The Effects of Housing Reconstruction on Post-Disaster Psychosocial Health

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On December 26, 2004 a 9.1 magnitude earthquake with epicenter 250 km south-west of Banda Aceh, in the northern tip of the Indonesian island of Sumatra, caused one of the deadliest tsunamis on record. Aceh, a province in Indonesia, (and to a lesser extent North Sumatra) was the location hit hardest. It is estimated that in Aceh, five percent of the population died, and over 700,000 were displaced (McKeon, 2008; Masyrafah and McKeon, 2008). Economic losses reached about US$4.5 billion. About 60 percent of losses were accounted for by damages to assets, including damage to or destruction of about 190,000 houses.

In this paper we address the question of whether the reconstruction of the housing stock, which was one of the largest post-tsunami programs, affected levels of post-traumatic stress. This question is important as it has been argued that poorly designed and executed post-disaster reconstruction initiatives can be more detrimental to survivors than the disaster itself (Myers, 1994; Quarantelli, 1985). Further, despite evidence that shows housing is an important dimension for both physical and mental health (Shaw, 2004; Evans et al., 2003; Dunn, 2000), little empirical research has rigorously investigated the causal impact of housing assistance in the aftermath of a natural disaster.

The data for this study are drawn from the Study of the Tsunami Aftermath and Recovery (STAR), a longitudinal study of individuals, their households, and their communities in two provinces, Aceh and North Sumatra, on the island of Sumatra, Indonesia. Baseline data collection took place about 10 months prior to the tsunami by Statistics Indonesia (BPS) as part of their annual cross-sectional survey of the socioeconomic status of households, SUSENAS. The baseline sample is representative of the pre-disaster population at the kabupaten (district) level, which is one administrative level below the province. The survey includes respondents who were living in over 400 enumeration areas spread along the coastlines of Aceh and the west coast of North Sumatra.

The first annual follow-up survey began five months after the tsunami in May 2005, and was followed by four more annual follow-ups with the fifth follow-up completed in May 2010. An additional survey, started 10 years after the tsunami, in 2014, was completed in 2015. The pre-tsunami baseline collected information about housing ownership and house characteristics along with detailed demographic and socio-economic information. Follow-up surveys added extensive information on experience of the tsunami and damage to (or loss) to housing, other assets and livelihoods, loss of family in the tsunami, health and socio-economic status, and multiple measures of subjective well-being and mental health. Information about aid, including housing aid, and the sources of all aid, is also collected in each wave. A specially designed community-level survey provides information about land topography and extent of damage (which the team supplemented with high resolution satellite imagery) as well as data collected on humanitarian assistance and reconstruction at the community level.

A critical measure for this paper is housing reconstruction, both in terms of receipt of assistance as well as timing of receipt. We define housing assistance based on household level reports collected between 2005 and 2010, when most of the reconstruction was happening. To create an individual-level measure of housing reconstruction, we use a broad definition of beneficiary. We define receipt of housing as an indicator that takes a value equal to one if, at any point during the 2005-2015 period of analysis, the individual's baseline household benefited from a new house, regardless of whether they are still living in that household at the time of subsequent interviews.

We also constructed a measure of timing of receipt of housing assistance based on information on the month and year of house receipt for the household, which is reported by the household head. We define this measure as the number of months since the tsunami a person reports receipt of a tsunami assistance house. To create this individual measure of timing of housing reconstruction, we applied the same date to all individuals that were living in the same household prior to the tsunami. Based on these definitions of housing and timing of aid our analysis estimates an "intent-to-treat" effect.

The sample for this analysis includes a total of 12,447 adults (25 years or older) who were interviewed at baseline, survived the tsunami, and have at least two interviews in the period between 2005 and 2015. We exclude people for whom we could not establish whether they received housing aid (two percent of eligible adults), those who did not have at least two post-tsunami measurements (1.7 percent of eligible adults), as well as people for whom we do not have complete information on their outcomes of interest (2.3 percent of eligible adults). Table 1 includes summary statistics for the sample. Prior to the tsunami, 81 percent of household heads in the sample reported owning a home. About 40 percent reported their house destroyed and about 23 percent reported it damaged. An estimated 21 percent of the sample reports housing assistance after the tsunami. Among those who benefited from receipt of a house, over 90 percent experienced either home destruction (78 percent) or home damage (29 percent). On average, housing aid receipt happened about 23 months after the tsunami.

To assess the effect of housing reconstruction on mental health, we focus on two measures. First, we look at post-traumatic stress reactivity (PTSR), which we constructed using seven symptom items from the 17-item PTSD Checklist-Civilian Version (PCL). During interviews, adult respondents provide information on their experiences with certain reactions post-disaster, as well as the intensity and frequency of the reaction. Responses to these questions where quantified using a scale ranging from 0 (no experience) to 3 (experienced often). The sum of the scores for each questions results in a final PTSR scale, which ranges from 0 to 21 (for those most affected) (Frankenberg et al., 2008).

