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Measuring preparedness to infectious diseases among people exposed to climate disasters in Cabo Delgado, Mozambique: a cross-sectional study

Francesco Vladimiro Segala[1*], Edoardo Occa[2], Elsa Chambisse[2], Francesco Cavallin[3], Agostinho Nanomba[2], Rumela Cobre[2], Giorgia Gelfi[2], Vitor Laguessa[2], Simone Cadorin[2], Abdul Chorai[2], Ketan Chitnis[4], Claudia Marotta[5], Inusso Chuau[4], Angelo Ghelardi[4], Aida Mahomed[4], Giovanni Putoto[5], Manuel Aly Mussa[6], Annalisa Saracino[1] and Francesco Di Gennaro[1]

Abstract

Introduction Climate change is contributing to increase the frequency and severity of climate disasters in Mozambique, leading, since 2019, to extensive damage to infrastructure and displacement 1.3 million people. Aim of this study is to evaluate baseline preparedness to vector-borne and water-borne infections among households and internally displaced people exposed to climate disasters in Mozambique.

Methods This was a cross-sectional, community-based survey assessing the preparedness to infectious diseases outbreaks among people exposed to climate disasters in six districts in Mozambique. Structured form was delivered via face-to-face between October 15th and November 7th, 2022. Study outcome was defined as a seven-point score of preparedness to infectious disease outbreaks. Multivariable analysis of the score was conducted using Conway-Maxwell-Poisson regression.

Results This study included 2,140 households and 11,239 people, with IDPs accounting for 30% of them. Overall, 1,186 (55.4%) households were overcrowded. Median score of preparedness was 3 points (IQR 2–4). At multivariable analyses, districts with low preparedness were Montepuez and Mueda. Higher preparedness was associated with family planning ($p < 0.0001$), access to primary education for all children living in the household ($p < 0.001$) and possession of a birth certificate for all children aged < 5y ($p < 0.0001$), while preparedness was heterogeneous among the districts ($p < 0.05$). Households composed by IDPs were not associated with a lower preparedness score.

Conclusions In climate-vulnerable communities in Mozambique, households practicing family planning, providing access to primary education and birth certificate for all children were less vulnerable to water-borne and vector-borne infectious disease outbreaks. Being family planning and childcare primarily performed by women, our findings can

*Correspondence:
Francesco Vladimiro Segala
fvsegala@gmail.com

Full list of author information is available at the end of the article

inform policymakers and practitioners on the importance of addressing women to mitigate the impact of climate disasters and reduce the risk of infectious disease outbreaks.

Keywords Climate change, WASH, Cholera, Malaria, Internally displaced people, Climate-sensitive infectious diseases, Low- and middle-income countries, Sub-saharan africa, Mozambique

Background

Human-induced climate change is exacerbating the frequency and severity of climate disasters in Mozambique [1]. Since 2019, extremely vulnerable communities in Mozambique were hit by Ciclone Idai, Cyclone Kenneth, Tropical Storm Ana, Cyclone Guambe and Cyclone Freddy [2]. These disasters have impacted over 3.1 million people, resulting in the destruction of approximately 318,000 houses and displacing up to 1.3 million people [3–6]. Internally displaced people (IDPs) are especially vulnerable to infectious diseases due to their profoundly under-resourced living conditions [7].

Frequent floods, droughts, and cyclones have caused extensive damage to infrastructure, including water and sanitation systems. These disruptions in hygiene and prevention practices have escalated the risk of waterborne [8] and vector-borne diseases [9]. Malaria and cholera – two highly climate-sensitive diseases tracked by the Lancet Countdown [10] – frequently lead to epidemics following cyclones and floods.

