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# Mental health recovery and economic recovery after the tsunami: High-frequency longitudinal evidence from Sri Lankan small business owners

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## Abstract

A sample of 561 Sri Lanka microenterprise owners affected to various extents by the December 2004 Indian Ocean tsunami were surveyed five times at quarterly intervals between March 2005 and April 2006. Mental health recovery was measured through questions on return to normalcy and change in life outlook. Business profits were used to measure livelihoods recovery. We find that these mental health process measures are correlated with post-traumatic stress disorder and general mental health in a validation survey, and display similar correlates to both in the cross-section. However, socioeconomic factors are not found to be significant in predicting the dynamics of mental health recovery in a fixed effects logistic regression. Mental health recovery from a given initial level therefore appears to depend largely on time since the disaster, and not on economic recovery of an individual's livelihood.

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*Keywords:* Sri Lanka; Tsunami; Livelihood recovery; Mental health recovery; Return to normalcy; Fixed effects

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## Introduction

The Indian Ocean tsunami of December 26, 2004 killed 35,322 people in Sri Lanka, displaced 1 million people, and affected over two-thirds of the island's coastline (Joint Report of the Government of Sri Lanka and Development Partners, 2005). In addition to the terrible losses of life and

injuries, the tsunami also caused extensive damage to personal and business property, disrupting the livelihoods of many of the multitude of small-scale enterprise owners. There is general acceptance that most, and perhaps every, individual who experiences such a disaster is affected psychologically (WHO, 2001). Mental health effects often include post-traumatic stress disorders (PTSD), depressive or anxiety disorders, somatic complaints, and general mental morbidity (Batniji, van Ommeren, & Saraceno, 2006).

In the aftermath of the tsunami, Norris (2005) conducted a review of 62 recent empirical studies of the mental health consequences of natural disasters

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around the world in order to identify possible risk factors for psychosocial health after the tsunami. Studies in developing countries were often of a relatively small size, and began on average 10 months after the disaster. The most universal risk factor across studies was the degree of individual-level severity of exposure, measured by factors such as bereavement, injury to oneself or to family members, life threat, panic, and extensive loss of property. Women were almost always found to be affected more adversely than men, and minority status was associated with greater risk of adverse outcomes in samples in the USA and Australia. The effect of age varied across studies, while marital status and being a parent were generally found to add to the stressfulness of disaster recovery. Socio-economic status as measured by education or income was associated with poorer outcomes of disaster victims in a number of studies.<sup>1</sup>

A recent study in Thailand examining mental health after the tsunami found correlates of PTSD, anxiety and depression which broadly match these predictions (Van Griensven et al., 2006). Mental health was found to be worse among women, those who had suffered more exposure to the tsunami, and especially those who had lost their livelihood as a result of the tsunami. As a result the authors conjecture that restoration of livelihood is of utmost importance in mental health recovery.

However, the evidence base is much weaker when it comes to longitudinal data on mental health recovery. Only four of the studies reviewed by Norris (2005) were longitudinal, with only one study examining more than two points in time. The single study, taken at 6, 12, 18 and 24 months after floods and mudslides in Mexico found both linear and quadratic effects of time, as PTSD initially declined and then stabilized (Norris, Murphy, Baker, & Perilla, 2004). As a result, Norris (2005) concludes that there is a “critical need for longitudinal research that can inform us about the course of recovery under low-resource conditions”.

In particular, longitudinal data on the process of recovery from a major disaster is needed to determine whether the same risk factors associated with the initial level of mental morbidity also act to

determine the length of recovery. For example, do affected women take longer to recover from such disasters than affected men? More evidence on the heterogeneity of the recovery process is needed to determine whether specialized interventions are needed for particular at-risk groups.

Secondly, there is increasing emphasis on the importance of social interventions in addition to mental health interventions for reducing public stress (Van Ommeren, Saxena, & Saraceno, 2005). Critics of the focus on PTSD argue that a core determinant of whether or not survivors do well is their capacity to re-establish social networks and a viable way of life, including work (Summerfield, 2005). A commentator on the Thai tsunami study suggested that the fact that loss of livelihood was such an important correlate of mental health problems in the cross-section makes it seem plausible that programs for rebuilding fishing boats after the tsunami may have been one of the best mental health interventions in encouraging psychosocial recovery (Silove & Byrant, 2006). However, longitudinal data on economic recovery in addition to mental recovery are needed to investigate how closely tied the two are.

