



Research article

“Beyond the flood: Exploring the psychosocial consequences and resilience challenges in the aftermath of “El Niño” in Tumbes, Peru”

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ABSTRACT

Background: El Niño's impacts on health are widespread, but evidence of its psychosocial effects on historically affected communities is limited. We aimed to describe perceived mental health impacts, local barriers to psychological well-being, and challenges in accessing support post-El Niño in Tumbes, Peru.

Methods: Between May–June 2017, we conducted 27 semi-structured interviews and three focus groups in Spanish with 24 adult residents, including local authorities and residents from heavily and minimally El Niño affected areas. Data were analyzed thematically.

Results: Initially, participants minimized El Niño's mental health impact, claiming to be "accustomed" to it. However, most described specific cases of suffering, including socioeconomic struggles, feelings of lack of support, unfairness, and helplessness. Local authorities acknowledged inadequate support availability. Psychosocial distress was exacerbated by poverty, scarce work opportunities, and disproportionate effects on vulnerable groups. Contextual factors like corruption, underfunding of prevention, and lack of reconstruction led to despair and distrust of authorities. Participants identified responsibility gaps at different levels but rarely acknowledged their responsibility or suggested alternatives. Psychosocial problems, therapy availability, or community support programs were seldom mentioned, though mutual collaboration was highlighted as useful but non-existent.

Conclusions: We found multiple interrelated issues in under-resourced post-disaster communities, highlighting the psychological burden of living "between disasters" and how socioeconomic distress and lack of support contribute to suffering. Beyond emergency aid, these communities require integrated care considering contextual and community-level distress, improving access to prevention and reconstruction activities, and addressing ongoing anxiety about future disasters to foster long-term resilience.

1. Introduction

Extreme environmental events increasingly pose significant threats to population mental health, with devastating consequences, particularly in vulnerable regions [1,2]. The World Meteorological Organization estimates climate-related disasters have increased threefold over the past five decades, disproportionately impacting low- and middle-income countries [3]. Constant exposure to stressors like disasters, dangerous living and working conditions, and poor health contribute to greater group vulnerability [4–7]. In Latin America, extreme

environmental events have shown profound psychological consequences, with studies revealing substantial mental health disruptions following environmental disasters [8,9].

Early warning systems (EWS) have emerged as critical interventions in mitigating disaster-related psychological impacts [10]. In the El Niño Southern Oscillation (ENSO) context, a recurrent complex climate pattern involving temperature fluctuations in the Pacific Ocean that directly impacts rainfall distribution, EWS are crucial as the climate pattern directly influences ecological and social vulnerabilities [11]. El Niño and La Niña are ENSO's extreme phases, causing disasters through

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impacts on ecosystems and sectors like health, transport, tourism, fishing, and agriculture, with substantial effects in developing countries [11,12]. Subsistence farmers are especially vulnerable, heavily depending on weather patterns yet having limited access to essential services and resources [13,14].

As human-induced climate change intensifies [15,16], more frequent and severe cyclical events like El Niño are expected [17,18], with most countries lacking proper preventive measures. This may require increased mental health support in post-disaster recovery and reconstruction settings [19]. However, mental health program coverage and disaster response capacity are low in many low-and-middle-income countries (LMIC), including Peru [20,21]. Reconstruction can be prolonged [22] without communities ever reaching full recovery.

Post-disaster psychological responses vary. However, the benefits of community support and participation [23–25] in mediating resilience and psychological wellbeing cannot be overstated. In this study setting, resilience can be conceptualized as a dynamic process of adaptive capacity that enables individuals and communities to anticipate, respond to, and recover from environmental disruptions [26]. This multidimensional construct encompasses psychological adaptation, social network mobilization, and systemic transformation, representing a continuous process of learning and strategic response to extreme environmental challenges [23]. Resilience integrates individual coping mechanisms, collective social resources, and adaptive institutional strategies, allowing communities to withstand, recover from, and potentially benefit from environmental stress [27]. Affected groups often experience deteriorating social fabric [28,29] and increased psychological suffering [30]. Healing social ties can foster adaptation and decision-making involvement [31,32]. Post-disaster community participation [33,34] can diminish common psychosocial disorders [35,36] through social support, information exchange [37,38] and trust among members [39] and authorities [40]. This is crucial for forced displacement [41] and adapting to the climate emergency's global influence [42,43], where severely affected areas contributed minimally [44].

In Peru, neurological and psychiatric disorders account for the most significant disease burden [45], with prevalence nearly twice as high among those unable to meet basic needs [46]. The population has significant vulnerability to disaster-related mental disorders due to location, climatic event vulnerability, and past/recent violence [47,48]. Peru also has high El Niño vulnerability [49], with the coastal region experiencing increased rainfall, floods, landslides, and consequential losses.

The repeatedly El Niño-affected northern coastal region lacks infrastructural preventive measures and disaster response education [50,51]. Tumbes residents face structural challenges, authority corruption scandals, and social conflicts even without El Niño [52,53]. The 2015–2016 El Niño and 2017 El Niño Costero [54,55] brought further losses, increased communicable diseases, displacement, food insecurity, and reportedly insufficient aid or reconstruction efforts, likely impacting individual and ecological wellbeing [56,57].