Only Cyclone Freddy, which made landfall in Mozambique twice in less than a month (24 February and 11 March 2023) [11], lead to nearly 30,000 cholera cases [6], while cyclone Idai led to nearly 26,000 cumulative cases of malaria [3]. Risk factors for cholera include poverty, overcrowding, inadequate access to clean water and poor hygiene conditions such as the impossibility to wash hands, dispose waste and access to proper sanitation facilities. At present, Cabo Delgado province is facing the deadliest cholera outbreak in the country in the past 25 years. Since September 2022, the outbreak has resulted in over 6,000 reported cases, with 801 (3.1%) of these cases originating from Cabo Delgado itself [12]. On the other hand, prevention against vector-borne diseases if heavily affected by humanitarian emergencies, which disrupt access to health facilities and public health programs such as mass insecticide-treated nets (ITN) distribution, or indoor residual spraying [13]. Cabo Delgado, this exacerbates the disease burden in the province with the highest malaria prevalence, which reaches 57.3% in children aged 0–5 years. The situation is further exacerbated by severe malnutrition and ongoing armed conflicts, resulting in the displacement of up to one million individuals. These conflicts are fueled by the socioeconomic exclusion experienced by northern Mozambique, alongside political and religious beliefs, and are intensified by the inequalities stemming from mineral and natural gas discoveries in the area [14].

In response to the recurrent outbreaks exacerbated by climate disasters, Doctors with Africa CUAMM (University College for Aspiring Missionary Doctors) and UNICEF (United Nations Children's Fund) Mozambique, conducted a multi-stakeholder, Social Behavioural Change program titled "Support adoption of key behaviors to prevent Covid-19, cholera, malaria, malnutrition and improve access to services in Cabo Delgado". Implemented in six districts of the Cabo Delgado province, the program focuses on piloting the national strategy for preventing communicable diseases, primarily cholera. Its objective is to encourage family units to adopt fourteen observable, low-cost behaviors that immediately reduce vulnerability to climate-sensitive outbreaks.

Aim of this study is to evaluate baseline preparedness to vector-borne and water-borne infections among family units and internally displaced people exposed to climate disasters in Mozambique.

Methods

Study design

This was a cross-sectional, community-based survey assessing the preparedness to vector-borne and water-borne infectious diseases outbreaks among people exposed to climate disasters in Mozambique. The survey was conducted between October 15th and November 7th, 2022, with face-to-face interviews. This reports follows the STROBE statement for cross-sectional studies [15].

Study setting

In Cabo Delgado province, resettlement started as early as March 2019, when both Cyclone Idai and non-state armed group (NSAG) violence hit local communities and continued through COVID-19 pandemic until mid-2022. As of today, roughly one million IDPs are living in the Cabo Delgado province. The present study was conducted in six of the seventeen districts in Cabo Delgado, which were supported by both CUAMM and UNICEF: Ancuabe, Balama, Chiure, Ibo, Montepuez, Mueda. The study involved both IDP sites and villages hosting sedentary population. At the time the study was conducted, all districts were affected by conflicts involving the Islamist armed group Ahlu Sunna Wal Jama [16].

Data collection and sampling

Data collection was conducted by trained community health workers who administered structured questionnaires through face-to-face interviews. Responses were standardized as either "available" or "not available". All variables included in the questionnaire were initially derived from the 2028 Mozambique Malaria indicator survey [17] and from the annual Global World Health Organization report on water, sanitation, and hygiene [18]. Subsequently, they were adjusted to suit the local context with the assistance of community leaders. A convenience, non-probability sampling method was employed, relying on the availability of family units and approval from local authorities. Prior to study implementation, residents in target resettlement sites and villages were extensively informed through dedicated meetings led by community leaders, who also supervised and assisted in the fieldwork.

Study outcome

To assess the household preparedness for waterborne and vector-borne infectious disease, seven variables were identified as indicators of adaptation to climate-sensitive outbreaks. These included (i) presence of insecticide treated mosquito nets (ITNs) [13]; (ii) presence of a functional latrine; (iii) presence of a sanitary landfill to dispose waste; (iv) capacity to dry food; (v) possibility to protect aliments from domestic animal contamination (i.e.: availability of a pylon stick); (vi) possibility of handwashing and (vii) disposal of safe water treatment and water storage system [19, 20]. Each of these practices was assigned a score of 1 point if present, resulting in a final score ranging from 0 (indicating complete unpreparedness) to 7 (indicating high preparedness).