To estimate incidence of high PTSR levels, we use the individual items from the 7-item PTSD Checklist to discretize PTSR scores. To construct this variable, we adapted the criteria described by Weathers et al. (1993) to fit the 7-item Checklist. We define a binary outcome that takes the value of one if a person reports at least one symptom from items 1-2, two symptoms from items 3-4, and at least two symptoms from items 5-7. Following Weathers et al. (1993) we used a cut-off score of at least 2.

In the aftermath of the tsunami, average PTSR was 5.2. By the last STAR follow up, average PTSR for the sample was 1.7 points, which represents an overall 67 percent decline. As shown in Figure 1, this decline in PTSR levels coincides with the roll-out of housing assistance, which was over 70 percent completed by the fourth STAR follow-up. This figure is computed only based on information from individuals who were eventual beneficiaries of housing assistance.

Assessing the effects of exposure to post-disaster reconstruction is complicated. If allocation of aid is not random, a simple comparison between those that received aid and those that did not would result in biased estimates of the effect of post-disaster recovery assistance. To test this relationship that housing reconstruction is mainly a function of tsunami damage, and recover a causal effect of housing reconstruction on PTSR, we first estimate individual level multivariate models where we determine the probability of housing aid receipt, as well as timing of housing aid, as a function of tsunami damage, and characteristics of the households and individuals.

We show results from the multivariate model exploring individual determinants of housing aid in Table 2. Individuals living in areas that experienced higher levels of tsunami damage were more likely to receive aid earlier than communities that sustained lower levels of destruction. People whose homes were destroyed and, to a lesser extent, those whose homes were damaged, were more likely to receive housing assistance compared to those that did not have any home damage. The second column of Table 2 shows predictors for timing of housing aid. People in areas that sustained large levels of tsunami damage benefited from housing aid, on average, six months before compared to those in communities that were exposed to medium and low levels of destruction. People that lost their homes also benefited from housing aid about five months faster than those who did not have any damage. Results from this model also show that there are no household or individual correlates that explain people benefiting from housing assistance faster. So it appears that housing assistance was selectively targeted to those who were from hard hit communities and/or experienced housing damage or destruction, but not on the basis of demographic factors.

After showing that housing assistance is mainly determined by tsunami damage and need of housing reconstruction, we turn to explore the causal relationship between housing aid and PTSR. We take advantage of the longitudinal nature of STAR, which allows us to observe individuals before and after the receipt of housing aid, to estimate individual fixed effects models.

Table 3 shows results for the fixed effects models. Panel A (column 1) shows that receipt of housing reconstruction results in lower levels of PTSR by 0.21 units, although this result is not statistically significant. Column 2 shows that people that received post-tsunami housing assistance are 1.2 percentage points less likely to fall within a threshold for high PTSR. Results from Table 3 (Panel B) are consistent with the hypothesis that tenure of the home is also an important factor. Each additional year of housing tenure reduces levels of PTSR by 0.06 points (statistically significant at the 1 percent level). This reduction represents a one percent decrease in the average PTSR score relative to just after the tsunami (the 2005-2006 period). Further, each additional year of exposure to housing aid reduces the probability that a person would fall within a threshold for high PTSR by 0.2 percentage points (also statistically significant at the 1 percent level).

Finally, Panel C in Table 3 supports the hypothesis that effects of exposure to housing assistance are non-linear. People who received housing assistance for two or more years at the time of interview have a 0.32-point reduction in PTSR levels (statistically significant at the 5 percent level). This reduction accounts for a six percent decrease in the average PTSR score after the tsunami (2005-2006), which was the highest level recorded. Further, people that had been exposed to post-tsunami assistance housing for more than 6 months are more likely to fall outside the high PTSR threshold. In particular, column 2 shows that exposure to housing for 6 to 24 months at the time of interview results in 1.3 percentage point reduction of the probability of a high PTSR levels. And, exposure to housing assistance of two or more years results in a 2.1 percentage point decrease in the likelihood to fall within a high PTSR threshold.

This paper provides an important contribution to the literature on the impacts of natural disasters. It shows that programs that target reconstruction of infrastructure, in particular in areas that are central for individual well-being, such as housing, can have significant positive effects on the recovery of disaster victims. We are not aware of other research that provides a causal link between reconstruction and post-disaster individual outcomes over the long term for a population representative group, and, therefore, it has important public health implications. It shows that the rapid deployment of resources to rebuild can result in important gains for the recovery of victims suffering from trauma. Further, improved mental can have additional positive effects on the overall recovery process of affected communities as people may be more willing to engage in community activities, are able to return to work, and resume their daily activities.

