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Geographic distribution and determinants of mental health stigma in central Mozambique

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Abstract

Purpose This study describes patterns of community-level stigmatizing attitudes towards mental illness (MI) in central Mozambique.

Methods Data for this study come from a representative community household survey of 2933 respondents ≥ 18 years old in Manica and Sofala Provinces, Mozambique. Six MI stigma questions represented primary research outcomes. Bivariate and multivariable analyses examined the relationship between key explanatory factors and each stigma question. Spatial analyses analyzed the smoothed geographic distribution of responses to each question and explored the association between geographic location and MI stigma controlling for individual-level socio-demographic factors.

Results Stigmatizing attitudes towards MI are prevalent in central Mozambique. Analyses showed that males, people who live in urban places, divorced and widowed individuals, people aged 18–24, people with lower education, people endorsing no religion, and people in lower wealth quintiles tended to have significantly higher levels of stigmatizing attitudes towards MI. Individuals reporting depressive symptoms scored significantly higher on stigmatizing questions, potentially indicating internalized stigma. Geographic location is significantly associated with people's response to five of the stigma questions even after adjusting for individual-level factors.

Conclusion Stigmatizing attitudes towards MI are common in central Mozambique and concentrated amongst specific socio-demographic groups. However, geographic analyses suggest that structural factors within communities and across regions may bear a greater influence on MI stigma than individual-level factors alone. Further implementation science should consider focusing on identifying the most significant modifiable structural factors associated with MI stigma in LMICs to inform the development, testing, and optimization of multi-level stigma prevention interventions.

Keywords MI stigma · Geographic information systems · Spatial analysis · Determinants of stigma · Mozambique

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Introduction

Mental, neurological, and substance use disorders are the leading causes of disability worldwide and profoundly impact the social and economic well-being of individuals and communities [1, 2]. This is also true in low- and middle-income countries (LMICs) such as Mozambique, where mental illness (MI) is estimated to account for more years lived with disability (YLD) than HIV/AIDS, TB, malaria, neglected tropical diseases, diarrhea, lower respiratory infections, and neonatal conditions combined [3]. However, MI treatment gaps exceed 90% in many LMICs, including Mozambique [4]. Academic leaders have argued that stigma associated with MI is one of the main barriers to the provision of effective care and treatment for those suffering from mental ill health [5]. Yet, to our knowledge, there has never been an assessment of MI stigma in Mozambique.

Recent multi-country studies have found very high rates of negative discrimination for patients with schizophrenia, including that 70% of individuals feel the need to conceal their illness [6]. A recent study from Ethiopia found that 75% of respondents felt that keeping individuals with MI locked in their house was the best way to deal with their MI [7]. Stigmatizing attitudes are not only confined to serious MI; additional cross-national studies have shown that the level of stigmatization directed at individuals with depression can be similar to individuals with schizophrenia [8]. The most frequently reported stigmatizing beliefs about, or actions against, individuals with MI include a lack of trust to allow individuals to care for loved ones, a lack of willingness to have individuals with MI as in-laws, negative perceptions such as potential for violence and unpredictability, and perceptions that individuals with MI should be isolated from others in society [8].

MI stigma can result in negative consequences for the management of mental disorders including delays in seeking care, sub-standard treatment outcomes, as well as an overall decline in quality of life [9–11]. Studies have shown that health providers are less likely to refer patients with MI for essential primary health care compared with the general population, which may contribute to lower effectiveness of care provided to this population [12–14]. While reducing MI-related stigma in health-care settings is increasingly becoming an important in high-income countries (HICs) [10, 15, 16], little attention has been paid to address MI stigma in LMICs where stigma around MI is often more prevalent and mental health treatment gaps are larger [17, 18].

Studies on factors associated with stigmatizing attitudes in LMICs have found that (1) males tend to have more stigmatizing attitudes towards MI than females [7, 19–21]; (2) education level is inversely related to MI stigma [7, 22]; (3) single individuals have lower stigmatizing attitudes than married people [7]; (4) people in older age groups have more

stigmatizing attitudes [22, 23]; and (5) socio-economic status is inversely related to stigma [22, 23]. In addition, several studies have suggested that religion plays a critical role in individual understandings of causation and treatment of MI [24–27]. Location and neighborhood-level characteristics have also been associated with stigmatizing attitudes towards MI. For example, a study in Ethiopia found that individuals living in a neighborhood with someone suffering from MI generally had lower stigmatizing attitudes than those who only encountered individuals with MI in the street or another locale [7, 22]. Further, rural respondents tended to have more positive opinions compared to urban populations in Ethiopia [21]; however, the opposite has been found in South Sudan [24].

In Sub-Saharan Africa, compared to MI stigma, HIV stigma is relatively well studied and documented. Innovative work in Kenya has found significant geographic heterogeneity of externalized HIV stigma, even after controlling for individual-level factors—suggesting that externalized stigma may be driven more by community-level structural factors, whereas internalized stigma may be more the result of individual-level characteristics outside of the domain of community influence [28]. More population-level research is needed to identify factors associated with MI stigma to identify potential structural drivers of stigma to inform how and where community-level interventions can be most effective.

This paper aims to be, to our knowledge, the first assessment of community-level MI stigma in Mozambique. We explore the geographic distribution of MI stigma, as well as individual-level determinants of stigma. We also analyze whether MI stigma shows geographic heterogeneity after controlling for key individual-level characteristics. We hypothesize that individuals in the same geographic region may harbor similar levels of MI stigma due to sharing of information, social networks, influential political and religious leaders, and shared cultural domains [29]. We aim for these analyses to help identify specific individual- and community-level factors associated with MI stigma that can motivate targeted implementation science.

Methods

Study setting: Sofala and Manica Provinces, Mozambique

Sofala Province is located in central Mozambique with an estimated population of 1.8 million, 37% of which is urban. Of the 11 provinces in Mozambique, Sofala ranks among the poorest, but key health indicators are slightly above the country average and have improved at a more accelerated pace than other provinces over the past 10 years [30, 31]. Manica Province is located to the west of Sofala with an estimated population of 1.4 million [32]. Manica has similar

population density as Sofala as well as similar results of key health indicators [33]. Wealth distribution is more even in Manica (Gini coefficient: 0.44) than in Sofala (Gini coefficient: 0.55) [33]. As an example of mortality trends, both Sofala and Manica's under-5 mortality rates (U5MR) exceeded the national average in 2000 at 187 and 178 per 1000 live births, respectively. However, by 2010, Sofala's U5MR was below the national average at 83, with Manica's U5MR lagging a bit behind the average at 107 [31].

Mozambique had a Civil War from 1976 to 1992—although there are still sporadic conflicts happening in some regions including northern part of Manica [34, 35]. Resources for the provision of mental health services in Mozambique are very scarce. As of 2011, Mozambique allocated only 0.16% of the national health budget to mental health care [36]. However, even with limited financial resources allocated to mental health services, Mozambique has been a leader across LMICs in accelerating task-shared delivery of community-based mental health care. The vast majority of mental health care is provided by psychiatric technicians who have been trained since 1996 to diagnose all categories of mental health conditions and treat them using brief psychotherapy and all therapeutic categories of psychotropic medications [37, 38]. As of 2014, there are 13 psychiatrists in the country, together with 241 psychiatric technicians, 109 psychologists, and 44 nurses serving MI patients [37]. Although there has been an increasing number of mental health professionals and facilities during the past 7 years as a result of the implementation of the National Mental Health Program, treatment gaps remain. For example, there is limited availability of essential psychotropic medicines, and psychiatric technicians are limited mostly to district-level health facilities [37, 39, 40]. There is also a gap in care-seeking and mental health care for patients with common MI—currently over 70% of outpatient mental health consults in Sofala Province are for more severe MIs—with less than 4% for any mood disorder [39].

Data sources

Data for this study come from a representative community household survey conducted in Manica and Sofala Provinces, Mozambique, from September 2016 to February 2017. A detailed description of the sampling procedures has been previously published [41]. Briefly, this survey was part of a program evaluation of a 7-year health systems strengthening intervention in Mozambique [30]. Survey teams used satellite imagery to digitize buildings and develop a representative community multi-stage sampling frame to visit and verbally interview a total of 3096 households with 1549 in Sofala and 1538 in Manica [41]. For the purpose of the present study, the MI stigma questions were administered to the 3080 participants who were the self-appointed "head-of-household", or, if this person was unavailable, another individual ≥ 15 years

of age willing to answer questions on behalf of the household. We excluded those who failed to answer all six MI stigma questions and those who were less than 18 years of age, yielding a final sample of 2933 (Table 1).

MI stigma variables are categorized into two groups: three questions that assessed social distance towards people living with MI and three questions that assessed general perceptions of mental health. The social distance questions were drawn from "Stigma in Global Context-Mental Health Survey (SGC-MHS)" [8, 42] while the general perception questions were sourced from unpublished surveys conducted by the Ministry of Health and the Carter Center's Mental Health Collaboration in Liberia (Brandon A. Kohrt, personal communication). Each question used a Likert-scale format ranging from 0 to 3, with 0 representing the least stigmatizing response and 3 representing the most stigmatizing (see Table 2 for the question list).