Statistical analysis

Continuous data were summarized as median and interquartile range (IQR), and categorical data as number and percentage. Multivariable analysis of the score of preparedness to infection disease outbreaks was conducted using Conway-Maxwell-Poisson regression, which was preferred to Poisson regression due to the underdispersion of the dependent variable in the model [21]. Multivariable analysis was performed in different sets of family units, as follows. In the whole sample, the model included the following independent variables: district, family planning, overcrowding (at least 5 people in the family unit), and the presence of IDP, children aged 0–5 months, children aged 6–60 months, children aged 6–14 years, pregnant women, lactating women, adults with disability and children with disability. In the subset of family units with children of any age, a variable about nutrition (all children eating at least three times a day) was added to the original list of independent variables. In the subset of family units with children aged $\geq$6 years, a variable about nutrition (all children eating at least three times a day) and a variable about school (all children aged $\geq$6 years go to school) were added to the original list of independent variables, while the variables about child age (presence of children aged 0–5 months, children aged 6–60 months, and children aged 6–14 years) were removed. In the subset of family units with children aged 0–60 months, a variable about nutrition (all children eating at least three times a day) and having the birth certificate were added to the original list of independent variables, while one variable about child age (presence of children aged 6–14 years) was removed. All tests were 2-sided and a p-value $<$ 0.05 was considered statistically significant. Statistical analysis was performed using R 4.3 (R Foundation for Statistical Computing, Vienna, Austria) [22].

Ethical approval

Data collection that informs this study served as a pilot activity for the program implementation mentioned earlier. The project operates under a framework agreement between CUAMM and the government of Mozambique, and an agreement with Cabo Delgado province, which authorizes all study activities. Participation was voluntary, anonymous, and without compensation. Data were collected anonymously at the family-unit level and aggregated for analysis.

Results

This study included a total of 2,140 households and 11,239 people. Characteristics of the study participants are summarized in Table1. Most households lived in the Mueda district (n=803, 37.5%), followed by Ancuabe (n=416, 19.5%) and Montepuez (n=371, 17.3%). Overall, IDPs accounted for 30% (n=3,375/11,239) of the participants and 37.5% (n=803/2,140) of all households. Displacements were non-uniformly geographically distributed, ranging from 74.1% (n=1100) of all people living in Chiure to 10.8% (n=1,215) of the people living in Balama district. Also, 979/1,857 (52.7%) households with children were able to provide at least 3 meals a day and 484/1,496 (32.4%) households with school-aged children were able to provide primary education.

Information regarding adaptation to climate-sensitive outbreaks is reported in Fig. 1. The median score of preparedness to infection disease outbreaks was 3 out of maximum 7 points (IQR 2–4). Overll, the most available adaptation strategy to climate-sensitive outbreaks was insecticide-treated mosquito net (n=1,697, 79.3%), while the least available ones were the pylon stick (n=203, 9.5%) – a tool used to protect food from domestic animal contamination – and the availability of handwashing facilities (n=282, 13.2%).

Table2 presents the results from multivariable analyses of the preparedness score for infectious disease outbreaks. In synthesis, family planning was associated with higher score of preparedness (p<0.0001) across

Table 1 Characteristics of the study participants, overall and stratified per study district

