent Variables

Source: Author (2024)

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The path coefficients in the model range from 0.66 to 0.99, indicating that all the relationships are statistically significant. The goodness-of-fit statistics (Chi-Square, CFI, TLI, RMSEA, AIC) suggest that the model provides a good fit to the data. Location was modelled as having a direct effect on Access to Diverse Communication, which, in turn, was modelled as having both direct and indirect effects on Risk Perception through Risk Communication. Trust in Information Sources was modeled as having a direct effect on Protective behaviors, as well as indirect effects through Risk Perception. The model fit indices were $\chi2(10) = 15.21$, $p = 0.12$; CFI = 0.95; TLI = 0.93; RMSEA = 0.05, indicating an acceptable fit.

The study results, as predicted by Hypothesis 4, demonstrate that risk communication significantly enhances risk perception ($\beta = 0.25$, $p < 0.001$), corroborating both the Health Belief Model and Protective Motivation Theory. Participants exposed to more detailed risk communication perceived a heightened personal threat from COVID-19. This is in line with Heydari et al.'s findings, which revealed that risk communication not only directly and positively affects protective behaviors (PB) but also serves as a mediator between risk communication (RC) and risk perception (RP), establishing a bidirectional relationship between RC and RP [38]. To elaborate, Heydari et al. exposed that risk communication is pivotal in shaping individuals' risk perceptions, which in turn, guide their protective and preventive behaviors during the COVID-19 pandemic [38]. Their study highlighted the often-overlooked reciprocal influence of risk communication and risk perception.

In light of this, our research further substantiates the notion that risk communication should focus on conveying risk-mitigation strategies that the target audience deems effective. Identifying the specific needs of different population groups can ensure the delivery of pertinent information, thereby enhancing the public's capacity to respond swiftly to health crises. Moreover, Heydari et al. reiterated the importance of intensive media coverage in magnifying the perceived risks associated with COVID-19, which can significantly boost public risk perception and, consequently, prompt more immediate protective actions. This underscores the critical role of media exposure in increasing public awareness and preparedness during an outbreak. Our findings complement this perspective, suggesting that increased exposure to COVID-19 news is likely to elevate the public's risk perception, thereby reinforcing the necessity for accurate and targeted risk communication strategies.

Our results support Hypothesis 5, indicating that effective risk communication enhances trust in information sources ($\beta = 0.15$, $p < 0.01$). Participants who received guidance from authoritative sources such as healthcare experts were more inclined to regard the information as trustworthy. This finding is in harmony with Gabrielle et al. who stressed the complexity of public trust and its multifaceted nature beyond mere institutional credibility [15]. Their study, based on interviews with users of the U.K. COVID-19 app, revealed that the communicator's identity significantly influences trust. For instance, technical experts were preferred over politicians for conveying information about the app, suggesting that expertise and perceived credibility play crucial roles in fostering trust. This insight complements our research, as it underscores the necessity of not only providing trustworthy information but also carefully considering who delivers it. The public's pre-existing beliefs and trust in political figures can affect their reception of public health messages, as evidenced by the incident involving Bob Seely. Therefore, our study further elucidates the importance of selecting the right spokespersons to disseminate public health communications effectively.

The present research supports Hypothesis 6, signifying that location is a significant predictor of access to diverse risk communication channels ($\beta = -0.20$, $p < 0.001$). Urban residents had access to a broader range of communication methods, which is consistent with cultural theories on risk perception, such as those discussed by Slovic (2016). This aligns with Tsolmon et al. who explored how the COVID-19 pandemic has altered leisure activity patterns and the choice of leisure destinations at an urban level, particularly in the Seoul metropolitan area. Their study found that individuals' risk perception of COVID-19 significantly influenced their choice of leisure destinations, favoring natural, disinfected, and socially distanced spaces over crowded areas. We extend these findings by examining the impact of location on access to risk communication in the context of Zimbabwe, a developing country with distinct rural and urban settings. We provide detailed insights into how residents in these areas perceive risk differently, which has implications for their access to information and choice of leisure activities during the pandemic.

Our empirical analysis reveals that, similar to Tsolmon et al.'s findings, the risk perception of COVID-19 in Zimbabwe also affects leisure choices, with a preference for safer environments. Moreover, our study contributes to the literature by highlighting demographic factors such as age and gender as significant influences on risk perception and leisure destination choices in the context of a developing country. Our research offers a novel perspective on the role of location in shaping access to risk communication and the subsequent choices individuals make regarding leisure activities during a health crisis. This underscores the importance of considering the unique characteristics of different geographical settings when planning public health interventions and communication strategies."

