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Climate change, extreme events and mental health in the Pacific region

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Abstract

Purpose – This paper aims to address a gap in investigating specific impacts of climate change on mental health in the Pacific region, a region prone to extreme events. This paper reports on a study on the connections between climate change, public health, extreme weather and climate events (EWEs), livelihoods and mental health, focusing on the Pacific region Islands countries.

Design/methodology/approach – This paper deploys two main methods. The first is a bibliometric analysis to understand the state of the literature. For example, the input data for term co-occurrence analysis using VOSviewer is bibliometric data of publications downloaded from Scopus. The second method describes case studies, which outline some of the EWEs the region has faced, which have also impacted mental health.

Findings – The results suggest that the increased frequency of EWEs in the region contributes to a greater incidence of mental health problems. These, in turn, are associated with a relatively low level of resilience and greater vulnerability. The findings illustrate the need for improvements in the public health systems of Pacific nations so that they are in a better position to cope with the pressures posed by a changing environment.

Originality/value – This paper contributes to the current literature by identifying the links between climate change, extreme events, environmental health and mental health consequences in the Pacific Region. It calls for greater awareness of the subject matter of mental health among public health professionals so that they may be better able to recognise the symptoms and relate them to their climate-related causes and co-determinant factors.

Keywords Extreme events, Climate change, Environmental health, Mental health, Livelihoods, Pacific region

Paper type Research paper

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1. Introduction

1.1 Introducing climate change, extreme weather events and health

The influence of humans on the climate system is evident. The recent global anthropogenic greenhouse gas emissions due to population growth and massive industrial processes are the highest in history; therefore, they are the leading cause of climate change and global warming (IPCC, 2014). While the evidence explicitly links anthropogenic climate change with extreme weather and climate events (EWEs) frequency and intensity, indicators suggest human-mediated global warming has *likely* increased compound EWEs since the 1950s (IPCC, 2012, 2018, 2019, 2021; Mycoo *et al.*, 2022).

Besides its substantial environmental and economic risks, climate change is one of the world's leading health risks (Berry *et al.*, 2018). It is a primary culprit for the increased rates of many communicable and non-communicable diseases, including zoonoses (Leal Filho *et al.*, 2022). Of particular concern are the impacts of climate change on mental health and the stress related to it (Searle and Gow, 2010). There is a strong association between EWEs and mental illness (Berry *et al.*, 2018). These impacts may range from significant short-term to long-term impacts. The short-term impacts on mental health occur during or in the few days following a EWE and are likely to subside with time. Heatwaves, for instance, were found to negatively impact mental well-being equivalent to unemployment (Ding *et al.*, 2015). Severe environmental events such as floods result in injuries, loss of properties and businesses and loss of loved ones, aggravating or leading to mental illnesses, such as anxiety, depression, distress and trauma (Berry *et al.*, 2018). Low-income and developing countries are naturally more prone to such effects due to their lack of preparedness and limited adaptation capacity (Alderman *et al.*, 2012). Overall, the most prevalent psychological illness in people affected by EWEs is post-traumatic distress syndrome (PTSD), followed by depression and anxiety (Liu *et al.*, 2006). The magnitude of stress experienced by the victims depends on the extent of the damage, losses and inconvenience caused by the event (Tapsell *et al.*, 2002).

Although there is no solid evidence about how long psychological impacts could last after a flood event, some studies suggest that psychological distress caused by floods affects the quality of life in the long term, too (Berry *et al.*, 2018). For example, the levels of psychological distress in the community affected by the floods in 2000 in Lewes, Southern England, had doubled, and those psychological problems were still recognisable four years after the flood (Reacher *et al.*, 2004). Figure 1 presents an overview of some of the impacts of climate change on mental health.

In addition, there is growing evidence linking climate change and extreme environmental events to human migration that together with its accompanying stressors become a significant cause of increased mental illness rates (Bhugra, 2004; Black *et al.*, 2013).

1.2 Impacts of climate change and extreme events in the Pacific Island countries

1.2.1 Health impacts of climate change and extreme events as a whole. Current projections indicate that climate change and environmental disasters will become among the leading causes of migration in the 21st century (IPCC, 2014). One of the world's most affected regions by climate change and EWEs is the Pacific Islands Countries (PICs), which comprise hundreds of scattered islands that are small in size and poor in natural resources. PICs have weak economies, poor infrastructure and a combined population of about 6.6 million. Most of the population work in agriculture (WHO, 2013), and 50% live within 1.5 km of the ocean (Tiatia-Seath *et al.*, 2018).

