

**Hydro-meteorological Disaster Preparedness and Public Health Response in Fiji:
Facilitators and Barriers**

Saori Kitabatake

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Committee:

Kristie Ebi

Jeremy Hess

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Department of Global Health

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Abstract

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Saori Kitabatake

Chair of the Supervisory Committee:
Kristie Ebi, PhD
Department of Global Health

Background: Small Island Developing States in the Pacific and other regions are among the most vulnerable to the impacts of climate change due to geographic, demographic and socioeconomic factors. Studying preparedness and response to hydro-meteorological hazards can facilitate climate change adaptation. In February 2016, Fiji was hit by the category 5 tropical cyclone Winston, which resulted in 44 deaths. TC Winston adversely impacted Fiji's health systems, damaging eighty-eight healthcare facilities, about forty percent of the healthcare facilities in the country.

Objective: The general objective of this study was to identify facilitators and barriers to improving hydro-meteorological disaster preparedness and public health response after extreme weather events in Fiji.

Methods: This qualitative study used in-depth semi-structured interviews with purposively selected key informants (n=15) and a focus group consultation (n=3). The interviews and focus group were divided into two sections: 1) reflection on TC Winston and perceptions about current hydro-meteorological disaster preparedness in Fiji, and 2) climate change perceptions. All interview/focus group were audio-recorded and manually transcribed. Thematic analysis was conducted using Dedoose.

Results: A total of 18 participants participated in the study [UN organizations n=5; NGOs n=4; national

nursing association n=4; affected village n=3; Ministry of Education n=1; and national university n=1].

Six key emerging themes relating to organizational issues were identified: coordination, supply chain management, human resources, community involvement, policy and legislation. Prominent themes relating to individual/community impacts were psychosocial health and occupational health. When interviewed, ten informants of Fijian nationality agreed that climate change was occurring in Fiji and that it could affect human health.

Conclusion: Effectively managing disaster risk and advance adaptation to climate change in Small Island Developing States such as Fiji should include top-down and bottom-up approaches. Recommendations based on this retrospective qualitative study were: 1. To strengthen health systems and existing structures; 2. To strengthen cluster coordination and Public Private Partnership; and 3. To involve communities in disaster risk reduction.

Keywords: disaster management, disaster risk management, disaster risk reduction, climate change adaptation, climate change and health, Fiji

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List of Acronyms

4W	Who is doing What, Where and When
DM	Disaster Management
DPS	Division of Pacific Technical Support
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
ENSO	El Niño Southern Oscillation
FBDRC	Fiji Business Disaster Resilience Council
GHG	Green House Gases
HEADMAP	Health Emergencies and Disaster Management Plan
IPCC	Intergovernmental Panel on Climate Change
IRB	Institutional Review Board
MoHMS	Ministry of Health and Medical Services
NCD	Non-Communicable Disease
NDMO	National Disaster Management Office
NGO	Non-Governmental Organization
SIDS	Small Island Developing States
SOPs	Stand Operating Procedures
TC	Tropical Cyclone
UN	United Nations
UNICEF	United Nations Children’s Fund
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

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“It always seems impossible until it’s done.”

-Nelson Mandela-

Introduction

Climate change augmented by human activities is a threat to human health and well-being. The Intergovernmental Panel on Climate Change (IPCC) assessment reports state that human activities, such as the burning of fossil fuels and changes in land cover, are altering the concentration of atmospheric constituents and properties of the Earth's surface that absorb or scatter radiant energy (1). This has caused an increase in the concentrations of greenhouse gases (GHGs) and aerosols, which are strongly implicated as contributors to climatic changes observed during the 20th century. These changes in atmospheric composition are likely to alter temperatures, precipitation patterns, sea level, and extreme weather events such as storm surges or tropical cyclones (1).

Climate change in the Pacific Island Countries

Although climate change impacts countries in all the regions in the world, the degree of impact in each country varies as a function of vulnerability, hazards and exposure (1). Small Island Developing States, including many Pacific Island countries, are particularly vulnerable to the impacts of climate change due to geographic, demographic and socioeconomic risk factors (2)(3). Their low elevation and small country size makes them vulnerable to sea level rise, which may lead to partial or total inundation. Saline intrusion and sea flooding are causing changes in aquifer volume and water quality that affect the population's livelihood. Furthermore, the majority of the populations and critical infrastructures (including healthcare facilities) are located near the coast, which makes them highly vulnerable to sea level rise and hydro-meteorological disasters. Finally, food insecurity due to altered agricultural production and fisheries is an urgent issue as Pacific Island countries have high dependence on natural resources (4).

Although Pacific Island countries have made progress on improving health indicators such as life expectancy, their general health status is still poor with shorter average life expectancies compared to developed countries (2). High prevalence of obesity and non-communicable diseases (NCDs) is

prominent in the region and is posing a high burden on national health systems. In view of these existing health vulnerabilities, it is a matter of great concern that the impacts of climate change will act as “multipliers” of existing health problems and place a heavier burden on health systems (2). The expected increase in the intensity and frequency of extreme weather events affect countries’ economies and development that may threaten the progress made (5). Overall, this highlights the importance of making adaptation a key priority for the government so that the health and well-being of the population is protected and promoted in the region.