N of family units	Overall 2140	Ancuabe 416 (19.5)	Balama 251 (11.7)	Chiure 319 (14.9)	Ibo 306 (14.3)	Montepuez 371 (17.3)	Mueda 477 (22.3)
Households with IDP [b]	803 (37.5)	129 (31.0)	16 (6.4)	246 (77.1)	183 (59.8)	94 (25.3)	135 (28.3)
Households with at least one child aged 0–5 months	395 (18.5)	62 (14.9)	82 (32.7)	57 (18.2)	60 (19.6)	61 (16.4)	72 (15.1)
Households with at least one child aged 6–60 months	1201 (56.1)	255 (61.3)	151 (60.2)	180 (56.4)	201 (65.7)	211 (56.9)	203 (42.6)
Households with at least one child aged 6–14 years	1496 (69.9)	286 (68.8)	167 (66.5)	219 (68.7)	222 (72.5)	267 (72.0)	335 (70.2)
Households with at least one pregnant woman	275 (12.9)	53 (12.7)	52 (20.7)	46 (14.4)	42 (13.7)	33 (8.9)	49 (10.3)
Households with at least one lactating woman	684 (32.0)	144 (34.6)	106 (42.2)	104 (32.6)	96 (31.4)	116 (31.3)	118 (24.7)
Households with at least one adult with disability	110 (5.1)	21 (5.0)	0 (0)	15 (4.7)	24 (7.8)	9 (2.4)	41 (8.6)
Households with at least one child with disability	65 (3.0)	14 (3.4)	1 (0.4)	12 (3.8)	18 (5.9)	3 (0.8)	17 (3.6)
Households with overcrowding (at least 5 people)	1186 (55.4)	251 (60.3)	129 (51.4)	153 (48.0)	183 (59.8)	225 (60.6)	245 (51.4)
Households doing family planning (contraception)	712/2139 (33.3)	127 (30.5)	88 (35.1)	108 (33.9)	139/307 (45.6)	111 (29.9)	139 (29.1)
Households with all children eating at least 3 times a day	979/1859 (52.7)	175/362 (43.3)	181/232 (78.0)	93/283 (32.9)	137/272 (50.4)	207/316 (65.5)	186/394 (47.2)
Households in which all children aged ≥ 6 years go to school	1115/1496 (74.5)	221/286 (77.3)	131/167 (78.4)	180/219 (82.2)	197/222 (88.7)	163/267 (61.0)	223/335 (66.6)
Households in which all children aged ≥ 6 years concluded primary school	484/1496 (32.4)	74/286 (25.9)	78/167 (46.7)	34/219 (15.5)	63/222 (28.4)	101/267 (37.8)	134/335 (40.0)
Households where all children aged 0–5 years have a birth certificate	867/1367 (63.4)	195/282 (69.1)	135/190 (71.1)	92/208 (44.2)	190/215 (88.4)	132/230 (57.4)	123/242 (50.8)
Total n of people	**Overall 11,239**	**Ancuabe 2285 (20.3)**	**Balama 1215 (10.8)**	**Chiure 1485 (13.2)**	**Ibo 1775 (15.8)**	**Montepuez 2071 (18.4)**	**Mueda 2408 (21.4)**
N of IDP	3375 (30.0)	553 (24.2)	56 (4.6)	1103 (74.3)	718 (40.5)	508 (24.5)	437 (18.1)
N of children aged 0–5 months	430 (3.8)	66 (2.9)	85 (7)	63 (4.2)	63 (3.5)	74 (3.6)	79 (3.3)
N of children aged 6–60 months	1660 (5.9)	379 (16.6)	210 (17.3)	231 (15.6)	296 (16.7)	271 (13.1)	273 (11.3)
N of children aged 6–14 years	2863 (24.4)	594 (26)	298 (24.5)	401 (27)	421 (23.7)	520 (25.1)	629 (26.1)
N of people aged > 14 years	6286 (55.9)	1246 (54.5)	622 (51.2)	790 (53.2)	995 (56.1)	1206 (58.2)	1427 (59.3)
N of pregnant women	291 (2.6)	59 (2.6)	54 (4.4)	50 (3.4)	44 (2.5)	34 (1.6)	50 (2.1)
N of lactating mothers	739 (6.6)	160 (7)	108 (8.9)	109 (7.3)	103 (5.8)	130 (6.3)	129 (5.4)
N of children aged 0–14 years with disabilities	73 (0.6)	21 (0.9)	1 (0.1)	13 (0.9)	18 (1)	3 (0.1)	17 (0.7)
N of people aged > 14 years with disabilities	128 (1.1)	29 (1.3)	0 (0)	17 (1.1)	24 (1.4)	10 (0.5)	48 (2)