Five PICs are ranked among the top 20 countries in the World Risk Index for countries at-risk of extreme natural events in 2019, having Vanuatu and Tonga islands as first and third on the list, respectively (The World Bank, 2020). Intense cyclones, floods, sea-level rise (SLR), freshwater shortage and changes in seasonal weather are expected consequences of climate change in the Pacific region. Due to the concentration of most people in the coastal

areas, only a few people could be safe from these climatic phenomena (Tiatia-Seath *et al.*, 2018). These consequences may have disastrous economic implications such as land and coastal infrastructure losses and severe health impacts such as malaria and dengue fever. Nevertheless, the impacts of EWEs on mental well-being, in particular, have recently gained much recognition by public health experts in the Pacific region. The damaging climate-related impacts on mental health may be direct or indirect. The direct impacts include, for instance, anxiety, depression, distress and trauma occurring following devastating natural events. On the other hand, the indirect impacts include the movement of people due to the destruction of the infrastructure and the subsequent economic and social collapse of the affected cities. Furthermore, climate change in the Asia Pacific region might force up to 75 million people to migrate to other destinations by 2050 (Tiatia-Seath *et al.*, 2018); this kind of forced migration represents a real stressor for the affected people and negatively affects their mental well-being.

The specific impacts of climate change and EWEs on mental health in the Pacific region and the different PICs are not well studied, and only little is known about it up to date. For instance, Gibson *et al.* (2020) stated,

> Evidence is emerging of the mental health impacts of climate change. Tuvaluans are experiencing distress because of the local environmental impacts caused or exacerbated by climate change and hearing about the potential consequences of climate change.

This paper tries to fill this gap by studying the connections between climate change, extreme weather events and mental health, focusing on the PICs in general, particularly the Federated States of Micronesia (FSM), Fiji, Kiribati, Marshall Islands, Nauru, Pal au, Samoa, Solomon Islands, Tuvalu and Vanuatu. Besides reviewing case studies of EWEs, the paper describes how they disrupt life-support systems and population livelihoods and well-being by affecting determinant factors such as food security, malnutrition, water security, vector- and water-borne diseases and displacement affect the population's mental health/psychosocial condition.

Pacific island countries (PICs) are among those most vulnerable to the health impacts of climate change (Hanna and McIver, 2014) due to their exposure to changing weather patterns (McIver *et al.*, 2016). Consequently, extreme events' frequency, timing, intensity and duration vary (Karl *et al.*, 1995). Increased precipitation, drought, cyclone, hurricane, windstorm and SLR result in the rise of climate-sensitive health risks and limits the capacity of PICs to manage and adapt in the face of such risks.

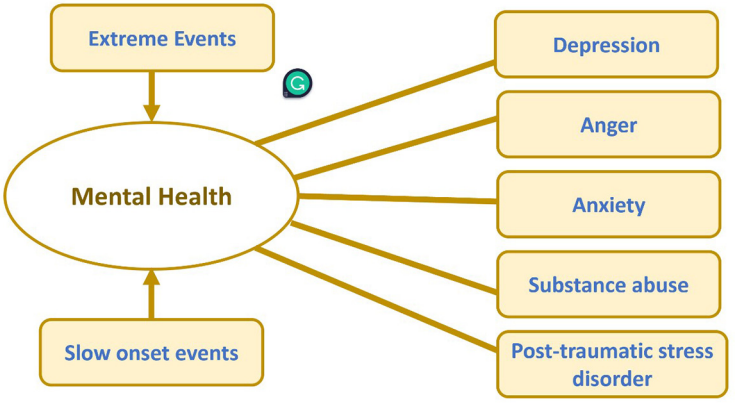

Figure 1.
Some of the impacts of climate change on mental health

Source: Authors

The extent to which the impacts of EWEs could affect future susceptibility is determined by whether affected communities can prepare for and cope with the exposure and if the health systems can fully recover from an event before the next occurs (Ebi and Bowen, 2016). Further, EWEs can have prolonged effects on communities and health-care services; their impacts increase the vulnerability to successive events. For example, a hurricane followed by a flooding event in low-lying coastal areas does not allow adequate time for recovery, which can take decades (UNES-CAP, 2015).

Climate change has substantial and diverse impacts on human health (Kotcher *et al.*, 2021). Furthermore, the pathways by which climate change affects health differ according to their modes of action (McIver *et al.*, 2016). The potential health impacts of EWEs include direct impacts, such as traumatic deaths and injuries; indirect impacts, such as illnesses associated with water-borne, food-borne, vector-borne diseases and zoonoses; diffuse or delayed impacts such as mental/psychosocial health disorders, non-communicable diseases (NCDs), health system deficiencies through ecologic or social disruption (McIver *et al.*, 2016; Butler and Harley, 2010).

1.2.2 Delayed health impacts of climate change and extreme events on mental health. Several climate-related health risks are of concern in the Pacific not documented elsewhere globally, for example, NCDs, mental/psychosocial health disorders and ciguatera (McIver *et al.*, 2016; Mannava *et al.*, 2015). The countries prone to climate-related mental or psychosocial health disorders (e.g. anxiety, depression and post-traumatic disorder) include FSM, Fiji, Marshal Islands, Nauru, Palau, Solomon Islands, Tuvalu and Vanuatu (McIver *et al.*, 2016). In addition, EWEs affect an individual's emotional or mental health (Ebi and Bowen, 2016; Lawrance *et al.*, 2021) as the aftereffect or recovery phase from catastrophic damages is full of social and financial challenges.

Figure 2 schematises the climatic changes and EWEs' direct and indirect adverse impacts on health (e.g. infectious diseases and malnutrition) and mental health (e.g. relocation/resettlement), highlighting the importance of windstorms/hurricanes and SLR on mental health.