Our aims were to use a high-frequency longitudinal survey of poor microenterprise owners in Southern Sri Lanka to examine the risk factors for initial incidence of mental health effects from the tsunami, to trace the trajectory of mental health responses over time, and to investigate the degree of interrelationship between mental health recovery and economic recovery.

## Data and methods

### *Sampling and participants*

The Sri Lanka Microenterprise Survey (SLMS) is designed to study the process of tsunami recovery for microenterprise owners in Kalutara, Galle and Matara Districts of Sri Lanka. The 2001 Sri Lankan Census was used to select 31 Grama Niladhari (GN) areas with high self-employment rates, stratified according to whether firms in the area were affected or not by the December 26, 2004 tsunami. Directly affected firms were defined as firms suffering business damage, indirectly affected firms were in the same geographic neighborhoods, but did not suffer business damage, and unaffected firms were further inland, without business damage. A door-to-door listing exercise in March 2005 then listed 3361

<sup>1</sup>Das, Do, Friedman, McKenzie, and Scott (2007) examine the correlations between mental health and these socioeconomic characteristics in non-disaster situations, and show in general that women have worse mental health than men, but there is no strong relationship between mental health and levels of income.

households, with less than 1% of households refusing to be listed.

Each household was asked whether or not any member of the household currently operated a business. Each of the 998 enterprises answering yes were administered a screening survey, which was used to select the baseline sample of 659 enterprises owned by 20- to 65-year-old males and females in full-time work with no non-family paid employees and with business assets excluding land and buildings of less than 100,000 Sri Lankan Rupees (approximately US \$1000). Only one enterprise was chosen per household, so none of the individuals in the survey live with other surveyed individuals. The baseline survey was carried out between 21 March 2005 and 4 May 2005, beginning just 3 months after the tsunami. Fieldwork was conducted by ACNielsen Lanka (Pvt) Ltd.

After reviewing the baseline survey we eliminated 41 enterprises because either a follow-up visit could not verify the existence of an enterprise, or because the capital stock of the business exceeded the 100,000 Rupee maximum size we intended to study. The remaining 618 firms constituted the baseline sample. Four follow-up surveys of the same individuals were then conducted at 3-monthly intervals, in July and October 2005, and in January and April 2006. We were able to survey 561 of these 618 firms all five times.

All interviews were conducted in person in the house or at the business of the enterprise owner. Questionnaires were administered in Sinhala, with Tamil translation available. All participants provided oral informed consent after they were given a detailed description of the survey and the potential costs and benefits of participation were explained to them.

### Data

The survey was designed to investigate the recovery of microenterprises from the tsunami, and collected detailed information on the accounts of the businesses each month. Retrospective questions were used to measure pre-tsunami revenues and profits of the business for the month of November 2004. Basic demographic information including age, sex, marital status, ethnicity, education and household size were collected for each participant.

Exposure to the tsunami was measured geographically through the location of the business in an

area where the tsunami was designated as directly affecting, indirectly affecting, or not affecting. Direct exposure to the tsunami was measured through self-reports of physical encounters with the tsunami, whether or not the individual had friends or family members killed in the tsunami, and whether or not the household suffered damage to business assets, housing structural damage or damage to housing contents as a result of the tsunami.

Table 1 shows summary statistics for the sample. Full data were collected for 288 men and 273 women. Most individuals were married (0.82) and of Sinhalese ethnicity (0.90). Ethnic minorities mainly consisted of Sri Lankan Moors. Pre-tsunami monthly household income per capita averaged 2206 Sri Lankan Rupees (US \$22.06), less than one dollar per day. Enterprise owners were chosen only if they worked full-time (35 h or more a week) in their businesses. The profits from these businesses account are significant contributors to household earnings, averaging 46% of household income.