Explanatory factors

We selected explanatory variables on the basis of the existing peer-reviewed literature on MI stigma with a focus on limited existing literature from LMICs [7, 8, 23, 43–47]. These explanatory factors included age, gender, urban or rural household location, education attainment, wealth index by quintile, marital status, religion, self-reported lifetime suicidal ideation, self-reported experience with depressive-like symptoms (defined as ever having a period of sadness or loss of energy that lasted more than 2 weeks), any previous mental health care-seeking, and household location based on latitude and longitude (see Table 1 for categorization of explanatory variables). Wealth quintiles were generated from the first component of the principal component analysis of household characteristics (type of floor, roof, latrine, source of drinking water and main cooking energy) and ownership of household items (radio, TV, bed, fridge, bicycle, motorcycle, car, boat, mobile phone, and landline phone) [48, 49].

Statistical analyses

Our analysis plan included (1) univariate analyses of individual variables to determine how to best categorize groups and to visualize potential missing data issues; (2) bivariate analyses of each explanatory factor's individual relationship with each stigma question; (3) multivariable analyses including age, gender, urban or rural household location, education attainment, wealth index by quintile, religion, and marital status in one model simultaneously to examine the relationship of each variable on each stigma question while controlling for other potential confounding factors; (4) the development of spatial point pattern analyses to develop smoothed geographic maps of responses to each question; and (5) exploratory spatial analyses to explore the spatial

Table 1 Demographic characteristics among 2933 participants from a representative household survey conducted in urban and rural Sofala and Manica provinces in Mozambique, 2017

Characteristic	N (%)
Gender	
Male	1349 (46.0)
Female	1547 (52.7)
Missing	37 (1.3)
Urban/rural	
Urban	878 (29.9)
Rural	2042 (69.6)
Missing	13 (0.4)
Marital status	
Married/common law marriage	2430 (82.9)
Divorced	163 (5.6)
Widowed	233 (7.9)
Single/never married	67 (2.3)
Missing	40 (1.4)
Age	
18–24	576 (19.6)
25–34	952 (32.5)
35–44	634 (21.6)
45–54	336 (11.5)
55–99	397 (13.5)
Missing	38 (1.3)
Highest level of schooling you attended	
No school	557 (19.0)
Basic	1513 (51.6)
Higher	775 (26.4)
Missing	88 (3.0)
Religion	
No religion	486 (16.6)
Catholic	381 (13.0)
Muslim	38 (1.3)
Zion	383 (13.1)
Evangelical/Pentecostal	1342 (45.8)
Anglican	41 (1.4)
Johane Masowe	32 (1.1)
Christian	120 (4.1)
Others	84 (2.9)
Missing	26 (0.9)
Wealth quintile	
Lowest	589 (20.1)
Second	586 (20.0)
Middle	572 (19.5)
Fourth	579 (19.7)
Highest	597 (20.4)
Missing	10 (0.3)
Ever had a period of sadness or loss of energy that lasted more than 2 weeks?	
No	2336 (80.7)
Yes	558 (19.0)

Table 1 (continued)

Characteristic	N (%)
Missing	9 (0.3)
Ever in your life had thoughts of suicide or self-harm?	
No	2449 (83.5)
Yes	477 (16.3)
Missing	7 (0.2)
Ever sought care for a mental health problem?	
No	2818 (96.1)
Yes	102 (3.5)
Missing	13 (0.4)

distribution of each stigma question when controlling for our list of individual-level explanatory factors. Initial correlation matrices were conducted prior to multivariable analyses to ensure that multi-collinearity was not an issue.

Spatial regression using generalized additive models (GAMs) was performed to identify clustering of individuals scoring high stigma (those who responded "agree somewhat"/"agree completely" or "probably unwilling"/"definitely unwilling") relative to that of individuals scoring low stigma (those who responded "definitely willing"/"probably willing" or "disagree somewhat"/"disagree completely"), adjusting for potential confounding by individual-level variables that might account for any observed spatial pattern of stigma. These variables include age, gender, marital status, education level, wealth quintile, and religion. Smoothed maps of predicted prevalence were produced using a locally weighted regression smoother in a GAM framework with a logistic link function and a non-parametric component for the residual spatial surface [50].

All analyses were done in the R statistical package version 3.4.3 [51]. For bivariate and multivariable analyses of explanatory factors on each stigma question, we used cumulative link ordinal logistic mixed models (ordinal R package), controlling for clustering by each primary sampling unit from the community survey. Spatial analyses were conducted using the R Splancs package and geo-coordinates of each household.

Results

Basic demographic characteristics

Among the 2933 participants in this study, 53% were female, 83% were married, and 70% lived in rural areas. The mean age was 38 (median: 33). 19% of the participants had never attended any school, 52% had basic literacy or had attended primary school, and 27% had higher than primary school education. 46% of the participants were Evangelical or Pentecostal and 17% reported that they had no religion. In

Table 2 Responses to general mental health questions among 2933 participants from a representative household survey conducted in urban and rural Sofala and Manica provinces in Mozambique, 2017

Questions	Stigma score (higher score = more stigmatizing)	N (%)
Social distance questions		
Would you be willing to have a friend with mental illness?		
Definitely willing	0	445 (15.2)
Probably willing	1	350 (11.9)
Probably unwilling	2	86 (2.9)
Definitely unwilling	3	2052 (70.0)
Would you be willing to let someone with mental illness take care of your children?		
Definitely willing	0	72 (2.5)
Probably willing	1	89 (3.0)
Probably unwilling	2	59 (2.0)
Definitely unwilling	3	2713 (92.5)
Would you be willing to assist someone with mental illness?		
Definitely willing	0	1925 (65.6)
Probably willing	1	468 (16.0)
Probably unwilling	2	94 (3.2)
Definitely unwilling	3	446 (15.2)
General mental health perceptions		
People with mental illness should be chained, tied and locked in their homes		
Agree completely	3	526 (17.9)
Agree somewhat	2	490 (16.7)
Disagree somewhat	1	328 (11.2)
Disagree completely	0	1925 (54.2)
It is possible to catch mental illness from treating or helping someone who is mentally ill		
Agree completely	3	166 (5.7)
Agree somewhat	2	153 (5.2)
Disagree somewhat	1	185 (6.3)
Disagree completely	0	2429 (82.8)
Mental health problems are caused by witchcraft or a curse placed on a person by someone else		
Agree completely	3	988 (33.7)
Agree somewhat	2	899 (30.7)
Disagree somewhat	1	195 (6.6)
Disagree completely	0	851 (29.0)

terms of MI, 19% had experienced depressive-like symptoms, 16% had thoughts of suicide, and 4% had sought care for MI (Table 1).

Descriptive results for stigma questions

The full description of the distribution of responses to MI stigma questions is listed in Table 2. Briefly, 70% of respondents were "definitely unwilling" to have a friend with MI. Over 92% were unwilling to have someone with MI take care

of their children. Finally, over 64% of participants "agreed completely" or "somewhat" that MI is caused by witchcraft or a curse placed on someone. By contrast, over 65% were willing to assist someone with MI. A combined 34% of participants "agreed completely" or "somewhat" that individuals with MI should be chained, tied, and locked in their homes. Over 90% of participants disagree that "It is possible to catch MI from treating or helping someone who is mentally ill".

Gender and stigma

All statistically significant relationships between stigma questions and gender showed males to have significantly higher levels of stigmatizing attitudes towards MI compared to females (Table 3). For example, in adjusted associations, males were 2.2 times more likely [adjusted odds ratio (aOR): 2.2; 95% confidence interval (CI): 1.8, 2.7] to score higher on unwillingness to have a friend with MI, 1.6 times more likely (CI: 1.1, 2.3) to score higher on unwillingness to let someone with MI care for their children, and 1.2 times more likely (CI: 1.0, 1.5) to score higher on agreement that people with MI should be chained, tied, and locked in their homes compared to females.

Urban/rural location and stigma

People who lived in urban places tended to have significantly higher levels of stigmatizing attitudes towards MI than those who lived in rural places (Table 3). Significant relationships include people who live in urban places are more likely to score higher on unwillingness to have a friend with MI (aOR: 2.0; CI: 1.5, 2.6) and agreeing that mental health problems are caused by witchcraft or a curse placed on a person by someone else (OR: 1.4; CI: 1.1, 2.7).

Marital status and stigma

Compared to those who were married, those who were divorced were more likely to be unwilling to have a friend with MI (aOR: 1.6; CI: 1.1, 2.4), unwilling to let someone with MI take care of their children (aOR: 3.1; CI: 1.2, 7.9), and unwilling to assist someone with MI (aOR: 1.5; CI 1.1, 2.1) (Table 3). Widowed individuals also scored higher on being unwilling to have a friend with MI (aOR 1.4 CI 1.0, 2.0). By contrast, people who were single were more likely to be willing to have a friend with MI (OR: 1.75; CI: 1.1, 2.8) (Table 3).