The most prevalent psychological illness in people affected by EWEs is PTSD, followed by depression and anxiety (Liu *et al.*, 2006). The prevalence of mental illnesses in the first two years following flood events ranges from 8.6% to 53% (Jackson and Devadason, 2019).

There is, however, no solid evidence about how long psychological impacts could last after flood events, but some surveys suggested that they may last for as long as six years (Jackson and Devadason, 2019).

1.2.3 Zooming in the pacific region: the effects of extreme events. The EWEs cause many deaths and injuries annually in the Pacific region and disrupt the local environment and communities (Lei and Zhou, 2012; NDMO, 2014; OCHA, 2015; UFCOP, 2017; Terry and Lau, 2018). Over the years, the severity of EWEs has forced the people to relocate, for example, the climate-induced relocation of the Vunisavisavi community in Fiji (Singh *et al.*, 2020). For Pacific Islanders, the land (e.g. Vanua in Fiji) provides a sense of place and identity. Therefore, the relocation or resettlement from the roots of their cultural, psychological and spiritual well-being has emotional and psychological implications (McAdam, 2014; McNamara *et al.*, 2021).

In the recent past, PICs have been a hotspot for a series of EWEs such as flooding, tropical cyclones and hurricanes (Chand and Walsh, 2009; Magee *et al.*, 2016), causing injuries, loss of lives, massive destruction to infrastructure (Aquino *et al.*, 2019) and economic loss (Benson, 1997). Cyclones and floods are the most frequent climate-related disaster and the leading cause of death and injuries from EWEs in PICs (Lei and Zhou, 2012; NDMO, 2014). Table 1 presents some of these events.

Future climate scenarios project an increase in the frequency of EWEs, SLR and, consequently, an increased risk of floods (Meehl *et al.*, 2000; Vitousek *et al.*, 2017), especially in low-lying coastal areas. The severity of a flood is determined mainly by topography, the

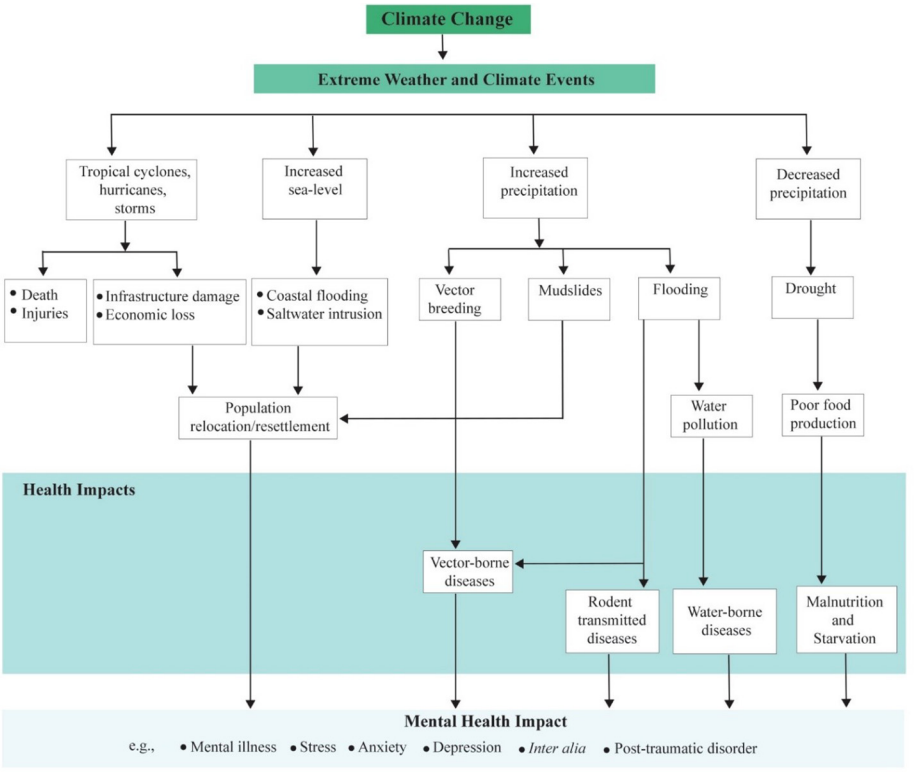

Figure 2.
A conceptualisation of the pathways by which climate change will affect mental health in the Pacific Islands Countries (PICs) and the significant anticipated impacts throughout the region

Source: Authors

surrounding infrastructure of the flooded area, various human-generated factors and the potential of floodwater to spread over a wide area. Cyclones can be massive, cutting broadband of destruction as they traverse the PICs. For instance, Vanuatu experienced drastic effects from the windstorm in 1999, causing 32 deaths (Lei and Zhou, 2012). Severe drought conditions have been associated with widespread crop failure and food shortages, resulting in malnutrition and starvation in PICs (Barr, 1999; Hoot *et al.*, 2012). Fiji has experienced six prolonged periods of drought events since 1970, affecting over 900,000 Fijians (Government of Fiji, 2017). A historical extreme rainfall deficit and drought occurred in Fiji during the El Niño event of 1997/1998 (Lightfoot, 1999). Thus, the factors that could reduce longer-term resilience from EWEs in PICs would likely include poor food and water security, mental health issues and displacement.