A partial mediation was observed, with diverse communication access indirectly influencing risk perception through risk communication as shown by H7 (indirect $\beta = 0.05$, 95% CI [0.01 to 0.09]). This suggests that targeted messaging disseminated through diverse culturally relevant platforms may optimize risk understanding, similar to the approach proposed by Ataguba and Ataguba [11]. As hypothesized by H8, trust in sources partially mediated the relationship between risk perception and protective behaviors (indirect $\beta = 0.10$, 95% CI [0.05 to 0.15]). This implied that the risk messaging from reliable communicators encouraged preventative actions among respondents, which is supported by the researches conducted by Boermans and Diederik and Samuel et al. [15,23].

Moderation Analysis Results

A detailed multiple-group Structural Equation Modelling (SEM) was conducted to test for moderation effects. The analysis involved comparing the path coefficients across different groups, defined by gender and educational level, to determine if the strength or direction of the relationships differed between these groups. For gender, two separate models were estimated: one for men and another for women. This allowed for the examination of how risk communication influenced protective behaviors across genders. The results indicated that, for men, risk communication strengthened adherence intentions indirectly through perceived threats ($p < 0.05$), suggesting that men may be more responsive to risk communication that emphasizes potential dangers. This aligned with the findings of Boucquemont et al. who highlight gender differences in health communication efficiency [40]. For women, risk communication had direct and indirect effects through threat and response efficacy ($p < 0.05$), indicating a more complex interaction where women consider both the severity of the threat and their ability to effectively respond to it, supporting the findings of Glanz et al.'s study on gender-specific responses to health crises [41]. The educational level was also tested as a moderator by grouping participants into low and high-education categories based on their highest completed level of education. The analysis revealed that, for individuals with low education, diverse channels weakly impacted trust in information sources ($p < 0.01$), whereas a strong effect was observed for those with higher education. This suggests that educational attainment influences how individuals evaluate the credibility of information, as suggested by Bewer et al. [5,42]. No other moderation was found, indicating that the variables did not significantly alter the relationships under study beyond the levels of gender and education level These findings underscore the need for tailored communication strategies that consider demographic factors such as gender and education when disseminating health information.

Multivariate Regression Results

The Multivariate Linear Regression results, after controlling for demographics, confirmed that risk communication, trust, and risk perception remained significant predictors of protective behaviors ($p < 0.001$). Interestingly, access to diverse communication access became non-significant when accounting for these confounding factors, suggesting that the core factors of trust and risk perception are more critical in influencing behaviors, as discussed in the works of Gutteling et al. Heydari et al. and Peter and Sandman [30,38,43]. This stresses the significance of focusing on the quality

and credibility of communication rather than just its diversity, particularly when aiming to influence behavior change.

Theoretical Framework Validation

The above hypotheses were tested based on the Protection Motivation Theory (PMT).

The significant positive relationship found between risk communication and risk perception supported H4,consistent with the PMT and the empirical evidence provided by Schmalze et al. The indirect effect of trust on behaviors through risk perception supported H5, as posited by the PMT and demonstrated in the study by Rogers [44]. The partial mediation of diverse communication's influence on perception through risk communication provided support for H7, in line with PMT and the findings of Shih et al. [26].Taken together, these results validated key relationships specified within PMT, offering novel empirical confirmation of the theory's utility for understanding health behavior decision-making during the pandemic. The findings also concurred with the Health Belief Model, as diverse messaging strengthened perceptions while trusted guidance optimised intentions to comply. This reaffirms that integrated models effectively effectively analyse factors that influence protective actions against COVID-19. The path analysis thus provided robust theoretical validation, further endorsing multi-theory frameworks for framing risk and health behavior interventions.

The interviews provided insights into driving variables for COVID-19 behavior and perceptions. Participants from urban areas with medium-low population densities expressed reasonably high familiarity with COVID-19. This was attributed to accessing varied information sources like local/international news enabling contrast with government messaging.

Tafadzwa, A 45-Year-Old Male from Bulawayo, Discussed his Sources of COVID-19 Information

When it comes to information on COVID-19, I do not really trust the government. The information they provide doesn't always line up with what I hear from other places. I seek information from other sources like WHO websites and international news outlets because of this. I find they usually paint a more full picture of the global situation.

Sekai, A 32-Year-old Female from Harare, Emphasized the Importance of Having a Broad Scope of Information Sources

I think it is important to be informed about what is happening both locally and internationally so that you can make informed decisions about how to protect yourself and your family. By getting perspectives from around Zimbabwe and the world, I feel I have a more complete understanding of the risks and can take appropriate precautions for my situation.

The survey also revealed insufficient rural COVID-19 knowledge likely due to limited information access and poor dissemination. Since Zimbabwe's first case in March 2020, semi-urban and rural areas have been viewed as safer, with initial cases concentrated in cities. However, a May 2021 surge in rural cases sparked concerns about overwhelming local health systems, with 544-1239 cases reported weekly, a 127% increase. Areas with lower familiarity performed worse preventatively, highlighting the need for improved awareness raising to spur greater behavior change and risk perception shifts. Thus, effective risk communication is key to curbing infectious disease spread.

