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ABSTRACT

This paper analyzes the effects of earthquakes that impacted Mexico on women's mental health and substance abuse in 2017. Using a difference-in-differences approach we found the following: i. the earthquakes had negative consequences on women's mental health; ii. there was no evidence that earthquakes increased the consumption of alcohol or cigarettes; and iii. women who received psychological support improved in certain measures of mental health. While the Mexican government has set up the Fund for Natural Disasters (FONDEN) to alleviate the impact of events such as earthquakes by distributing food and money for reconstruction, our findings indicate that it would be beneficial to analyze the possibility of extending this support to the realm of mental health.

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Keywords: natural disasters; mental health

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1 Introduction

The impact of natural disasters on mental health has been widely explored in the literature. Yet, despite efforts to document the effects of natural disasters on mental health, Goldmann and Galea (2014) point out four important limitations in this body of literature: (1) the baseline information is often lacking in studies analyzing the effects of natural disasters on mental health. In addition, it can be observed that many studies lack a comparison group, thus limiting the ability to draw causal inferences; (2) there is still insufficient knowledge about the variables (pre-disaster and post-disaster) that worsen the effects of natural disasters on mental health; (3) additional studies are needed to understand the types of interventions that work in reducing mental health problems among disaster victims; and (4) most of the studies have, to date, been conducted in the United States, with little known about the impacts of earthquakes on mental health in emergent countries.

In this paper, we analyze the effects of the earthquakes that hit Mexico during September 2017 on women's mental health and substance abuse, using the Survey of Social Mobility in Disaster Zones in Mexico (SoMoDiZ). These data allow us to

face some of the limitations pointed out by Goldmann and Galea (2014): (1)the survey contains information regarding both affected (treatment) and non-affected (control) localities; (2) the survey gathered information regarding variables that could worsen the effects of natural disasters (pre-disaster and post-disaster); and (3) it contains information regarding women who received psychological support after the earthquake.

Using a difference-in-differences estimation, we found that: i. the earthquakes had negative consequences on women's mental health; and ii. there was no evidence that the earthquakes increased the consumption of alcohol or tobacco. In addition we explored how childhood variables (such as the death of the father or mother, being in a car accident, suffering a natural disaster, and sexual assault), pre-disaster (self-esteem, self-control, attending school, and age), and post-disaster factors (assets, savings, loss of partner's job, family size, and degree of neighbor- hood security) worsened the impact of the natural disaster on women's mental health. We found evidence that the post-disaster variables could explain certain heterogeneous effects. In particular, the effects of earthquakes on mental health were found to be worst among women whose partner had stopped contributing income to the home, and women who felt more insecure in their neighborhoods. Finally, we analyzed the effects of receiving psychological support, finding that women who received psychological support improved their mental health.

Our work relates to literature studying the effects of natural disasters on mental health. Using a sample of 392 low-income parents exposed to hurricane Katrina that affected the United States in 2005, Rhodes et al. (2010) found that the effects on mental illness persisted one year after the hurricane, with nearly half of the respondents presenting with post-traumatic stress disorder (PTSD). Tracy et al. (2011), using a sample of 658 adults exposed to hurricane Ike that affected the United States in 2008, found the prevalence of PTSD and depression following the hurricane to be 6% and 5%, respectively. Studying 2,205 older individuals aged 54-80 affected by Hurricane Sandy in 2012, Heid et al. (2017) found that greater storm exposure was linked to higher levels of PTSD.

The main contributions of this paper are threefold. First, this paper contributes to the literature on the effects of natural disasters on mental health, addressing some of the preceding studies' limitations in terms of deriving causal effects. In particular, our data contain information about both the pre- and post-occurrence periods of the natural disaster, and we use a comparison group to approximate causal effects. Second, this paper provides evidence regarding certain factors (pre- and post-disaster) that can worsen the impacts of natural disasters on mental health.

Galea et al. (2008) present evidence of pre-disaster variables such as shocks during childhood, age, personality or socioeconomic status that can worsen the mental health of disaster victims. While we did not find evidence that these pre-disaster factors worsened the effects of the earthquakes under study on mental health, we did uncover evidence that post-disaster variables such as perceptions of insecurity could worsen the mental health of the women affected. Finally, the results provide some insights into the significance of receiving psychological support after the natural disaster, indicating that women who received this support had reduced mental health problems.

The remainder of this paper is organized as follows. Section two presents the literature review and section three describes the background, data, and empirical methods used. In Section four, we present the results, and section five concludes.

2 Literature Review

The impact of disasters on mental health has been a topic largely explored in the literature. In 1909, Eduard Stierlin studied the consequences of the earthquake in Messina, where people reported sleeping problems. Recently, major efforts have been made to summarize over 100 years of research in this area, including the

works of Goldmann and Galea (2014), and Neria and Norris (2009). In this section, we briefly review the existing literature on this broad subject.

The most frequently reported psychopathologies emerging as mental health consequences of natural disasters include Post-Traumatic Stress Disorder (PTSD), Major Depressive Disorder (MDD), anxiety, and substance abuse (Goldmann and Galea, 2014). The effects of natural disasters on mental health have been estimated to lie in the range of 5% to 40% (Galea et al., 2008). Yet, the debate regarding which factors worsen the effects of natural disasters on mental health remains open. Goldmann and Galea (2014) provide a framework with which to analyze the mental health consequences of natural disasters. They establish an order of pre- disaster, peri-disaster and post-disaster risk factors that generate heterogeneous effects. Pre-disaster risk factors include prior mental health problems, being fe- male, being single, low socioeconomic status, minority ethnic status, and a younger age. Peri-disaster risk factors include the duration of exposure to the natural dis- aster, the death toll, and proximity to where the disaster occurred. Post-disaster factors include life stressors (job loss, property damage, marital stress, displace- ment), and social support (perceived degree of social support and communication).