Age and stigma

Compared to those aged 18–24, older age groups tended to have less stigmatizing attitudes toward MI (Table 3). For example,

Table 3 Bivariate and multivariate analyses of mental health stigma among 2933 participants from a representative household survey conducted in urban and rural Sofala and Manica provinces in Mozambique, 2017

Characteristic	Not willing to have a friend with mental illness			
	OR (95% CI)	*p* value	aOR (95% CI)	*p* value
Gender				
Female	1 (reference)		1 (reference)	
Male	2.0 (1.7, 2.3)**	< 0.01	2.2 (1.8, 2.7)**	< 0.01
Urban/rural				
Rural	1 (reference)		1 (reference)	
Urban	1.3 (1.0, 1.6)*	0.03	2.0 (1.5, 2.6)**	< 0.01
Marital status				
Married/common law marriage	1 (reference)		1 (reference)	
Divorced	1.3 (0.90, 1.9)	0.16	1.6 (1.1, 2.4)*	0.01
Widowed	1.1 (0.81, 1.5)	0.55	1.4 (1.0, 2.0)*	0.04
Single/never married	0.57 (0.36, 0.91)*	0.02	0.69 (0.42, 1.1)	0.13
Age				
18–24	1 (reference)		1 (reference)	
25–34	1.2 (0.93, 1.4)	0.19	0.99 (0.78, 1.3)	0.91
35–44	1.2 (0.91, 1.5)	0.25	0.79 (0.60, 1.0)	0.08
45–54	1.3 (0.95,1.7)	0.11	0.83 (0.60, 1.2)	0.27
55–99	1.8 (1.3, 2.4)**	< 0.01	1.1 (0.75, 1.5)	0.74
Highest level of schooling attended				
Secondary or higher	1 (reference)		1 (reference)	
Basic literacy or primary	1.3 (1.03, 1.5)*	0.02	1.1 (0.90, 1.4)	0.28
No school	1.1 (0.84, 1.4)	0.58	1.2 (0.86, 1.6)	0.30
Religion				
No religion	1 (reference)		1 (reference)	
Catholic	0.75 (0.57, 1.0)	0.05	0.81 (0.60, 1.1)	0.16
Muslim	0.46 (0.24, 0.89)*	0.02	0.63 (0.31, 1.3)	0.21
Zion	1.3 (0.93, 1.7)	0.13	1.3 (0.93, 1.7)	0.13
Evangelical/Pentecostal	1.0 (0.83, 1.3)	0.73	1.1 (0.87, 1.4)	0.43
Anglican	1.8 (0.82, 4.1)	0.14	2.0 ((0.89, 4.6)	0.09
Johane Marange	1.4 (0.61, 3.2)	0.43	1.6 (0.71, 3.8)	0.24
Christian	0.96 (0.63, 1.5)	0.85	1.0 (0.64, 1.6)	0.96
Others	2.1 (1.1, 3.8)*	0.02	2.0 (1.1, 3.8)*	0.03
Wealth quintile				
Highest	1 (reference)		1 (reference)	
Fourth	1.7 (1.3, 2.1)**	< 0.01	1.8 (1.4, 2.4)**	< 0.01
Middle	1.8 (1.4, 2.4)**	< 0.01	2.3 (1.6, 3.2)**	< 0.01
Second	1.6 (1.2, 2.2)**	< 0.01	2.1 (1.5, 2.9)**	< 0.01
Lowest	1.7 (1.3, 2.2)**	< 0.01	2.1 (1.5, 3.0)**	< 0.01
Mental health status-related factors				
Ever had period of sadness or loss of energy that lasted more than 2 weeks?				
No	1 (reference)		1 (reference)	
Yes	1.0 (0.85, 1.3)	0.70	1.1 (0.86, 1.3)[a]	0.56
Ever in your life had thoughts of suicide or self-harm?				
No	1 (reference)		1 (reference)	
Yes	1.2 (0.92, 1.4)	0.22	1.2 (0.94, 1.5)[b]	0.16
Ever sought care for a mental health problem?				
No	1 (reference)		1 (reference)	
Yes	0.55 (0.37, 0.81)**	< 0.01	0.67 (0.45, 1.0)[c]	0.06

Table 3 (continued)

Characteristic	Not willing to let someone with mental illness take care of their children			
	OR (95% CI)	*p* value	aOR (95% CI)	*p* value
Gender				
Female	1 (reference)		1 (reference)	
Male	1.3 (0.94, 1.7)	0.13	1.6 (1.1, 2.3)*	0.02
Urban/rural				
Rural	1 (reference)		1 (reference)	
Urban	0.78 (0.55, 1.1)	0.18	0.87 (0.55, 1.4)	0.57
Marital status				
Married/common law marriage	1 (reference)		1 (reference)	
Divorced	2.6 (1.1, 6.5)*	0.04	3.1 (1.2, 7.9)*	0.02
Widowed	0.80 (0.50, 1.3)	0.36	1.2 (0.68, 2.0)	0.55
Single/never married	1.4 (0.5, 4.1)	0.50	1.3 (0.46, 3.9)	0.59
Age				
18–24	1 (reference)		1 (reference)	
25–34	0.90 (0.58, 1.4)	0.63	0.88 (0.56, 1.3)	0.59
35–44	0.78 (0.49, 1.2)	0.30	0.70 (0.42, 1.2)	0.18
45–54	0.53 (0.32, 0.87)**	0.01	0.49 (0.28, 0.86)*	0.02
55–99	0.72 (0.44, 1.2)	0.23	0.62 (0.34, 1.2)	0.13
Highest level of schooling attended				
Secondary or higher	1 (reference)		1 (reference)	
Basic literacy or primary	1.0 (0.73,1.5)	0.85	1.1 (0.72,1.6)	0.68
No school	0.81 (0.53,1.2)	0.34	1.0 (0.58,1.8)	0.94
Religion				
No religion	1 (reference)		1 (reference)	
Catholic	1.1 (0.64, 1.8)	0.79	1.1 (0.64,1.9)	0.72
Muslim	0.52 (0.20, 1.4)	0.19	0.77 (0.25, 2.5)	0.66
Zion	0.82 (0.50, 1.3)	0.44	0.82 (0.49, 1.4)	0.43
Evangelical/Pentecostal	1.2 (0.80, 1.3)	0.37	1.2 (0.76,1.8)	0.50
Anglican	3.2 (0.42, 24.3)	0.26	3.1 (0.41, 24.2)	0.27
Johane Marange	0.44 (0.15, 1.3)	0.12	0.46 (0.16, 1.3)	0.15
Christian	2.7 (0.95, 7.9)	0.06	3.3 (0.98, 11.2)	0.05
Others	1.5 (0.55, 3.9)	0.45	1.3 (0.48, 3.5)	0.60
Wealth quintile				
Highest	1 (reference)		1 (reference)	
Fourth	1.4 (0.87, 2.2)	0.17	1.2 (0.73, 2.0)	0.47
Middle	1.2 (0.75, 1.9)	0.45	1.1 (0.59, 2.0)	0.82
Second	1.4 (0.88, 2.3)	0.14	1.4 (0.72, 2.6)	0.34
Lowest	1.3 (0.80, 2.1)	0.30	1.2 (0.62, 2.3)	0.60
Mental health status-related factors				
Ever had period of sadness or loss of energy that lasted more than 2 weeks?				
No	1 (reference)		1 (reference)	
Yes	0.94 (0.66, 1.3)	0.74	0.89 (0.62,1.3)[a]	0.55
Ever in your life had thoughts of suicide or self-harm?				
No	1 (reference)		1 (reference)	
Yes	1.2 (0.83, 1.9)	0.30	1.3 (0.87, 2.0)[b]	0.20
Ever sought care for a mental health problem?				
No	1 (reference)		1 (reference)	
Yes	0.36 (0.21, 0.63)**	< 0.01	0.34 (0.19, 0.62)**[c]	< 0.01

Table 3 (continued)

Characteristic	Not willing to assist someone with mental illness			
	OR (95% CI)	*p* value	aOR (95% CI)	*p* value
Gender				
Female	1 (reference)		1 (reference)	
Male	0.92 (0.78, 1.1)	0.29	1.0 (0.82, 1.2)	0.86
Urban/rural				
Rural	1 (reference)		1 (reference)	
Urban	1.1 (0.84, 1.3)	0.63	1.1 (0.82, 1.4)	0.58
Marital status				
Married/common law marriage	1 (reference)		1 (reference)	
Divorced	1.5 (1.1, 2.1)*	0.01	1.5 (1.1, 2.1)*	0.03
Widowed	1.2 (0.92, 1.6)	0.17	1.1 (0.78, 1.5)	0.66
Single/never married	1.5 (0.90, 2.4)	0.13	1.4 (0.86, 2.3)	0.17
Age				
18–24	1 (reference)		1 (reference)	
25–34	0.77 (0.61, 0.96)*	0.02	0.79 (0.63, 1.0)*	0.05
35–44	0.92 (0.72, 1.2)	0.48	0.93 (0.71, 1.2)	0.57
45–54	1.1 (0.82, 1.4)	0.54	1.1 (0.82, 1.5)	0.46
55–99	1.1 (0.80, 1.4)	0.73	0.95 (0.68, 1.3)	0.75
Highest level of schooling attended				
Secondary or higher	1 (reference)		1 (reference)	
Basic literacy or primary	1.1 (0.90, 1.33)	0.38	1.0 (0.82, 1.3)	0.83
No school	1.4 (1.1, 1.8)**	< 0.01	1.3 (0.96, 1.8)	0.09
Religion				
No religion	1 (reference)		1 (reference)	
Catholic	0.67 (0.52, 0.87)**	< 0.01	0.64 (0.47, 0.87)**	< 0.01
Muslim	1.1 (0.57, 2.1)	0.77	0.31 (0.13, 0.72)**	< 0.01
Zion	0.99 (0.76, 1.3)	0.92	0.72 (0.54,0.97)*	0.03
Evangelical/Pentecostal	0.82 (0.67, 1.0)	0.05	0.81 (0.65, 1.0)	0.07
Anglican	0.92 (0.50, 1.7)	0.80	0.70 (0.35, 1.4)	0.32
Johane Marange	0.84 (0.43, 1.6)	0.60	0.54 (0.25, 1.2)	0.12
Christian	0.81 (0.55, 1.2)	0.30	0.92 (0.59, 1.4)	0.73
Others	0.68 (0.42, 1.1)	0.10	0.60 (0.35,1.0)	0.06
Wealth quintile				
Highest	1 (reference)		1 (reference)	
Fourth	1.3 (1.0, 1.7)*	0.05	1.3 (0.95, 1.7)	0.11
Middle	1.1 (0.84, 1.5)	0.42	1.0 (0.73, 1.5)	0.86
Second	1.0 (0.76, 1.4)	0.87	0.95 (0.66, 1.4)	0.79
Lowest	1.2 (0.91, 1.7)	0.17	1.0 (0.72, 1.5)	0.83
Mental health status-related factors				
Ever had period of sadness or loss of energy that lasted more than 2 weeks?				
No	1 (reference)		1 (reference)	
Yes	1.4 (1.2, 1.7)**	< 0.01	1.5 (1.2, 1.8)**,[a]	< 0.01
Ever in your life had thoughts of suicide or self-harm?				
No	1 (reference)		1 (reference)	
Yes	1.1 (0.90, 1.4)	0.32	1.1 (0.89, 1.4)[b]	0.34
Ever sought care for a mental health problem?				
No	1 (reference)		1 (reference)	
Yes	0.53 (0.32, 0.88)*	0.01	0.55 (0.33, 0.93)*,[c]	0.02