Data summarized as n (%) or [a] median (IQR). [b] The median proportion of IDP within the household was 100% (IQR 57–100%). IDP: internally displaced people

the entire sample and in each subset. Additionally, the analyses indicated varying levels of adaptation to water-borne and vector-borne outbreaks among the six study districts ($p < 0.001$), with Mueda and Montepuez showing the lowest preparedness. Among households with at least one child aged ≥ 6 years, the variable related to school attendance ("all children aged ≥ 6 years go to school") ($p < 0.001$) and the presence of adults with disabilities were associated with a higher preparedness ($p < 0.05$). Moreover, in family units with children aged 0–60 months, possessing birth certificates for all children was associated with higher preparedness for infectious disease outbreaks ($p < 0.0001$). Notably, the variable regarding child nutrition ("all children eating at least three times a day") was not associated with the preparedness score in households with children.

Discussion

In this study, we observed varying levels of vulnerability against infectious diseases among people exposed to climate disasters in Mozambique, with factors such as district of residence, access to family planning, and key child development indicators influencing preparedness for these outbreaks. Following cyclones, tropical storms and floods, the risk for water-borne [20] and vector-borne [23] outbreaks increases substantially, with both cholera and malaria monitored by The Lancet Countdown for climate change's impact on human health [10]. Since, under current trends of fossil fuel extraction, global temperatures and extreme weather events are expected to rise [24], assessing adaptation strategies for climate-sensitive diseases imperative for public health in low- and middle-income countries (LMICs). Mozambique, despite producing roughly 0.02% of the annual share of global CO2

