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Understanding People with Water Insecurity: Insights from the Lloyd's Register Foundation 2021 World Risk Poll

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Abstract: Water insecurity, or lacking sustainable access to adequate quantities of safe water, is a threat to human health and well-being worldwide. To inform communications for people with water insecurity, we examined key characteristics of people with (vs without) water insecurity around the world, as reported on the 121-country 2021 Lloyd's Register Foundation World Risk Poll ($n > 125,000$). We discuss three findings, which showed robustness across multiple analyses. First, participants with (vs without) water insecurity felt less prepared for disasters. Second, local news and emergency services were the most universally trusted information sources, though participants with (vs without) water insecurity trusted these sources slightly less. Third, water safety concerns were more strongly associated with severe weather concerns than with climate change concerns, especially among participants with (vs without) water insecurity. Thus, communications targeting people with water insecurity should aim to improve disaster preparedness, use trusted information sources such as local news and emergency services, and highlight connections between water security threats and worsening severe weather.

Keywords: Water insecurity, disaster communications, disaster preparedness, trust, public climate risk perceptions.

1. Introduction

Water insecurity refers to lacking consistent access to clean water, especially during times when water supplies are stressed by natural and manmade disasters.^{1,2} Water insecurity poses elevated risks of exposure to water-borne illness, mental health struggles, diminished economic opportunities, and social unrest.³ For these reasons, the United Nations considers access to water a human right and is committed to “ensuring access to water and sanitation for all” as a Sustainable Development Goal.¹ Unfortunately, water insecurity is a growing global challenge.⁴ Due to climate change, population growth, and industrial pollution, this number is forecasted to exceed 5 billion people by 2050.⁵

Organizations such as the United States Centers for Disease Control and Prevention (CDC) inform people about what they can do to protect themselves against threats to water

security, both before and during water-based disasters like floods and droughts.⁶ These communications target people with water insecurity and tend to share information about stockpiling bottled water and treating contaminated water by boiling or using chemicals.⁷ Prior research suggests that experiencing water insecurity may have implications for risk communications about people's (1) perceptions of disaster preparedness, (2) trust in disaster information sources, and (3) links of water safety concerns with severe weather concerns and climate change concerns.

Perceptions of Disaster Preparedness: Natural disasters (such as floods, droughts and violent storms) and human-caused disasters (such as pollution accidents and cyber-attacks) can threaten the water security of millions of people simultaneously.⁸ Helping people feel prepared for disasters is therefore one important aspect of

addressing water insecurity.⁹ Initiatives to increase disaster preparedness focus on changing people's behaviors in ways that reduce their disaster risk and increase their ability to cope with disasters.¹⁰ Interviews with water infrastructure managers suggest that communities tend to have better health outcomes after floods and droughts when they had better disaster preparedness, which includes knowing about evacuation routes and early warning systems.¹¹

Trusted Disaster Information Sources: Information about threats to water security is often shared through local news and government outlets.¹² For example, in the United States, the National Weather Service uses social media to communicate about water safety best practices in places vulnerable to droughts, both proactively and in response to urgent drought situations.¹³ These organizations tend to be highly trusted as information sources.¹⁴

Public Perceptions of Climate Change and Severe Weather: Environmental threats to water security are manifold.¹⁵ Extreme weather events, especially droughts and floods, can interrupt utility services and damage water infrastructure, forcing people to rely on risky water sources.¹⁶ Global climate change is exacerbating some threats, as climate change has been linked to increasing intensity and frequency of severe weather events.¹⁷ Although water insecurity is exacerbated by climate change, people may find it difficult to make this connection because of the distant, abstract, and uncertain nature of climate change.¹⁸ It might be more intuitive for people to associate water risks with the concrete threat of severe weather events than the abstract threat of climate change.¹⁹

1.1. Current Study

Although water insecurity and associated communications pose a global challenge, most

existing water insecurity research has been conducted in countries with high levels of water-safety performance,^{20,21} where water infrastructure tends to be developed and water insecurity is uncommon.²² Few global studies have examined the experiences of people with (vs without) water insecurity worldwide,²³ even though they stand to benefit the most from water risk communications. Truly global comparative data on the adverse impacts of water insecurity is an important research gap to fill because people with water insecurity may have specific water security communication needs relevant to alleviating their water insecurity burdens.