While environmental disasters' mental health links are documented [58], most studies use quantitative measures. Qualitative exploration in similar contexts is scarce [59,60], with evidence of repeated environmental stressors' effects on complex social systems in LMIC still emerging.

This qualitative study aims to explore the relationships between extreme environmental events and community mental health in Tumbes, Peru. By examining experiences from both local authorities and residents, we seek to: 1) Investigate the lived experiences of El Niño events among Tumbes residents and local authorities; 2) Analyze institutional and community responses to environmental disasters, and 3) Understand the psychosocial impacts of repeated environmental stressors on community structures and individual mental health. By examining multifaceted perspectives of local authorities responsible for disaster preparation and response and residents experiencing varying levels of impact, we aimed to understand how environmental disasters reverberate through the region's economic, social, and institutional structures to influence mental health and psychosocial wellbeing at the community level.

2. Methods

This study employed a qualitative descriptive design to explore the complex psychosocial impacts of El Niño in Tumbes, Peru. Our methodological approach integrated in-depth semi-structured interviews and focus group discussions to capture nuanced perspectives from local authorities and residents.

Tumbes is a northern coastal Peruvian region (See Fig. 1) historically vulnerable to recurring El Niño-related floods and heavy rains. Traditional El Niño events are characterized by broader Pacific Ocean temperature changes, typically occurring every 2–7 years, with significant global climate repercussions [11]. In contrast, *El Niño Costero* (Coastal El Niño) is a localized coastal phenomenon specific to the Peruvian and



Fig. 1. Map of participants' communities in Tumbes, Peru. The map displays the seven communities within the Tumbes region where qualitative data collection was conducted, illustrating the geographic distribution of study participants across areas with varying levels of El Niño impact exposure.

Ecuadorian coastlines, characterized by sudden, intense warming of near-shore waters that can trigger rapid and devastating local impacts [61]. Tumbes experienced a major El Niño event from December 2015 to April 2016 with varied intensity and regional specificity, followed by an unexpected "El Niño Costero" from February to May 2017. By August 2017, these events destroyed 3438 farming acres in Tumbes [62] and the regional response capacity collapsed, with facilities impacted with lack of medicines/supplies and health/administrative staff shortages, requiring national support. Emergencies were declared in 14/25 Peruvian regions and nationally, 1.7 million people were affected, rendering 283,000 homeless [63].

Study participants were adults (18+ years) residing ≥ 2 years in Tumbes districts categorized as highly or minimally affected by El Niño rains/floods in 2015–2016 and 2017, per government reports. Participants were purposively recruited to represent four critical perspectives: a) Local urban authorities; b) Regional authorities (peri-urban/rural); c) Residents from highly affected localities and d) Residents from minimally affected localities. The last group was included as some minimally affected residents work in high-risk areas impacting livelihoods, and official damage reports may not accurately differentiate areas. Previously, aid was distributed in minimally affected but accessible areas. This strategic sampling ensured a comprehensive understanding of El Niño's multifaceted community effects.

Data collection instruments comprised three topic guides in English and Spanish which were designed to explore life experiences, mental health impacts, community responses, and resilience strategies. (See Supplementary Files S1-S3). These guides underwent iterative refinement with local staff input, to ensure clarity and comprehensibility, allowing flexibility to capture emerging contextual subtleties.

Between May and June 2017, the first researcher (ECF) conducted 27 individual interviews (15 local authority employees and 12 residents), and interviewed an additional 24 participants across three focus groups. Interviews were conducted in Spanish with the senior author's (NT) support. Interviews/FGDs lasted between 45 and 90 min, were audio-recorded with participant consent and transcribed verbatim. ECF coded Spanish transcripts and translated data into English to analyze and remove identifiers. Interviews were conducted privately, in participants' preferred settings, with FGDs held in venues provided by authorities. Refreshments were provided, but there was no monetary compensation. ECF conducted all interviews, accompanied by NT as a silent observer in most. For FGDs, 2–3 local staff attended as silent observers for logistical support. Participants were explained the study aims and appeared to understand the research team's independence from the Ministry of Health.

Our final sample comprised 51 total participants. (See Tables 1-4). Among individual authorities interview participants 66.7 % were male ($n = 10$) with a median age of 47.8 years, while 75 % of the residents were female ($n = 9$) with a median age of 60 years. Around 75 % of the resident participant pool ($n = 26$) were homemakers, with ten working as farmers. A notable gender dynamic emerged, with all regional-level authorities ($n = 9$) being men, in contrast to the female-dominant local/district level representation.

The authorities represented diverse disciplines, including two councilors, one public health officer, three physicians, two midwives, two teachers, three engineers, and two from other professions. The median job tenure across those authority employees relocated from Lima to those with local experience was similar at 27 months for regional authorities (range 2 months to 24 years) and 26 months for local/district authorities (range 2 months to 26 years).

Data saturation was evaluated throughout the data collection and analysis process using a convergent approach, focusing on both thematic and contextual redundancy. We tracked the emergence of new insights as interviews and focus groups progressed, noting when no substantial new information emerged that altered existing themes. Saturation was identified through three indicators: recurring narrative patterns, consistent thematic emergence, and the sense that further data collection

would not yield new insights. The final set of 27 interviews and three focus groups, marked the point of theoretical saturation, as no new conceptual categories emerged in the last interviews.