Table 3 (continued)

| Characteristic | Agreeing that people with mental illness should be chained, tied, and locked in their homes | | | |
	OR (95% CI)	*p* value	aOR (95% CI)	*p* value
Gender				
Female	1 (reference)		1 (reference)	
Male	1.2 (1.1, 1.4)**	< 0.01	1.2 (1.0, 1.5)*	0.02
Urban/rural				
Rural	1 (reference)		1 (reference)	
Urban	0.85 (0.70, 1.0)	0.10	1.0 (0.81, 1.3)	0.82
Marital status				
Married/common law marriage	1 (reference)		1 (reference)	
Divorced	1.1 (0.79, 1.5)	0.62	1.2 (0.86, 1.7)	0.28
Widowed	1.1 (0.83, 1.4)	0.64	1.1 (0.81, 1.5)	0.55
Single/never married	1.2 (0.77, 1.9)	0.39	1.4 (0.89, 2.3)	0.14
Age				
18–24	1 (reference)		1 (reference)	
25–34	1.0 (0.82, 1.2)	0.96	0.98 (0.79, 1.2)	0.86
35–44	1.1 (0.87, 1.4)	0.46	0.99 (0.78, 1.3)	0.96
45–54	1.3 (0.98, 1.6)	0.08	1.1 (0.83, 1.5)	0.48
55–99	1.2 (0.95, 1.6)	0.11	1.1 (0.81, 1.5)	0.57
Highest level of schooling attended				
Secondary or higher	1 (reference)		1 (reference)	
Basic literacy or primary	1.4 (1.1, 1.6)**	< 0.01	1.2 (1.0, 1.5)	0.53
No school	1.3 (1.0, 1.6)*	0.04	1.2 (0.87, 1.5)	0.33
Religion				
No religion	1 (reference)		1 (reference)	
Catholic	0.67 (0.52, 0.87)**	< 0.01	0.73 (0.55, 0.96)*	0.02
Muslim	1.1 (0.57, 2.1)	0.77	1.49 (0.75, 3.0)	0.25
Zion	0.99 (0.76, 1.3)	0.93	1.0 (0.78, 1.3)	0.92
Evangelical/Pentecostal	0.82 (0.67, 1.0)	0.05	0.88 (0.71, 1.1)	0.22
Anglican	0.92 (0.50, 1.7)	0.80	1.0 (0.55, 1.9)	0.94
Johane Marange	0.84 (0.43, 1.6)	0.60	0.90 (0.46, 1.7)	0.75
Christian	0.81 (0.55, 1.2)	0.30	0.92 (0.61, 1.4)	0.70
Others	0.68 (0.42, 1.1)	0.10	0.74 (0.46, 1.2)	0.21
Wealth quintile				
Highest	1 (reference)		1 (reference)	
Fourth	1.3 (0.99, 1.6)	0.06	1.2 (0.92, 1.6)	0.17
Middle	1.6 (1.3, 2.1)**	< 0.01	1.5 (1.1, 2.1)**	< 0.01
Second	1.4 (1.1, 1.8)*	0.01	1.3 (0.92, 1.8)	0.15
Lowest	1.6 (1.2, 2.0)**	< 0.01	1.4 (1.0, 2.0)*	0.05
Mental health status-related factors				
Ever had period of sadness or loss of energy that lasted more than 2 weeks?				
No	1 (reference)		1 (reference)	
Yes	1.2 (1.0, 1.5)*	0.04	1.2 (1.0, 1.5)*,a	0.03
Ever in your life had thoughts of suicide or self-harm?				
No	1 (reference)		1 (reference)	
Yes	0.86 (0.71, 1.0)	0.13	0.86 (0.70, 1.1)[b]	0.15
Ever sought care for a mental health problem?				
No	1 (reference)		1 (reference)	
Yes	1.3 (0.87, 1.8)	0.22	1.3 (0.90, 1.9)[c]	0.16

Table 3 (continued)

Characteristic	Agreeing that it is possible to catch mental illness from treating or helping someone who is mentally ill			
	OR (95% CI)	p value	aOR (95% CI)	p value
Gender				
Female	1 (reference)		1 (reference)	
Male	0.91 (0.74, 1.1)	0.33	1.0 (0.79, 1.3)	0.92
Urban/rural				
Rural	1 (reference)		1 (reference)	
Urban	1.1 (0.84, 1.4)	0.61	0.98 (0.72, 1.3)	0.91
Marital status				
Married/common law marriage	1 (reference)		1 (reference)	
Divorced	1.1 (0.69, 1.6)	0.83	1.1 (0.68, 1.6)	0.82
Widowed	1.2 (0.83, 1.6)	0.39	1.2 (0.79, 1.8)	0.42
Single/never married	0.96 (0.51, 1.8)	0.91	0.98 (0.50, 1.9)	0.95
Age				
18–24	1 (reference)		1 (reference)	
25–34	0.87 (0.66, 1.2)	0.34	0.79 (0.59, 1.1)	0.12
35–44	1.1 (0.82, 1.5)	0.50	1.0 (0.72, 1.4)	1.0
45–54	1.0 (0.73, 1.5)	0.82	0.81 (0.54, 1.2)	0.30
55–99	0.91 (0.65, 1.3)	0.61	0.75 (0.49, 1.1)	0.17
Highest level of schooling attended				
Secondary or higher	1 (reference)		1 (reference)	
Basic literacy or primary	1.1 (0.87, 1.4)	0.41	1.2 (0.87, 1.5)	0.31
No school	1.4 (1.1, 1.9)*	0.02	1.5 (1.0, 2.2)*	0.03
Religion				
No religion	1 (reference)		1 (reference)	
Catholic	0.75 (0.53, 1.1)	0.10	0.69 (0.47, 1.0)	0.05
Muslim	1.96 (0.97, 4.0)	0.06	2.0 (0.96, 4.3)	0.06
Zion	0.82 (0.58, 1.2)	0.27	0.84 (0.59, 1.2)	0.35
Evangelical/Pentecostal	0.69 (0.53, 0.90)**	< 0.01	0.68 (0.52, 0.90)**	< 0.01
Anglican	0.70 (0.30, 1.6)	0.42	0.70 (0.30, 1.6)	0.41
Johane Marange	0.94 (0.40, 2.2)	0.88	0.94 (0.40, 2.3)	0.89
Christian	0.45 (0.24, 0.84)*	0.01	0.46 (0.24, 0.87)*	0.02
Others	0.57 (0.29, 1.1)	0.10	0.59 (0.30, 1.2)	0.13
Wealth quintile				
Highest	1 (reference)		1 (reference)	
Fourth	0.90 (0.65, 1.2)	0.47	0.89 (0.63, 1.3)	0.52
Middle	1.0 (0.70, 1.4)	0.87	0.92 (0.61, 1.4)	0.70
Second	0.82 (0.59, 1.1)	0.23	0.69 (0.45, 1.1)	0.10
Lowest	0.91 (0.65, 1.3)	0.57	0.77 (0.49, 1.2)	0.25
Mental health status-related factors				
Ever had period of sadness or loss of energy that lasted more than 2 weeks?				
No	1 (reference)		1 (reference)	
Yes	1.1 (0.81, 1.4)	0.73	1.1 (0.81, 1.4)[a]	0.70
Ever in your life had thoughts of suicide or self-harm?				
No	1 (reference)		1 (reference)	
Yes	0.81 (0.61, 1.1)	0.15	0.76 (0.57, 1.0)[b]	0.06
Ever sought care for a mental health problem?				
No	1 (reference)		1 (reference)	
Yes	2.7 (1.7, 4.1)**	< 0.01	2.9 (1.8, 4.5)**,[c]	< 0.01

Table 3 (continued)