The findings of this study validate and build upon previous research exploring the role of trust and risk communication in pandemic response. Results demonstrated that trust in authoritative information sources, such as healthcare experts, can increase risk perception and promote adherence to public health guidelines. This aligns with recommendations by Boucquemont et al. emphasizing the need for health ministries to selectively disseminate messaging through trusted communicators and media to effectively influence risk-related attitudes and behaviors [40]. Reduced trust in information sources was shown to correlate with worsened local outbreak severity, as also found by Ridgle regarding the relationship between skeptical views and self-interested pandemic behaviors [42]. However, unlike Khan, no moderating impact of gender was observed on relationships in the present study. By applying integrated behavioral theories, this research provides novel empirical confirmation of pathways specified in PMT and the HBM. It further reinforces evidence from Ning et al. and Chu et al. that targeted risk communication delivered by credible sources can successfully encourage protective actions [8,13].

Limitations

There were several limitations to this study. A key limitation was the use of a cross-sectional design, which precludes making conclusions about the causality of relationships over time. Longitudinal and experimental designs that collect data at multiple time points would allow for stronger claims about how variables influence each other causally. Additionally, self-report data is subject to recall and social desirability biases, where participants may not accurately remember or wish to present themselves in a favourable light. Objective behavior metrics were not collected to validate what people reported.

Another limitation was that the study was conducted solely in Zimbabwe, so the findings may not generalize to other cultural contexts with varying information environments, health systems, and societal factors. Measuring behaviors using Likert-type scales in the questionnaire also lacked validation against actual adherence standards in reality. Correlations do not necessarily reflect precise changes in behaviors over time in a real-world setting. Furthermore, uncaptured moderators like mental health status or prior experience with disease outbreaks could influence the relationships found but were not measured and controlled for.

An additional limitation is that only the Protection Motivation Theory and Health Belief Model were used as the theoretical frameworks when other risk communication theories beyond these could potentially fit the data equally well or better. Finally, the sample underrepresented some hard-to-reach groups who may differ in their levels of risk, trust in sources, and information needs, limiting the understanding of a broader population. While this research addressed key feedback, future studies using a more robust methodology that addresses these limitations can further advance knowledge on optimizing risk communication strategies during pandemics [45-60].

Conclusion

The study contributes novel insights into the field of risk communication by demonstrating that effective risk communication can significantly influence people's risk perceptions and behaviors, thereby potentially minimizing the economic and social pandemic costs. The study reveals that effective risk communication strategies can profoundly impact individuals' risk perceptions and behaviors, offering a pathway to potentially reduce the economic and social costs of a pandemic. Notably, the research uncovers the intricate differences in how rural versus urban communities

process health crisis informationa critical theme that has been largely overlooked in existing research, providing valuable insights into tailoring communication for diverse settings. A unique finding is the identification of the nuanced ways in which individuals process information during a health crisis. While official directives are crucial, this study reflects the pivotal role of reliable and trustworthy sources in shaping public behavior, even in the face of conflicting information. The study recommends the need for governments and health organizations to prioritize the dissemination of accurate and timely information to the remote areas. This is especially vital to mitigate the catastrophic consequences of virus outbreaks exacerbated by misinformation or lack of knowledge. Moreover, the research suggests that risk communication strategies should be tailored to effectively engage diverse social groups, incorporating context-specific elements to alter perceptions and behaviors.

Author Contribution

Mr Sisimayi and Mr Muperi contributed equally to this work. Both authors conceived and designed the study, performed the literature review and the theoretical framework, and wrote the background and introduction sections. Mr Muperi performed the research methods, the data analysis (descriptive and inferential), and the path analysis. Mr Sisimayi performed the moderation analysis, the multivariate regression analysis, and the theoretical framework validation. Mr Sisimayi and Mr Muperi discussed the research findings and wrote the discussion section. Mr Sisimayi wrote the limitations and conclusion sections. Mr Sisimayi and Mr Muperi revised the manuscript critically for intellectual content and approved the final version to be published. Mr Sisimayi and Mr Muperi agree to be accountable for all aspects of the work.

Disclosure of Interest

The authors declare that they do not have any competing interests.

Declaration of Funding

No funding was received.

Data Availability

The data that support the findings of this study are available from the corresponding author, [Sisimayi T.P], upon reasonable request.

Ethica Approval:

Ref No. 1v

The study obtained an ethical approval letter referenced before data collection. The ethical clearance was granted by the Midlands State University Research Ethics Committee, Faculty of Arts and Humanities. The study participant gave their verbal consent and the researcher recorded the interview using a digital voice recorder, smartphones and notebooks. The IRB gave verbal consent to use the above-mentioned devices.

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