To address these research gaps, we analyzed survey data spanning 121 countries in the 2021 Lloyd's Register Foundation's World Risk Poll, with the aim of better understanding the impact of individual water insecurity on multiple facets of water disaster communication and disaster resilience.²⁴ We asked three research questions to guide our analyses.

1. Did participants who reported water insecurity (vs not) perceive less disaster preparedness?
2. Did participants who reported water insecurity (vs not) differentially trust information sources to learn about disasters?
3. Did participants who reported water insecurity (vs not) show differential associations between water safety concerns, severe weather concerns and climate change concerns?

2. Methods

2.1 Sample

The 2021 Lloyd's Register Foundation World Risk Poll was conducted by Gallup and its local vendor partners.²⁴ In total, Gallup interviewed 125,911 participants in 121 countries and territories, representing approximately 94% of the world's age 15+ population. In each country,

Gallup interviewed a national probability-based sample of approximately 1,000 people age 15 or older. Using survey weights provided by Gallup, the sample was 53% female, 26% of participants had a college degree, and average age was 42. The Lloyd's Register Foundation (2022) 2021 World Risk Poll's dataset and methodology are publicly available at <https://wrf.lrfoundation.org.uk/data-resources>.

2.2 Survey Questions

Survey questions were tested in deployment countries for participant comprehension using multi-stage cognitive interviews. Primary survey questions and response options are described below.

Water insecurity: Participants were asked whether in the past twelve months, they had "been without clean drinking water for more than a day?" Response options for this question were *yes* (=1) and *no, don't know, and refused to answer* (=0).

Disaster preparedness: Participants were asked "Do you think each of the following are well prepared to deal with a disaster in your country, or not?" about four targets: 1) the national government"; 2) "hospitals in the city or area where you live"; 3) "you and your family"; and 4) "local government". Response options for each rating were *yes, well prepared* (=1) and *no, not well prepared, don't know, and refused to answer* (=0).

Trusted disaster information sources: Participants were asked "Suppose you needed information about a possible disaster in the city or area where you live, such as floods or violent storms. Would you look to any of the following for information, or not?" about seven targets in their country: 1) "the national weather service"; 2) "the national disaster management agency"; 3) "local news"; 4) "local religious leaders"; 5) "a famous or influential person"; 6) "emergency services"; and 7) "internet / social media". Response options for each were *yes* (=1) and *no, don't know, and refused to answer* (=0).

Water safety concerns: Participants were asked: "In general, how worried are you that the water you drink could cause you serious harm?" Response options were *very worried* and *somewhat worried*

(=1) or *not worried, don't know and refused to answer* (=0).

Severe weather concerns: Participants were asked: "In general, how worried are you that severe weather events, such as floods or violent storms, could cause you serious harm?" Response options were *very worried* and *somewhat worried* (=1) or *not worried, don't know and refused to answer* (=0).

Climate change concerns: Participants were asked: "Do you think that climate change is a very serious threat, a somewhat serious threat, or not a threat at all to the people in this country in the next 20 years? If you do not know, please just say so." Response options were *very serious threat or somewhat serious threat* (=1), or *not a threat at all, don't know and refused to answer* (=0).

2.3 Analytical plan

To answer our first research question, we conducted two-tailed chi-square tests to examine whether there was a significant association between participants' reported water insecurity and perceived disaster preparation of their national government, their local government, hospitals in their area, and they themselves and their families.

To answer our second research question, we conducted two-tailed chi-square tests to examine whether there was a significant association between participants' reported water insecurity and reported trust of their national weather service, national disaster agency, local news, local religious leaders, famous person, emergency services, and internet/social media.

To answer our third research question, we reported on two multilevel logistic regression models, one for participants who reported water insecurity, and one for participants who did not report water insecurity. These paired multilevel logistic regressions predicted water safety concerns (vs not), using severe weather concerns (vs not) and climate change concerns (vs not) as independent predictors. These multilevel logistic regressions accounted for the hierarchical structure of the data by treating participants as nested within countries, using random intercepts for each country and fixed effect controls for participants' gender, level of education, age and within-country income quintile.

All reported analyses utilized survey weights, as provided (and recommended) by Gallup to align country samples to country populations in terms of gender, age, education and socioeconomic status for multinational analyses. Additionally, we coded the survey data into binary responses such that *don't know* and *refused to answer* are 0 (as opposed to missing or NA), as recommended for analyzing survey data relating to perceived risks and health-related behaviors.²⁵ Analyses were conducted in R version 4.1.1. In light of the number of statistical tests, we used a $p < 0.001$ significance level.