The Republic of Fiji

The Republic of Fiji is located in Melanesia in the Southwest Pacific Ocean. It is a country with a surface area of 18,272 sq km and is comprised of approximately 330 islands – a third of which are inhabited. The two main islands are Viti Levu and Vanua Levu with a collective population of 898,000 people (6)(7). According to the World Bank classification, Fiji is classified as an upper middle- income country with a GDP per capita of 5,112 US dollars (7)(8). The country ranks 90th in International Human Development Indicators (9).

The climate of Fiji is known as an oceanic tropical marine climate with an average temperature of 25 degrees Celsius (annual variation between 20-27 degrees Celsius). The country experiences a distinct wet season (November to April) and a dry season (May to October). The ENSO (El Niño Southern Oscillation), as well as Trade Winds and Convergence Zones, are major features of climate variability in Fiji. Dry areas in the country experience extremely low rainfall during ENSO episodes (10). The country is located in an area prone to tropical cyclones, with an average of ten to twelve cyclones per decade affecting the country (10). Traditionally, cyclone season occurs during the period of November to April. However, there have been a few off-season cyclones traversing the country and the Southwest Pacific region. In the year 2017 alone, there were two off-season cyclones (cyclone Donna and Ella) traversing

the region. Tropical cyclone Donna was the strongest May tropical cyclone ever recorded in the Southern Hemisphere¹ (11).

Some studies in Fiji show associations between weather and climate variables and outbreaks of communicable diseases. For example, in the Ba province, a study showed that the likelihood of dengue and diarrhea outbreaks were 10 times and 9 times higher, respectively, one month after floods associated with a tropical depression compared to months when no tropical depression occurred. Similarly, the likelihood of a dengue outbreak was 5 times greater during months with drought compared to months without drought. It is thought that water stored in uncovered containers during drought months contribute to outbreaks as they create ideal breeding sites for *Aedes Aegypti* (12). In the past, Typhoid fever outbreaks were noted to follow floods and cyclones as the proximity of people, and compromised sanitary and hygiene facilities in evacuation centers create favorable conditions for bacterial transmission. Damage to agricultural products by extreme weather events is of a great concern especially in regard to non-communicable diseases. In March 2012, floods in the Western division resulted in fresh fruit and vegetable shortages that led the population to depend on canned and preserved food.

Tropical Cyclone Winston

In February 2016, Fiji was hit by a category 5 tropical cyclone called Winston (TC Winston), one of the most severe cyclones to ever hit the country, resulting in 44 deaths. The country declared a state of emergency as an estimated 40% of the country's population (350,000 people) was impacted, 9,000 homes destroyed, 17,000 homes severely damaged, and 131,000 people in need of immediate shelter (13). The cyclone also adversely impacted Fiji's health system; eighty-eight out of the 214 health facilities were damaged and seven healthcare facilities temporarily relocated due to severe damage (14). The cyclone left thousands without basic health needs such as food, clean drinking water, and sanitation. As the whole country was in the state of emergency, all schools were closed for at least 1 week (13), while some

¹ Category 4 tropical cyclone Donna that passed through Solomon Islands, Vanuatu and New Caledonia in the second week of May and tropical cyclone Ella that passed northern parts of Fiji during May 2017.

children in the more severely affected areas could not attend school for 2 to 3 months. All of these factors had detrimental psychosocial impacts on those affected.

As of June 2017, 16 months after the event, many people are still living in the tents provided by humanitarian agencies, the trees that were blown away by the wind have not grown back, and some of the crops that were damaged have not borne any fruit. The effects of TC Winston are still visible and felt by many people residing in the affected areas.

Given the above, it is critical to identify and use the lessons learnt from TC Winston to improve Fiji's health system's response during and after a disaster. It is also of paramount importance that the country improves its disaster-preparedness so that the damages can be minimized.

The general objective of this study is to identify factors that facilitate or inhibit improving hydro-meteorological disaster preparedness and public health responses after extreme weather events in Fiji. This study explored the experiences of those who were affected and/or involved in the health-related relief effort during the emergency and recovery period after TC Winston. The study participants were asked to explain their roles in the relief effort and to reflect on their experiences such as recalling the needs of communities they served and the challenges they faced during those periods. They were also encouraged to share the practices which they thought facilitated the response. Finally, they were asked about their perceptions of the current disaster-preparedness of their respective organizations and/or country and their perceptions about whether or not climate change was occurring in Fiji.

Methods

Study type:

This is a qualitative study using in-depth semi-structured interviews with purposively selected key informants and a focus group consultation. The interviews and focus group were divided into two sections. The first section reflected on TC Winston and perceptions of current hydro-meteorological disaster preparedness in Fiji. The second section focused on informants' perception of climate change in Fiji. An interview guide was developed by the researcher and used during interviews to facilitate the

process. Each interview was adapted to the specific informant according to their background and type of organizations they belonged to. Additionally, published materials and grey literature were reviewed to supplement the information provided by the informants.