2. Methods

This paper deployed two main methods and consisted of two steps.

In Step 1, a bibliometric analysis was performed based on the need to review the existing literature. Bibliometric analysis has become an increasingly popular data analysis and visualisation method due to its ability to provide an overview of the structure and trends in a field or sub-field. Specifically, the text mining ability offered by bibliometric analysis tools

Name of event and year	Country affected	No of people affected	References
Drought–2011	Tuvalu	>5,200	IFRC (2011), Kuleshov *et al.* (2014)
Floods–2012	Fiji	±150,000	Kuleshov *et al.* (2014), ReliefWeb (2012a)
Tropical cyclone (Evan)–2012	Samoa Fiji	>10,000	Kuleshov *et al.* (2014), ReliefWeb (2012b)
Floods–2013	Solomon Islands	>10,000	BBC (2014), Noy (2016)
Tropical cyclone (Ian)–2014	Tonga	±5,500	United Nations (2015), World Bank (2014)
Tropical cyclone (Pam)–2015	Fiji, Vanuatu, Tuvalu Solomon Islands Tonga	±166,600	Le Dé *et al.* (2018), United Nations (2016), ReliefWeb (2015a)
Tropical cyclone (Mitag)–2002	Federated States of Micronesia	>175	Guha-Sapir (2018)
Tropical cyclone (Chata'an)–2002	Federated States of Micronesia	±1,448	Guha-Sapir (2018)
Tropical cyclone (Lupit)–2003	Federated States of Micronesia	>1,000	Guha-Sapir (2018)
Tropical cyclone (Sudal)–2004	Federated States of Micronesia	±6,008	Guha-Sapir (2018)
Coastal flooding–2008	Federated States of Micronesia	>1,200	Guha-Sapir (2018)
Tropical cyclone (Maysak)–2015	Federated States of Micronesia	>35,000	United Nations (2016), Guha-Sapir (2018), ReliefWeb (2015b), Tiwari *et al.* (2019)
Drought–2016	Federated States of Micronesia	>100,000	Guha-Sapir (2018)
Tropical cyclone (Winston)–2016	Fiji, Vanuatu	±150,000	European Commission (2019), ReliefWeb (2016), Thomas *et al.* (2019)
Earthquake–2018	Papua New Guinea	>544,000	OCHA (2019)
Tropical cyclone (Gita)–2018	Tonga	±80,000	OCHA (2019), Foley (2020)
Tropical cyclone (Yasa)–2020	Fiji, Vanuatu	±93,000	Fiji Meteorological Service (2021), ReliefWeb (2020)
Tropical cyclone (Harold)–2020	Vanuatu Fiji Solomon Islands	±170,000	Ahmed and McDonnell (2020), FAO (2020)

Table 1. Examples of extreme weather events in the Pacific islands (2003–2020) Source: Authors supported by the literature.

allows for analysing relationships between specific sets of terms. As such, the authors perform a bibliometric analysis to understand the state of the literature concerning psychiatric conditions and climate change events. The input data for analysis using VOSviewer is bibliographic data of academic publications downloaded from Scopus. Scopus was selected given its broad coverage of quality peer-reviewed academic journals and also the compatibility of its bibliographic outputs with VOSviewer. Web of Science is another frequently used database. However, it was not used in this analysis since its coverage of journals is limited compared to Scopus.

To find relevant documents, the authors designed an inclusive search string of terms associated with mental health and climate change that was not limited by date (Appendix). The search string was developed iteratively to ensure its comprehensiveness. For example, the authors first searched for "climate change" and "mental health". The authors then checked the returned articles and added other relevant terms to the string. This process was repeated until adding new terms did not result in retrieving new articles. Although some relevant articles may have been overlooked, the authors believe this approach has helped us retrieve as many articles as possible.

Overall, our initial search on 23 October 2021 returned 501 articles written in English. Titles and abstracts of these articles were screened, and 355 articles, book chapters, reviews, conference papers and letters related to this study's scope were selected for bibliometric analysis using VOSviewer. The excluded articles did not include issues associated with mental health. For the selected articles, "full record and cited references" were downloaded from the Web of Science to be used as input data for bibliometric analysis. After inputting these data into VOSviewer, the authors used the term co-occurrence analysis to understand the knowledge structure of the field (Figure 3).