Diverse research techniques have been employed to analyze the effects of nat-

ural disasters on mental health. Studies include a few longitudinal surveys and cross-section surveys (Norris and Elrod, 2006). According to Friedman (2006), the lack of longitudinal studies accounts for the corresponding lack of understanding of what constitute good variables to build a theory on recovery and resiliency processes. Another challenge comes from small sample sizes. When reviewing the samples used in the empirical literature of mental health and natural disasters, Norris and Elrod (2006) found that sample sizes are frequently small, ranging from 37 to 157.

In summary, this brief literature review highlights the long-standing tradition of exploring the impact of exposure to natural disasters on mental health. Given that the extant literature has principally focused on the USA, we do not know much about the mental health impacts of earthquakes in emergent countries, such as in the Latin America region. More importantly, to date, the studies have been characterized by small samples and a lack of comparison groups. Finally, there is little evidence regarding the factors that worsen the impacts of natural disasters on mental health.

3 Background, Data, and Empirical Methods

3.1 Background

According to the World Bank (2012), 27% of the population in Mexico is ex- posed to earthquakes. During September 2017, more than 5,000 earthquakes took place in Mexico. Two of them were major earthquakes, occurring on September 7 and 19. On September 7, an earthquake of 8.1 degrees caused the death of at least 102 people in the states of Oaxaca, Chiapas and Tabasco. The most serious damage occurred in the locality of Juchitán in the state of Oaxaca, where 70 people died and 15,000 homes were affected.

On September 19, an earthquake of 7.1 degrees caused over 369 fatalities in Mexico City, Morelos and Puebla. The Government estimates that as a con- sequence of this earthquake, 369 people died and 12 million were affected (by injuries, property losses, and interruptions in the educational cycle, among other aspects). One of the most affected localities was Jojutla, a municipality in the State of Morelos, 80 miles south of Mexico City.

3.2 Description of the Data

To estimate the impact of earthquakes on women's mental health, we used the Survey of Social Mobility in Disaster Zones (SoMoDiZ). The SoMoDiZ data contain information on two selected municipalities affected by the earthquakes: Juchitán in Oaxaca, and Jojutla in Morelos. Data were also collected from two municipalities that were used as a comparison group: Martínez de la Torre in Veracruz, and Rincón de Romos in Aguascalientes. The criteria for selecting these two control localities were: i. that they had a Human Development Index similar to the municipalities affected by the natural disaster; and ii. that they had a similar level of income per capita and economic growth trajectory over the last 25 years with respect to the treatment municipalities. Regarding the data collection, sur- vey streets were randomly selected in each municipality, with five households on each street interviewed until the sample size was reached. The estimated sample size was 400 units in the treatment localities and 400 in the control localities.

The objective of the survey was to collect information on the effects of natural disasters on consumption and prices. In this sense, the survey was mainly directed towards women who were either the head of the household or the spouse of the latter. If a woman was not present, the survey was applied to her husband or partner. For the purpose of this study, we limited our sample to women only, interviewing

a total of 361 women in the treatment and 394 in the control municipalities.

The SoMoDiZ collected data for nine questions regarding mental health and two questions regarding substance use. The questions concerning mental health referred to having nightmares, sleep problems, feeling irritated, feeling tired, con- centration problems, feeling sad, feeling fear, having oppression, and suffering from trembling in the body.[1] The questions regarding substance abuse referred to the consumption of alcohol and tobacco. This information was collected for the months of August (recall) and October. Panel A in Table 1 compares the measures of mental health prior to (period 1) and after (period 2) the earthquake in the treatment and control municipalities. For the eight items, important increases in the probability of experiencing mental problems in the localities affected by the natural disaster can be observed. For example, the number of women in the treatment localities who reported having nightmares increased from 13% to 51% while, in the comparison municipalities, it can be seen that mental health outcomes remained relatively constant. Regarding the variables of substance abuse (alcohol and tobacco), no major changes can be seen between the periods of analysis for both the treatment and control groups (see Table 1).

[1]These questions were obtained from a test assessing depression and anxiety that was applied to families living in poverty in Mexico by Palomar (2012). The questions regarding depression covered: sleeping problems, feeling irritated, concentration problems, feeling sad, and feeling tired. The questions regarding anxiety covered: having oppression, suffering from trembling in the body, feeling fear, and having nightmares.

Panel B in Table 1 includes information about the variables that were used in the regression analysis as controls, such as age, school attendance, being head of the household, being relocated as a consequence of the natural disaster, and family size. In addition, the receipts of funds from PROGRESA[2], the Temporary Employment Program[3], the Program for those aged 70 or above[4], remittances, money for reconstruction, and money to buy durable goods are also considered as control variables in Table 1. In addition, Panel C in Table 1 includes information about variables pertaining to shocks during childhood, pre-disaster and post-disaster that were used to analyze heterogeneous effects. The variables covering childhood shocks (aged 15 or younger) include: father's death, mother's death, being in an automobile accident, experiencing a natural disaster, and sexual as- sault. Pre-disaster variables include self-esteem and self-control; in addition, we used age and education (school attendance). Post-disaster variables include: as- sets, savings, partner's contribution to the family income, insecurity during the day, and family size. Finally, the data also contain information about women who reported having received psychological support after the natural disaster. It can be observed that 30% of the women in the localities affected by the earthquake reported receiving this kind of support.