Study/target population:

The study population is individuals involved in the health-related relief effort of a land-falling cyclone in Fiji. A small sample of affected individuals were included to identify individual/community impacts.

Sampling strategy and recruitment:

The Health and Environment unit at the Division of Pacific Technical Support of the World Health Organization (WHO) Western Pacific Region was consulted to help map individuals and/or organizations that were involved in the health-related relief effort of TC Winston in Fiji. The unit selected candidates based on their knowledge and experiences with regard to climate change adaptation, disaster management, disaster risk management, disaster risk reduction, and/or disaster-preparedness in Fiji. The candidates were contacted by email or in person and were asked whether they would be willing to participate in an interview. Subsequently, a snowball sampling technique was used to identify further participants using a system of referrals. Sixteen out of the twenty-four contacted individuals responded. Thirteen of those who responded were available during the data collection period and agreed to participate. Additionally, two more informants were identified by referral during a field visit to an affected village.

Ethical considerations:

The study was determined as IRB exempt (Category 2) by the University of Washington Human Subjects Division. The study proposal was reviewed and approved by the Health and Environmental Unit of the World Health Organization Division of Pacific Technical Support in Fiji. Verbal consent to participate in the study as well as permission for audio-recording were obtained from each participant before starting the interviews/focus group. The participants were assured that all the information provided would be kept confidential. All of the recorded interview/focus group session and transcripts were

secured in a password protected folder.

Study instrument:

Because this was an exploratory study with participants with a wide range of roles and responsibilities, a questionnaire was not developed. Instead, an interview guide was developed after the researcher reviewed relevant literature with regards to disaster preparedness and response. Prior to the interviews, the researcher studied each organization (e.g. mission statement and relevant activities) based on their websites and/or published materials. If the researcher found activities in which more details and/or clarifications would be useful, she noted this on the interview guide and asked about them during the interviews. The researcher asked the eighteen questions from the interview guide in most of the interviews. However, in some cases, questions were omitted when a judgement was made that it would result in repetitive answers. Open-ended questions were used throughout the interviews to allow exploration of the topics although some close-ended questions were used for clarification purposes. The same approach was used for the focus group.

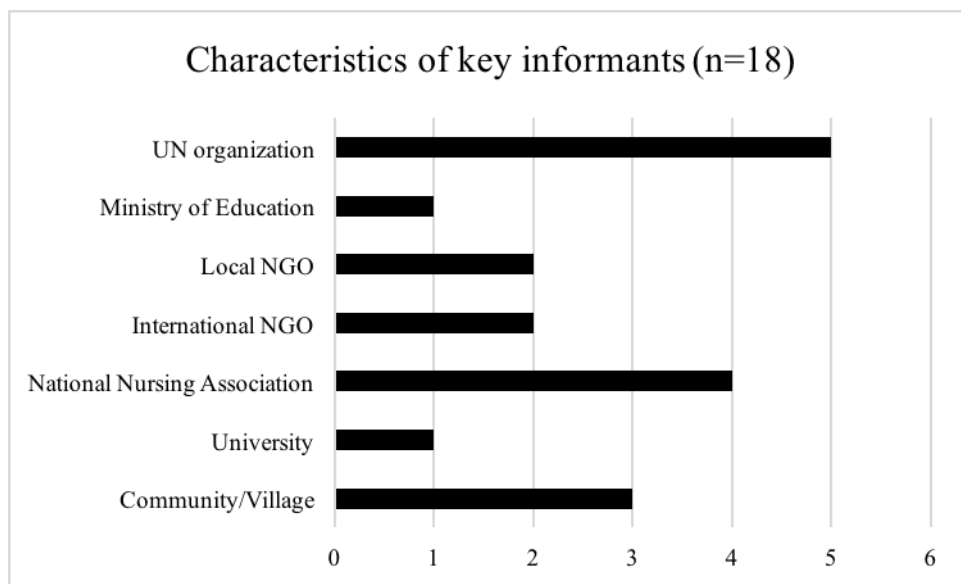
Analysis:

Audio-recorded qualitative data from the interviews/focus group were manually transcribed. The audio-recorded interviews were listened to at least twice to ensure they were transcribed correctly. The transcripts were then uploaded to Dedoose, a mixed methods web-based analysis program. Excerpts were selected based on whether they contained contents that were relevant to the research questions. Across the selected excerpts, emerging themes were studied and the excerpts were then coded based on these themes. After all the transcripts were coded once, a second round of coding was conducted to further ensure the ideas captured were accurate. Coded excerpts were analyzed again in an excel format to allow further analysis into meaningful units, to organize, compare, categorize into sub-themes. Sub-themes were then categorized into two categories to facilitate labeling and analysis; organizational issues and individual/community impacts. Finally, emerging themes and other critical elements highlighted in the interviews and review of published materials were reviewed to identify factors facilitating or inhibiting effective response to TC Winston.