Table 1  
Characteristics of the survey participants

	Mean	SD
<b>Socioeconomic characteristics</b>		
Proportion female	0.487	
Proportion married	0.815	
Proportion minority (Sri Lankan Moor)	0.100	
Age	42.1	11.1
Years of education	9.4	2.9
Household size	4.9	1.7
November 2004 monthly household income per capita (100 SLR = US \$1)	2206	1573
Business profits as percentage of household income in November 2004	45.9	29
<b>Tsunami exposure</b>		
Proportion who saw the tsunami directly	0.624	
Proportion hit by water from the tsunami	0.349	
Proportion who had a family member killed	0.250	
Proportion who had a close friend killed	0.217	
Proportion who had a household member injured	0.137	
Proportion whose business assets were damaged	0.367	
Proportion whose housing structure was damaged	0.316	
Proportion whose housing contents were damaged	0.362	
Sample size	561	

Table 2  
Incidence of tsunami exposure by geographic grouping

	Directly affected	Indirectly affected	Unaffected
Proportion who saw the tsunami directly	0.947	0.718	0.157
Proportion hit by water from the tsunami	0.796	0.147	0.034
Proportion who had a family member killed	0.369	0.271	0.090
Proportion who had a close friend killed	0.340	0.232	0.062
Proportion who had a household member injured	0.282	0.090	0.017
Proportion whose business assets were damaged	1.000	0.000	0.000
Proportion whose housing structure was damaged	0.782	0.079	0.011
Proportion whose housing contents were damaged	0.883	0.102	0.017
Median distance to coastline of business (m)	264	516	7245
Sample size	206	177	178

The sample varied in its degree of exposure to the tsunami. Just under two-thirds of the sample (0.62) saw the tsunami come in, and 35% were physically hit by the water. Just over one-third (0.39) of the individuals suffered some form of personal loss, and 41% suffered economic loss in the form of damage to business assets, housing structure or housing contents.

Table 2 shows how the degree of exposure varied according to geographic locations designated by our survey team as where firms were directly affected, indirectly affected, or unaffected. The average firm in the directly affected, and indirectly affected zones are located 260–520 m from the coastline, while the average unaffected firm was 7 km inland. This geographic grouping provides a clear ranking of more to less affected in terms of each of the separate indicators, and will be used for graphical representation of the recovery by extent of exposure. Even within the unaffected locations, almost 16% of individuals report that they saw the tsunami directly, perhaps as a result of being in a nearby coastal town or city at the time.

#### *Mental health measures*

Three general measures of the recovery of mental health from the tsunami were used, following sociological measures proposed to examine recovery from other disasters (Tatsuki et al., 2003). Four-point Likert scales (strongly agree, agree, disagree, strongly disagree) were used to indicate the degree of agreement with each of the following statements:

- (a) I feel I am living in a normal everyday life.
- (b) I no longer talk about the tsunami these days.

- (c) I have changed my outlook on life as a result of the tsunami.

These questions were chosen to span the three recovery processes highlighted in Tatsuki et al. (2003).<sup>2</sup> Question (a) measures the sense of return to normalcy, and is based on Berger and Luckman's (1966) sociological view of how everyday life is constructed. Recovery occurs as individuals are able to internalize the disaster event and maintain the new reality as normal life. Efforts to normalize the lives of individuals as quickly as possible were recommended as one of the key mental and psychosocial efforts for the general community (Chakrabhan et al., 2005).

Question (b) measures the degree of retreat from the tsunami, as it becomes less of an all-consuming thought for the individual. However, a possible concern with this measure is that while this may represent mental health recovery for some individuals, for others the refusal to talk about the tsunami may be a form of post-traumatic avoidance. We investigate below whether this measure is likely to be informative about mental health recovery.

Question (c) measures the struggle for meaning and acceptance that can often accompany disasters of this nature. We expect the proportion of people saying that they have changed their life outlook to be high in the early period after the tsunami, as

<sup>2</sup>Given the length and complexity of our enterprise survey module, the eight-items of Tatsuki et al. (2003) were reduced to these three questions which span the three recovery processes, and which were the items which pre-testing showed could be understood easily in Sinhala, the local language.

individuals struggle to finding meaning in the event. This proportion should decline over time, as individuals who recover from the tsunami no longer feel the need to attribute such meaning to the disaster.

