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Mainstream News Media's Role in Public Health Communication During Crises: Assessment of Coverage and Correction of COVID-19 Misinformation

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ABSTRACT

Public health crises like the ongoing COVID-19 pandemic appear to be the perfect breeding ground for misinformation. As influential information sources, mainstream news media have a unique opportunity to use their platform to debunk and educate the public about misinformation. Despite evidence lending support to the potential for mainstream news media to play a larger role in combating misinformation in society, empirical explorations of how they have contributed to the management of misinformation remain scant. This study aims to address these major gaps in research by investigating how mainstream news dailies gatekeep and correct COVID-19 related misinformation in Singapore. The content of 164 news articles published by the mainstream news dailies in Singapore from January 1 to April 30, 2020 on COVID-19 misinformation was analyzed qualitatively and quantitatively. Results show that the two main types of misinformation, fabricated and reconfigured misinformation, were covered almost equally by mainstream news media. Misinformation related to science and health were most frequently reported, followed by scams, and government policy. Statistically significant differences were found between how mainstream news media corrected the various types and topics of misinformation. Significant differences were also found within the various types, topics, and corrections of misinformation across the early stages of the pandemic. Taken together, these findings shed light on the critical role of mainstream news media as public education tools to correct misinformation during public health crises. From a theoretical perspective, these findings contribute to the understanding of media misinformation gatekeeping, and misinformation correction. From a practical perspective, it highlights the capacity and potential roles of the press in supporting government efforts to combat misinformation.

Background

The COVID-19 pandemic is widely considered a battle that the world has fought on two fronts. On one end of the spectrum is the race to contain and curb the spread of the disease, and on the other, the spread of false information. Possibly fueled by the negative emotions around the pandemic and the ease at which news can propagate online, false information about COVID-19 rapidly proliferated online. Since the outset of the pandemic from January to April 2020, more than a thousand false claims about COVID-19 have been identified and debunked by fact-checking organizations globally (Nielsen et al., 2020). If left unabated, the spread of false information can greatly impede the effective mitigation of a health crisis: it can compromise the efficacy of public health messaging, undermine the adoption of evidence-based preventive behaviors, and even promote erroneous behaviors that pose health risks to those who adopt them (Tasnim et al., 2020).

Conventionally, false information can be categorized as either misinformation or disinformation, depending on its intention to mislead (Wardle & Derakhshan, 2017). Misinformation refers to false information about “factual matters that are not supported by clear evidence or expert opinion” (Nyhan & Reifler, 2010, p. 305), while disinformation refers to false claims deliberately created with the intention of causing

harm (Wardle & Derakhshan, 2017). To circumvent potential issues arising from the ambiguities in establishing the intention behind a piece of false information, this study will henceforth adopt the definition of misinformation by Brennen et al. (2020) and use the term *misinformation* to refer to all types of false information with no distinction being made to the intention behind the falsehood.

While the mainstream news media has been, whether unintentionally or intentionally, at the other end as purveyors of incorrect information, they have a unique opportunity to use their platform to debunk and educate the public about misinformation. Despite overall declines in news consumption over the past decades, mainstream news media are still influential sources of information the public relies on (Vijaykumar et al., 2015). Their prominence as key information sources in society is especially salient during times of public health crises where there is a high and urgent need for timely information (Thelwall & Stuart, 2007). A global survey of information-seeking behavior during the COVID-19 pandemic found the mainstream news media to be the top source of information the public go to for the COVID-19 updates (Nielsen et al., 2020). On top of being the primary sources of information for the public, mainstream news media also have more

stringent editorial control over what and how misinformation can be corrected on their platform. It is in contrast with other sources of information in a society like social media platforms where the creation and dissemination of information is more unmediated and unchecked (Ceron, 2015). Taken together, mainstream news media are well positioned to serve as key platforms to combat the rise of misinformation, especially during public health crises.

The potential for mainstream news media to play a more central role in the debunking of misinformation is also particularly promising in Singapore – a small but technologically advanced nation that was also adversely affected by the COVID-19 pandemic. This study defines mainstream news media in Singapore as local legacy media companies that publish news dailies licensed under the Newspaper and Printing Presses Act. Singapore has a unique media landscape characterized by high public trust in mainstream news media (Digital News Report, 2020) juxtaposed with tight media regulation and strict legislation against misinformation. Unlike their western counterparts, mainstream news media in Singapore are generally expected by the public to contribute to the betterment of the nation, society, and the government (Tandoc & Duffy, 2016).