Results

In total, fifteen people participated in the interviews with one informant organizing a focus group session of three participants, resulting in eighteen total participants [UN organizations n=5; NGOs n=4 (international n=2, local n=2); national nursing association n=4; affected village n=3; Ministry of Education n=1; and national university n=1]. The average duration of the interviews was 34 minutes for the organizations (range: 15 to 58) while the average with the affected individuals was 17 minutes (range: 9 to 27). The duration of the focus group was 42 minutes.

Graph 1. Characteristics of key informants



Result I. TC Winston and hydro-meteorological disaster preparedness in Fiji

Overall relief response for TC Winston

Overall relief response was led by the Fijian Government through their National Disaster Management Office (NDMO), which is supported by various organizations, including UN organizations and NGOs. Fiji utilizes a cluster approach; there are 8 national clusters: 1) health and nutrition; 2) shelter;

3) education; 4) food security; 5) safety and protection; 6) water, sanitation and hygiene (WASH); 7) logistics and 8) public works and utilities. Each cluster has a designated lead agency; these are governmental line ministries and co-leads agencies that range from UN organization such as WHO and UNICEF to NGOs (15). There was also external assistance, for example, countries such as Australia and New Zealand sent army personnel to provide medical assistance. The private sector, including a large number of local and regional businesses, and those from civil society, along with many volunteers, were active and made significant contributions to the humanitarian response and recovery efforts.

The majority of key informants were from UN organizations and NGOs that were a part of the health and nutrition, and WASH clusters. Two informants were seconded to the Ministry of Health and Medical Services (MoHMS) to provide assistance after TC Winston for an extended time period. Other prominent roles included counselors who provided psychosocial interventions, members of the national nursing association who coordinated nurses in the MoHMS, and a professor from a national university who specialized in environmental health.

Key themes to improve disaster preparedness

6 key themes emerged in responses about TC Winston: coordination, supply chain management, information management, human resources, community involvement, and policy and legislation.

Organizational issues

Coordination

Four informants responded that coordination was insufficient, while three stated that coordination was good and one stated that it was better compared to the response for TC Evans in 2012. TC Winston brought new actors who did not previously have a presence in Fiji. Although different organizations exchanged information in regard to their activities in cluster meetings, there were those who were not familiar with the cluster approach and, therefore, did not report to health officers in charge of their areas. Informants active on the ground stated there were duplications of responses particularly in easily

accessible areas situated along roadside. This caused some areas receiving more supplies and assistance compared to other hard to reach areas².

A history of working closely with government (i.e. MoHMS and NDMO) prior to the disaster seemed to facilitate coordination because the organizations knew the focal points. Communication was a challenge for many in affected areas because the radio telephones normally used were destroyed by water and/or wind and there was no mobile reception in some areas. Even when they were able to communicate via mobile, lack of electricity made charging impossible. Informants stated this hindered effective coordination. However, coping behaviors were observed in some places. For example, using other means such as Facebook to communicate the results of rapid assessment.

Supply chain management

Supply chain management was a challenge found across most of the organizations involved (i.e. UN, government, NGOs). Most of the supplies including donations from foreign countries were processed through the NDMO and stored in a warehouse in Suva, the capital port city of Fiji. Three informants stated that distribution of supplies was not made in timely manner and the supplies were found stuck for some time in Suva. One informant described that the government was not able to process huge amount of supplies coming in from overseas, which could be due to a lack of capacity in inventory management. One NGO had its own containers pre-stocked in various parts of Fiji to stock their pre-positioned items for a disaster. This facilitated the timely distribution of supplies to affected areas. Two informants from this organization discussed about challenges of finding where to procure additional supplies after pre-positioned stocks were depleted and described this process as long and time-consuming. Right after the disaster, access to some affected areas were compromised due to road condition; access to smaller maritime islands was also a challenge that was often discussed by informants.

² Two types of hard to reach areas identified during TC Winston were mountainous areas known as interior and remote islands often referred to as maritime.

Information management

Informants from UN organizations and NGOs stated that information management was a significant challenge. Two informants who assisted a team at the MoHMS in receiving information from the field explained that a lack of baseline data (ex. number of villages in an area, number of healthcare centers and their locations) made it challenging to summarize the data in a meaningful and presentable way to be shared with partners in the clusters. Communication flow within the MoHMS was also described as somewhat challenging. For example, one informant described that the manner in which reporting occurred from lower to upper levels (i.e. divisional to national) was ineffective. Two respondents described their experience with information management as following:

It was impossible because always the denominator number is never there, for us to say effectively % so and so. We will have one hundred people who were affected, women were affected, but then what is the denominator?

And then you are trying to make sense of... you know they are writing in hurry. Some writings, you know, things in abbreviation. And some words were too technical. Even some writings were not really, we can't read that. So it was back and forth, you know, some issues that they were trying to clarify. It was trying to group information into something that was much clearer.