*Validation: are these measures informative about mental health?*

The three measures discussed above were explicitly designed by Tatsuki et al. (2003) to look at several key aspects of the psychological recovery process: return to normalcy, struggle for meaning, and retreat. The question which then arises is how closely these measures relate to more standard measures of mental health. In order to investigate this, we carried out a validation survey in early July 2007. The validation exercise attempted to re-interview all firm owners in the district of Galle, and succeeded in re-interviewing 169 of the target 177 individuals.

The survey asked firm owners to think back to the first 3 months after the tsunami, and asked them the extent to which they agreed or disagreed with the normal life, change in life outlook, and no longer talking about the tsunami questions with reference to these first 3 months. Firm owners were then asked, with reference to the same time period, the seven-item DSM-IV PTSD screening question of Kimerling et al. (2006), who recommend a cutoff score of 4 for detecting individuals with PTSD. In addition, firm owners were asked, again with reference to three months after the tsunami, the five-item Mental Health Inventory (MHI-5) of Veit and Ware (1983), which has been shown to perform well in a number of settings in detecting major depres-

sion, general affective disorders, and anxiety disorders (Berwick et al., 1991). The MHI-5 index runs from 5 to 25, with higher scores indicating worse mental health—the median score in our sample is 15.

The validation survey then enables us to examine the relationship that the three mental health indicators included in our main survey have with PTSD, and with a general, non-disaster specific, measure of mental health. About 43% of the firm owners have PTSD scores of four or more, and 25% have scores of five or more, suggesting high levels of PTSD during the first 3 months after the tsunami. Column 1 of Table 3 shows marginal effects from a probit of having PTSD on the three measures in our main survey. The normal life question is strongly significant ( $p < 0.01$ ) and the change in life outlook significant at the 10% level. Individuals who feel like they are living a normal life are 33 percentage points less likely to have PTSD and individuals who say they have changed their outlook on life as a result of the tsunami are 15 percentage points more likely to have PTSD. The measure of no longer talking about the tsunami has no relationship to PTSD.

Column 2 of Table 3 shows a similar pattern with the overall PTSD score (out of seven). The third column shows that the question on feeling like they are living a normal life is strongly and significantly associated with the MHI-5 score. Individuals who feel they are living a normal life have lower MHI-5 scores, indicating better mental health. Changing ones outlook on life as a result of the tsunami is positively associated with the MHI-5, but is not statistically significant when the normal life measure is also included. Column 4 shows it is significant at

Table 3  
Are recovery indicators correlated with other mental health measures

	PTSD indicator	PTSD score	MHI-5 index	MHI-5 index	MHI-5 index
I feel I am living a normal life	−0.331 (0.095)***	−1.614 (0.45)***	−2.962*** (0.66)		
I no longer talk about the tsunami these days	0.0113 (0.11)	−0.114 (0.46)	0.468 (0.66)		0.26 (0.76)
I have changed my outlook on life as a result of the tsunami	0.148 (0.089)*	0.415 (0.39)	0.684 (0.56)	1.008 (0.56)*	
Constant		4.544 (0.44)***	17.59 (0.63)***	15.13 (0.31)***	15.34 (0.28)***
Observations	169	169	169	169	169

Source: Validation survey of firm owners in Galle District, July 2007.

Note: Robust standard errors in parentheses, \* $p < 0.1$ , \*\* $p < 0.05$ , and \*\*\* $p < 0.01$ .

Column 1 shows marginal effects from probit estimation. Columns 2–5 show OLS coefficients.

the 10% level when we omit the normal life variable. However, as with PTSD, no longer talking about the tsunami shows a small and insignificant relationship with general mental health.

The second validation exercise we perform is to examine whether the three recovery indicators have similar associations in the cross-section as PTSD and the MHI-5 with the risk factors to be considered in this paper. Given the smaller sample size here than in our full survey, we choose one measure of exposure to the tsunami: property loss from the tsunami. For ease of comparison with the other measures which are all binary, we choose a cut-of threshold of 16 and above for the MHI-5, indicating an individual is in the worst 37% of mental scores in our sample.