Supporting Information provides analyses in which models are re-estimated on groups of countries segmented based on the degree to which they protect their citizens from unsafe water,²⁶ in which *don't know* and *refused to answer* participants are treated as missing, and in which demographics are included as fixed effect controls. We highlight the robustness of our main findings with these supplemental analyses.

3. Results

3.1 Descriptive Statistics

Across the 121 countries, the proportion of participants who reported water insecurity varied considerably (Figure 1; Table A1). About 25% of World Risk Poll participants around the world reported water insecurity. Across the 121 countries, rates of reported water insecurity varied considerably, ranging from less than 1% of participants in Singapore to 88% of participants in Venezuela (Figure 1).



Figure 1: Percent of participants who reported water insecurity, by country

3.2 Disaster preparedness perceptions

Globally, reporting perceived disaster preparedness was less common among participants with (vs without) water insecurity, specifically for disaster preparedness of their national government, their local government, nearby hospitals, and themselves and their families (Figure 2).

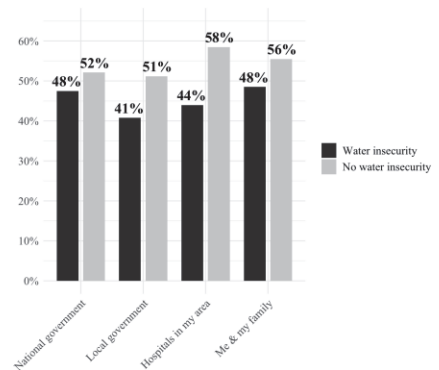


Figure 2: Proportion of participants who reported perceived disaster preparedness, by reported water insecurity (all splits statistically significant at $p < 0.001$)

Regression analyses confirmed small-to-medium effect sizes for the negative association between water insecurity and perceived disaster preparedness, after controlling for demographics (Tables A2–A14). Specifically, participants who reported water insecurity (vs those who did not) had between 0.68 (for local government) and 0.86 (for themselves and their families) the odds of perceiving disaster preparedness in the four targets.

3.3 Trust in disaster information sources

Among all participants, local news and emergency services providers were the most trusted sources of disaster information; at least 68% of participants said these sources were trustworthy (Figure 3).

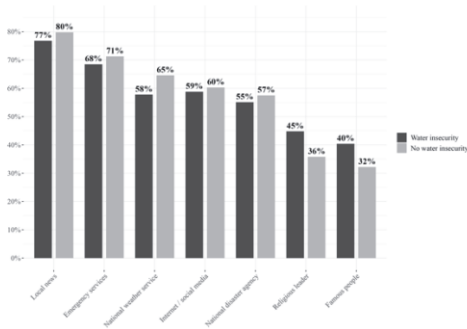


Figure 3: Proportion of participants who reported trust in information sources, by reported water insecurity

Global analyses found that that the proportion of participants who trusted specific disaster information sources varied only slightly with reported water insecurity (Figure 3). Globally, participants with (vs without) water insecurity less frequently trusted local news, emergency services, national weather services, internet / social media, and national disaster agencies, and more frequently trusted religious leaders and famous people (Figure 3). Nevertheless, one consistent pattern that held across all country water-safety performance groups and all analyses was that local news and emergency services were systematically in the top two or three most commonly trusted information sources, irrespective of reported water insecurity (Tables A15–A17).

Regression analyses confirmed that reported water insecurity was not a strong predictor of trust in most media sources, after controlling for participants' country of residence and demographics (Tables A18–A24). Specifically, participants who reported water insecurity (vs those who did not) had between 1.00 (local news) and 1.16 (famous people) the odds of trusting the seven targets. Indeed, regressions revealed educational attainment was the strongest predictor.