Sometimes when the report that comes up to us (national level), it's already in some form of consolidated, the way it's hard for us to analyze which particular area. Because when it comes from division, division will just write Ba or Lautoka, Nadi, and does not specify which case is from here, which injury is from where.....,

One informant noted that the use of different reporting templates by organizations created challenges when compiling the data. There was a reporting template known as 4W that the participating organizations in the clusters were encouraged to use³. Three informants, in the health and nutrition cluster and the WASH cluster, stated that it was challenging to use 4W because a lot of organizations had no previous experience using it, therefore they did not understand how to fill it out correctly. Although its usage improved over time, there are some organizations requesting training on how to properly use the 4W, according to an informant. Another informant from an UN organization explained that the

³ 4W is a reporting template used in clusters that indicates Who is doing What, Where and When. It is intended to help coordination of relief efforts during humanitarian crisis.

monitoring and evaluation of supplies distributed and activities implemented was a weakness during their relief efforts for TC Winston; no proper assessment was conducted to determine whether supplies were received and considered useful by the communities.

An informant who assisted the government and another informant from an NGO stated that having an improved platform for assessment on mobile devices (i.e. smart phone and tablet) was useful in providing a timely response. Otherwise, the communication channel could be quite long for the government. The platform utilized by the government allowed environmental health workers to input assessment information on their mobile phones and have the information delivered directly to an official at the national level. Through this platform, an official at the national level received information such as how many communities had damaged water supplies. Access to this information facilitated timely decision making at the national level. Sharing information through a central database was also suggested by an informant to improve coordination and information management among different organizations.

Human resources

Staffing of healthcare workers in affected areas was an issue as healthcare workers themselves were also affected. Many government workers in severely affected areas were brought back to Suva as their houses were destroyed. Some nursing stations were not operational for almost one month because there was no nurse to provide services⁴. Two informants commented on the lack of disaster training for nurses; they hope to include it in the nursing school curriculum as one of the nursing competencies. One informant noted that healthcare workers in some remote islands were given insufficient resources to achieve optimal health outcomes.

They need to have... them in place. Like those basic items. Torches, lanterns, and maybe they need some kind of, form of transport, like a bicycle... and people in the maritime, the nurses in the maritime, they need to have a transport, like a boat.

⁴ In order to assist with health service delivery in affected areas, government relief teams including retired midwives were dispatched from Suva.

The same informant emphasized that healthcare facilities need to be staffed and equipped with basic and essential items during non-disaster times because radio telephones in some healthcare facilities were nonfunctional prior to TC Winston.

Community involvement

The need to involve communities in disaster management and disaster preparedness during non-disaster time was discussed throughout. Six informants indicated there is a lack of initiative or ownership from communities, that they have a tendency to rely on government and external assistance. One informant from an affected village stated there was lack of awareness as the community had never experienced a disaster of this magnitude and more training was needed for community members to understand and be aware of the danger and consequences of disasters. One informant from a UN organization stated that more NGOs are needed to represent the community.

Concerns regarding quality of evacuation centers, especially in regard to poor WASH status, were raised. There were insufficient numbers of toilets for the number of people occupying the area. Safety in evacuation was also a concern, especially for females because there were some cases of rape within the evacuation centers. When asked about the keys to increasing the community's resilience to disasters, raising awareness of the importance of disaster preparedness at community level was discussed. In order to achieve this, training should be conducted and explained in a way community members can understand to maximize their usefulness. An example one informant gave was conducting training in the local dialect that is pertinent to that community. The need to include consequences, such as the dangers of a category 5 cyclone, was also emphasized by multiple informants. The following is a quote from an informant who provided psychological first aid in an affected village:

This is where awareness comes in. The importance of break-down information to target groups, suited to their own mother-tongue to their own dialect, and train them. So not only that top people to know the changes, but it needs to come down to the level of communities. It needs to be broken down and prepare them about the changes that are coming up. Even the cyclone Winston, the category 5 is a shock to them, what is category 5? I have to try all my best to break it down to their level of understanding in their own dialect.

Continuity of training, especially during non-disaster time, was mentioned as an important factor to improve the communities' vigilance and disaster preparedness. Identifying existing community structures and strengthening existing partnerships were also discussed. Because Turaga ni Koro has a special role in connecting his village and external organizations, including the government and international organizations, he should be trained well. One informant discussed the importance of acknowledging and documenting traditional knowledge to increase the communities' resilience. Capacity building on the building code and encouraging people to build back houses that are cyclone-resilient was also suggested.

Policy and Legislation

Several informants discussed the importance of reviewing and updating policies and legislation that are relevant to disaster preparedness. These included the Natural Disaster Management Act of 1998 (16) and Health Emergencies and Disaster Management Plan (HEADMAP) of the MoHMS (17). One informant stated that the HEADMAP is scheduled for a review in 2017. This provides an opportunity to incorporate the lessons learnt from TC Winston into the plan. Furthermore, one informant spoke of the Fiji Business Disaster Resilience Council (FBDRC) that was launched in July 2016 to expand the engagement of the private sector in national disaster management⁵ (18).