Table 4 then shows that in the validation subsample, the normal life and change in life outlook measures display similar associations as PTSD and MHI-5 with the risk factors of interest. Recall that we want an odds ratio below one in the normal life logistic regression if the odds ratio in PTSD or MHI-5 measures are above one (normal life represents better mental health, whereas having PTSD or a high MHI-5 score represents worse mental health). Those with property damage are significantly less likely to feel they are living a normal life, and more likely to have changed their life outlook, have PTSD score above the threshold, and have a high MHI-5 score. Minorities and

females have significantly higher odds of PTSD and high MHI-5 scores, and lower odds of feeling they have a normal life and higher odds of having changed their life outlook. Age, marital status, education, and per capita income are not significantly associated with any of the measures.

In contrast, the question on no longer talking about the tsunami shows that retreat, if anything, has similar determinants as poor mental health. Coupled with the lack of correlation between not talking about the tsunami and PTSD and the MHI-5, it therefore appears that the question on no longer talking about the tsunami is not likely to be informative about the mental health recovery process. We therefore concentrate our analysis on the return to normalcy and change in life outlook measures. The validation surveys show that both are correlated with PTSD and MHI-5, and have similar risk factors to them both in the cross-section. It is therefore reasonable to expect that these variables will also be informative about mental health recovery.

#### Statistical analysis

All analyses were done with STATA/SE (version 9.0). Attrition over the five waves was marginally higher for individuals who saw the tsunami (10.9%) than for individuals who did not (6.6%,  $p = 0.07$  for  $t$ -test of difference). Mental health scores in the first

Table 4  
Do the recovery indicators show the same risk factors as mental health odds ratios from logistic model

	Agree I am living normal life	I no longer talk of tsunami	I have changed indicator life outlook	PTSD	MHI-5 > 16
	(1)	(2)	(3)	(4)	(5)
Business, housing, or contents damage from tsunami	0.375 (0.15)**	1.541 (0.60)	2.377 (0.83)**	3.260 (1.17)***	2.163 (0.80)**
Female	0.567 (0.22)	2.567 (1.03)**	2.018 (0.71)**	2.526 (0.93)**	3.377 (1.36)***
Age	0.975 (0.017)	1.008 (0.020)	1.019 (0.017)	1.019 (0.017)	1.001 (0.017)
Minority	0.436 (0.21)*	1.237 (0.75)	3.080 (1.46)**	5.075 (2.37)***	4.628 (2.20)***
Household size	1.109 (0.13)	0.860 (0.11)	1.115 (0.12)	1.054 (0.12)	1.294 (0.14)**
Married	1.696 (0.80)	0.949 (0.45)	1.470 (0.68)	0.891 (0.42)	1.603 (0.79)
Years of education	1.008 (0.066)	1.009 (0.072)	1.094 (0.071)	0.934 (0.064)	1.068 (0.068)
Log pre-tsunami income per capita	1.550 (0.54)	0.593 (0.24)	1.261 (0.39)	0.839 (0.24)	0.820 (0.25)
Observations	164	164	164	164	164

Source: Validation survey of firm owners in Galle District, July 2007 and SLMS baseline survey.

Note: Robust standard errors in parentheses; \* $p < 0.1$ , \*\* $p < 0.05$ , and \*\*\* $p < 0.01$ .

Column 1 shows marginal effects from probit estimation. Columns 2 and 3 show OLS coefficients.

wave did not differ significantly for individuals who subsequently attrited compared to those in the sample for all five periods after controlling for tsunami-exposure.

Pre-tsunami household income per capita and monthly profits were positively skewed and were thus transformed (natural log). We transformed the Likert scales for the mental health indicators into binary variables (agree/disagree). Ordered probit models carried out using the full four-point scale gave similar results. The set of indicators on degree of exposure to the tsunami were used to construct two composite indicators: personal loss, measured by having a family member injured or killed, or a close friend killed; and economic loss, measured by suffering damage to the business assets, housing structure or its contents.