Moreover, mainstream news media in Singapore have heavily relied upon as key information sources by the public during public health crises. For instance, since the start of the COVID-19 pandemic in January 2020, there has been a marked rise in mainstream news consumption among the Singapore public. Subscriptions to news dailies under the Singapore Press Holdings (SPH) increased, and visits to their online news sites and applications doubled as compared to the previous year (Teh, 2020). Similar reliance on mainstream news media can also be observed in past health crises such as the 2009 H1N1 crisis in Singapore. *The Straits Times*, an English-daily under SPH, was identified as one of the most important sources of H1N1 information for the Singapore public (Basnyat & Lee, 2015). Given the collaborative association between the press and the government, as well as the high reliance on the mainstream news media as key information sources, mainstream news media in Singapore are uniquely placed to serve as major platforms to combat misinformation.

Even though evidence lends support to the potential for mainstream news media to play a larger role in combating misinformation in society, empirical explorations of how they have contributed to the management of misinformation remain scant. Past research on health misinformation and mainstream news media have largely examined the role of mainstream news media as creators of misinformation (Inoue-Choi et al., 2013; Thomas et al., 2018). Existing research gaps around how mainstream news media cover and correct misinformation not only encumber our theoretical understanding of the roles of the mainstream news media, but they also limits the practical applicability of the mainstream news media to correct misinformation. To address these major gaps in research, this study will investigate how the mainstream news media have been contributing to the fight against misinformation in society by investigating mainstream newspaper reports of COVID-19 related misinformation in Singapore. Specifically, it seeks to examine how mainstream news media in Singapore gatekeeps and corrects misinformation.

Mainstream news media as gatekeepers of misinformation

Not much has been researched about how the news media gatekeep misinformation (Tsftati et al., 2020). Media gatekeeping is a theoretical concept that addresses how the media filters and selects news items from a wide range of news events (Shoemaker & Reese, 1996). In explaining how news gets selected, gatekeeping argues that pieces of information pass through a series of gates controlled by gatekeepers, such as reporters and editors, who open or close the gate at each stage, ideally making sure that only accurate information passes through and gets to the next gate. Such a conceptualization assumes that gatekeepers shut the gate to prevent inaccurate information – or misinformation – from passing through. And yet as news organizations find themselves playing an important role in fighting misinformation, gatekeeping now also entails letting misinformation pass through the gates for the main purpose of publicly debunking it.

In the context of misinformation debunking during the pandemic, the gatekeeping of misinformation then refers to how mainstream news media filter through the sea of COVID-related misinformation and select which to cover in their news articles. With over a thousand COVID-related misinformation being debunked in the first four months of 2020 globally (Nielsen et al., 2020), and potentially more that have been spreading under the radar of fact-checkers, the gatekeepers in mainstream news media will have to decide which misinformation they would like to allocate their often-limited editorial resources to debunk. Understanding the characteristics of COVID-related misinformation the mainstream news media decides to debunk in their news articles can offer a lens for understanding the misinformation-related priorities and goals of the mainstream news media. For example, a US study examining the patterns between misinformation and media coverage found misinformation coverage differs by the level of partisanship of the media and that partisan media were more likely to cover misinformation than less-partisan media (Vargo et al., 2017). As such, examining the characteristics of misinformation mainstream news media select to cover can reflect their editorial policies, financial interests, and political agenda in relation to misinformation, as well as the kind of misinformation the mainstream news media deem newsworthy to debunk.

This study will investigate how the mainstream news media in Singapore gatekeeps misinformation by analyzing the characteristics of COVID-19 misinformation reported by the mainstream news dailies. Building on earlier works (Brennen et al., 2020; Wardle, 2019), this study will classify misinformation claims along two dimensions of type and topic based on how the claims were presented in the news article. *Misinformation types* refer to the nature of the misinformation content and the level of veracity of the misinformation as presented in the news article. Based on how the claim was described in the article, it will be further classified into two broad categories: (a) reconfigured misinformation, which contains existing true information that is “spun, twisted, recontextualized, or reworked,” and (b) fabricated misinformation, whose contents are entirely made up (Brennen et al., 2020; Wardle, 2019). *Misinformation topic*, on the other hand, refers to the subject discussed in the misinformation claim. Given that the subjects of the misinformation are often highly

contextualized to the society it is spreading in, the misinformation topics will be derived inductively in the study.