Identifying information was recorded/stored separately to minimize confidentiality risks, and participants were assigned unique codes. Ethics approval were secured from the London School of Hygiene & Tropical Medicine ethics committee, the Universidad Peruana Cayetano Heredia and the Tumbes Regional Health Authority. Written consent was obtained and participants received a leaflet with mental health/disaster information and advice on accessing local mental health services.

Data analysis followed Braun and Clarke's six-phase thematic content approach [64,65], including data familiarisation, open coding, grouping/regrouping codes, refining descriptive topic categories, and allocating data into revised categories. The initial coding process was guided by our research objectives but remained open to emerging themes. Eight subthemes were identified through an iterative process of constant comparison, where codes were grouped and regrouped based on their conceptual relationships and theoretical relevance to psychosocial impacts of El Niño. Particular attention was provided to themes capturing: Historical experiences and memory; Institutional and individual perceptions of disaster impact; Power dynamics and responsibility attribution; Psychological and social coping mechanisms and Systemic challenges in disaster response (See Supplemental Subtheme Derivation Theme Table). Separate spreadsheets for interviews and FGDs were created after English translation for parallel analysis by ECF with NT's support, identifying themes/relationships aligned with study objectives using NVivo© (QSR International Pty Ltd. Version 14). Authority data were described/compared by sector, position tenure, and scope (regional vs local). Resident data from highly/minimally affected areas were contrasted, and all resident/authority data were compared. The methodological design intentionally triangulated perspectives from different stakeholder groups, allowing for a robust exploration of El Niño's psychosocial impacts. By centering local voices and experiences, the study sought to move beyond traditional disaster research approaches, instead offering a deeply contextualized understanding of community resilience and vulnerability.

Some reflections on the study team's position and the study's conduct are warranted to contextualize these findings. During fieldwork conduction, the first author (ECF), a Peruvian female physician with epidemiology training from Peru and the UK, was introduced to participants as "la doctora", a culturally accepted title for health professionals. Some initially viewed ECF as an outsider due to her manner of speaking despite identifying as Peruvian from outside the Tumbes region.

Senior co-investigator (NT), a British national, was presented as an experienced researcher with limited Spanish skills, which may have signaled a high educational status. Our local research team had previously worked in Tumbes, facilitating initial community entries. After establishing our independence from government institutions, most participants willingly shared their El Niño experiences and knowledge.

The research team maintained a reflexive stance, acknowledging potential power dynamics inherent in cross-cultural health research. This may have influenced what participants felt comfortable disclosing, especially criticisms of authorities. Participants frequently deferred by replying "Yes/No doctor" before elaborating. While this study primarily utilized semi-structured interviews and focus group discussions, we incorporated elements of ethnographic observation alongside interviews to enrich our understanding. The research team acknowledged the potential for deeper contextual insights through prolonged engagement. As noted in our reflexivity statement, the researchers recognized that employing more extensive ethnographic observations alongside interviews could provide additional nuanced context around disaster impacts on daily life. However, the current study's scope and resources limited full ethnographic immersion, focusing instead on structured qualitative data collection methods prioritizing participants' direct experiences and perspectives.

Table 1
Representative quotes – key subthemes.