Individual / Community impacts

Psychosocial Health

TC Winston psychologically affected a range of people. One informant from an affected village stated that she was unable to get enough rest when sleeping in a crowded area and the subsequent lack of privacy. The other informant from the same affected village explained that the devastation caused by TC Winston is still very much present in the village and is affecting people psychologically.

⁵ The FBDRC was formed after TC Winston to build a local structure to coordinate business engagement with the government and other partners including NGOs and UN organizations in disaster risk reduction, emergency preparedness, response and recovery (18).

I know that TC Winston affects people now. It's in their mind. What all they've seen and what is happening. As I said, if some big sound (were) coming, "What is that? What is happening?" It affects their life. It's in them, not just during the time (of TC Winston). Even today.

Two informants who provided psychosocial interventions in the affected communities described their experiences as following:

Psychologically, they were having a flashback, sometimes they would not sleep, especially men, they are thinking of how to build a house, because their family, their children were already affected. Children were just crying. When there is strong wind, it will make them cry.

Women were looking for food to feed for children and men. (Men) they get firewood, and all the things to plant. So they were in the very stressful situations as well. That ended up in a lot of violent cases. So there were other things that has contributed to... Well Winston has brought lots of issues.

Concern regarding the lack of personnel qualified in providing psychosocial interventions to affected areas was addressed by three informants.

Occupational Health

Occupational health issues relating to highly stressful workloads were mentioned by informants from various organizations (n=9). For example, healthcare workers who remained in affected areas to provide service were described as overwhelmed because they attended to additional patients from nearby villages where the healthcare facilities closed. One informant who coordinated nurses at a divisional level explained the experiences of nurses in affected areas and those dispatched to affected areas:

For the affected areas they have to work throughout their own interests. They are already affected, their houses already damaged, and they have to attend to the injured. The injured ones, the injured communities. So they have to work, they are exhausted, physically exhausted and probably mentally and emotionally exhausted. For those that were affected. And for those that were sent to the areas, same thing as well. They are exhausted and very tired. That's why we didn't want to send them for one whole month. At least 2 weeks, come back. 2 weeks, come back.

The national nursing association provided financial assistance to affected nurses. In some cases, counseling services were provided for healthcare workers in affected areas who were traumatized by what they observed during TC Winston. A highly stressful workload was not only prevalent among healthcare

workers in affected areas, but also among those coordinating the response and those dispatched from non-affected areas.

Table 1. Additional activities and resources needed to prepare for the next extreme weather event (by type of organization)

Cluster-related	<ul style="list-style-type: none"> • capacity building on information management (4W); • improving coordination; • more NGO participation
Government-related	<ul style="list-style-type: none"> • capacity building on disaster-preparedness among healthcare professionals; • capacity building on information management; • community involvement to build local capacity; • decentralization of response; • human resources with technical expertise on DM/DRM/DRR; • improving availability of resources in healthcare facilities; • improving supply chains; • including DM/DRM/DRR training into nursing school curriculum; • strengthening Public-Private Partnership; • increasing the number of human resources to provide psychological interventions; • reviewing relevant policy and legislation; • strengthening existing government structure; • urban DRR
NGO-related	<ul style="list-style-type: none"> • funding; • improving supply chains (i.e. proper storage)
Community	<ul style="list-style-type: none"> • capacity building on carpentry skills; • capacity building on disaster preparedness; • evacuation center

Result II. Climate change perceptions

Table 2. Climate change perceptions

Climate change questions	n	(%)
Do you think extreme weather events like cyclone or flood happen more frequently than they used to?		
Yes	8	(80%)
No	0	(0%)
Not sure	2	(20%)
Do you think extreme weather events like cyclone or flood are stronger or more intense than they used to be?		
Yes	7	(70%)
No	0	(0%)
Not sure	3	(30%)
Do you think climate change is occurring in Fiji?		
Yes	10	(100%)
No	0	(0%)
Not sure	0	(0%)
Do you think changes in climate can affect human health?		
Yes	10	(100%)
No	0	(0%)
Not sure	0	(0%)

Ten informants of Fijian nationality were asked their perceptions about climate change. Informants of non-Fijian nationality were excluded as they are unlikely to have spent enough time in the country to be able to identify changes in weather patterns. Informants whom the researcher was cognizant of their perceptions and knowledge regarding climate change and health from previous interactions were also excluded. The majority of respondents agreed that the frequency (n=8) and intensity (n=7) of extreme weather events were increasing while a few stated they were not sure whether they were more frequent (n=2); or intense (n=3) and it was hard to tell at this moment. Nevertheless, all of the respondents agreed that climate change was occurring in Fiji and that it could affect human health. The respondents gave wide ranging answers about how changes in climate could affect human health. Four out of 10 respondents stated that an increase in the number of people getting sick because of changes in temperature, including heat-related illnesses, could occur. Three out of 10 respondents stated that climate

change could affect the occurrence of communicable diseases such as typhoid fever, leptospirosis and acute respiratory infection. Three respondents noted that a change in a viral strain of influenza seemed to have occurred and one respondent said that she suffered from persistent cough. Three respondents mentioned the potential effects on vector borne diseases such as effects on incidence of dengue and Zika, including the possibility of climate change bringing diseases like malaria to new areas. Effects on mental health were discussed frequently. This could be largely categorized into increased distress due to relocation and psychological effects after TC Winston. Two respondents described their experiences when visiting affected areas:

They are really worried about their land. They will be saying, "This used to be my farm. My taro farm. My cassava farm. But that's all covered with water now." So they have to move up. Those are some of the effects, psychologically they will be affected.