RQ 1: *What a) types and b) topics of COVID-19 misinformation do mainstream dailies in Singapore report about?*

Mainstream news media as correctors of misinformation

Another gap in the current literature pertains to how the mainstream news media corrects the misinformation it reports (Tsfati et al., 2020). It is important to examine how the mainstream news media correct misinformation as ineffective corrections can paradoxically lead to further reinforcement and amplification of the misinformation (Nyhan & Reifler, 2010; Tsfati et al., 2020; Van der Meer & Jin, 2020). One evidence-based way to increase the effectiveness of misinformation correction is through providing a more complex rebuttal to the misinformation (Cook et al., 2015). Richer rebuttals that explain why and how the misinformation is wrong can help to fill the coherence gap a person experiences when being corrected, which in turn reduce one's reliance on the misinformation and minimize the continued influence of the misinformation (Cook et al., 2015; Johnson-Laird, 2012). This study will hence investigate how the mainstream news media in Singapore corrects misinformation by evaluating the complexities of rebuttals used by the mainstream news dailies to correct COVID-19 related misinformation.

RQ 2: *What level of rebuttal complexities do Singaporean mainstream dailies tend to employ when they report about COVID-19 related misinformation?*

Stages of the COVID-19 pandemic

In addition, little is known about how the mainstream news media's coverage of misinformation evolves across the current pandemic. As the public's attitudes and information need change as a health crisis unfolds (Centers for Disease Control and Prevention [CDC], 2014), it is relevant to examine if the

reporting and correction of misinformation by the mainstream news media have changed as the pandemic progressed. Guided by past studies that have examined strategic communications around disease outbreaks (Juarbe-Rey et al., 2018; Lwin et al., 2018), this study will use the Crisis and Emergency Risk Communication (CERC) model to guide the analysis. Developed as a framework to guide public communication during health crises, the CERC model posits that public health crises are likely to unfold in predictable stages, namely pre-crisis, initial, maintenance, resolution, and evaluation (CDC, 2014).

RQ 3: *How do Singaporean mainstream dailies reporting of COVID-19 misinformation vary across the three pandemic stages in terms of a) type, b) topic, and c) rebuttal complexity?*

Method

Figure 1 details how the news articles were selected for inclusion in this study. A literature search was conducted via the Factiva platform to retrieve news articles that were published by mainstream news outlets in Singapore from January 1 to April 30, 2020 that mentioned the following keywords: (COVID-19 OR "Covid 19" OR Corona OR Coronavirus OR "Wu Han Virus" OR "Wuhan virus" OR "Wuhan pneumonia" OR "Wuhan flu" OR "China flu" OR lockdown OR Circuit Breaker OR Quarantine OR Curfew OR SARS-COV-2) AND ("Fake news" OR misinformation OR fake OR untrue OR debunk* OR rumor* OR "false claim" OR false OR unverified OR verify OR correction* OR incorrect OR clarification OR falsehood*).

A multistage selection process was used whereby the news articles containing the search terms were retrieved and screened for relevance. The title and first paragraph of the news articles were assessed for their applicability to the study and the full texts were also assessed for confirmation. A total of 2242 articles were first identified through database keyword searches. After undertaking a series of filter processes, a total of 164 unique news articles were included for analysis. A total of 85.4% of the news articles were published by The Straits Times

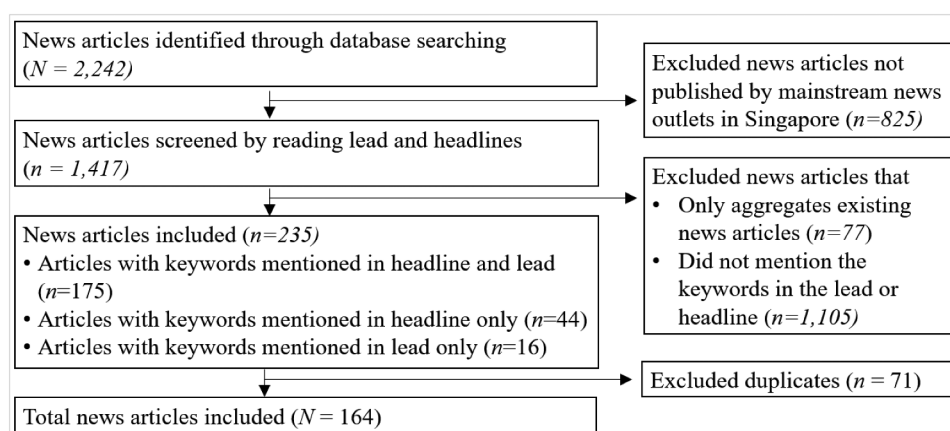


Figure 1. Article review and selection process.

($n = 140$), followed by 24.4% by Channel News Asia ($n = 40$), 18.3% by The New Paper ($n = 30$), 13.4% by Today ($n = 22$), and 0.01% by The Business Times ($n = 1$).