Theme	Representative Quotes
Personal historical memories of El Niño events	<p>“I’ve already suffered two disasters...the ’83...it was rougher than this one...I went to work in Tumbes (city) because there was no work here, no bananas, nothing left on the river, and the disaster left us nothing. That’s how we spent almost six months of rain...They were stronger than now...the president didn’t help us much...We suffered, we didn’t have food, my children were kids...” (Male, 88, Farmer, high-affected, Semi-rural)</p> <p>“...the river took a bridge in Corrales...we were in boats, and I was a child then, and I was traumatized...they carried me in arms...and for me, there has been a long effect, because I always remember it...until now, I remember it...When I see the river, I always remember it. The images return like yesterday” (Male, 45, Regional Level, Economic Development, Urban).</p>
Chronic and acute effects of El Niño	<p>“Let’s understand, then, that it is not a ‘now’ problem; it is an ‘always’ problem.” (Male, 43, Regional Level, Mental Health Sector, Urban)</p> <p>“Well, for us Tumbes residents, this type of event is something like a tradition...always at the end of the year the rains begin and go away after 3, 4 months...” (Male, 45, Regional Level, Economic Development, Urban)</p> <p>“...they have a stream that blocks them...then they stay 10, 15 days without food, without anything, right? That is normal for them...” (Male, 55, Regional Level, Disasters Sector, Urban)</p> <p>“The effects El Niño has generated in our Tumbes region, in the agrarian sector, have been tremendously strong...” (Male, 47, Regional Level, Agriculture Sector, Urban)</p> <p>“I believe for people who have not had experience, like our children...for them this could have been traumatic...the elderly...some live alone, or their family is not around to help them...the elderly could have suffered that type of trauma.” (Male, 45, Regional Level, Economic Development, Urban)</p> <p>“There were increased cases of anxiety disorder, depression...people engaged in agriculture, the river overflowed and took their crops...and now they have debt, how will I pay, I can’t sleep...patients with chronic treatment, schizophrenia, bipolar disorder...” (Female, 33, Regional Level, Health Sector - Psychiatry, Urban)</p> <p>“Today environmental events have spread so much that it is no longer limited to normally affected places.” (Male, 48, Local Level, District Mayor, high-affected, Semi-Urban)</p>
Blame and Responsibilities	<p>“The municipalities must coordinate more closely...What happens is each one walks alone, so efforts are duplicated...and there is not enough care in executing resources.” (Male, Regional Level, Social Development Sector, Urban)</p> <p>“...a part of the population is incomprehensible...I need to live...but I cannot go live in a stream...and if the flood comes, I blame the authorities because they did not clean up...but they cannot, living in a ravine is illegal.” (Male, 48, Local Level, District Mayor, High-affected, Semi-Urban)</p> <p>“The population continues to grow, and groups are settled in the dry beds of river streams. They think that as the rains did not affect them in the past, it will not happen. But that is not the power of nature...and we do not have a map where you can establish your home safely...right now, they go and place themselves there. And they shouldn’t...” (Male, 47, Regional Level, Agriculture Sector, Urban)</p> <p>“In this sense...of El Niño, I have suffered a lot...because...I have no support from any authority.” (Female, 62, High-affected, Semi-Urban)</p> <p>“Yes, the landslides have been very strong here...and have damaged several houses, crops, farmers’ farms too...Oh, the farmers have lost a lot; until now, they have not received help.” (Female, 56, Low-affected Semi-Urban)</p> <p>“No, we do not have that help that farmers should have...even now...we do not have anyone to turn to...you do not feel you have someone (who helps)...No, we do not have any support from anyone.” (Male, 62, High-affected, Semi-Urban)</p>
Coping and Resilience	<p>“No”, “Nothing”, “You simply rely on your faith, well, your belief in God...”, “It is a custom already to have faith in God”, “Well, as Catholics, right?”, “Nothing, doctor.” (Focus Group Discussions)</p> <p>“I have no support, from nobody, from nobody, only from God who gives me health and strength to walk and work.” (Female, 62, High-affected, Semi-Urban)</p> <p>“The authorities do not care for us...they do not listen to us, doctor, right? So that’s the problem.” (Male, 86, High-affected, Semi-Urban)</p> <p>“...my husband suffers from osteoarthritis, so he has mostly not moved...I have to ask the neighbors...please help me carry this because I cannot do it alone...we got the help of the neighbors...very loving neighbors, they did help us...” (Female, 63, High-affected, Semi-Urban)</p>
Psychosocial distress	<p>“What we saw were anxiety disorders...patients who arrived with depression, they lost their investment, land, animals...second, patients with chronic treatments like schizophrenia, bipolar disorder who could not access it [mental health services]...and the child population, as they see so much concern from parents, neighbors commenting how bad they were doing...” (Female, 33, Regional Level, Psychiatry Sector, Urban)</p> <p>“With the news of [other regions] Chiclayo, Piura, river overflows, here we were waiting, with anguish...the news repeating rains of greater intensity were coming.” (Male, 45, Regional Level, Social Development Sector, Urban)</p> <p>“They said the river will overflow...everything was anguish...it was distress, and in reality, it was not going to happen...a psychologist should advise the programs, to control the ‘psychosocial’ misinformation, because it increases the anguish...” (Female, 33, Regional Level, Psychiatry Sector, Urban)</p> <p>“Many only had a headache...but when asking, it was an anxiety disorder, distress. [they said] I lost my chickens, my cows...it was obvious they needed psychological support...we referred them to psychology...the psychologist was the last to finish, patients came continuously.” (Female, 35, Local Level, Head of Primary Care Centres, high-affected, Semi-Urban)</p>
Fairness in aid distribution	<p>“Here personnel have not reached where I live...(they go) maybe as far as the paved roads, to avoid mud, but not the far back.” (Female, 62, High-affected, Semi-Urban)</p> <p>“Their criteria are not very good...if they were professionals, the mayors’ projects would be good or regular, no? But some do not have the education to do something good...” (Male, 55, Regional Level, Disasters Sector, Urban)</p>
Corruption and distrust	<p>“Sometimes the mayor does not want to send water pumps...he sends where he wants...as people say, where he has influence...” (Female, 49, High-affected, Semi-Urban)</p> <p>“We are exhausted; there is corruption in the country, it is sad to know how the human value is degenerating...” (Female, 47, Regional Level, Health Promotion Education Sector, Urban)</p> <p>“When the mayor arrives, neighbors get together and kick him out...because they cheat on us a lot...they have tricked us with a path for children to go to school, an unpaved road...it has been many years...” (Female, 49, High-affected, Semi-Urban)</p> <p>“The Tumbes authorities are not good...I say this because I have seen workers sometimes take out 10 or 12 corrugated sheets for themselves...” (Female, 62, High-affected, Semi-Urban)</p> <p>“They do some useless work just to cover up...so many millions spent, and now there is no money...” (Female, 32, High-affected, Semi-Urban)</p>
Interconnected nature of problems	<p>“The problem is the ‘famous’ loans to banks that do not allow evacuation...the people do not evacuate because they have to pay the loan...it is not only one factor, there are many.” (Male, 43, Regional Level, Mental Health Sector, Urban)</p> <p>“Here...where the river overflows, are rice fields...several farmers have not sown (...) around 800 hectares not sown this season. Many have changed occupations or are looking for work.” (Male, 47, Regional Level, Agriculture Sector, Urban)</p> <p>“The crime rate has increased...Immigration...the native Tumbes people maybe 50 % now...a lot migrate from other places...people who are not good come camouflaged as farmers, they’re hiding out there...” (Male, 63, Regional Level, Health Sector, Urban)</p> <p>“In urban areas, the crime rate is so high that people distrust everyone. To do community work, you need contacts with people, but there have been cases of people pretending to be health workers entering houses to steal.” (Male, 42, Local Level, Health Sector, moderately affected, Semi-Urban)</p>