They would not relocate, you know, to higher grounds. They refused because they said that is the place where their ancestors have placed them. But yet again, due to climate change, water has just reached to front of their house, but they still refuse to move up. And some of them were pretty sick just thinking of relocating.

Climate change's effects on agriculture increasing rise of non-communicable diseases was discussed by two respondents.

After TC Winston, there was a lot of food donations, processed food coming into the community. What it has done is that more people have become dependent on eating food from off the supermarket shelves.

If we don't have a proper place to plant, like in atoll countries, if we don't have enough land to use for planting green vegetables, of course you'll be buying processed foods. And what does processed food give you?

Discussion

There is a complementary interface between managing disaster risks and climate change adaptation. The IPCC states that the severity of the impacts of climate extremes depends strongly on the level of the exposure and vulnerability to these extremes; and that both disaster risk management and adaptation to climate change focus on reducing exposure and vulnerability as well as increasing resilience to the potential adverse impacts of weather and climate extremes (19).

Several opportunities and approaches to improve hydro-meteorological disaster preparedness in Fiji were identified. First, Fiji has a strong governmental structure in responding to disasters that is led by the NDMO. The national cluster approach allows widely varying partners to work together. Private sector involvement is being fostered through entities such as the FBDR that are likely to serve as a solid foundation in strengthening the Public-Private Partnership.

However, there is room for improvement. The WHO operational framework for building climate resilient health systems emphasizes the importance of strengthening the six building blocks of health systems⁶ (20). The interviews and focus group consultation revealed challenges in regard to these building blocks; namely the most frequently mentioned were the urgent need to strengthen health information systems, service delivery, and health workforce, and improve supply chain management particularly in highly vulnerable areas such as remote islands and mountainous areas (21). Access to these areas is a major challenge due to limited infrastructure and means to travel. During TC Winston, there was no communication available in some of these areas. This highlights the need to ensure that healthcare facilities in these areas are prepared to respond to emergencies. Developing Standard Operating Procedures (SOPs) for different types of disasters that are suited to regional geographic characteristics and/or availability of infrastructure might facilitate overcoming the wide variability in vulnerability experienced. Investing in occupational health to protect worker's well-being should also be considered by

⁶ Six building blocks are: 1) leadership and governance; 2) health workforce; 3) health information systems; 4) essential medical products and technologies; 5) service delivery; and 6) financing.

the government during emergency and nonemergency periods.

It is also important to identify risk communication strategies that are suitable for the targeted populations, to maximize the impact of disaster preparedness training and DRR at the community level. The messages have to resonate with the community members for them to sense the urgency of risk and take the initiative to reduce the risks. Urban DRR should also be taken into consideration as they take distinct approach and resources. Finally, urban squatters and informal settlement are issues not to be neglected in Fiji because they hinder the enforcement of building code. This is critical in building disaster resilient buildings and infrastructure that can withstand cyclones and other types of natural disasters.

Limitations

The study was limited to the perceptions of a small number of participants. No official evaluations using assessment tools such as safety hospital index were conducted to evaluate disaster preparedness in healthcare facilities. Furthermore, perceptions were limited to mainly those from UN organizations and NGOs, and did not widely include those from the MoHMS. Generalizability was not established because the geographic characteristics and extent of damage in the areas to which the informants referred varied widely. Similarly, the study sample did not include Indo-Fijians who might have different perceptions and cultural practices from iTaukei Fijians. Answers to climate change questions may not reflect the level of knowledge of Fijians as a whole because the majority of participants were highly educated individuals working in the fields of public health, environmental health, and humanitarian coordination; therefore, they were likely to have had a prior engagement with climate change and health. Finally, researcher bias might have influenced the results because the researcher had interactions and formed relationships with some of the participants prior to interviews; and no inter-coder reliability was established because the study was conducted by one researcher.

Conclusion

Fiji, along with other Small Islands Developing States, are among one of the most vulnerable to the impacts of climate change and climate variability. These impacts negatively affect the country's development and progress on health outcomes. Extreme weather events pose an additional burden on SIDS who are often already confronted with economic, social and environmental challenges associated with climate change. TC Winston revealed several challenges and opportunities to improving hydro-meteorological disaster preparedness in Fiji and, subsequently, resilience to climate change. The approach to effectively manage disaster risk and advance adaptation to climate change should include top-down and bottom-up approaches, including to:

1. Strengthen health systems and existing structures;
2. Strengthen the cluster coordination and Public Private Partnership; and
3. Involve communities in disaster risk reduction to raise awareness of climate change and disaster risks. Capacity building should be continuous during non-disaster periods and should be tailored according to the community context.