Plan of analysis

The content of the 164 unique news articles was individually analyzed by three independent coders, SY, CP, and a trained research assistant, from which the 100 misinformation claims present in the articles were extracted for further analysis. The misinformation claims were coded by the three coders using a pre-defined coding scheme for the following measures.

Type of misinformation

Guided by the coding scheme used by Brennen et al. (2020), their analysis of COVID-19 misinformation, the 100 misinformation claims were coded for their misinformation content type as either *reconfigured misinformation* or *fabricated misinformation*. Reconfigured misinformation refers to misinformation made up of true information that has been “spun, twisted, or recontextualized” (Wardle, 2019). An example of reconfigured content includes a doctored image of a tweet purportedly from a mainstream news outlet announcing that all schools will be closed due to COVID-19 when there were none of such measures in place then. On the other hand, fabricated misinformation refers to misinformation made up of content that is entirely made up and false (Brennen et al., 2020). An example of fabricated content includes false claims alleging that a train station was closed for disinfection due to COVID-19 when it was in fact operational.

Topic of misinformation

The typology of misinformation topics was derived via a thematic analysis of the 100 misinformation statements. Four prevalent misinformation topics were derived inductively from the thematic analysis. They are namely: (1) Science and health-related misinformation, which includes false claims related to COVID-19 treatments or health remedies, COVID-19 cases in Singapore, and other untrue scientific claims about COVID-19, (2) Scams, which includes false information related to the impersonation of public officials or companies, fake COVID-related job opportunities in Singapore or products that falsely claim to prevent or detect COVID-19, (3) Government policy-related misinformation, which includes false claims regarding the elevation or enforcement of safe distancing measures in Singapore, and untrue claims about Singapore government’s policies or actions, and (4) Others, which includes other topics that cannot be fitted into the first three categories such as false claims involving foreign workers or prominent public figures in Singapore.

Misinformation correction

The 100 misinformation claims were also assessed based on how they were corrected in the article via an evaluation of their rebuttal complexities. The rebuttal complexities were identified based on a qualitative analysis of the corrections in the news articles. Corrections that merely labeled a claim as false were coded as low rebuttal complexity, while corrections that offered

more information about the misinformation were coded as high rebuttal complexity.

Intercoder reliability

Two coders first coded 11.0% of the news articles to check intercoder reliability ($n = 18$), and the differences in coding were discussed to achieve mutual agreement. The final coding scheme was refined iteratively via an in-depth analysis of the selected news articles and discussions between the three independent coders, SY, CP, and a trained research assistant. The intercoder reliability for each variable was assessed via Cohen’s Kappa test and there was a moderately strong agreement between the two coders for the type of misinformation ($k = .84, p < .001$), topic of misinformation ($k = .78, p < .001$), and complexity of rebuttal ($k = .65, p < .001$).

Data analysis

Chi-square tests were conducted to investigate the associations between the three variables: type of misinformation, misinformation topic, and rebuttal complexity. Follow-up Cramer’s V tests were also conducted to assess the effect size of associations, if any. As the spread of the number of articles and the number of days in which a misinformation claim was reported do not follow a normal distribution, they were reported as medians. Associations between the two variables and type, topic, and correction of misinformation were assessed with Kruskal–Wallis H tests and post hoc pairwise comparison with multiple Mann–Whitney U tests.

Stages in the pandemic

The pandemic period included in the study was categorized into crisis stages based on crisis characteristics purported by the CERC model and the events in the ongoing outbreak. As the first local COVID-19 case was only reported in Singapore on 23 January, the period preceding that (January 1 to January 22) was operationalized as the pre-outbreak stage. From January 23 onwards, the cases in Singapore increased slightly to 33 cases on February 7, which prompted the local government to raise the Disease Outbreak Response System Condition (DORSCON) level for COVID-19 from yellow to orange. As such, the period after the detection of the first COVID-19 case in Singapore and before the elevation of the DORSCON level (January 23 to February 6) was operationalized as the initial-outbreak stage.

After the elevation of the DORSCON level, the number of COVID-19 cases in Singapore continued to increase steadily until 5 April, which saw the start of a large rise in COVID-19 cases in migrant worker dormitories that lasted beyond the end of April 2020. A national lockdown, termed as “circuit breaker” by the local government, was also instituted on 7 April and lasted beyond the scope of this study until 1 June. The outbreak phase after 7 February was hence operationalized as two distinct outbreak stages: outbreak wave one comprising the period from the elevation of the DORSCON level to before the start of the COVID-19 outbreak in migrant workers dormitories (7 February to 4 April), and outbreak wave two comprising the period after the start of the outbreak among migrant workers to the end of the study (5 April to 30 April).