Characteristic	Agreeing that mental health problems are caused by witchcraft or a curse placed on a person by someone else			
	OR (95% CI)	p value	aOR (95% CI)	p value
Gender				
Female	1 (reference)		1 (reference)	
Male	0.94 (0.82, 1.1)	0.43	1.0 (0.85, 1.2)	0.88
Urban/rural				
Rural	1 (reference)		1 (reference)	
Urban	1.4 (1.1, 1.7)*	0.01	1.8 (1.4, 2.3)	< 0.01
Marital status				
Married/common law marriage	1 (reference)		1 (reference)	
Divorced	1.15 (0.86, 1.55)	0.35	1.1 (0.78, 1.5)	0.69
Widowed	1.1 (0.82, 1.4)	0.68	1.1 (0.81, 1.5)	0.57
Single/never married	0.67 (0.42, 1.1)	0.08	0.77 (0.48, 1.2)	0.29
Age				
18–24	1 (reference)		1 (reference)	
25–34	1.1 (0.87, 1.3)	0.59	1.0 (0.82, 1.3)	0.89
35–44	1.1 (0.86, 1.3)	0.52	0.96 (0.76, 1.2)	0.75
45–54	1.0 (0.78, 1.3)	0.91	0.85 (0.63, 1.1)	0.25
55–99	1.0 (0.79, 1.3)	0.94	0.85 (0.64, 1.1)	0.28
Highest level of schooling attended				
Secondary or higher	1 (reference)		1 (reference)	
Basic literacy or primary	1.6 (1.4, 1.9)**	< 0.01	1.5 (1.2, 1.8)**	< 0.01
No school	1.5 (1.2, 1.9)**	< 0.01	1.4 (1.0, 1.8)*	0.02
Religion				
No religion	1 (reference)		1 (reference)	
Catholic	0.59 (0.45, 0.76)**	< 0.01	0.59 (0.45, 0.77)**	< 0.01
Muslim	0.58 (0.32, 1.1)	0.08	0.69 (0.37, 1.3)	0.25
Zion	0.80 (0.62, 1.0)	0.10	0.76 (0.58, 1.0)	0.05
Evangelical/Pentecostal	0.64 (0.53, 0.79)**	< 0.01	0.63 (0.51, 0.78)**	< 0.01
Anglican	0.52 (0.28, 0.96)*	0.04	0.51 (0.27, 0.95)*	0.03
Johane Marange	0.84 (0.42, 1.7)	0.61	0.80 (0.40, 1.6)	0.52
Christian	0.49 (0.33, 0.73)**	< 0.01	0.56 (0.38, 0.85)*	< 0.01
Others	0.76 (0.48, 1.2)	0.23	0.70 (0.44, 1.1)	0.14
Wealth quintile				
Highest	1 (reference)		1 (reference)	
Fourth	1.5 (1.2, 1.9)**	< 0.01	1.4 (1.1, 1.9)**	< 0.01
Middle	1.8 (1.4, 2.4)**	< 0.01	1.8 (1.3, 2.5)**	< 0.01
Second	1.5 (1.2, 2.0)**	< 0.01	1.4 (1.0, 2.0)*	0.04
Lowest	1.7 (1.3, 2.3)**	< 0.01	1.7 (1.2, 2.4)**	< 0.01
Mental health status-related factors				
Ever had period of sadness or loss of energy that lasted more than 2 weeks?				
No	1 (reference)		1 (reference)	
Yes	1.4 (1.2, 1.7)**	< 0.01	1.5 (1.2, 1.8)**,[a]	< 0.01
Ever in your life had thoughts of suicide or self-harm?				
No	1 (reference)		1 (reference)	
Yes	1.1 (0.90, 1.3)	0.51	1.1 (0.89, 1.3)[b]	0.45
Ever sought care for a mental health problem?				
No	1 (reference)		1 (reference)	
Yes	0.81 (0.57, 1.2)	0.25	0.93 (0.64, 1.4)[c]	0.71

Table 3 (continued)

We used cumulative link ordinal logistic mixed models controlling for clustering by each primary sampling unit from the community survey. This function uses a maximum-likelihood-based estimation with mixed effects being estimate through adaptive Gauss–Hermite quadrature with 25 points. Random intercepts were assumed to come from a normal distribution

OR odds ratio, *CI* 95% confidence interval, *aOR* adjusted odds ratio; adjusted for individual-level factors including gender, age, urban/rural, wealth quintile, education, marital status, and religion

*$p < 0.05$; **$p < 0.01$

[a]Adjusted for individual factors and "ever had period of sadness and lost of energy for more than 2 weeks"

[b]Adjusted for individual factors and "ever in your life had thoughts of suicide or self-harm"

[c]Adjusted for individual factors and "ever sought care for a mental health problem"

individuals aged 45–54 were more likely to let someone with MI take care of their children (aOR: 0.53; CI: 0.32, 0.87) and those in the age group 25–34 were more likely to be willing to assist someone with MI (aOR: 0.79; CI: 0.63, 1.0). However, people who were ≥ 55 years old were more likely to be unwilling to have a friend with MI (OR: 1.8; CI: 1.3, 2.4), though this bi-variable relationship became not significant after adjustment.

Education and stigma

On average, compared to individuals with secondary or higher education, those with basic or no schooling had higher stigmatizing attitudes (Table 3). For example, individuals with no education were more likely to agree that it is possible to catch MI from treating or assisting someone who is mentally ill (aOR: 1.5; CI: 1.0, 2.2) and that MI is caused by witchcraft (aOR: 1.4; CI: 1.0, 1.8).

Religion and stigma

Compared with no religion, individuals identifying with a major religion (e.g., Catholic, Muslim, Evangelical/Pentecostal) showed less stigmatizing attitudes toward MI (Table 3). However, in fully adjusted model, those who had religions other than those specified in our questionnaire were 2.0 times more likely to be unwilling to have a friend with MI (CI: 1.1, 3.8).

Wealth and stigma

In fully adjusted models, the relationship between wealth and stigma was consistent across three of our stigma questions, with people below the highest wealth quintile scoring higher on not willing to have a friend with MI, agreeing that people with MI should be chained in their home, and agreeing that MIs are caused by a curse (Table 3).

Mental health factors and stigma

People who had ever experienced depressive-like symptoms held more stigmatizing attitudes toward people with MI,

scoring significantly higher on not willing to assist someone with MI (aOR: 1.5; CI: 1.2, 1.8), agreeing that people with MI should be chained, tied, and locked in their homes (aOR: 1.2; CI: 1.0, 1.5), and agreeing that mental health problems are caused by witchcraft or a curse placed on a person by someone else (aOR: 1.5; CI: 1.2, 1.8) (Table 3). On the other hand, people who ever sought care for a mental health problem were less likely to score higher on these questions, but they were more likely to score higher on agreeing that it is possible to catch MI from treating or helping someone who is mentally ill (aOR: 2.9; CI: 1.8, 4.5) (Table 3). No significant associations were found between thoughts of suicide and stigma (Table 3).

Spatial analysis results

The geographic distribution comparing individuals reporting stigmatizing attitudes to those reporting non-stigmatizing attitudes showed significant evidence of spatial clustering, even after controlling for individual-level covariates. Every stigma question showed statistically significant spatial clustering in both adjusted and unadjusted models ($p < 0.05$), except for the question: "people with mental illness should be chained, tied and locked in their homes" (Chi square = 22.5, $p = 0.11$; aChi square = 9.5, $p = 0.46$) (see Figs. 1, 2, 3, 4, 5, 6). We observed very small differences between the proportion of the total deviance explained by the models with spatial terms alone and the models with both spatial terms and individual-level covariates. For example, for the question "would you be willing to have a friend with mental illness?", the difference in deviance explained by the unadjusted model and adjusted model is 3.6%. The geographic patterns, however, differ by stigma question. For example, willingness to have a friend with MI was the highest in the northeast region of the study area, while willingness to assist someone with MI was highest in the central-eastern region of the study area (see Figs. 1 and 3). A strong geographical gradient (Chi square = 125.6, $p < 0.01$) was observed regarding thoughts that MI is caused by witchcraft or a curse, with the northern region of the study area showing much higher agreement compared to the southern region of the study area.
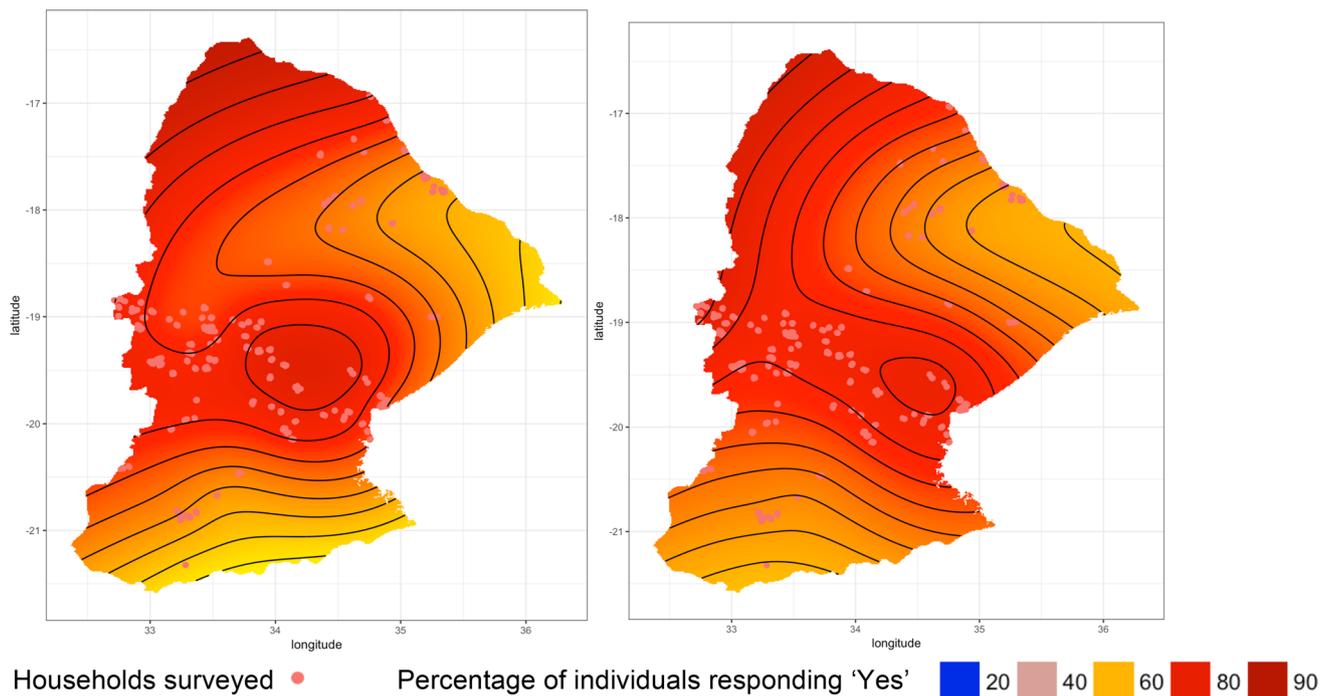
Fig. 1 Smoothed geographic maps of response to the question "are you willing to have a friend with MI". Left: unadjusted map, deviance explained = 1.59%, $p <$ 0.01; right: adjusted map, deviance explained = 5.25%, $p <$ 0.01. Notes. Smoothed maps of predicted prevalence were produced using a locally weighted regression smoother in a generalized additive model (GAM): Logit $(P) = \alpha 0 + S(\text{lat, lon})$; Logit$(P_a) = \alpha 0 + \beta 1(x1) + S(\text{lat, lon})$. P is the probability of reporting any stigma versus reporting no stigma; $\times 1$ is the linear combination of demographic variables (age, gender, marital status, educa-tion, wealth quintile); and S is the spatial smoothing term of the log odds of reporting any stigma relative to reporting no stigma over the geographic extent of the study area. We adjusted for individual-level factors in the model to estimate the residual spatial surface and test whether it was significantly different from a flat surface. We then plotted the 'residual' surface to explore the spatial clustering of indi-viduals reporting stigma relative to individuals not reporting stigma beyond that explained by individual-level covariates