Appendix I. List of themes and sub-themes emerged

Themes	Challenges/ Strengths	Sub-themes
Coordination	Challenges/Barriers/Constraints	Duplication of responses in easily accessible areas; insufficient inter-cluster coordination; organizations not linking up with correct government departments
	Strengths/Facilitators/Opportunities	Previous working relationship; assistance from near-by branches (NGOs); Central Emergency Respond Fund (CERF)
Supply Chain Management	Challenges/Barriers/Constraints	Untimely distribution; unable to process the large amount of donations; lack of information of the needs from the communities; long procurement process;
	Strengths/Facilitators/Opportunities	Pre-positioned supplies; pre-allocated budget for emergency
Information Management	Challenges/Barriers/Constraints	Lack of baseline data; inconsistent reporting templates used; monitoring and evaluation; summarizing data; government's protocol on sharing information
	Strengths/Facilitators/Opportunities	Improved assessment platform; having central database to share information;
Human Resource	Challenges/Barriers/Constraints	Occupational health issues (workloads); lack of qualified counselors; lack of transportation; lack of disaster related curriculum in nursing school
	Strengths/Facilitators/Opportunities	Flexibility of roles during response; utilizing qualified personnel that are out of workforce (retired midwives); External assistance from overseas; volunteers; occupational health (financial assistance)
Community Involvement	Challenges/Barriers/Constraints	Reliance on external assistance; lack of initiative/ownership; lack of evacuation center; lack of enforcement of building code; trainings need to be community-specific
	Strengths/Facilitators/Opportunities	Traditional local knowledge; community's desire for capacity building on disaster preparedness and carpentry skills to build back stronger housings that can withstand natural disasters
Policy and Legislation	Challenges/Barriers/Constraints	More human resources with technical expertise on DM/DRM/DRR needed
	Strengths/Facilitators/Opportunities	Fiji Business Disaster Resilience Council; Relevant policies are being reviewed and updated; Natural Disaster Management Act of 1998; HEADMAP

Appendix II: Interview guide

Interview Guide for Interviewing International Organizations

I, Saori Kitabatake, will interview individuals who were involved with relief efforts for TC Winston about their experiences during TC Winston, particularly regarding their perception on challenges they faced; practices they thought facilitated the response; their perception on procurement and distribution of urgent and essential medicine and equipment during and immediately after the cyclone; their perceptions on coordination with external rescue workers; their perception on level of emergency-preparedness; and climate change awareness.

Interviewer speaking to respondent [Go over each point carefully]:

- I am a MPH Global Health student in the University of Washington in U.S. I am also currently working as a volunteer at WHO office in Suva.
- The purpose of this interview is to identify facilitators and barriers to improving hydro-meteorological disaster preparedness in Fiji, especially with regards to health. I aim to achieve this by asking you to reflect on your experiences during the TC Winston. For example, I may ask about challenges you faced during the TC Winston.
- The results of these interviews will be analyzed to write my MPH thesis at the University of Washington. I would like to ask your permission to audio-record the interview for analysis purpose. Your individual response will be kept confidential. However, I may include anonymized quotes in my thesis.
- I will also send the final report to you for your information upon your request.

Demographics

Personal Information

- What is your current position?
- Are you currently working in the same position you were working during TC Winston?
- How many years have you worked in your current position at this organization?

Agency Information

- How long has this organization been part of the PHT Health and Nutrition Cluster?
Probes
 - Did the organization join before TC Winston?
 - Did the organization join after TC Winston?

TC Winston

- What was your organization's role during/after TC Winston?
 - What did your organization's do during/after TC Winston?
- What are some of the challenges you or organization faced during/after TC Winston?
 - Probes
 - Any challenges faced logistically?
 - Did you have any difficulty transporting supplies to the affected areas?
 - If so, what were the reasons?
 - How did you manage to intervene in so-called hard-to-reach areas?
- Was there any practice that you thought facilitated the response? If so, what are they?
- How do you describe communication between different participating organizations?

Disaster-Preparedness

- Current overall preparedness for extreme weather event
 - How do you rate your organization's overall preparedness for extreme weather events like cyclone on the scale of 1-5?
 - 1. Completely unprepared
 - 2. Somewhat unprepared
 - 3. Neither prepared nor unprepared
 - 4. Somewhat prepared
 - 5. Completely prepared
- What do you think are the barriers and constraints to improving disaster preparedness in Fiji?
- What do you think are the facilitators to improving disaster-preparedness in Fiji?
- What additional activities and resources do you think are needed to prepare for the next cyclone?
- What do you think are the keys to increasing resilience of communities?

Climate Change Awareness

- Do you think extreme weather events (i.e. tropical cyclones or flood) happen more frequently than they used to?
- Do you think extreme weather events (i.e. tropical cyclones or flood) are stronger or more intense than they used to be?

- Do you think climate change is occurring in Fiji?
- Do you think changes in climate can affect human health?
 - If so what do you think are some of the health effects of climate change?

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