The operationalizations above thus gave rise to four distinct pandemic stages: pre-outbreak, initial-outbreak, outbreak wave

1, and outbreak wave 2. However, as none of the 164 unique news articles included in this study were published before 25 January, the pre-outbreak stage will be excluded in this analysis, and only the remaining three stages will be examined.

Results

Misinformation types and topics

The research data were analyzed both qualitatively (to identify themes) and quantitatively (in terms of the categorization and content frequency). RQ1 sought to answer what types of misinformation and misinformation topics were reported in the mainstream newspaper coverage of COVID-19 in Singapore (Table 1).

Misinformation types

Table 1 shows that 59.0% of the misinformation claims reported by the mainstream news media were based on *fabricated* information, while the remaining 41.0% of the misinformation claims were *reconfigured* misinformation which refers to a mix of both authentic and fabricated information. An example of fabricated content includes false claims alleging that an MRT station was closed for disinfection due to COVID-19 when it was operational, while an example of reconfigured misinformation includes a WhatsApp post about a food delivery rider being fined \$300 for wearing a cloth mask (when the rider was, in fact, approaching the police officer for assistance). The reconfigured content involved the modification of a real photo of the delivery rider in conversation with the police.

The two types of misinformation did not differ significantly in the frequency in which each misinformation claim under them was reported according to separate Kruskal–Wallis H tests, $\chi^2(1) = 2.14$, $p = .144$, and $\chi^2(1) = 1.97$, $p = .160$. Each fabricated misinformation claim was reported by a median of two unique news articles, while each reconfigured misinformation claim was reported by a median of one unique

Table 1. Types and topics of misinformation claims reported by mainstream news media.

Characteristics ($n = 100$)	%
Type of misinformation content	
Fabricated misinformation	59
Reconfigured misinformation	41
Type of misinformation topic	
Science and health	38
COVID-19 treatments or health remedies	20
Avoid places visited by COVID-19 cases	7
Speculation about suspected patient cases of death	6
Others	5
Government policy and measures	22
Enforcement of safe distancing measures	16
Government policies or actions	6
Scams	17
Scams involving the impersonating of public officials	8
Scams involving COVID-19 related job opportunities	6
Others	3
Others	23
Foreign workers	8
Prominent actors including companies or public figures	6
Singapore's relations with other countries	5
National preparedness	3
Untrue crimes around COVID-19	1

news article. As for the duration through which the misinformation claim was reported, each fabricated misinformation claim was reported over a median of two days, while each reconfigured misinformation claim was reported over a median of one day.

Misinformation topics

Four overarching topics of the COVID-19 misinformation were derived inductively from a thematic analysis of the 100 misinformation claims. They are, namely, science and health, government policy and measures, scams, and others. Among the four topics, science and health-related misinformation accounted for the largest proportion of misinformation reported (n & % = 38), followed by others (n & % = 23), government policy and measures (n & % = 22), and scams (n & % = 17). A detailed breakdown of the four categories can be seen in Table 1.

The misinformation topics also differ in the frequency of which each misinformation claim under those topics was reported according to follow-up Kruskal–Wallis H tests, $\chi^2(3) = 17.49$, $p = .001$. Each misinformation claim related to government policy and measures was reported by a median of three unique news articles, while each misinformation claim related to scams as well as science and health was only reported by a median of two unique news articles. A similar difference between the misinformation topics was also observed in the duration through which the misinformation claims were reported in the newspapers. Each misinformation claim related to government policy and measures was reported over a median of two days, while each misinformation claim related to scams as well as science and health was only reported over a median of two days.

Associations between the misinformation type and topic

Additional statistical tests were done to investigate the associations between the misinformation types and topics, if any. Statistically significant differences in the proportion of misinformation types among the misinformation topics were found with moderate effect size, $\chi^2(3) = 19.29$, $p < .001$, Cramer's $V = .474$. Misinformation under the topic of government policy and measures as well as science and health was more likely to be fabricated (n and % = 68.2; n and % = 65.8%), while misinformation related to scams is more likely to be reconfigured (n and % = 88.2%). A cross-tabulation showing the distribution of misinformation topics by the type can be seen in Table 2.

Complexity of rebuttal

RQ2 asked how Singapore mainstream newspapers correct the reported COVID-19 related misinformation in terms of

Table 2. Crosstab between types and topics of misinformation claims.