[2]PROGRESA provides cash transfers to families in exchange for regular school attendances, health clinic visits, and nutrition support.

[3]This program grants temporary monetary support to individuals whose income has been affected due to an adverse economic situation.

[4]This program grants monetary support to adults who do not have a formal pension and who are over 70 years old.

3.3 Empirical Strategy

We used a difference-in-differences (DID) approach to examine the effect of the earthquakes on women's mental health:

$$Y_{it} = \beta_0 + \beta_1 After_t + \beta_2 Earthquake_i + \beta_3 (After_t * Earthquake_i) + X_{1i}\theta_i + e_{it}$$

where Y_{it} is the outcome of interest for women i at time t; $After_t$ takes the value of 1 in the period after the shock; $Earthquake_i$ takes the value of 1 in the municipalities affected by the natural disaster and zero otherwise; X_{1i} is a set of control variables. Standard errors are clustered at the street level. It should be noted that the coefficient of interest is β_3, which estimates the effect that the earthquake has on mental health in the treated municipalities compared to the control group. In order to identify the causal effect, the above difference-in-differences (DID) estimator needed to satisfy the following:

1. That the additive structure imposed was correct.

2. $cov(e_{it}, After_t * Earthquake_i) = 0$.

The latter assumption is known as *parallel-trend* meaning that the outcome variables of the treatment and comparison groups followed the same trend over time before the hurricane took place. In other words, the unobserved characteristics that created a gap between the measured treatment and control outcomes are assumed to be time invariant, consequently eliminating the problem of omitted variable bias.

While the survey collected information for localities that followed a similar tra- jectory in terms of economic growth over the last 15 years, we only had two data points for the mental health variables and, as a consequence, were unable to test the parallel trends assumption. To address this problem of potentially omitted variables, we employed the bounding approach proposed by Altonji et al. (2005) and refined by Oster (2017). Altonji et al. (2005) observed that a common approach towards evaluating robustness in terms of omitted variable bias has been to include additional control variables on the right hand side of the regression. If such additions do not affect the coefficient of interest, then this coefficient can be considered unlikely to be biased. This strategy implicitly assumes that the selection on observables informs the selection on unobservables. Oster formalizes this idea, and provides conditions for bounds and identification.[5]

[5]Oster shows that even though a consistent estimator of the parameter of interest can be ob- tained, this is nonetheless a function of two parameters unknown by the econometrician: (1) the R-squared for a hypothetical model that contains both the observable and unobservable variables;

Finally, we estimated the heterogeneous effects with respect to variables re- garding shocks experienced during childhood, and pre- and post-disaster. The equation that we estimate is as follows:

$$Y_{it} = \beta_0 + \beta_1 After_t + \beta_2 Earthquake_i + \beta_3 Z_{it} + \beta_4 After_t Earthquake_i + \beta_5 After_t Z_{it} + \beta_6 Earthquake_i Z_{it} + \beta_7 After_t Earthquake_i Z_{it} + X_{1i}\theta_i + e_{it}$$

where Z_{it} is a variable of interest regarding heterogeneous effects. In this spec- ification β_7 is our coefficient of interest.

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and, (2) the proportion of the selection of unobservables to observables. In particular, Oster defines R_{max} as the overall R-squared of the model, that is the R-squared that would be obtained from a regression of the dependent variable (Y) on the variable of interest ($After_t * Earthquake_i$), observables (X_1), and unobservables (X_2). In addition, Oster defines δ to be a parameter that ensures the equality Cov(Aftert*Earthquake$_i$, X2)/ Var(X2) = δ Cov(Aftert*Earthquake$_i$, X1)/ Var(X1) , i.e. this relationship formalizes the idea that the magnitude and sign of the relationship between $After_t * Earthquake_i$ and X_1 provides some information about the magnitude and sign of the relationship between $After_t$ *$Earthquake_i$ and X_2.

Oster argues that the selection on unobservables should not be greater than the selection on observables. Thus, the lower bound of δ is zero and the upper bound is one. To determine R_{max}, Oster tested the robustness of treatment parameters from randomized control studies published in top economic journals between 2008 and 2013 by using $R_{max} = min\{\pi\tilde{R}, 1\}$ with various values of π and $\tilde{R}$ being the R-squared of regressing Y on the variable of interest and observables. Oster found that only 20% of results were robust when $R_{max} = 1$ while using $R_{max} = 1.3\tilde{R}$ (or $\pi = 1.3$) reproduced 90% of randomized results. Thus, Oster suggests that β^* (the parameter of interest) be calculated for the following ranges of δ: $0 \leq \delta \leq 1$. This allows one to construct the set $[\beta^*(\delta = 0), \beta^*(\delta = 1)]$ assuming $R_{max} = 1.3\tilde{R}$. If this set excludes zero, the results from the controlled regressions can be considered to be robust with regard to omitted variable bias. In other words, the results indicate that $\beta^* \neq 0$.