Table 2
Sample - interviews.

Characteristics of Study Population - Interviews		N	%
Participants			
Gender - Authorities	Local Authorities	15	55.6
	Residents	12	44.4
Gender - Residents	Female	5	33.3
	Male	10	66.7
Age (years) ^a Authorities	Female	9	75
	Male	3	25
Age (years) ^a Residents	47.8	SD ±10.46	
Location – Authorities	60	SD ±17.07	
Location – Residents	Urban Tumbes	10	66.7
	Semi-Urban / Rural	5	33.3
Position – Authorities	High Affected Areas	7	58.3
	Low Affected Areas	5	41.7
Time in Position (Sector) – Authorities	Director / Head – Regional	4	26.7
	Coordinator - Regional	5	33.3
	Mayor – Locality	2	13.3
	Head of Health Division - District	3	20
	Area Coordinator – Regional	1	6.7
Principal Occupation – Residents	Months in the same role	26.8	(4–156) ^b
	Months in the same sector	126.4	(6–432) ^b
	Homemaker	6	50
	Homemaker and casual worker	2	16.7
	Homemaker and shopkeeper	1	8.3
	Farmer	2	16.7
	Farmer and casual worker	1	8.3

^a Mean. Otherwise N (%).^b Min-Max.**Table 3**
Sample – focus group discussions.

Characteristics of Study Population – Focus Groups		N	%
Gender - Residents			
Age (years) ^a Residents	Female	19	79.2
	Male	5	20.8
Location – Residents		SD ±12.45	
Principal Occupation – Residents	High Affected Areas	16	66.7
	Low Affected Areas	58	33.3
Principal Occupation – Residents	Homemaker	13	54.2
	Homemaker and casual worker	23	12.5
	Homemaker and shopkeeper	11	4.2
	Farmer	5	20.8
	Employee	2	8.3

^a Mean. Otherwise N (%).

events compared to adults, owing to their lack of control and increased vulnerability.

Divergent perspectives between residents and authorities further complicate the psychological landscape. While some authorities appeared desensitized, normalizing these recurring disasters and suggesting communities had grown "accustomed" to such events, residents articulated profound experiences of vulnerability, helplessness, and ongoing psychological distress. This was highlighted especially for vulnerable groups like subsistence farmers, older adults, children, low-income families, and those with pre-existing mental or physical conditions. This disconnect was particularly evident in aid distribution, institutional response, and community resilience discussions.

Some authorities described the latest El Niño as "unexpected" with "unimagined consequences" despite preventive measures, attributing this to reduced vigilance after the milder 2015–16 event gave a false sense of security. While most did not directly acknowledge climate change's role, one local authority explicitly noted that climatic effects "have spread" outside where they would normally affect the population.

The phenomenon of blame and responsibility for the adverse outcomes of El Niño emerged as a critical analytical theme. Participants engaged in complex negotiations of accountability, with regional authorities frequently attributing failures to national government underfunding, while local authorities and residents highlighted systemic institutional shortcomings. Additionally, residents were blamed for making poor housing decisions that increased their risk, such as settling in hazardous zones and reoccupying flood-prone farmland; however, some acknowledged the lack of authoritative information to confirm an area's safety and that population growth contributed to the problem. In contrast, residents' narratives highlighted profound suffering, feelings of helplessness, and perceived abandonment by authorities who failed to provide adequate aid and support. This blame narrative was not merely a rhetorical exercise but a profound expression of collective trauma and institutional mistrust.

Psychosocial distress manifested in multiple, interconnected ways. Initially, participants minimized mental health impacts, presenting a facade of resilience. However, deeper conversations revealed profound psychological wounds. The psychological burden of living "between disasters" emerged as a critical theme. Participants described a constant state of anticipatory anxiety, struggling to recover from previous events while feeling perpetually underprepared for future environmental threats. This ongoing stress disproportionately affected vulnerable groups, including subsistence farmers, elderly populations, and families with limited economic resources. Health professionals and mental health authorities highlighted the prevalence of mental disorders among vulnerable groups.