Misinformation topic	Fabricated misinformation		Reconfigured misinformation		Total
	n	% of topic	n	% of topic	
Science and health	25	65.8	13	34.2	38
Government policy and measures	15	68.2	7	31.8	22
Scams	2	11.8	15	88.2	17
Others	17	73.9	6	26.1	23

rebuttal complexity. Both low and high rebuttal complexities were fairly evenly used to correct the misinformation claims. A total of 54.4% of corrections used low complexity rebuttals ($n = 166$), while the remaining 45.6% of corrections used high complexity rebuttals ($n = 139$). Table 3 shows the breakdown of the rebuttal complexity across misinformation types and topics.

Type of misinformation and correction

Additional statistical tests were also done to investigate the associations between how each type of misinformation was corrected. Statistically significant differences in the proportion of rebuttal complexity among the two types of misinformation were found with weak effect size, $\chi^2(1) = 14.5$, $p < .001$, Cramer's $V = .22$. Fabricated misinformation claims were more likely to be corrected with low complexity rebuttals, while reconfigured misinformation claims were more likely to be corrected with high complexity rebuttals. A total of 61.5% of fabricated misinformation claims were corrected using low complexity rebuttals ($n = 131$) and the remaining 38.5% were corrected with high complexity rebuttals ($n = 82$). Only 38.0% of the reconfigured misinformation claims were corrected with low complexity rebuttals ($n = 35$) and the remaining 62.0% were corrected with high complexity ($n = 57$), on the other hand.

Misinformation topic and correction

Statistically significant differences in the proportion of rebuttal complexity across the four types of misinformation were also found with weak effect size, $\chi^2(3) = 9.57$, $p < .05$, Cramer's $V = .18$. Misinformation claims related to science and health were more likely to be corrected with low complexity rebuttals, while misinformation claims related to scams as well as government policy and measures were more likely to be corrected with high complexity rebuttals. A total of 58.0% of misinformation related to science and health were corrected with low complexity rebuttals ($n = 51$), while the remaining 42.0% were corrected with high complexity rebuttals ($n = 37$). On the other hand, only 41.8% of misinformation related to government policy was corrected with low complexity rebuttals ($n = 33$), while the remaining 58.2% were corrected with high complexity rebuttals ($n = 46$). A total of 46.9% of claims related to scams were corrected with low complexity rebuttals ($n = 15$), while the remaining 53.1% were corrected with high complexity rebuttals ($n = 17$).

Table 3. Breakdown of media rebuttals by misinformation type and topic.

	Complexity of rebuttal used to correct the misinformation				Total <i>n</i>
	Low		High		
Misinformation type	<i>n</i>	%	<i>n</i>	%	
Fabricated misinformation	131	61.50	82	38.50	213
Reconfigured misinformation	35	38.04	57	61.96	92
Misinformation topic					
Science and health	51	57.95	37	42.05	88
Government policy and measures	33	41.77	46	58.23	79
Scams	15	46.88	17	53.13	32
Others	67	63.21	39	36.79	106

Misinformation coverage across the pandemic timeline

RQ3 focused on how the mainstream newspaper's coverage and correction of COVID-19 misinformation vary across the pandemic timeline in Singapore. The 100 unique misinformation claims were corrected a total of 305 times in the 164 unique news articles collected. Table 4 shows the breakdown of the misinformation type, topic, and complexity of rebuttal across the three stages of the pandemic based on 305 corrections of the misinformation claims.

Frequency of reports across pandemic stages

A total of 24.4% of the news articles ($n = 40$) were published in the initial-outbreak stage, followed by 47.6% in the first wave of the outbreak ($n = 78$), and 28.0% in the second wave of the outbreak ($n = 46$). While the initial outbreak stage accounted for the least number of published articles, it had the highest number of news articles published daily with 2.67 news articles per day as compared to the first and second waves of the outbreak with 1.34 and 1.77 news articles published per day, respectively. Of the 305 misinformation corrections, 23.3% of the corrections were reported in the pre-outbreak stage, with an average of 4.73 corrections per day ($n = 71$), 50.2% were reported in the first outbreak stage, with an average of 2.73 corrections per day ($n = 153$), and 26.6% were reported in the second outbreak stage with an average of 3.12 corrections per day ($n = 81$).

Misinformation type across pandemic stages

Statistically significant differences in the proportion of misinformation types across the three pandemic stages were observed with weak effect size according to chi-square tests, $\chi^2(2) = 29.22$, $p < .001$, Cramer's $V = .31$. In the pre-outbreak stage, fabricated misinformation accounted for 87.3% of the 71 corrections of misinformation claims ($n = 62$), while reconfigured misinformation accounted for the remaining 12.7% of the claims ($n = 9$). As for the first outbreak stage, fabricated misinformation accounted for 73.2% of the 153 corrections of misinformation claims ($n = 112$), while reconfigured misinformation accounted for the remaining 26.8% of the claims ($n = 41$). In the second outbreak stage, however, fabricated misinformation only accounted for 48.2% of the 81 corrections of misinformation claims ($n = 39$), while reconfigured misinformation accounted for 51.9% of the claims ($n = 42$).