4 Results

4.1 Main results and bounding methodology

Table 2 presents estimates of the impact of earthquakes on women's mental health. All the regressions control for age, education, family size, and being head of the household. In addition, we controlled for participation in the following social programs: PROGRESA, Temporary Employment, and assistance for those aged 70 and above. Finally, we included being relocated as a consequence of the natural disaster, receiving psychological support, receiving money for reconstruction, receiving money to buy durable goods, remittances, and municipality fixed effects. The estimates show a positive and significant effect of earthquakes on nightmares (0.369), i.e. when a woman was affected by an earthquake, this increased her probability of suffering nightmares by 36.9 percent. The remainder of the estimates are positive and statistically significant: sleep problems (0.572), feeling irritated (.356), concentration problems (0.442), feeling tired (0.475), feeling sad (0.792), feeling fear (0.752), oppression (0.414), and trembling body (0.423).[6] In addition, it can be observed that the index of mental health problems of women affected by the earthquakes increased by 1.6 standard deviations (Table 2 Column j).[7]

[6]The effects of natural disasters on increasing the prevalence of mental health conditions are estimated in the range of 5% to 40% Galea et al. (2008). Yet, many of these results came from comparing the treatment and control group after the occurrence of the disaster, in this case a hurricane.

[7]The index of mental health was constructed using the questions regarding mental health. To generate the index we use principal components and we retain only the first factor. Then, we standardize the index to have a mean of zero and a standard deviation of one

Table 3 presents estimates of the impact of earthquakes on substance abuse. Using the same controls as in Table 2, we did not find evidence that the earthquakes increased the use of alcohol or tobacco.

A crucial assumption for our results is that: $cov(e_{it}, After_t * Earthquake_i) = 0$. In other words, that we do not have an omitted variable bias problem. Thus, we estimated the range of the estimated parameters using the bounding methodology proposed by Oster (2017). Table 4 presents the results of the bounding method- ology for the variables regarding mental health. We found that the bounds for all the outcomes analyzed did not include the zero, suggesting that the results were robust.

4.2 Heterogeneous Effects

The literature on earthquakes highlights certain factors that can worsen the impact of natural disasters on the people affected. In light of this, we explored how variables experienced during childhood, and pre- and post-disaster, worsened the impact of the earthquakes on women's mental health.

Table 5 presents the heterogeneous effects regarding shocks that affected the

women when they were 15 years old or younger (father's death, mother's death, automobile accident, suffering a natural disaster, and sexual assault). Our hypothesis was that women who received these kinds of shocks during childhood were more likely to be affected by the earthquakes. However, we found no evidence that these shocks worsened the women's mental health conditions.

Table 6 presents the heterogeneous effects of the earthquakes on women's mental health according to the pre-disaster variables of self-esteem, self-control, school attendance and age. Our hypothesis was that people who have higher levels of self-esteem and self-control (our measure being lack of self-control) would be more resilient to external shocks. In addition, the literature has found that people with more education and who are older are more resilient to natural disasters (Galea et al., 2008). In general, we observed that while people with more self-esteem and self-control were more resilient to the natural disasters studied, we did not find these coefficients to be statistically significant. Regarding education, we applied a dummy variable that took the value of 1 if the women had attended high school and 0 otherwise. In general, we observe a positive relation, yet it is only statistically significant for one variable: nightmares. Finally, we observe that older women were more resilient to the natural disaster, yet the coefficients were not statistically significant.

Table 7 presents the heterogeneous effects of the earthquakes on women's mental health depending on the post-disaster variables of having assets, savings, and a partner who continued contributing to the household income after the earthquake, as well as family size and degree of neighborhood insecurity. Regarding assets and savings, our hypothesis was that women living in households that lost more assets and where savings were reduced would be more affected in terms of their mental health. In the case of having a partner who continued contributing to the household income after the earthquake, we expected this to reduce the negative effect on women's mental health. Regarding the perception of living in an unsafe area, we expected this variable to worsen the women's mental health. Finally, regarding family size, one hypothesis was that women who lived with a greater number of people had an increased probability of receiving psychological support and would, consequently, experience lower levels of mental health problems after suffering a shock such as an earthquake. On the other hand, it is possible that the earthquake would affect the family size through the death of a relative, in which case the earthquake would negatively impact the women's mental health.

We did not find evidence of heterogeneous effects regarding assets and savings (see Panel A and B). We found that having a partner who continued contributing

to the household income after the earthquake could mitigate the extent of shock pertaining to the event on the women's mental health (see Panel C). Regarding family size, we observed that women who lived in a bigger family suffer from fewer mental health indications; yet, most of the coefficients are not statistically significant (see Panel D). Finally, we observed that the perception of living in an unsafe area could worsen the effect of the earthquake on women's mental health (Panel E).

Finally, we analyzed the heterogeneous effects of receiving psychological sup- port. According to the Survey of Social Mobility in Disaster Zones (SoMoDiZ), 30% of women living in areas affected by the earthquake received some kind of psychological support. One hypothesis behind this is that women who received psychological support were better able to handle their mental health after experiencing the shock. However, another hypothesis states that women who received psychological support would be more aware of the situation and, as a consequence, would report a higher level of mental health problems. Table 8 presents mixed results. It can be observed that women who received psychological support felt less irritated, suffered from fewer concentration problems, were less tired and felt less fear. However, we also observed that women who received psychological support were more likely to suffer from nightmares, sleep problems, sadness, oppression, and a trembling body. Lastly, we analyzed the index of mental health problems.

We observed that women who received psychological support suffered from fewer mental health problems compared with women who did not have that support (see Column j).

5 Conclusion

This paper analyzes the effects of the earthquakes that affected Mexico in September 2017 on women's mental health and substance abuse. We used the following measures of mental health: having nightmares, sleep problems, feeling irritated, feeling tired, concentration problems, feeling sad, feeling fear, having op- pression, and suffering from a trembling body. In the case of substance abuse, we analyzed the consumption of alcohol and tobacco. In addition, we analyzed the role of pre- and post-disaster variables that could debilitate the women affected by the earthquake or, alternatively, make them more resilient. Finally, we evaluated the effect of receiving psychological support after the earthquake.