3. Results

The emergence of El Niño's psychological and social impacts revealed a multidimensional landscape of community experiences, characterized by intersecting narratives of resilience, trauma, and institutional disconnect (See Table 5 for participants' representative quotes). Participants' accounts traced a nuanced journey through personal and collective memories of environmental disasters, psychological and social responses exposing deep-rooted vulnerabilities and adaptive mechanisms that transcended simple disaster narratives. Historical memories of El Niño events emerged as a powerful interpretive lens through which current experiences were understood. Participants, particularly those who experienced the devastating events of 1982–1983 and 1997–1998, described these past disasters as transformative moments that continued to shape collective consciousness. Nearly all participants provided vivid eyewitness accounts of these events, detailing infrastructure damage, transportation disruptions, losses of crops/livelihoods, and community isolation. Older residents shared vivid, persistent memories that transcended time, with traumatic recollections triggered by seemingly mundane environmental cues like river landscapes. Some suggested children may have experienced more profound trauma from such

Table 4
Sample characteristics - interviews.

Group	ID	District	Sex (M/F)	Age (years)	Occupation	Organisation (Authorities)	Time at position/ Sector (Authorities)
Authorities	AUTHORITIES_Tumbes City 001	Tumbes	M	55	Head Disaster Government Body	Disaster Oversee- Coordination	6 Months / 6 Months
	AUTHORITIES_Tumbes City 002	Tumbes	M	50	Head Regional Health administration	Health - Regional	18 Months / 24 years
	AUTHORITIES_Tumbes City 003	Tumbes	M	65	Epidemiology -Regional Health administration	Health - Regional- mental	18 Months / 36 years
	AUTHORITIES_Tumbes Region 004	Pampa Grande	M	42	Head local health center Node of Pampa Grande	Health - Local	25 Months / 10 years
	AUTHORITIES_Tumbes City 005	Tumbes	M	45	Regional Coordinator - Ministry of Devel- opment and Inclusion	Ministry - Local	12 Months / 6 years
	AUTHORITIES_Tumbes City 006	Tumbes	M	42	Head Regional Government - Economic Development	Regional Government - Economic Develop- ment Dep.	7 Months / 2 years
	AUTHORITIES_Tumbes Region 007	Zorritos	F	35	Head local health center Node of Zorritos	Health - Zonal	12 Months / 6 years
	AUTHORITIES_Tumbes City 008	Tumbes	M	43	Regional Coordinator - Mental health strategy - Ministry of Health	Health - Regional- mental	13 years / 17 years
	AUTHORITIES_Tumbes City 009	Tumbes	F	47	Head Regional Education and Health Promotion - Ministry of Health	Health promotion - Regional	3 years / 6 years
	AUTHORITIES_Tumbes City 010	Tumbes	F	33	Head Psychiatry Regional Hospital of Tumbes	Health - Zonal	20 Months / 9 years
	AUTHORITIES_Tumbes Region 011	Zarumilla	F	46	Head local health center Node of Zarumilla	Health - Zonal	12 Months / 18 years
	AUTHORITIES_Tumbes City 012	Tumbes	M	47	Head Regional - Ministry of Agriculture	Agriculture - Regional	16 Months / 13 years
	AUTHORITIES_Tumbes Region 013	Zarumilla	M	48	Major	Municipality - Local	2.5 years / 10 years
	AUTHORITIES_Tumbes City 014	Tumbes	F	45	Head Regional Education - Ministry of Education	Education - Regional	4 Months / < 1 years
	AUTHORITIES_Tumbes Region 015	Pampas de Hospital	M	74	Major	Municipality - Local	2.5 years / 2.5 years
Residents	RESIDENT_High affected 001	Zarumilla	F	62	Homemaker & casual worker	N/A	N/A
	RESIDENT_High affected 002	Zarumilla	F	49	Homemaker	N/A	N/A
	RESIDENT_High affected 003	Zarumilla	F	63	Homemaker	N/A	N/A
	RESIDENT_High affected 004	Pampas de Hospital	M	88	Farmer	N/A	N/A
	RESIDENT_High affected 005	Pampas de Hospital	M	86	Farmer	N/A	N/A
	RESIDENT_High affected 006	Pampas de Hospital	M	55	Farmer & welder	N/A	N/A
	RESIDENT_High affected 007	Pampas de Hospital	F	47	Shopkeeper & Homemaker	N/A	N/A
	RESIDENT_Low affected_008	El Rodeo	F	75	Homemaker	N/A	N/A
	RESIDENT_Low affected_009	El Rodeo	F	28	Homemaker	N/A	N/A
	RESIDENT_Low affected_010	El Rodeo	F	56	Homemaker	N/A	N/A
	RESIDENT_Low affected_011	Pechichal	F	63	Homemaker	N/A	N/A
	RESIDENT_Low affected_012	Pechichal	F	48	Homemaker & health promoter	N/A	N/A

Local media coverage contributed to a general "sense of anguish." It constantly featured devastation in neighboring regions while announcing imminent intense rains in Tumbes, creating a pervasive sense of anticipatory anxiety. Health providers in affected areas recognized residents' somatic symptoms as tangible expressions of underlying psychological suffering, despite limited mental health resources.

Corruption and social trust erosion emerged as central narrative threads. Authorities acknowledged this perception among residents and media reports of widespread corruption cases. Authorities were perceived as deciding which neighborhoods received aid based on personal factors or political convenience. Some authorities have linked widespread corruption to the "degeneration" of human values, eroding social ties and community morale.