Misinformation topic across pandemic stages

Statistically significant differences in the proportion of misinformation topics across the three pandemic stages were also observed with weak effect size according to chi-square tests, $\chi^2(6) = 54.01$, $p < .001$, Cramer's $V = .30$. In the pre-outbreak stage, 54.9% of the misinformation corrections were for health and science misinformation ($n = 39$), followed by 33.8% for misinformation under others ($n = 24$), 11.3% for misinformation under government policy and measures ($n = 8$), and none for misinformation under scams ($n = 0$). In the first outbreak stage, however, 36.6% of the misinformation corrections were for misinformation under others ($n = 56$), followed by 27.5% for health and science misinformation ($n = 42$), 24.2% for misinformation under government policy and measures ($n =$

Table 4. Breakdown of each variable across the pandemic.

	Stages of the pandemic						
	Pre-outbreak stage		First outbreak stage		Second outbreak stage		Total <i>n</i>
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Misinformation type							
Fabricated misinformation	62	87.32	112	73.20	39	48.15	213
Reconfigured misinformation	9	12.68	41	26.80	42	51.85	92
Misinformation topic							
Science and health	39	54.93	42	27.45	7	8.64	88
Government policy and measures	8	11.27	37	24.18	34	41.98	79
Scams	0	0.00	18	11.76	14	17.28	32
Others	24	33.80	56	36.60	26	32.10	106
Complexity of rebuttal							
Low	48	67.61	74	48.37	44	54.32	166
High	23	32.39	79	51.63	37	45.68	139

37), and 11.8% for misinformation under scams ($n = 18$). As for the second outbreak stage, 42.0% of the misinformation corrections were for misinformation under government policy and measures ($n = 34$), followed by 32.1% for misinformation under others ($n = 26$), 17.3% for misinformation under scams ($n = 14$), and 8.64% for health and science misinformation ($n = 7$).

Complexity of rebuttal across pandemic stages

Statistically significant differences in the proportion of rebuttal complexity across the three pandemic stages were also observed with weak effect size according to chi-square tests, $\chi^2(2) = 7.27$, $p = .027$, Cramer's $V = .15$. In the pre-outbreak stage, 67.6% of the misinformation was corrected using low complexity rebuttals ($n = 48$), while 32.4% of the remaining misinformation was corrected using high complexity rebuttals ($n = 23$). In the first outbreak stage, only 48.4% of the misinformation was corrected using low complexity rebuttals ($n = 74$), while 51.6% of the remaining misinformation was corrected using high complexity rebuttals ($n = 79$). In the second outbreak stage, 54.3% of the misinformation was corrected using low complexity rebuttals ($n = 44$), and 45.7% of the remaining misinformation was corrected using high complexity rebuttals ($n = 37$).

Discussion

This study sets out to investigate the potential role of the mainstream news media as gatekeepers and correctors of health-related misinformation. It sought to examine the extent to which mainstream news organizations in Singapore reported about and debunked misinformation claims via qualitative and quantitative analyses of news articles on COVID-19 misinformation.

Public health crises like the ongoing COVID-19 pandemic can be the perfect breeding ground for misinformation. It is especially so for emerging disease outbreaks where information about the novel threat tends to be scarce and public confusion is high (Thelwall & Stuart, 2007). The high demand for and low supply of information can create a knowledge gap that enables and fuels the growth of conspiracy theories, rumors, fake news, and other types of misinformation. It is important to combat the propagation of misinformation as it can undermine key public health communication efforts and worsen the strain on

public health systems (Tasnim et al., 2020). The spread of misinformation about false COVID-19 preventive behaviors has, for example, led to an increase in poisoning cases caused by exposure to cleaners and disinfectants in the United States (Chang et al., 2020) and methanol in Iran (Soltaninejad, 2020).

While the mainstream news media have, both intentionally and unintentionally, contributed to the genesis and dissemination of incorrect information (Tsfati et al., 2020), they can also be an important platform to debunk these pieces of misinformation. With their social importance, wide reach, and role as a credible information source to the public during times of uncertainty (Vijaykumar et al., 2015), mainstream news media can play a crucial role in the timely dissemination of misinformation correction and prevent people from being hoodwinked and acting on potentially harmful misinformation.