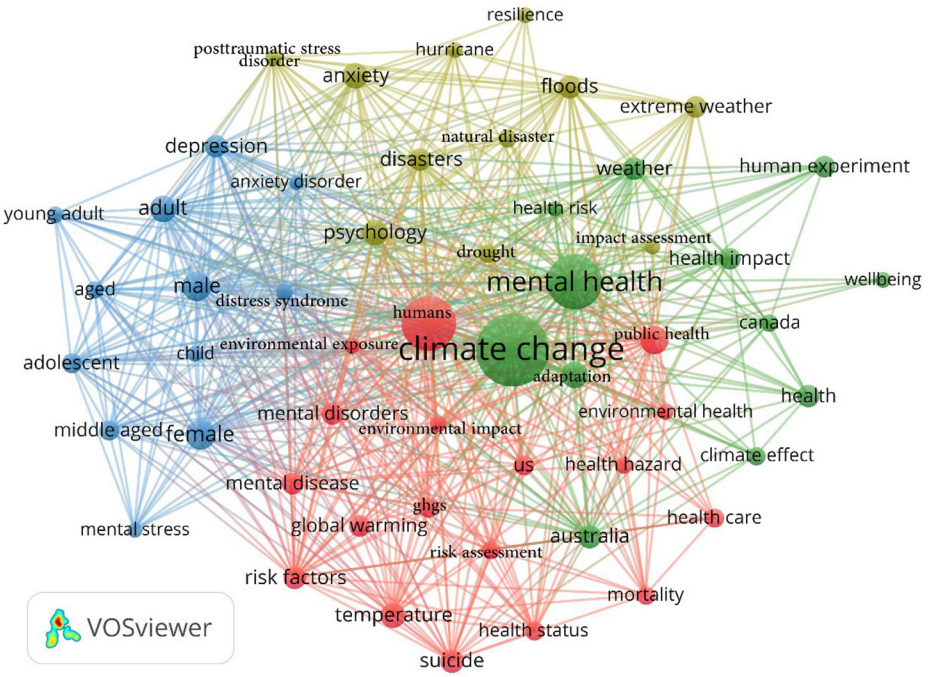

Figure 3.
Co-occurrence map of mental health and climate change-related terms

Figure 3 shows that the output is presented as a graph, where the node size is proportional to the terms' frequency, and the connecting lines' width indicates their strength. Words that frequently co-occur form clusters that show major thematic research areas in a field.

In a second step, the authors deployed a follow-up method, namely, a description of case studies. This outline some of the region's EWEs. The case studies, which were compiled based on available evidence and first-hand information gathered by some of the authors in their home countries, provide concrete examples of the impacts of extreme events on the life-support systems, population livelihood, well-being, health (especially malnutrition and infectious diseases), focusing on mental health.

The results of the data collection approaches are presented in the next section.

3. Results and discussion

3.1 Bibliometric analysis

Results of the bibliometric analysis are evidenced in Figure 3. It can be seen that climate change impacts and extreme events have been linked to various types of mental health issues in the literature. Some key features are as follows:

- Four major thematic clusters link climate change, EWEs and mental health.
- The green cluster mainly focuses on general and mental health impacts.
- Mental health has a central position in the term map and frequently co-occurred with climate change.
- Various climate-related stressors and EWEs indicate that the potential adverse climate-related impacts on mental health and public health are well-recognised in the literature.
- The red cluster mainly focuses on the mental health impacts of slow-onset and long-term climatic impacts such as temperature changes or exposure to environmental pollution exacerbated by climate change. Based on the interlinkages between the terms, it can be seen that in addition to increasing mortality rate, temperature and environmental impacts can be significant risk factors contributing to mental health issues such as mental disorders and suicide.
- The yellow cluster focuses on acute and rapid-onset disasters such as floods and hurricanes, closely linked to mental health issues such as anxiety and post-traumatic stress disorder.
- The blue cluster includes various demographic groups such as males, females, children, adolescents, young adults, middle-aged and aged people. These demographic groups are linked to different mental health issues from other clusters, indicating that climate change will likely impact all demographic groups negatively.

Overall, this term co-occurrence analysis suggests significant documented effects of climate change on mental health, with analyses into the effects of heat and temperature and natural disasters predominating. However, secondary climate change impacts such as loss of culture or community due to forced migration have received relatively less attention in the literature regarding mental health impacts (Hayes *et al.*, 2018). Additionally, many psychological disorders, such as schizophrenia, bipolar disorder or obsessive-compulsive disorder, are not highlighted in this term map but could be significantly impacted by individuals' experiences of their environments that could be affected by climatic changes (Hayes *et al.*, 2018). Additionally, the links between mental and physical health in the face of climate change are unclear in this analysis but remain salient to the discourse. While further research on such

issues is needed, it is clear from this analysis that mental health impacts of climate change are essential and need to be appropriately integrated into vulnerability assessment and climate adaptation efforts and processes (Hayes and Poland, 2018). More details about the four clusters highlighted by the term co-occurrence analysis can be found in Section 3.3.1.

3.2 Case studies: reviewing the impacts of climate change and extreme weather and climate events on the life-support systems, livelihoods, well-being and mental health in the Pacific Islands Countries

3.2.1 The Federated States of Micronesia (FSM). EWEs that disrupt and impact the FSM's lives include tropical cyclones, increased floods and droughts, landslides and coastal flooding events related to SLR (Table 1).

While direct health effects of EWEs are traumatic injuries and deaths, it also includes psychosocial impacts. Diffuse effects include unspecified detrimental effects of social disruption, e.g. loss of life, land or livelihoods due to climate-change-related phenomena, including anxiety, depression and post-traumatic stress disorder.