Discussion

To our knowledge, this is the first assessment of MI stigma in Mozambique. As have been observed in studies in other LMICs, the prevalence of MI stigma was generally high. 70% of respondents were "definitely unwilling" to have a friend with MI and 93% were "definitely unwilling" to have someone with MI take care of their children. These findings are similar to those found in Pescosolido et al. [8], where MI stigma was analyzed across 16 countries, finding that unwill-ingness to let people with MI take care of one's children was one of the most frequently reported stigmatizing attitude. In our study, a combined 34% of participants agreed that "indi-viduals with MI should be chained, tied, and locked in their homes", which is lower than the 75% of respondents in Ethi-opia who reported that "keeping patients with mental illness behind locked doors is the best way of handling patients" [7]. It may not be surprising that separating individuals with MI from society is a commonly accepted way to deal with individuals with MI given that over 64% of individuals in our study agreed that MI is caused by witchcraft or a curse.

Furthermore, those who responded that MI is caused by a curse were more likely to respond that individuals with MI should be chained. This may suggest belief that (1) indi-viduals with MI deserve this as a punishment for some sort of transgression; or (2) individuals with MI are violent and hence need to be kept locked. However, 82% of respondents were willing to assist someone with MI, which, when com-bined with the low percent of participants who believe that MI is contagious (< 11%), suggests a general willingness to engage on at least a surface level with those suffering from MI in Mozambique. Given the vague nature of the stigma questions in our study discussing "someone with mental ill-ness" or "mental health problems", it is likely that individu-als in our study sample also were picturing an individual with severe mental illness, such as psychosis, rather than someone with more common mental illness, like anxiety or depression. However, this perception of mental health problems is, in and of itself, an interesting finding and an important component of addressing mental health stigma in Mozambique and other similar LMICs.
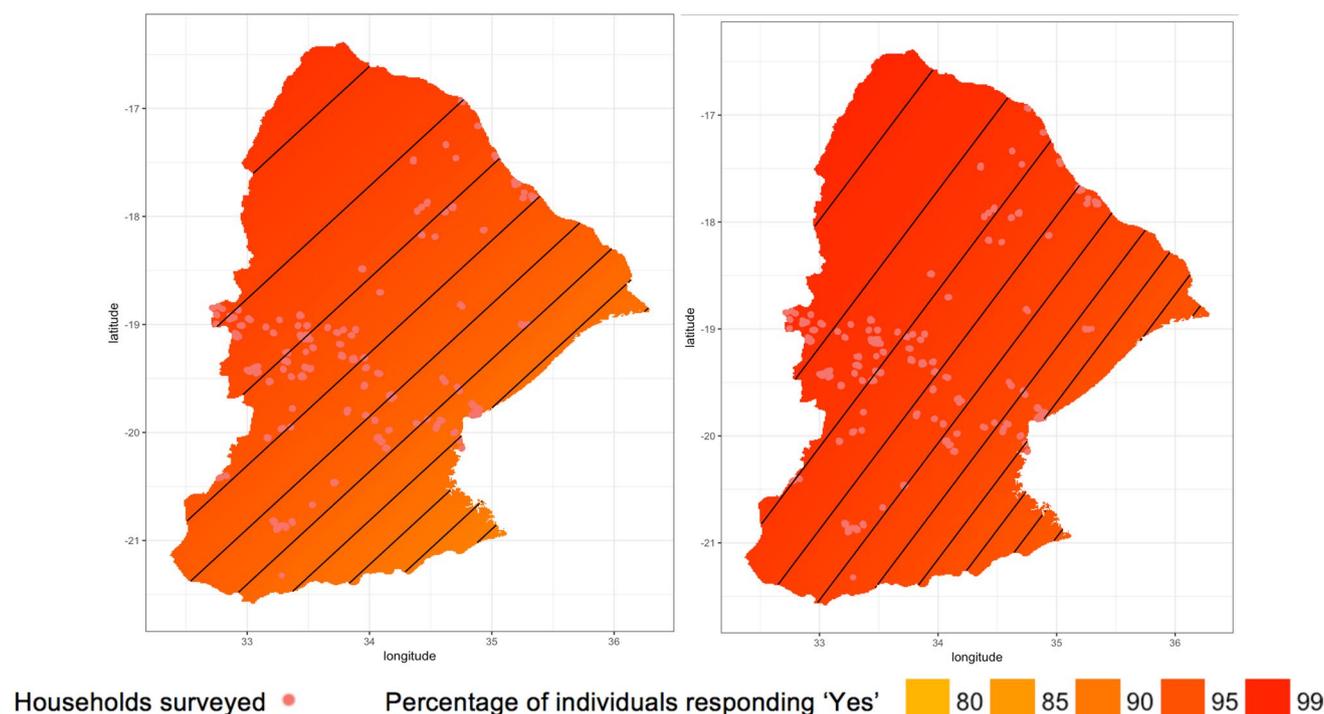
Fig. 2 Smoothed geographic maps of response to the question "are you willing to let someone with MI to take care of your children". Left: unadjusted map, deviance explained = 1.01%, $p < 0.01$, right: adjusted map, deviance explained = 3.05%, $p < 0.01$

Spatial analysis is the quantitative analysis of the difference of behaviors, implementation strategies, contextual factors, health interventions, or health outcomes between people who reside in different geographic locations. Using geo-coordinates, spatial analyses can quantitatively examine the variation in an outcome of interest that may be due to environmental determinants of health—which can go beyond just examining the effects of individual-level factors. In the present spatial analyses, we found significant geographic clustering of MI stigma, even after controlling for key individual-level covariates. These findings are consistent with previous analyses of HIV stigma in Kenya [52], which showed significant geographic clustering of externalized stigma after controlling for individual-level characteristics. In the present study, the addition of a constellation of individual-level factors into our spatial models explained only a small proportion of the overall variance in the spatial heterogeneity of MI stigma. This may suggest that structural factors within communities and regions may bear a greater influence than individual-level characteristics on the development, propagation, and maintenance of stigma towards MI. Individuals in the same geographic region may harbor similar levels of MI stigma due to sharing of information, social networks, influential political and religious leaders,

and shared cultural beliefs. For example, based on our geographic analysis, individuals living in northern Sofala and Manica provinces are much more likely to believe that mental illness is caused by a curse (80% agreement) than individuals who live in southern Manica province (20% agreement); (Fig. 6). Stigma reduction interventions should weigh this and all other evidence when developing and optimizing implementation science towards decreasing MI stigma in LMICs. Based on the findings of our study, narrow individually focused stigma reduction interventions may have limited effect if they do not target structural regional and community-level drivers of stigma.