Using a difference-in-differences estimator, we found that: i. the earthquakes negatively impacted the women's mental health; ii. there was no evidence that the earthquakes increased the consumption of alcohol or tobacco; iii. the post-disaster variables affected women's mental health more than the pre-disaster variables. For

example, living in an unsafe area worsened the effect of the earthquakes on mental health; and iv. receiving psychological support helped the women to face the mental health problems.

This study contains two major limitations. Firstly, we only had data for two points in time and were unable to check for whether the parallel trend assumptions held up (i.e. that the results were not driven by omitted variable bias). We agree that it is possible that unobserved characteristics may potentially have affected our results. Thus, in order to check that the results were not biased as a consequence of omitted variables, we employed the bounding approach proposed by Altonji et al. (2005) and refined by Oster (2017). The results suggest that our estimates were robust with regard to omitted variable bias. Secondly, we potentially faced the problem of recall. While we do not discard having had a recall bias problem, we consider that if this problem existed, it was minimal, especially given that the survey data were collected in October and the recall questions were asked pertaining to August (i.e., only one month before the occurrence of the earthquakes).

In terms of public policy, Mexico implemented the Natural Disasters Fund (FONDEN) to mitigate the risks of natural disasters. This fund provides short- term assistance (such as food) and long-term assistance (hospital infrastructure,

roads and schools) for affected communities. However, the fund does not make provision for psychological support. The literature has documented that an indi- vidual's mental health can, indeed, be affected after a natural disaster, and that this negative effect can prevail over a long period of time. In this sense, it would be necessary to review FONDEN's design and to analyze the possibility of incorporating provisions for psychological support for individuals affected by natural disasters. In addition, it would be necessary to document the types of psychological interventions that are most effective in improving the mental health of individuals affected by a natural disaster.

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6 Appendix

Table 1: Descriptive Statistics

	Period 1		Period 2	
	Treatment	Control	Treatment	Control
Panel A. Mental Health and Substance Abuse				
Mental Health Index (Mean=0)	-0.23	0.21	0.66	-0.60
Nightmares	0.13	0.12	0.51	0.11
Trouble sleeping	0.14	0.25	0.76	0.22
Irritated	0.18	0.22	0.51	0.23
Tired	0.24	0.40	0.74	0.43
Concentration problems	0.11	0.24	0.60	0.28
Sad	0.16	0.38	0.89	0.28
Fearful	0.13	0.25	0.84	0.19
Feeling oppressed	0.12	0.21	0.54	0.18
Physical trembling	0.09	0.20	0.47	0.15
Tobacco	0.06	0.07	0.06	0.07
Alcohol	0.11	0.07	0.14	0.08
Panel B. Control Variables				
Age	46.47	44.52	46.47	44.52
Attend high school: 1 Yes 0 No	0.28	0.20	0.28	0.20
Head of household: 1 Yes 0 No	0.38	0.29	0.38	0.29
Family size	5.34	4.53	5.25	4.46
PROGRESA program	0.15	0.29	0.11	0.27
Temporary Employment program	0.02	0.02	0.31	0.00
Assistance for those 70 +	0.09	0.04	0.09	0.03
Remittances	0.02	0.01	0.04	0.01
Relocation	0.00	0.00	0.76	0.00
Money for reconstruction	0.00	0.00	0.30	0.00
Money to buy durable goods	0.00	0.00	0.13	0.00
Panel C. Other variables				
Father's death (when 15 years old or younger)	0.10	0.04	0.10	0.04
Mother's death (when 15 years old or younger)	0.07	0.04	0.07	0.04
Automobile accident (when 15 years old or younger)	0.03	0.02	0.03	0.02
Natural disaster (when 15 years old or younger)	0.23	0.04	0.23	0.04
Sexual assault (when 15 years old or younger)	0.02	0.01	0.02	0.01
Self-esteem	-0.05	0.03	-0.05	0.03
Self-control	0.01	0.01	0.01	0.01
Assets	7.85	7.27	3.91	7.29
Savings	0.25	0.16	0.05	0.10
Partner's contribution to family income	0.69	0.84	0.54	0.84
Neighborhood day time insecurity	2.68	2.58	3.23	2.64
Neighborhood night time insecurity	3.00	3.16	3.64	3.22
Psychological Support	0.00	0.00	0.30	0.00
Observations	361	394	361	394

Source: Mexico's Survey of Social Mobility in Disaster Zones (SoMoDiZ)

Table 2: Difference-in-Differences Estimates of the Impact of Earthquakes on Men- tal Health

	Nightmares (a)	Sleeping (b)	Irritated (c)	Concentration (d)	Tired (e)	Sad (f)	Fearful (g)	Oppressed (h)	Trembling (i)	Mental Health (j)
After*Treatment	0.369***	0.572***	0.356***	0.442***	0.475***	0.792***	0.752***	0.414***	0.423***	1.651***
	(0.068)	(0.059)	(0.062)	(0.059)	(0.061)	(0.052)	(0.053)	(0.061)	(0.063)	(0.107)
After	-0.012	-0.028	0.008	0.030	0.018	-0.097***	-0.054**	-0.021	-0.048**	-0.811***
	(0.016)	(0.022)	(0.018)	(0.020)	(0.024)	(0.024)	(0.021)	(0.021)	(0.021)	(0.040)
Treatment	0.005	-0.121***	0.008	-0.086**	-0.215***	-0.220***	-0.092***	-0.076**	-0.121***	-0.426***
	(0.034)	(0.040)	(0.041)	(0.038)	(0.052)	(0.046)	(0.035)	(0.036)	(0.033)	(0.092)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.18	0.27	0.11	0.17	0.13	0.32	0.36	0.17	0.13	0.25
Observations	1454	1454	1453	1452	1453	1453	1453	1454	1450	1445