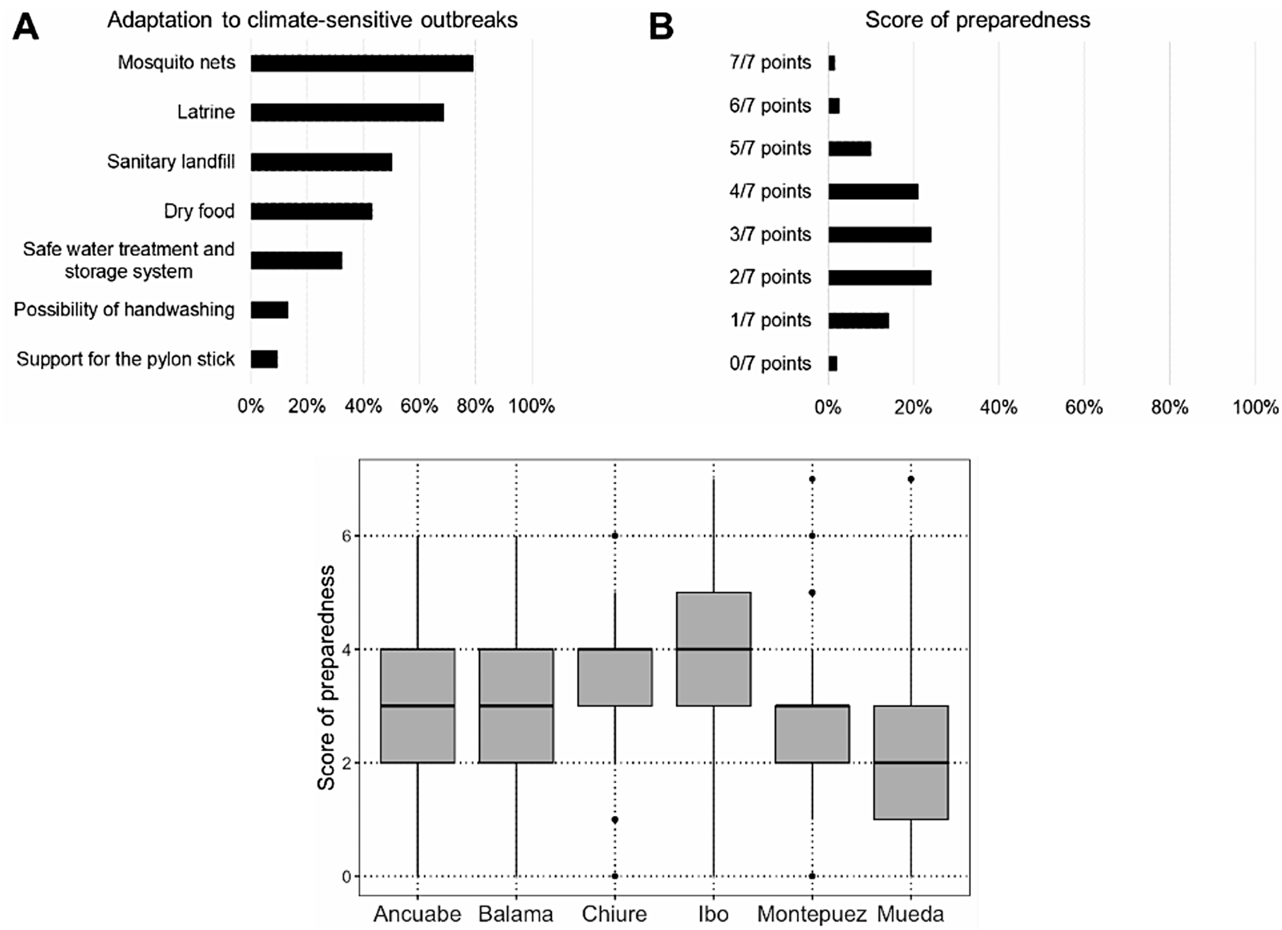

Fig. 1 Adaptation to climate-sensitive outbreaks (**A**), score of preparedness to climate-sensitive outbreaks in the overall population (**B**) and score result distribution stratified per study district (**C**)

emissions [25], is profoundly affected by human-induced climate change [26].

In this study, we assessed vulnerability to climate-sensitive outbreaks using a validated score comprising seven low-cost prevention strategies applicable during humanitarian emergencies, including insecticide-treated nets [13], and practices related to water, sanitation, and hygiene (WASH) [27]. A peculiar finding of our study was that, even afted adjusting for other variables, household with internally displaced people did not did not exhibit significantly different preparedness levels for water- and vector-borne infectious diseases. This could be attributed to the equitable access to sanitation resources among both internally displaced people and residents, along with comparable participation in public health initiatives such as insecticide-treated net distributions. Additionally, our survey targeted areas where people were displaced since early 2019, when Cyclone Idai made landfall, potentially equalizing access to sanitation services over time. Furthermore, despite the lack of association between outbreak preparedness and the provision of three meals per day for all children, this finding may be explained by the region's status as the most food insecure province in Mozambique during the study period, as reported by The United Nations World Food Programme. [28].

Interestingly, our multivariable analysis showed that indicators positively associated with high preparedness against climate-sensitive infectious diseases were were predominantly tasks associated with women: family planning and childcare [29]. Qualitative studies conducted in Mozambique [30, 31] and other sub-Saharan countries have consistently indicated low male participation in family planning, and in some cases, obstruction' [32]. This assumption is supported by by the lack of association between other indicators, such as overcrowding and presence of IDP in the household, and preparedness score. While acknowledging that the correlation found in our analysis does not imply causation – we highlight that family planning serves as an indicator of socio-economic wellbeing and positive female personal agency. It is associated with low child mortality [33], fewer unsafe abortions [34] and overall lower maternal mortality rates [35]. Thus, family planning may serve as a proxy for household resilience against climate-sensitive infectious diseases.

Table 2 Multivariable analysis of the score of preparedness to infection disease outbreaks (as proxy of household adaptation to climate-sensitive outbreaks)