Following typhoon Sudal in Yap in 2004, depression, anxiety and substance abuse (especially among youth) as the aftermath of disasters, especially in women and children, were reported in addition to the traumatic injuries. For socially disadvantaged atoll communities, post-disaster permanent displacement is stressful, and it unsettles and harms mental health through the loss of life-supporting traditional food production systems. The stress of migration is further aggravated by a lack of social support, inadequate health systems, economic hardship and lack of access to housing (FSM, 2015).

3.2.2 Tropical cyclone Winston 2016-Fiji islands. TC Winston affected approximately 40% of Fiji's population, with a death toll of 44 people. Following TC Winston in February 2016, a typhoid outbreak of 35 cases was observed on the Northeast coast of Viti Levu, Fiji's main island, but no fatalities were reported. Also, vector-borne diseases were reported, e.g. Dengue and Zika (Fiji Health and Nutrition Cluster, 2016a, 2016b).

After TC Winston, malnutrition was a severe problem in some areas, especially among children under five (Fiji Health and Nutrition Cluster, 2016c). The cyclone significantly affected local fisheries, with about 96% of fishing boats sunk, affecting household food supplies (92% of which depend on local fisheries for subsistence), reducing the amount of fish delivered to the local school to 0% (World Conservation Society, 2016). On Koro Island, there were some cases of malnutrition. The terrestrial food supplies were disrupted or lost by severe winds, rain and storm surge due to the cyclone's damage to this island, resulting in saltwater pollution of the soil (Government of Fiji, 2016).

The cyclone also prolonged its effect on Koro's livelihoods, as Kava farming provided half of their revenue, which was utterly destroyed after the cyclone (World Conservation Society, 2016). In addition, the food situation was precarious (Government of Fiji, 2016).

Following TC Winston, 8,466 people received psychological first aid. Therefore, the Ministry of Health and Medical Services coordinated training trainers workshops to facilitate the deployment of workers in all areas of Fiji (Fiji Health and Nutrition Cluster, 2016a, 2016b). The cyclone affected people with disabilities as well. UNICEF and the Pacific Disability Forum surveyed 963 people. According to the results, 13.6% of disabled children needed psychological assistance and basic first aid and integrity kits to maintain a standard of hygiene that prevents the spread of diseases (Pacific Disability Forum and UNICEF, 2016).

3.2.3 Tropical cyclone Evan 2012-Samoa and Fiji. In December 2012, both Samoa and Fiji were hit by tropical cyclone Evan with a death toll of 14, and 10 sailors went missing. In addition, damage to plants and manufactured structures was substantial due to the storm moving near the Fijian islands, where over 8,000 people had to seek temporary shelter.

Cyclone-related economic losses also remained quite large, inflicting considerable negative consequences on the economies of both countries. Fiji's total losses from Evan were about 2.6% of the country's gross domestic product (GDP), plus another 1% due to short to medium-term losses. Economic losses in Samoa were even higher, in the order of US $203.9m (Kuleshov *et al.*, 2014), about 25% of the country's GDP.

3.2.4 Floods 2012-Fiji. The March 2012 flood was the worst flood to hit Fiji. The flooding was most severe in the western half of Viti Levu's main island. Thousands of people were displaced, about 3,500 people were placed in temporary shelters, and 8 likely perished in the floods; the majority were on the main island. Power and water supplies were disrupted in several regions, and roads were washed away. Crops and other infrastructure were damaged. The entire cost of the flood in March 2012 was over FJ $70 million (Kuleshov *et al.*, 2014), about 0.9% of the country's GDP.

3.2.5 Tc Harold 2020-Vanuatu, Fiji and the Solomon Islands. Tropical Cyclone Harold wreaked havoc on the Solomon Islands, Vanuatu, Fiji and Tonga in early April 2020. Heavy rain and strong winds wreaked havoc on homes, schools and gardens across four provinces in the Solomon Islands. Around 27 individuals were reported missing after being washed away on a ship from Honiara to Malaita. The cyclone caused the heaviest damage in Vanuatu when it landed on 6 April as a category five cyclone with sustained winds of more than 200 km/h. Roads, hospitals, schools, residences and churches were severely damaged on several northern and central islands. The worst-affected areas were home to 92,300 people, accounting for 30% of the country's population (UNICEF Pacific, 2020).

Many more families were displaced, without access to food crops or sanitation services. This circumstance was highly harmful to young children and severely threatened their survival and well-being. In addition, cases of dengue fever and malaria had been reported in Sanma Province. On 8 April, the storm impacted Fiji, causing significant flooding due to heavy rain and strong winds. In its wake, 2,494 homes were damaged. According to preliminary data, 116 schools were destroyed, affecting 11,524 children, with schools in the eastern and central divisions being the most brutal hit. The storm then impacted Tonga, causing damage or destruction to an estimated 428 homes (UNICEF Pacific, 2020).

3.2.6 Drought 2011-Tuvalu. Samoa, Tokelau, Tonga and Tuvalu were affected by the La Niña-induced rainfall deficit in 2011. Due to severely low water supplies, Tuvalu's Government announced a state of emergency on 28 September 2011. Households were rationed to roughly 40 litres of fresh water daily since some areas of Tuvalu had just a two-day water supply (Kuleshov *et al.*, 2014).