In our study, individual-level factors that were found to be generally associated with higher stigmatizing attitudes included being male, living in urban areas, having lower education, being at lower socio-economic status, and having experienced depression-like symptoms. These factors are generally consistent with what has been found in other studies in LMICs. Previous studies conducted in Ethiopia and Kenya found that males tend to have more stigmatizing attitudes towards MI than females—a relationship that has also been reported in HICs [7, 19–21]. This could be explained by different perceptions on MI and the intersection of stereotypes about gender and mental disorders. When asking
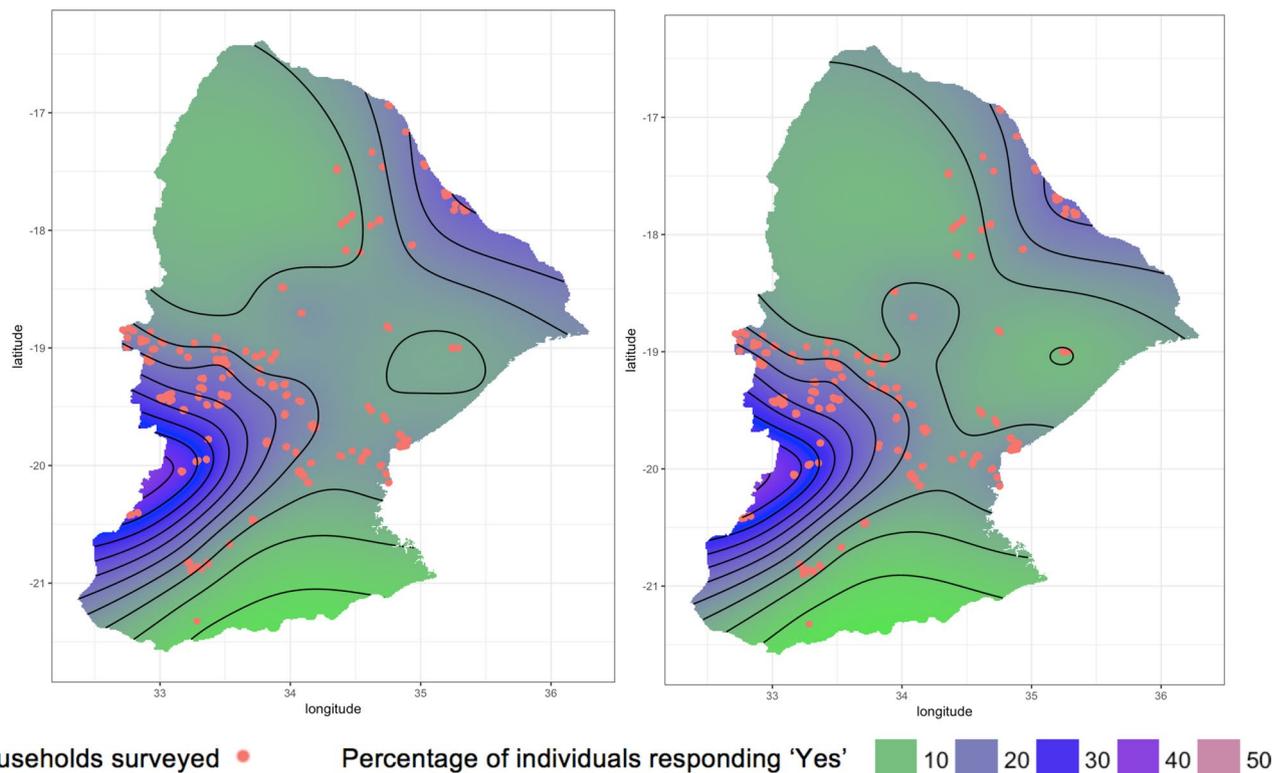
Fig. 3 Smoothed geographic maps of response to the question "are you willing to assist someone with MI". Left: unadjusted map, deviance explained = 2.16%, $p < 0.01$; right: adjusted map, deviance explained = 4.19%, $p < 0.01$

questions about MI generally, males and females may picture different types of MI. For example, a study conducted in the US found that African American women tend to believe that the main causes of MI are stress and trauma while African American men believe that MIs are mainly caused by alcohol and drug use [53]. Similar to our findings, a previous study in Ethiopia found that rural respondents tended to have more positive attitudes towards MI compared to urban populations [21]; however, the opposite has been found in South Sudan [24]. Our findings around socio-economic status (SES), marital status, and education are also consistent with findings from Ethiopia, Kenya, and Slovakia highlighting that SES, education, and being single are inversely related to MI stigma [7, 22, 23]. Our findings about the importance of religion in shaping MI stigma have also been corroborated in previous studies in Sub-Saharan Africa [24].

We also found patterns and stigma-associated factors that, to our knowledge, have not been previously reported in LMICs. We found an association between experiencing depressive-like symptoms and having higher stigmatizing attitudes towards MI. Specifically, controlling for all other factors, those with depressive symptoms were significantly

more likely than the general population to be unwilling to assist someone with MI, to believe that MI is caused by a curse or witchcraft, and to believe that people with MI should be chained, tied, and locked in their homes. Together these potentially suggest that individuals with depression-like symptoms in central Mozambique may experience significant internalized stigma. However, given the cross-sectional nature of this study we cannot discern whether individuals with depressive symptoms are more likely to develop internalized stigma through social experiences with their illness—or if these stigmatizing beliefs predispose individuals towards the development of depressive symptoms. Similar patterns of individuals with MI feeling the need to isolate themselves from society have been previously reported in HICs [54].

We found that those who had previously sought care for MI had generally lower levels of stigmatizing attitudes—being more willing to have a friend with MI, more willing to allow someone with MI take care of their children, and more willing to assist someone with MI. However, by contrast, one of the strongest associations seen across our study was that individuals who had previously sought care for MI were
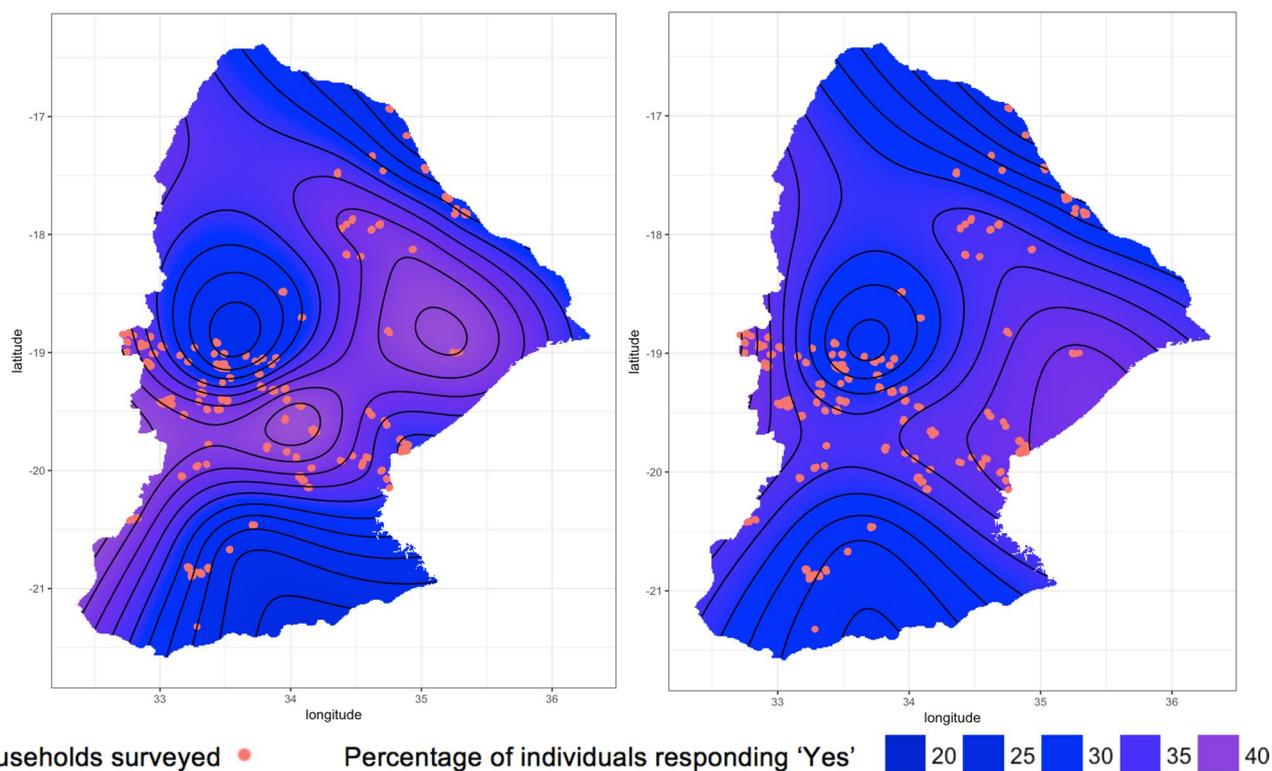
Fig. 4 Smoothed geographic maps of response to the question "do you agree that people with MI should be chained, tied and locked in their homes". Left: unadjusted map, deviance explained=0.887%, $p < 0.01$; right: adjusted map, deviance explained=2.11%, $p=0.45$

three times more likely to agree that it is possible to catch MI from treating or helping someone with MI. This association may suggest either (1) that individuals tend to seek care for MI when they think their condition may be contagious to others in their community; or (2) that allopathic and/or non-allopathic mental health care providers may be propagating stigmatizing attitudes to MI patients. While there are studies that have found traditional healers often hold the belief that MI is caused by a curse [55, 56], there are also studies that have shown that with proper training, traditional healers can have positive effects on closing the MI treatment gap in low-resource settings [57–59]. Further investigations on existing care-seeking pathways and the attitudes of providers towards MI are needed to ensure that the limited available care for individuals with MI does not propagate harmful stigmatizing beliefs around MI and to inform further training programs for mental health care providers.