	All family units		Family units with children of any age		Family units with children aged ≥ 6 years		Family units with children aged 0–60 months	
	Regression coefficient (95% confidence interval)	***p*-value**	**Regression coefficient (95% confidence interval)**	***p*-value**	**Regression coefficient (95% confidence interval)**	***p*-value**	**Regression coefficient (95% confidence interval)**	***p*-value**
Districts:								
Ancuabe	Reference	-	Reference	-	Reference	-	Reference	-
Balama	-0.10 (-0.22 to 0.01)	0.08	-0.07 (-0.20 to 0.05)	0.23	-0.22 (-0.45 to 0.01)	0.06	-0.07 (-0.21 to 0.07)	0.34
Chiure	0.25 (0.14 to 0 0.36)	**< 0.0001**	0.31 (0.19 to 0.43)	**< 0.0001**	0.18 (-0.01 to 0.36)	0.06	0.33 (0.18 to 0.47)	**< 0.0001**
Ibo	0.41 (0.30 to 0.52)	**< 0.0001**	0.44 (0.32 to 0.56)	**< 0.0001**	0.35 (0.16 to 0.53)	**0.0002**	0.40 (0.26 to 0.53)	**< 0.0001**
Montepuez	-0.21 (-0.32 to -0.10)	**0.0001**	-0.18 (-0.30 to -0.07)	**0.001**	-0.31 (-0.49 to -0.13)	**0.0005**	-0.13 (-0.26 to 0.01)	0.06
Mueda	-0.33 (-0.44 to -0.23)	**< 0.0001**	-0.32 (-0.44 to -0.21)	**< 0.0001**	-0.35 (-0.52 to -0.19)	**< 0.0001**	-0.31 (-0.45 to -0.16)	**< 0.0001**
Household with IDP	0.01 (-0.05 to 0.09)	0.61	0.00 (-0.07 to 0.07)	0.97	-0.02 (-0.14 to 0.09)	0.72	0.06 (-0.02 to 0.15)	0.16
Households with at least one child aged 0–5 months	0.06 (-0.04 to 0.17)	0.22	0.06 (-0.04 to 0.17)	0.25	-	-	0.08 (-0.04 to 0.20)	0.18
Households with at least one child aged 6–60 months	-0.06 (-0.14 to 0.01)	0.06	-0.06 (-0.14 to 0.01)	0.10	-	-	-0.04 (-0.19 to 0.10)	0.57
Households with at least one child aged 6–14 years	0.04 (-0.03 to 0.12)	0.26	0.05 (-0.04 to 0.15)	0.27	-	-	-	-
Household with at least one pregnant woman	0.02 (-0.06 to 0.12)	0.53	0.02 (-0.07 to 0.12)	0.66	-0.02 (-0.19 to 0.14)	0.79	0.03 (-0.07 to 0.15)	0.52
Households with at least one lactating woman	-0.01 (-0.10 to 0.08)	0.84	0.00 (-0.09 to 0.08)	0.91	0.02 (-0.33 to 0.38)	0.88	0.00 (-0.09 to 0.09)	0.95
Households with at least one adult with disability	0.04 (-0.10 to 0.18)	0.56	0.00 (-0.15 to 0.16)	0.94	0.22 (0.01 to 0.45)	**0.04**	-0.09 (-0.28 to 0.10)	0.34
Households with at least one child with disability	-0.05 (-0.23 to 0.12)	0.55	-0.02 (-0.20 to 0.16)	0.83	0.00 (-0.39 to 0.37)	0.97	-0.05 (-0.26 to 0.15)	0.62
Households with overcrowding (at least 5 people)	-0.02 (-0.10 to 0.06)	0.61	-0.01 (-0.09 to 0.06)	0.72	-0.10 (-0.22 to 0.01)	0.09	0.00 (-0.09 to 0.09)	0.95
Households doing family planning (contraception)	0.22 (0.16 to 0.29)	**< 0.0001**	0.20 (0.13 to 0.28)	**< 0.0001**	0.22 (0.10 to 0.35)	**0.0003**	0.21 (0.12 to 0.29)	**< 0.0001**
Households with all children eating at least 3 times a day	-	-	0.02 (-0.04 to 0.09)	0.51	-0.04 (-0.16 to 0.07)	0.47	0.03 (-0.04 to 0.12)	0.40
Households where all children aged ≥ 6 years go to school	-	-	-	-	0.19 (0.08 to 0.62)	**0.0007**	-	-
Households where all children aged 0–5 years have a birth certificate	-	-	-	-	-	-	0.22 (0.12 to 0.31)	**< 0.0001**