This study first explored the role of mainstream news media as gatekeepers of misinformation by examining the type of misinformation the media allow through their filters and report about. Guided by previous studies (Brennen et al., 2020; Wardle, 2019), this study found that fabricated and reconfigured misinformation were almost equally reported in mainstream news. As for the misinformation topics, most of the reported claims were about science and health, and they included themes such as the COVID-19 treatments, remedies, or updates on patient cases. The topic of scams was also particularly noteworthy – they were more likely to be reconfigurations, mixing accurate and inaccurate details, than complete fabrications. For example, some scams would involve someone pretending to be a public official to trick victims into sending donations or paying fines. This is characteristic of scams, even outside a pandemic context – their mixing of real and fake details helps in their ability to trick people (Baker & Puttonen, 2019).

We further examined the gatekeeping role of the news media by analyzing the variations in media attention over the different types of misinformation. It was found that misinformation related to government policy attracted more media attention than other topics, based on how often they are debunked by mainstream media. Such attention to immediately and frequently corrected misinformation related to government policy reflects not only the urgency and importance of implementing and monitoring compliance with government measures to curb the spread of the virus, but perhaps also of the long-established close, if not collaborative, association between

the state and the media in Singapore. Not only does the Singapore government have in place a system of laws closely regulating the press in the country, such as newspaper licensing and requiring similar systems for online publications and broadcasters, but journalists and news audiences in Singapore also acknowledge the collaborative function that is expected of the press when it comes to nation-building (Tandoc & Duffy, 2016). This contrasts with the watchdog role of the press often associated with Western news media (Hanitzsch, 2011).

Next, the study examined the role of mainstream news media as a corrector of misinformation by evaluating the complexity of rebuttal used in their reporting. It was found that high complexity rebuttals that offered additional information about the misinformation, and low complexity rebuttals that just mentioned that the claims were false were equally used by the media in their reporting across all news articles.

The media are, however, more likely to employ high complexity rebuttals in their reporting of reconfigured misinformation, as compared to fabricated misinformation. This could potentially be explained by the increased difficulty in correcting reconfigured misinformation; in contrast to fabricated misinformation which contains entirely wrong claims, reconfigured misinformation is spun with both true and false information, and more detailed explanations may be needed to justify why these claims were wrong when it contained some element of truth.

The use of high or low rebuttal complexity also varies across the misinformation topics the media report about. The mainstream news media are more likely to engage in high complexity rebuttals when it comes to debunking scams and misinformation related to government policy, while misinformation regarding science and technology is more likely to be debunked using low complexity rebuttals. It can be argued that such a collaborative role of the press on nation-building is particularly salient in the context of a pandemic, and, in the case of Singapore, highly reminiscent of how the mainstream media covered the SARS epidemic (Basnyat & Lee, 2015). Close collaboration between the press and the state might, however, also come at the expense of having necessary checks and balances, especially in contexts where governance is marked by inefficiency, corruption, and lack of transparency.

Lastly, the study examined how mainstream news media's coverage and corrections of COVID-19 misinformation evolved across the pandemic, if any, through the lens of the CERC model. It was found that while science and health-related misinformation accounted for more coverage in the earlier stages, misinformation related to government policy accounted for more coverage in the latter stages. This is reflective of how the government instituted several measures in response to the outbreak, enforcing stricter measures as the crisis worsened. Unfortunately, this is also reflective of how misinformation and confusion tend to accompany such government measures, which signals the importance of immediate clarification and correction. In this case, the findings point to the important role of the mainstream news media in helping the government clarify and debunk wrong information about critical measures being implemented to control the outbreak.

These findings, however, must be examined in the context of several limitations. First, the study mainly focuses on how mainstream news sources had reported and debunked

misinformation about COVID-19. As such, the findings are more about these news organizations' editorial judgment and decision-making in terms of selecting pieces of misinformation to correct, rather than a reflection of the actual extent of misinformation in Singapore. Future studies should compare the two and examine the link between news attention toward misinformation and the extent of misinformation in a community. In addition, these findings can only shed light on one side of the gatekeeping story, namely the misinformation the mainstream news media allows through their filters, and the misinformation that is halted and not reported remains a question for future research.

Second, the study was conducted within the specific context of Singapore, where the press is closely regulated by the state. Thus, future studies should build on these findings and examine whether the patterns found across the types and topics of misinformation reported as well as the complexities of rebuttal employed hold or vary across different media contexts. Third, as the study was conducted while the pandemic was still ongoing, and the operationalization of the crisis stages based on the CERC model is not a full reflection of the actual development of the crisis. As such, future studies can expand upon these findings to include misinformation reported in the later stages of the pandemic.

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