Our study has a number of important limitations. First, the stigma questions used in this study were not validated in Mozambique, and thus we cannot ensure these questions accurately reflect stigma towards MI among our study population. Second, based on the results to these questions

and our experience working and living in Mozambique, we see it as highly likely that most respondents were picturing an individual with severe mental illness (such as psychosis) when responding to the questions about "someone with mental illness" or "mental health problems". Third, as our data are cross-sectional in nature, no causal relationships between exploratory factors and MI stigma can be deduced. Fourth, only the self-appointed "head-of-household", or those comfortable responding to questions on behalf of the household, were asked the mental health stigma questions. This likely generated some sampling bias as our study only includes household members who have more authority in decision-making processes. Last, ongoing conflict in the study area precluded visiting a number of sampled clusters, potentially biasing our random cluster community sample [41]. Nevertheless, our study has a number of important strengths. This is, to our knowledge, the first representative community assessment of MI stigma in Mozambique. Our study had a large sample size, representative sampling frame, and stigma questions assessing a variety of attitudes towards individuals with MI. We also sought to use advanced statistical
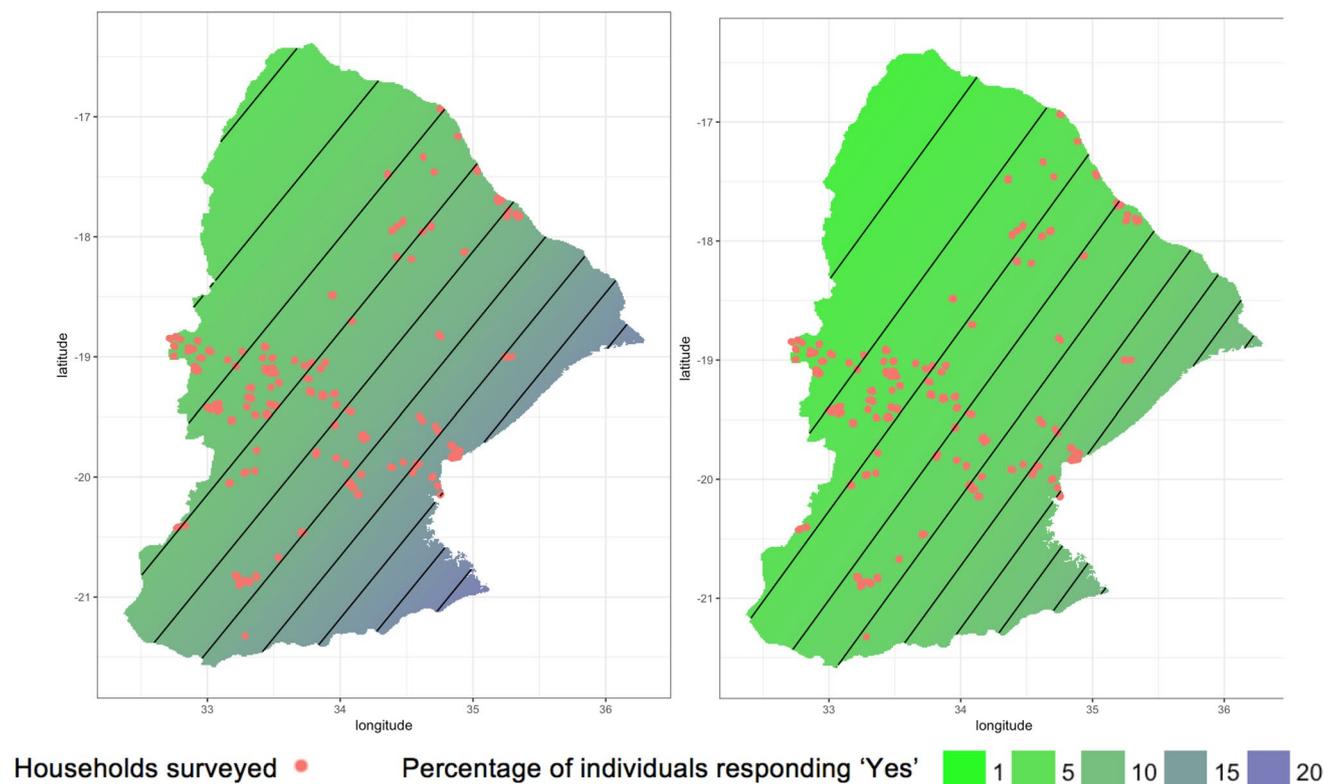
Fig. 5 Smoothed geographic maps of response to the question "do you agree that it is possible to catch MI from treating or helping someone with MI". Left: unadjusted map, deviance explained = 0.84%, $p < 0.01$; right: adjusted map, deviance explained = 2.58%, $p < 0.01$

modeling techniques to examine the geographic clustering of MI stigma and the influence of individual versus community-level structural drivers of MI stigma.

Conclusions

Our study found high levels of MI stigma in central Mozambique. High percentages of the population in central Mozambique are unwilling to have a friend with MI, unwilling to let someone with MI care for their children, and believe that MI is caused by witchcraft or a curse. However, by contrast, over 80% of the population is willing to assist someone with MI and do not believe that it is possible to catch MI from treating or helping someone with MI—suggesting a general willingness to engage on at least a surface level with those suffering from MI in Mozambique. In our study, factors that were found to be associated with higher stigmatizing attitudes included being male, living in rural areas, having lower education, being at lower socio-economic status, having no organized religion, being at the youngest age group, and experiencing depressive-like symptoms. We found evidence of internalized stigma—that those expressing depressive symptoms had higher stigmatizing attitudes, and that those who had previously sought care were more likely to believe that MI was contagious. We also found significant geographical clustering in stigmatizing attitudes—associations that persisted even when controlling for key individual socio-demographic characteristics. Furthermore, the addition of key individual-level characteristics explained very little of the overall geographic variance in MI stigma responses. Taken together, our results highlight the urgent need to address MI stigma to decrease the large MI treatment gap in Mozambique and other similar LMICs. Future implementation science is needed to develop, test, and optimize multi-level stigma interventions in LMICs. These interventions should consider individual-level factors that may predispose individuals to have higher stigmatizing attitudes, but likely will not be successful if they do not identify and address larger structural community and regional-level factors contributing to the propagation and maintenance of MI stigma. Future research should consider focusing on identifying the most significant modifiable structural and community-level factors associated with MI stigma in LMICs rather than the traditional focus on only individual-level-associated factors.
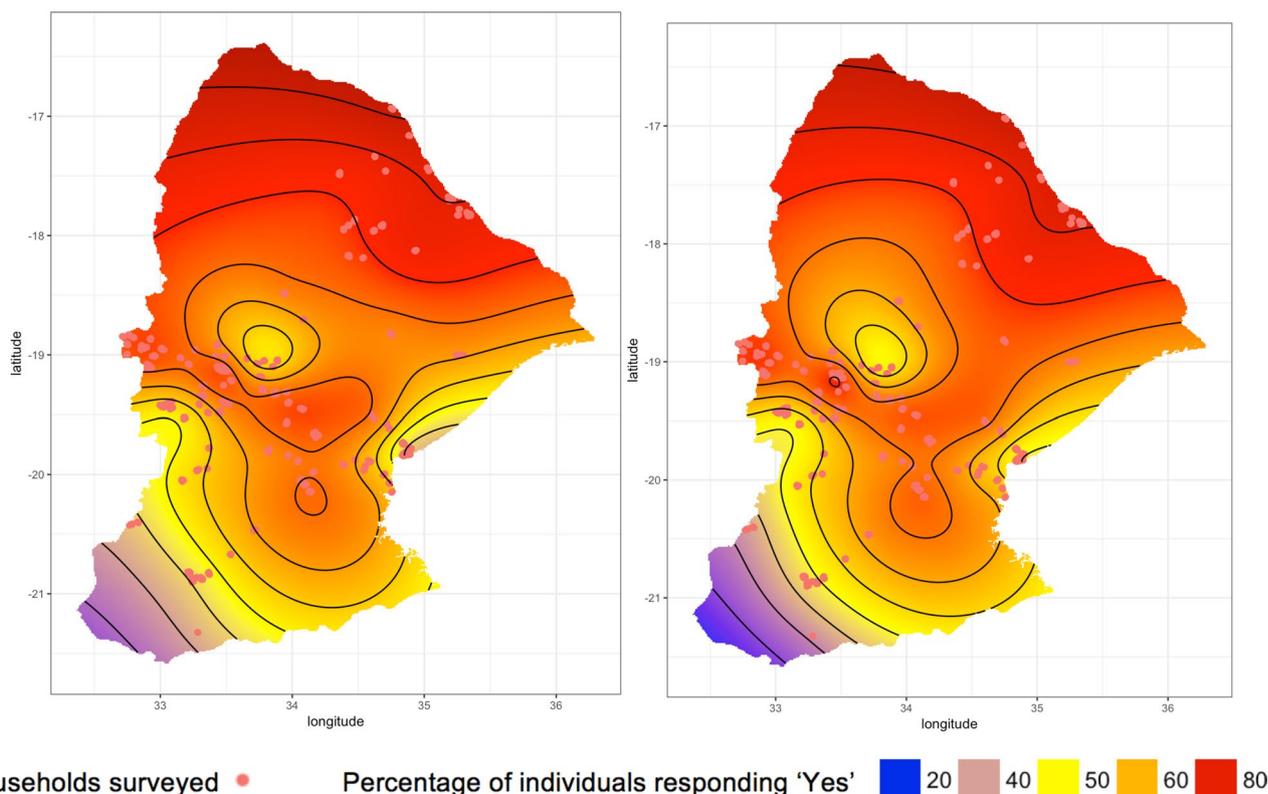
Fig. 6 Smoothed geographic maps of response to the question "do you agree that mental health problems are caused by witchcraft or a curse placed on a person by someone else". Left: unadjusted map, deviance explained = 4.83%, $p < 0.01$; right: adjusted map, deviance explained = 6.69%, $p < 0.01$

Compliance with ethical standards

Ethical approval This study was approved by the Institutional Review Board of the National Institute of Health in Mozambique.

Conflict of interest The authors report no conflicts of interest.

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