Each model did not include variables that could pose restrictions to the family units or could be incompatible with the subset of family units

p values < 0.05 are reported in bold

Recognizing the pivotal role of women during humanitarian crises in LMICs is essential in the fight against climate change and climate-sensitive infectious diseases. In sub-Saharan Africa, prioritizing women empowerment and agency through comprehensive strategies is essential for building resilient communities [36]. Beyond improving WASH behaviors, empowering women can lead to a better access to healthcare, increased education and awareness, enhanced economic growth, and contribute to long-term community resilience [37]. Despite facing disproportionate burden from the impacts of climate change – in terms of reduction of agency, increased unpaid workload and exacerbated gender-based violence [38] – women are pivotal in both adaptation and mitigation to the climate crisis [39]. The results of our study suggest that, by empowering women to lead community-based interventions, vulnerable people in Mozambique can enhance their capacity to combat cholera, malaria, and other infectious diseases that will be fostered by the ongoing climate crisis.

This study has some limitations that need to be considered. Firstly, our study was limited to six district in the Cabo Delgado province followed by CUAMM and UNICEF, thus limiting the generalizability of our findings to the broader Mozambican population. While our sample included data from more than two-thousands households, variations may exist between other provinces heavily impacted by cyclones and floods, such as Zambezia, Sofala, Nampula and Tete), which were not included in our study. Secondly, the unpredictable dynamics of extreme weather events, as well as the unique characteristics of a population both affected by climate disasters and conflicts, may further restrict the generalizability of our results. Thirdly, due to the challenging-to-reach nature of the population under study, we used convenience sampling, potentially affecting the representativeness of our findings. Fourthly, the outcome selected for this study served as a proxy of the overall prevention measures against post-disaster epidemics available to households at the time of the survey was conducted. Finally, we did not collect any clinical or microbiological data, precluding inferences regarding the true impact of water-borne and vector-borne outbreaks among the included population.

Among climate vulnerable people and IPD living in Mozambique, microbiological and syndromic surveillance of vector-borne and water-borne diseases is urgently needed. Further evidence is required to assess effective preventive strategies in reducing the burden of water-borne and vector-borne outbreaks in post-disaster humanitarian emergencies.

Conclusions

In climate-vulnerable communities in Mozambique, households practicing family planning and providing access to primary education and birth certificate to all children were foud to be less vulnerable to water-borne and vector-borne outbreaks. Our findings can inform policymakers and practitioners on the importance of addressing women to mitigate the impact of climate disasters and reduce the risk of infectious disease outbreaks. Also, our study clearly identifies two districts in which people are more vulnerable to climate-sensitive epidemics, which should be prioritized by local policymakers: Montepuez and Mueda.

Abbreviations

IDP	Internally displaces people
ITN	Insecticide-treated nets
LMIC	Low- and middle-income countries
NSAG	Non-state armed group

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Author contributions

FVS, EO, FDG and CM contributed to study concept and design. EC, AN, RC, GG, VL, SC, AC, IC, AG, AM, MAM contributed to patient inclusion and data collection. FC and FVS cleaned the data and FC contributed to the statistical analysis. FVS, EO, FDG, CM and FC interpreted the data. FVS, FC, GP and EO drafted the manuscript. FDG, AS and KC critically revised the manuscript. All authors approved the final manuscript.

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Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Data collection that informs this study was performed within a framework agreement between CUAMM and the government of Mozambique. The study was reviewed and approved by ethics committee of MINEC Ministerio dos Negocios Estrangeiros e Cooperaçao, Nota 1883/MINEC.DAJC.DONG/2022. Participation was voluntary, anonymous, and without compensation, and informed consent to participate in the study was obtained from all included households. This study has been conducted in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Clinic of Infectious Diseases, Department of Precision and Regenerative Medicine and Ionian Area - (DiMePRe-J), University of Bari Aldo Moro, Bari, Italy
[2]Doctors with Africa CUAMM, Maputo, Mozambique
[3]Independent Statistician, Solagna, Italy
[4]UNICEF Mozambique, Maputo, Mozambique
[5]Operational Research Unit, Doctors with Africa CUAMM, Padua, Italy

[6]NIOP Nucleo de Investigaçao Operacional del Pemba, Pemba, Mozambique

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