3.2.7 Trends from Kiribati. Kiribati is an island situated in the central Pacific Ocean. The entire population, about 115,840, lives only one kilometre from the sea (WHO, 2018). Due to frequent EWEs, Kiribati might become the first country to lose its national identity (WHO, 2018). The risk of climate-related transmission of vector and water-borne diseases is also high. However, the effects on Mental Health among the Kiribati population are unclear. Although per the WHO mental health report, mental disorders in the Republic of Kiribati have become a significant concern. Limited mental disease prevalence data is available, relying on a small national survey. Based on the disability national survey, 17% or 653 people were found to have a mental illness, including intellectual disability, epilepsy, or psychiatric illness. Moreover, the World Mental Health Survey 2004 reported that approximately 13% of the Kiribati young population (over 15) would experience mental disorders.

3.3 Overall discussion

3.3.1 Bibliometric analysis. The green cluster mainly focuses on climate change's general health and mental health impacts. The term "mental health" has a central position in the

term map and has co-occurred frequently with the term "climate change" and various climate-related stressors and adverse events such as drought, natural disaster and extreme weather. This indicates that the potential adverse impacts of climate change on mental health and public health are well-recognised in the literature. It is now well-recognised that climate change can have both direct and indirect negative impacts on mental health. The direct pathway occurs when rapid onset climate-induced disasters such as hurricanes, floods and wildfires expose people to trauma. Long-term climatic changes such as extreme weather events, droughts and SLR can also indirectly affect mental health through eroding the physical health and livelihood options of humans and threatening social processes essential for community well-being (Berry *et al.*, 2010; Palinkas and Wong, 2020). It is argued that marginalised, poor and vulnerable groups are disproportionately affected by climate change impacts, including impacts on mental health (Berry *et al.*, 2010). Despite this, the term map shows that literature on the nexus of climate change and mental health mainly focuses on developed countries such as Australia, Canada and the USA. More research on the mental health impacts in other contexts is, therefore, needed.

The red cluster mainly focuses on the mental health impacts of slow-onset and long-term climatic impacts such as temperature changes or exposure to environmental pollution that can be exacerbated by climate change. Based on the interlinkages between the terms, it can be seen that in addition to increasing mortality rate, temperature and environmental impacts can be significant risk factors contributing to mental health issues such as mental disorders and suicide. For example, evidence shows that environmental factors such as extreme heat and humidity have increased hospital admissions of patients with mood and mental disorders such as mania and schizophrenia. Such environmental stressors have particularly affected people with pre-existing mental health diseases and those with a history of drug and alcohol abuse (Hayes *et al.*, 2018). Several studies have also examined associations between climatic changes such as increased heat risk and suicide rates in countries such as Italy, New Zealand and the USA (Dumont *et al.*, 2020; Preti *et al.*, 2007; Williams *et al.*, 2015). Existing research indicates that, while other confounding factors are also essential and one should be cautious when associating suicide rates with climatic changes, the risk of suicide is higher during hotter and more polluted days (Dumont *et al.*, 2020; Preti *et al.*, 2007; Williams *et al.*, 2015).

The yellow cluster mainly focuses on acute and rapid-onset disasters such as floods and hurricanes. These are closely linked to mental health issues such as anxiety and PTSD. The association between mental health issues and climate-induced disasters such as floods, hurricanes and wildfires has been extensively studied in the literature (Crabtree, 2012; Upward *et al.*, 2021). It has been reported that climate-induced disasters can trigger mental issues such as "post-traumatic stress disorder (PTSD), major depressive disorder (MDD), anxiety, depression, complicated grief, and survivor guilt" (Hayes *et al.*, 2018). Further, major disasters could also trigger substance abuse and suicide ideation (Hayes *et al.*, 2018). Suicide and natural disasters are not closely linked in the term map, and it has relatively been more studied in the context of heat-related extreme events, as discussed earlier.

Finally, the blue cluster includes terms related to various demographic groups such as males, females, children, adolescents, young adults, middle-aged and aged people. These demographic groups are linked to different types of mental health issues from other clusters, indicating that climate change is likely to impact all demographic groups negatively. For example, different studies have discussed the mental health impacts of climate change on groups such as children and adolescents (Clemens *et al.*, 2020), women and older adults (Gifford and Gifford, 2016; Padhy *et al.*, 2015). It is worth mentioning that while all groups are exposed to mental health issues of climate change, evidence shows that some groups, such as women and older adults, experience more issues such as anxiety, distress and

mental disorders (Gifford and Gifford, 2016). These groups should, therefore, receive special attention in the resilience-building efforts.

3.3.2 Case studies. The tiny atoll ecosystems in the FSM are becoming uninhabitable, forcing communities to abandon their life-supporting systems and become refugees on elevated grounds or urban centres. Climate models show that climate will impact all aspects of life in the FSM yet in varying intensity. As the consequences of climate change are not inevitable, the island communities handle all the other significant challenges and opportunities on their terms and with external support.

These conditions have far-reaching environmental, social and livelihood effects that ultimately affect island communities' health and well-being. However, psychological aspects resulting from the climate-related impacts are largely unexplored in the FSM. While the climate-related mental health implications can affect anyone, the impacts amplify in the marginalised atoll populations. In addition, interference with livelihood opportunities, property and land damage and post-disaster displacement affect atoll communities' mental health and well-being.