Note: Other controls include age, education, family size, and being head of the household, as well as participation in the following social programs: PROGRESA, Temporary Employment, and assistance for those aged 70 and above. In addition, being relocated as a consequence of the natural disaster, receiving psychological support, receiving money for reconstruction, receiving money to buy durable goods, and remittances were also included. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Difference-in-Differences Estimates of the Impact of Earthquakes on Sub- stance Abuse

	Alcohol (a)	Tobacco (b)
After*Treatment	-0.002	-0.003
	(0.043)	(0.027)
After	0.001	0.000
	(0.011)	(0.005)
Treatment	-0.009	-0.005
	(0.032)	(0.031)
Other controls	Yes	Yes
Locality FE	Yes	Yes
R^2	0.03	0.03
Observations	1454	1454

Note: Other controls include age, education, family size, and being head of the household, as well as participation in the following social programs: PROGRESA, Temporary Employment, and assistance for those aged 70 and above. In addition, being relocated as a consequence of the natural disaster, receiving psychological support, receiving money for reconstruction, receiving money to buy durable goods, and remittances were also included. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Bounding Methodology: Effects of Earthquakes on Psychological Vari- ables

	Nightmares (a)	Sleeping (b)	Irritated (c)	Concentration (d)	Tired (e)	Sad (f)	Fearful (g)	Oppressed (h)	Trembling (i)	Mental H. (j)
After*Treatment	[0.299,0.439]	[0.518,0.626]	[0.286,0.426]	[0.374,0.511]	[0.343,0.606]	[0.403,1.181]	[0.354,1.149]	[0.356,0.473]	[0.274,0.572]	[1.119,2.182]
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1454	1454	1453	1452	1453	1453	1453	1454	1450	1445

Note: Other controls include age, education, family size, and being head of the household, as well as participation in the following social programs: PROGRESA, Temporary Employment, and assistance for those aged 70 and above. In addition, being relocated as a consequence of the natural disaster, receiving psychological support, receiving money for reconstruction, receiving money to buy durable goods, and remittances were also included.

Table 5: Heterogeneous Effects of of the Impact of Earthquakes on Mental Health by Shocks during Childhood

	Nightmares (a)	Sleeping (b)	Irritated (c)	Concentration (d)	Tired (e)	Sad (f)	Fearful (g)	Oppressed (h)	Trembling (i)	Mental H. (j)
					Panel A					
After*Treatment	0.392***	0.588***	0.367***	0.458***	0.481***	0.815***	0.752***	0.416***	0.421***	1.682***
	(0.069)	(0.061)	(0.064)	(0.062)	(0.064)	(0.054)	(0.056)	(0.065)	(0.064)	(0.117)
After*Treatment*Father's death	-0.139	-0.053	-0.028	-0.051	0.004	-0.290*	0.187	0.083	-0.037	0.033
	(0.113)	(0.149)	(0.185)	(0.169)	(0.147)	(0.175)	(0.146)	(0.147)	(0.129)	(0.313)
R^2	0.18	0.29	0.12	0.17	0.14	0.32	0.37	0.18	0.14	0.26
Observations	1447	1447	1446	1446	1446	1446	1446	1447	1444	1439
					Panel B					
After*Treatment	0.384***	0.580***	0.358***	0.443***	0.488***	0.793***	0.764***	0.403***	0.410***	1.664***
	(0.069)	(0.062)	(0.065)	(0.064)	(0.063)	(0.055)	(0.055)	(0.061)	(0.066)	(0.114)
After*Treatment*Mother's death	-0.263	-0.113	-0.071	-0.019	-0.237	-0.234	-0.245	0.057	0.057	-0.284
	(0.172)	(0.169)	(0.158)	(0.185)	(0.164)	(0.199)	(0.170)	(0.086)	(0.147)	(0.363)
R^2	0.18	0.29	0.12	0.18	0.14	0.33	0.37	0.17	0.14	0.26
Observations	1451	1451	1450	1450	1450	1450	1450	1451	1448	1443
					Panel C					
After*Treatment	0.380***	0.569***	0.367***	0.432***	0.482***	0.790***	0.744***	0.420***	0.419***	1.655***
	(0.069)	(0.060)	(0.062)	(0.060)	(0.062)	(0.053)	(0.054)	(0.062)	(0.065)	(0.110)
After*Treatment *Automobile accident	-0.100	0.306	-0.252*	0.217	-0.117	0.019	0.206	-0.122	0.086	0.127
	(0.219)	(0.196)	(0.148)	(0.165)	(0.242)	(0.248)	(0.242)	(0.155)	(0.206)	(0.359)
R^2	0.18	0.28	0.11	0.17	0.14	0.32	0.36	0.17	0.14	0.25
Observations	1451	1451	1450	1450	1450	1450	1450	1451	1448	1443
					Panel D					
After*Treatment	0.365***	0.570***	0.356***	0.435***	0.485***	0.788***	0.746***	0.414***	0.402***	1.636***
	(0.070)	(0.062)	(0.065)	(0.059)	(0.061)	(0.057)	(0.056)	(0.062)	(0.063)	(0.110)
After*Treatment*Natural disaster	0.111	0.008	0.034	0.071	-0.034	-0.056	-0.050	0.035	0.081	0.183
	(0.090)	(0.107)	(0.080)	(0.112)	(0.132)	(0.166)	(0.093)	(0.109)	(0.141)	(0.228)
R^2	0.18	0.28	0.12	0.18	0.15	0.32	0.36	0.18	0.14	0.25
Observations	1441	1441	1440	1440	1440	1440	1440	1441	1438	1433
					Panel E					
After*Treatment	0.374***	0.582***	0.359***	0.440***	0.478***	0.793***	0.754***	0.418***	0.418***	1.659***
	(0.069)	(0.060)	(0.064)	(0.060)	(0.061)	(0.053)	(0.053)	(0.062)	(0.064)	(0.109)
After*Treatment*Sexual assault	-0.017	-0.558*	0.136	-0.125	-0.111	-0.030	-0.316	0.006	-0.304	-0.187
	(0.252)	(0.322)	(0.200)	(0.358)	(0.320)	(0.179)	(0.322)	(0.197)	(0.346)	(0.668)
R^2	0.18	0.28	0.12	0.18	0.14	0.33	0.36	0.17	0.14	0.26
Observations	1451	1451	1450	1450	1450	1450	1450	1451	1448	1443
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Other controls include age, education, family size, and being head of the household, as well as participation in the following social programs: PROGRESA, Temporary Employment, and assistance for those aged 70 and above. In addition, being relocated as a consequence of the natural disaster, receiving psychological support, receiving money for reconstruction, receiving money to buy durable goods, and remittances were also included. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Heterogeneous Effects of the Impact of Earthquakes on Mental Health by Pre-disaster Variables