Participants described a systemic breakdown of social cohesion, with widespread perceptions of institutional misconduct. Residents recounted instances of aid misappropriation, with some directly witnessing theft or misallocating disaster recovery resources. This corruption narrative extended beyond immediate disaster response, representing a deeper erosion of the community's social fabric.

The economic dimensions of disaster impact were particularly profound. Subsistence farmers found themselves trapped in a cycle of vulnerability, forced deeper into debt and high-risk areas due to limited economic alternatives. This economic precarity intersected directly with psychological distress, creating a complex ecosystem of ongoing community suffering. Other issues that contributed to distrust and insecurity,

indirectly related to El Niño, included internal immigration disguised as farming, thieves posing as health workers, and rising crime rates breaking down community bonds.

4. Discussion

This study provides novel insights into the multifaceted stressors undermining psychosocial wellbeing and resilience among underserved coastal communities following severe El Niño events in northern Peru. By triangulating perspectives from residents and authorities, we highlighted three interrelated pathways in which disaster experiences intertwine with historical precedent to shape community wellbeing and suffering:

- 1) The interaction between previous and current experiences and consequences of El Niño.
- 2) Narratives of survival and resilience rooted in personal and familial experiences; and
- 3) Social trust breakdown between residents and authorities at regional and local levels.

Our findings fundamentally challenge the simplistic assumption that affected populations become "accustomed" to recurring environmental disasters over time. Instead, we reveal a more nuanced reality where traumatic memories persist and accumulate across generations,

Table 5
Sample characteristics – focus group discussion.

ID	District	Sex (M/F)	Age (Years)	Occupation
PARTICIPANT FGD1_001	Zarumilla	F	38	Homemaker and Health promoter
PARTICIPANT FGD1_002	Zarumilla	F	31	Homemaker and Health promoter
PARTICIPANT FGD1_003 -EMF	Zarumilla	F	42	Homemaker
PARTICIPANT FGD1_004	Zarumilla	F	36	Administrative worker
PARTICIPANT FGD1_005	Zarumilla	F	48	Health promoter and casual worker
PARTICIPANT FGD1_006	Zarumilla	F	48	School nurse and Governmental health agent
PARTICIPANT FGD1_007	Zarumilla	F	62	Homemaker
PARTICIPANT FGD2_008	Pampas de Hospital	F	49	Homemaker
PARTICIPANT FGD2_009	Pampas de Hospital	M	62	Farmer
PARTICIPANT FGD2_010	Pampas de Hospital	F	55	Homemaker
PARTICIPANT FGD2_011	Pampas de Hospital	M	70	Farmer
PARTICIPANT FGD2_012	Pampas de Hospital	F	52	Homemaker
PARTICIPANT FGD2_013	Pampas de Hospital	F	77	Homemaker
PARTICIPANT FGD2_014	Pampas de Hospital	F	50	Shopkeeper and Homemaker
PARTICIPANT FGD2_015	Pampas de Hospital	M	65	Governmental staff and Farmer
PARTICIPANT FGD2_016	Pampas de Hospital	F	59	Homemaker
PARTICIPANT FGD3_017	Pechichal	M	72	Farmer
PARTICIPANT FGD3_018	Pechichal	F	56	Homemaker
PARTICIPANT FGD3_019	Pechichal	F	50	Homemaker
PARTICIPANT FGD3_020	Pechichal	F	47	Homemaker
PARTICIPANT FGD3_021	Pechichal	M	59	Farmer
PARTICIPANT FGD3_022	Rodeo	F	32	Homemaker
PARTICIPANT FGD3_023	Rodeo	F	46	Homemaker
PARTICIPANT FGD3_024	Rodeo	F	37	Homemaker

consistent with other disaster research [66,67]. Repeated exposure to environmental disasters does not diminish psychological impact but instead creates layers of cumulative trauma, particularly for those who experienced formative events during their youth. This persistence of psychological vulnerability starkly contrasts prevailing narratives of adaptation and resilience.

The unique psychological experience of living "between disasters" represents a significant contribution to understanding climate change's human impact. Participants expressed a constant state of psychological vigilance, struggling to recover from previous events while feeling underprepared for potential future disasters they feel powerless to prevent. This ongoing uncertainty generates a persistent state of anticipatory anxiety that is especially acute for economically marginalized communities. The continuous stress transforms into a form of chronic trauma, fundamentally altering individual and collective psychological landscapes [30,68].

Institutional disconnection emerged as a pivotal barrier to effective community resilience. The apparent indifference of some authorities—who minimized residents' suffering and often blamed individuals for their vulnerability—underscores systemic challenges in disaster management, with some authorities resigning themselves to residents' plight as an inevitable outcome rather than a situation that can be improved. In Peru, widespread corruption in government and health sectors has severely undermined disaster reconstruction and recovery, fostering pervasive unfairness. Addressing these structural barriers requires a comprehensive approach that simultaneously tackles socioeconomic distress and psychological suffering. As in other disaster contexts where "weariness" follows repetitive trauma [69], affected residents described protracted financial distress, pervasive uncertainty, and feeling abandoned without substantive assistance. Older residents emerged as particularly vulnerable facing compounded challenges extending far beyond immediate disaster impacts. Lacking retirement funds, experiencing diminished familial support as younger generations relocate, and confronting limited opportunities to rebuild eroded community ties, the elderly exemplify the multidimensional nature of environmental vulnerability. Their experiences underscore how disaster impacts reverberate through social structures, creating lasting fractures in community resilience akin to other Tumbes survivors [70]. These findings align with post-disaster stressors research from other settings [30,71].