3.4 Intercorrelations between severe weather, climate change and water safety concerns

Concerning the intercorrelations of water safety, severe weather and climate change concerns, multilevel regression models suggested that, globally, especially among participants with (vs

without) water insecurity, water safety concerns were more strongly associated with their severe weather concerns than with their climate change concerns, as seen in the larger odds ratio for the former association (Table A25). Specifically, among participants who reported water insecurity, those who expressed severe weather concerns had 3.40 times the odds (99.9% Confidence Interval [3.39, 3.42]) of expressing water safety concerns than those who did not express severe weather concerns, while participants who expressed climate change concerns had 1.61 the odds (99.9% Confidence Interval [1.61, 1.62]) of expressing water safety concerns. For participants who did not report water insecurity, these odds ratios were, respectively, 2.96 (99.9% Confidence Interval [2.96, 2.97]) and 2.02 (99.9% Confidence Interval [2.02, 2.03]). Thus, the water safety concerns of participants who did (vs did not) report water insecurity may have been relatively more informed by their severe weather concerns than by their climate change concerns.

4. Discussion

Water insecurity, or lacking consistent access to safe water, is a growing concern that affects over 3.6 billion people worldwide.⁵ We analyzed the 2021 Lloyd's Register Foundation World Risk Poll to understand people with (vs without) water insecurity in terms of (1) perceived disaster preparation, (2) trust in disaster information sources, and (3) links between their water safety concerns, weather concerns, and climate change concerns.

Our first finding is that participants with (vs without) water more commonly perceived a lack of disaster preparedness among national and local governments, hospitals, and themselves and their families. This finding aligns with an analysis of 14 African countries, which suggested that experiences with water insecurity tend to emphasize potential problems with disaster aid, leading to the perception that

governments and hospitals are underprepared or incompetent.²⁷ Moreover, a recent review found that a lack of disaster preparedness is common even in countries with early warning systems, detailed evacuation plans, and ample water reserves.²⁸ To improve both perceived and actual preparedness, it has been recommended to involve citizens more in disaster preparedness and response planning at the community-level.²⁸

Our second finding is that, regardless of reported water insecurity and countries' water-safety performance, most people around the world said they would trust local news, followed closely by emergency services providers, to learn about an upcoming disaster. We also note that in the World Risk Poll, there was a positive association of water insecurity with trusting famous people and trusting religious leaders, a finding which persisted in global analyses and analyses by countries' water-safety performance. Hence, interventions that are targeted at people who have experienced water insecurity may benefit from using these informal information sources in addition to the commonly trusted local news and emergency service providers.

Our third finding was that participants' water safety concerns were more strongly predicted by their severe weather concerns than by their climate change concerns, irrespective of reported water insecurity. Additionally, participants with (vs without) water insecurity were even more likely to associate severe weather concerns with water safety concerns.

4.1 Limitations

Like any study, ours had limitations. First, we conducted secondary data analysis of the Lloyd's Register Foundation World Risk Poll, which was not collected with our research questions in mind. As a result, the World Risk Poll asked about disaster preparedness and trusted information sources for disasters in general,

rather than water-related disasters only.

Participants were also asked for their concerns about water safety, which constitutes only one aspect of water insecurity.²⁹ A second limitation pertained to our correlational analyses, which do not warrant causal conclusions. Third, despite survey questions being carefully tested by Gallup for participant comprehension in all surveyed countries, the World Risk Poll lacks questions examining participants' understanding of terminology such as "climate change" or "clean" water.³⁰ Fourth, regression models estimated small effect sizes for the impact of water insecurity on disaster preparedness perceptions and trust in disaster information sources, although even small effects can meaningfully improve health outcomes when scaled to the level of public policy.³¹

4.2 Implications for policymakers and water researchers

Despite these limitations, our findings have implications for policymakers and researchers aiming to improve water security and water disaster resiliency. First, our data highlight a need for greater disaster preparedness among people with water insecurity, who have low disaster preparedness. Interventions that attempt to boost people's perceived disaster preparedness may be especially powerful in mitigating flood risk.³² Second, our findings suggested that universal communications about water security will generally be most effective when disseminated through local news and emergency services, the most trusted sources for disaster information.³³ For communications targeted specifically at people with low water security, though, religious leaders and local celebrities might be an effective secondary communication channel. Finally, our findings suggest that water security communications should motivate people to support policy changes and take individual actions when possible, by mentioning the concrete threat worsening severe weather events pose to water supplies. Taken together, communicators should seek to better align water security communications with the specific

communication needs of those most vulnerable to and experienced with water insecurity.

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Appendix A. Chi-squared test statistics, group sensitivity analyses, methodological details, additional literature review and discussion, supporting tables and figures

Due to space restrictions, we are unable to publish the full version of the article in SRA-E Conference Proceedings. For the complete analysis and appendix, please email: inwald@usc.edu

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