	Nightmares (a)	Sleeping (b)	Irritated (c)	Concentration (d)	Tired (e)	Sad (f)	Fearful (g)	Oppressed (h)	Trembling (i)	Mental H. (j)
					Panel A					
After*Treatment	0.361***	0.562***	0.340***	0.432***	0.458***	0.787***	0.742***	0.417***	0.402***	1.624***
	(0.068)	(0.060)	(0.058)	(0.057)	(0.062)	(0.053)	(0.054)	(0.063)	(0.061)	(0.103)
After*Treatment*Self-esteem	0.045	-0.017	-0.031	-0.029	-0.006	0.029	-0.014	0.002	-0.036	-0.056
	(0.038)	(0.039)	(0.042)	(0.036)	(0.037)	(0.041)	(0.033)	(0.033)	(0.034)	(0.095)
R^2	0.19	0.30	0.13	0.19	0.15	0.33	0.37	0.18	0.14	0.28
Observations	1446	1446	1445	1445	1445	1445	1445	1446	1443	1438
					Panel B					
After*Treatment	0.352***	0.557***	0.331***	0.428***	0.462***	0.784***	0.742***	0.410***	0.400***	1.613***
	(0.068)	(0.060)	(0.059)	(0.056)	(0.062)	(0.052)	(0.053)	(0.063)	(0.061)	(0.102)
After*Treatment*Self-control	0.023	-0.005	0.023	0.029	-0.001	0.039	-0.026	0.033	0.053	0.094
	(0.034)	(0.042)	(0.045)	(0.041)	(0.045)	(0.043)	(0.042)	(0.034)	(0.039)	(0.100)
R^2	0.18	0.29	0.17	0.20	0.15	0.34	0.37	0.19	0.14	0.30
Observations	1447	1447	1446	1445	1446	1446	1446	1447	1443	1438
					Panel C					
After*Treatment	0.387**	0.709***	0.505***	0.661***	0.560***	0.850***	0.682***	0.405**	0.627***	1.768***
	(0.172)	(0.161)	(0.176)	(0.172)	(0.174)	(0.162)	(0.183)	(0.199)	(0.179)	(0.345)
After*Treatment*Age	-0.000	-0.003	-0.003	-0.004	-0.002	-0.001	0.002	0.000	-0.004	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.007)
R^2	0.18	0.28	0.11	0.18	0.14	0.32	0.36	0.17	0.14	0.25
Observations	1454	1454	1453	1452	1453	1453	1453	1454	1450	1445
					Panel D					
After*Treatment	0.404***	0.563***	0.377***	0.438***	0.455***	0.797***	0.753***	0.440***	0.409***	1.674***
	(0.072)	(0.061)	(0.065)	(0.062)	(0.065)	(0.058)	(0.058)	(0.063)	(0.067)	(0.118)
After*Treatment*High school	-0.122*	0.033	-0.077	0.024	0.075	-0.017	-0.022	-0.089	0.050	-0.102
	(0.073)	(0.080)	(0.081)	(0.088)	(0.073)	(0.081)	(0.076)	(0.075)	(0.083)	(0.146)
R^2	0.18	0.28	0.11	0.17	0.13	0.32	0.36	0.17	0.14	0.25
Observations	1454	1454	1453	1452	1453	1453	1453	1454	1450	1445
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Ye
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Ye

Note: Other controls include age, education, family size, and being head of the household, as well as participation in the following social programs: PROGRESA, Temporary Employment, and assistance for those aged 70 and above. In addition, being relocated as a consequence of the natural disaster, receiving psychological support, receiving money for reconstruction, receiving money to buy durable goods, and remittances were also included. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Heterogeneous Effects of the Impact of Earthquakes on Mental Health by Post-disaster Variables