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Figure 1: Relationship Between Housing Reconstruction and PTSR

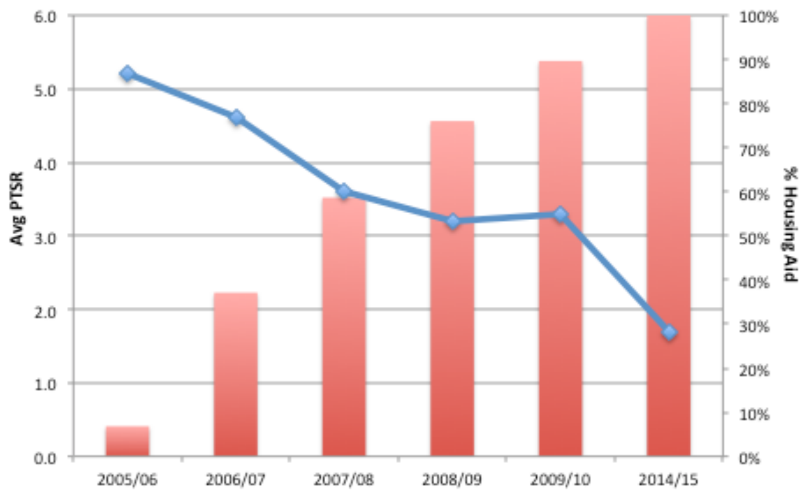

Table 1: Descriptive Statistics

	Sample
Demographic Characteristics	
Avg age	40.8
Avg yrs of education	7.5
% female	50.8
% married	80.0
Tsunami experience	
% house damage	23.2
% house destroyed	39.7
% direct physical exposure	63.2
Housing reconstruction	
% "tsunami assistance" house	21.1
% "tsunami assistance" house | house destroyed	78.9
% "tsunami assistance" house | house damaged	12.6
Avg time of receipt	22.9
	12,447

Table 2: Predictors of Receipt and Timing of Housing Aid

	Ever received house	Months since tsunami
Damage level		
(1) High exposure to tsunami	0.18***	-6.26***
	(0.04)	(2.18)
(1) House damaged in tsunami	0.05***	-0.31
	(0.01)	(2.15)
(1) House destroyed in tsunami	0.20***	-4.83**
	(0.02)	(1.88)
Household characteristics at baseline		
lnPCE_A 26-50 pctile	-0.02	-0.22
	(0.02)	(1.02)
lnPCE_A 51-75 pctile	-0.05***	0.18
	(0.02)	(1.18)
lnPCE_A 76-100pctile	-0.07***	2.01
	(0.02)	(1.43)
hh members 0-4yrs	-0.01	0.62
	(0.01)	(0.65)
hh members 5-14yrs	-0.01	0.70
	(0.00)	(0.41)
hh members 15-24yrs	0.01	0.41
	(0.00)	(0.40)
hh members 25-54yrs	-0.01	0.00
	(0.01)	(0.44)
males >=55ryrs	-0.01	0.49
	(0.01)	(0.94)
females>=55yrs	-0.00	1.43
	(0.01)	(1.17)
(1)Owned house	-0.00	-1.16
	(0.01)	(1.10)
(1)House had tile roof	-0.02	-1.01
	(0.03)	(2.02)
(1)House had brick walls	-0.00	0.16
	(0.01)	(0.82)
(1)Urban	-0.02	-0.23
	(0.02)	(1.47)

Individual characteristics at baseline		
Educ 1-6 yrs	-0.01	1.15
	(0.01)	(0.89)
Educ 7-9 yrs	-0.03	1.49
	(0.02)	(1.09)
Educ 10-16 yrs	-0.03	0.51
	(0.02)	(1.17)
(1)Female	-0.01	0.07
	(0.01)	(0.63)
Age 35-44	-0.03***	0.36
	(0.01)	(0.69)
Age >=45	-0.03***	0.19
	(0.01)	(0.86)
(1)married	-0.01	-0.51
	(0.01)	(0.94)
(1)widow	0.03	-2.54
	(0.02)	(1.50)
(1)hh head	-0.01	0.29
	(0.01)	(0.68)
R2	0.414	0.359
N	12,446	2,555

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors clusters at the pre-tsunami community level. Models control for kecamatan (subdistrict) fixed effects and household composition.

Table 3. Effects of Housing Reconstruction on PTSR

	FULL SAMPLE	
	PTSR	**High PTSR**
Panel A		
House by interview date	-0.211	-0.012**
	(0.117)	(0.005)
Panel B		
Years of exposure to house	-0.064***	-0.002***
	(0.019)	(0.001)
Panel C		
House 6 months in the future	0.036	-0.005
	(0.175)	(0.009)
House for 6 months or less	0.111	-0.002
	(0.136)	(0.006)
House for 6-24 months	-0.238	-0.013**
	(0.136)	(0.006)
House for >24 months	-0.319**	-0.021**
	(0.144)	(0.006)
N	63,145	63,145