Island communities in the FSM have an inseparable connection to and derive their sense of identity from the lands and resources of their islands. Climate change threatens this familial relationship with ancestral resources. It disrupts the continuity required for the health and well-being of these communities (Keener *et al.*, 2018; CDC, 2020). Women are more vulnerable to climate risks due to their economic activities, safety, health and livelihoods. Coastal flooding associated with SLR imperils atoll communities' livelihood opportunities. SLR in the western Pacific is three times higher than the global average, impacting traditional agriculture, coastal infrastructure, food security and livelihoods. Separation from traditional lands harms the island communities' spiritual and mental health in the FSM. Given the mounting evidence of the link between climate change and mental health and the particular vulnerability to many impacts of climate change, EWEs and climate disasters, island communities, especially the atoll communities, are likely to be at high risk for climate-related mental illnesses. Cultivating resilience and engaging the displaced atoll communities in site-specific adaptation strategies empowered them to face hardships and overcome distress situations followed by disasters (Krishnapillai, 2017, 2018).

EWEs cause disasters in Fiji due to climate instability and transition. These disasters hit the health sector with a rise in hospital admissions and treatments for accidents and infectious diseases, including diarrhoea, typhoid, dengue and leptospirosis. Malnutrition and stress-related illnesses are also on the rise. Dengue fever is one of Fiji's four major climate-sensitive diseases (Guillemot, 2011). Diarrheal, typhoid and leptospirosis are the other three major climate-sensitive diseases.

Mental health is vulnerable to climate-related catastrophes such as droughts and floods (Berry *et al.*, 2010; Cunsolo *et al.*, 2013; Reynolds *et al.*, 2010; Sharpe and Davison, 2021). Anxiety, sadness, excessive concern, PTSD, survivor guilt and "solastalgia" (distress experienced by those affected by the environmental change) may have previously been documented in many places, and the burden of these mental illnesses is considerable (McNamara and Westoby, 2011; Willox *et al.*, 2012; Owusu *et al.*, 2022).

Changes in local settings in the Pacific, where community identity and culture are tied to local settings, contribute to changes in cultural practices and identity, with potentially severe implications for mental health. Also, people in PICs are at high risk for mental diseases due to the link between climate-related disasters and mental health.

As the conditions seem alarming in Kiribati, the Kiribati Government has looked to relocate its population. Meanwhile, the Kiribati Ministry of Health is preparing a National Adaptation Programs of Action to help curb the impacts of climate change. In addition,

the Kiribati Government has also drafted the Strategic Health Plan (2008–2011) figured six primary objectives, one of which is to improve, revise the mental health policies, implement the mental health plan and enhance the mental health service delivery (Oten *et al.*, 2013).

On the population level, the residents of Kiribati have begun building walls from coral rocks. They have also intensified planting their lands with mangroves to protect the soil from erosion. Nevertheless, several communities have already moved to other islands (WHO, 2018).

A total of 10% of the Kiribati population will experience mild to moderate mental illness, and nearly 3% will experience a severe form of mental illness. The service utilisation data of 2011 estimates that only 364 people were treated, and those who were treated might have a severe mental disorder. The country holds only one psychiatric unit; there are no community mental health services, so most support and care are given to individual family members (Oten *et al.*, 2013).

A significant concern related to extreme weather events in the studied PICs is the decreased access to health services, which often occurs in the setting of disasters.

4. Conclusions

Climate change impacts, especially those from extreme events, have significant effects on mental health, though underexplored. The authors first conducted a bibliometric analysis of the relevant literature to explore the relationship between climate change and mental health impacts. The bibliometric analysis results highlighted that effects of heat and temperature predominate the literature, with secondary impacts such as loss of culture or community remaining largely absent in connection with mental health. In addition, anxiety, suicide and depression came up most often, with many other psychological disorders significantly impacted by individuals' experiences of their environments. To better understand the relationship between climate change, extreme weather events and mental health, the authors analysed several case studies in the Pacific region. A common thread amongst the case studies was the importance of place and local communities to small island nations, predominantly indigenous communities. The compound effects of climate-related disasters on critical infrastructure such as housing, food delivery, education and essential service provision can significantly impact Pacific Island communities' physical and mental health. Additionally, the lack of health infrastructure to treat people suffering from mental health issues, especially after a disaster, presents a barrier to receiving care.

The findings illustrate the need for improvements in the public health systems of Pacific nations so that they are in a better position to cope with the pressures posed by a changing environment. Apart from increased funding for handling more patients, a greater awareness about the connections between climate change and mental health is needed among public health professionals, so that they may be better able to recognise the symptoms and relate them to their climate-related causes.

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Appendix

The keyword search for the bibliometric analysis was as follows:

TITLE-ABS-KEY ("anxiet*" OR "schizophrenia" OR "mood disorder*" OR "depression" OR "suicide" OR "aggressive behavio*rs" OR "despair" OR "mental health") AND ("extreme weather event" OR "loss of landscape" OR "climate change*" OR "global warming" OR "climatic change*").

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