	Nightmares (a)	Sleeping (b)	Irritated (c)	Concentration (d)	Tired (e)	Sad (f)	Fearful (g)	Oppressed (h)	Trembling (i)	Mental H. (j)
					Panel A					
After*Treatment	0.400***	0.618***	0.378***	0.419***	0.444***	0.836***	0.774***	0.395***	0.411***	1.694***
	(0.077)	(0.063)	(0.070)	(0.067)	(0.070)	(0.057)	(0.055)	(0.070)	(0.068)	(0.121)
After*Treatment*Assets	0.015	0.019	-0.038	-0.003	0.059	-0.003	-0.034	-0.060	-0.039	-0.060
	(0.039)	(0.042)	(0.042)	(0.043)	(0.045)	(0.045)	(0.045)	(0.045)	(0.044)	(0.090)
R^2	0.18	0.28	0.11	0.17	0.14	0.32	0.37	0.17	0.13	0.25
Observations	1431	1431	1430	1429	1430	1430	1430	1431	1427	1422
					Panel B					
After*Treatment	0.384***	0.561***	0.368***	0.448***	0.476***	0.787***	0.737***	0.404***	0.409***	1.654***
	(0.069)	(0.063)	(0.064)	(0.063)	(0.065)	(0.055)	(0.055)	(0.061)	(0.062)	(0.114)
After*Treatment*Savings	-0.136	0.225**	-0.036	-0.006	-0.124	0.023	0.095	0.134	0.202	0.053
	(0.147)	(0.089)	(0.145)	(0.137)	(0.129)	(0.131)	(0.124)	(0.143)	(0.132)	(0.274)
R^2	0.18	0.28	0.11	0.17	0.14	0.32	0.37	0.17	0.14	0.25
Observations	1450	1450	1449	1448	1449	1449	1449	1450	1446	1441
					Panel C					
After*Treatment	0.439***	0.642***	0.439***	0.581***	0.546***	0.853***	0.914***	0.528***	0.553***	1.980***
	(0.092)	(0.096)	(0.089)	(0.096)	(0.089)	(0.085)	(0.075)	(0.105)	(0.100)	(0.181)
After*Treatment*Income (partner)	-0.083	-0.027	-0.123	-0.193**	-0.119	-0.092	-0.206***	-0.217**	-0.209**	-0.464***
	(0.076)	(0.091)	(0.084)	(0.093)	(0.094)	(0.086)	(0.072)	(0.096)	(0.086)	(0.168)
R^2	0.19	0.29	0.12	0.20	0.15	0.34	0.39	0.20	0.16	0.27
Observations	1281	1281	1280	1279	1280	1280	1280	1281	1277	1272
					Panel D					
After*Treatment	0.348***	0.720***	0.319***	0.583***	0.630***	0.929***	0.762***	0.550***	0.531***	1.930***
	(0.106)	(0.108)	(0.102)	(0.093)	(0.100)	(0.099)	(0.091)	(0.103)	(0.113)	(0.213)
After*Treatment*Family size	0.004	-0.033	0.006	-0.031*	-0.034*	-0.031*	-0.002	-0.030*	-0.024	-0.062
	(0.015)	(0.020)	(0.017)	(0.016)	(0.017)	(0.017)	(0.017)	(0.016)	(0.019)	(0.039)
R^2	0.18	0.28	0.11	0.17	0.14	0.32	0.36	0.17	0.14	0.25
Observations	1454	1454	1453	1452	1453	1453	1453	1454	1450	1445
					Panel E					
After*Treatment	0.363***	0.582***	0.325***	0.425***	0.448***	0.787***	0.723***	0.391***	0.420***	1.623***
	(0.071)	(0.060)	(0.062)	(0.060)	(0.062)	(0.056)	(0.056)	(0.062)	(0.065)	(0.112)
After*Treatment*Insecurity (day)	0.133***	0.145***	0.045	0.063*	0.010	0.103**	0.072**	0.079*	0.112***	0.312***
	(0.034)	(0.035)	(0.041)	(0.034)	(0.044)	(0.041)	(0.035)	(0.040)	(0.037)	(0.076)
(R^2	0.20	0.29	0.12	0.19	0.14	0.33	0.38	0.17	0.14	0.27
Observations	1450	1450	1449	1449	1449	1449	1449	1450	1447	1442
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Other controls include age, education, family size, and being head of the household, as well as participation in the following social programs: PROGRESA, Temporary Employment, and assistance for those aged 70 and above. In addition, being relocated as a consequence of the natural disaster, receiving psychological support, receiving money for reconstruction, receiving money to buy durable goods, and remittances were also included. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Heterogeneous Effects of the Impact of Earthquakes on Mental Health by Psychological Support

	ghtmares	eeping	itated	ncentration	tired	Sad	earful	pressed	mbling	ntal H.
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
reatment	.367***	71***	861***	0.447***	478***	90***	758***	413***	422***	555***
	(0.069)	.059)	).062)	(0.059)	).062)	.052)	).053)	0.061)	).063)	).108)
reatment*Psychological Support	.194***	32***	628***	0.615***	525***	38***	880***	194***	).142*	562***
	(0.065)	.057)	).074)	(0.074)	).066)	.051)	).056)	0.070)	).079)	).124)
ntrols	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.18	).27	0.11	0.17	0.13	).32	0.36	0.17	0.13	0.25
tions	1454	454	1453	1452	1453	453	1453	1454	1450	1445

Note: Other controls include age, education, family size, and being head of the household, as well as participation in the following social programs: PROGRESA, Temporary Employment, and assistance for those aged 70 and above. In addition, being relocated as a consequence of the natural disaster, receiving psychological support, receiving money for reconstruction, receiving money to buy durable goods, and remittances were also included. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

CÁTEDRA DE INVESTIGACIÓN

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