Findings emphasize the need for integrated, holistic approaches to disaster response. Effective interventions must adopt holistic approaches that simultaneously address the interplay of economic, psychological, and social dimensions of environmental trauma, especially in socioeconomically disadvantaged regions [21,72]. Critical to this approach is the need to sensitize authorities to the full magnitude of mental health outcomes and risks faced by survivors. Interventions must focus on restoring community dignity, providing alternative livelihoods, ensuring equitable aid distribution, and promoting positive community interactions. Institutional mindsets must shift from blame towards enhancing community self-efficacy and resilience and initiatives must harness and integrate available local and national resources rather than relying solely on external solutions [39]. Meaningful collaboration is necessary between residents, communities, and decision-makers.

Methodologically, our approach of triangulating perspectives from different stakeholder groups allowed for a nuanced exploration of disaster impacts. By centering local voices and experiences, we obtained a deeply contextualized understanding of community resilience and vulnerability. However, limitations exist. Lack of funding precluded professional translation services, so the English analysis was conducted on the original Spanish transcripts. To mitigate potential single-researcher bias, the first author (ECF) conducted all interviews and initial coding, while the senior author (NT) provided continuous consultation and independent review of the analysis. Local staff members were also consulted on regional terminology and contextual nuances during translation and analysis. Although involving multiple Spanish-speaking researchers would have enhanced perspective diversity and analytical rigor, we addressed this limitation through regular team discussions, peer debriefing, consulting local research team members for contextual validation across the fieldwork stage, and maintaining transparent documentation of the analytical process. Future research would benefit from a more diverse analytical team with multiple Spanish-speaking researchers to ensure comprehensive interpretation and consensus. The study also relied on self-reported flood exposure rather than objective assessments. Finally, challenges in arranging multi-sectoral authority focus groups necessitated one-on-one interviews, though these may have elicited more candid perspectives.

Initiatives aiming to bolster community resilience must be nested within broader systems to provide effective disaster preparedness, response, and recovery - rather than relying solely on individuals' coping

efforts. We must recognize how structural factors shape survivors' behaviors and organized community responses. Prioritizing efforts to mitigate systemic barriers alongside addressing socioeconomic distress and psychological suffering could tangibly improve individual and community wellbeing.

Overall, research co-designed with community stakeholders is necessary. Specifically, we propose an integrated intervention approach combining multiple components: psychological support elements would include community-based counseling programs, trauma-informed support groups, and mental health education. Financial protection components would involve microfinance initiatives, disaster insurance mechanisms, and livelihood reconstruction support. Loss mitigation strategies would encompass improved early warning systems, community-based disaster preparedness training, and infrastructure resilience programs. Social capital bolstering would focus on rebuilding community networks through collaborative recovery initiatives, inter-community support mechanisms, and participatory decision-making platforms, aligning with emerging frameworks for community trauma prevention and healing [73]. This approach, as demonstrated by recent policy initiatives [74], recognizes that psychological recovery cannot be separated from economic stability, community resilience, and structural support.

5. Conclusion

Interview findings exemplify how disaster impacts extend far beyond the immediate event, straining the resilience of disadvantaged populations and exacerbating pre-existing inequities. Economic hardship, property damage, and institutional failures converge to erode mental wellbeing and security. Trauma becomes a persistent condition, compounded by the uncertainty of inadequate recovery processes and the constant anticipation of future environmental threats.

The unique psychological burden of living "between disasters" creates constant uncertainty and anticipatory anxiety. Without robust support systems, prolonged stress becomes entrenched, fraying the social fabric. Addressing these challenges requires integrated interventions holistically addressing socioeconomic, psychosocial, and resilience-building needs across all disaster phases.

Amplifying marginalized voices and developing strategies that account for the unique challenges of climate-vulnerable regions requires a fundamental reimagining of disaster response. This approach must recognize the profound psychological dimensions of environmental challenges, prioritizing holistic, collaborative strategies that restore community agency and wellbeing.

By understanding the intricate ways in which environmental disasters shape psychological experiences, we can work towards more equitable and comprehensive approaches to resilience. This demands a shift from viewing disasters as discrete events to recognizing them as ongoing processes that fundamentally transform individual and collective experiences of security, belonging, and hope.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Andres G. Lescano reports financial support was provided by Fogarty International Center of the U.S. National Institutes of Health. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRedit authorship contribution statement

Elaine C. Flores: Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Daniela C. Fuhr:** Writing – review &

editing, Supervision, Methodology, Investigation, Formal analysis. **Victoria Simms:** Writing – review & editing, Supervision, Methodology, Investigation. **Andres G. Lescano:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition. **Nicki Thorogood:** Writing – review & editing, Supervision, Methodology, Investigation, Formal analysis, Conceptualization.

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Supplementary materials

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