We begin with a logistic regression with the first wave of the data to examine the relationship between each of our two mental health measures and an individual's socioeconomic characteristics and degree of exposure to the tsunami.

Secondly we graphically show the recovery process by calculating by survey wave and geographical exposure the proportion of individuals who agree with each of the mental health questions and by plotting the resulting recovery trends, along with 95% confidence intervals around the sample means. We then explore heterogeneity in this response among individuals who saw the tsunami by calculating this proportion separately for men and women, for those suffering economic loss, personal loss, and neither economic nor personal loss. Finally, we consider only firms which suffered a fall in business profits of at least 20% between November 2004 and March 2005, and split this sample into those with above the median and below the median profits growth over the five waves. We then examine whether the mental health recovery process varies according to how rapidly business profits recovered for this group.

Finally we consider only the subsample of individuals who saw the tsunami and test statistically whether the dynamics of mental health recovery varies with economic recovery and with socioeconomic characteristics by estimating a panel logistic regression for each mental health measure. The estimating equation for firm owner  $i$  in time period  $t$  for the normal life measure<sup>3</sup> is

$$\begin{aligned} \Pr(\text{normal life}_{i,t} = 1) \\ = \text{LOGISTIC} \left( \alpha \text{months}_t + \sum_{c=1}^C \delta_c X_i^c \times \text{months}_t \right. \\ \left. + \theta \text{profits}_{i,t} + \lambda_i + \varepsilon_{i,t} \right), \end{aligned} \quad (1)$$

where  $\text{months}_t$  is a linear time trend<sup>4</sup> in months since the tsunami,  $X_i^c$  is socioeconomic characteristic  $c$  for individual  $i$ , such as gender, education, minority status, and extent of tsunami exposure,  $\text{profits}_{i,t}$  are the (log) profits of firm  $i$  at time  $t$ , and  $\lambda_i$  is a firm-owner specific effect. We estimate Eq. (1) using both random effects, and fixed effects. The use of fixed effects allows us to condition on all time-invariant characteristics of the firm owner which might be expected to influence mental health and be correlated with profits, such as pre-tsunami profits, family history of mental illness, and other such factors.

Eq. (1) enables us to examine the trajectory of each mental health measure after the tsunami. The  $\delta_c$ 's measure the extent to which the recovery time trend varies according to the characteristics of the owner, while  $\theta$  measures the extent to which it varies according to changes in profits of the firm. We then consider various robustness checks in estimating Eq. (1). These include robustness to the number of terms included in the logistic regression, and to restricting the analysis only to firms where there was a large fall in profits from the tsunami, or where the firm profits constitute at least 50% of total household income.

## Results

Table 5 shows the cross-sectional association 3–4 months after the tsunami between our mental health measures, a firm owner's degree of exposure to the tsunami, and socioeconomic factors. Individuals with more exposure to the tsunami are less likely to feel they were living a normal life and more likely to have changed their outlook on life as a result of the tsunami. The effects are greater for individuals who suffered personal and economic losses from the tsunami, with more significant and larger effects from economic rather than personal losses. The odds ratio for changing one's outlook on life was 1.88 (95% CI: 1.21–2.91) for economic loss and 1.31

<sup>3</sup>The change in life outlook equation is estimated analogously.

<sup>4</sup>We also tested for the presence of a quadratic time trend, but the quadratic term was insignificant in all specifications.



Table 5  
Risk factors for mental health 3–4 months after the tsunami odds ratios from logistic models

	Agree I am living normal life	I have changed life outlook
	(1)	(2)
Saw the tsunami	0.677 (0.20)	1.714 (0.39)**
Friend or family member killed or injured	0.625 (0.14)**	1.308 (0.25)
Property damage	0.469 (0.13)***	1.872 (0.42)***
Female	0.754 (0.16)	1.686 (0.31)***
Age	1.003 (0.010)	0.997 (0.0085)
Minority	0.543 (0.20)*	2.079 (0.66)**
Household size	1.051 (0.072)	0.987 (0.057)
Married	1.290 (0.35)	1.373 (0.34)
Years of education	1.019 (0.038)	1.032 (0.033)
Log per capita income	1.092 (0.19)	0.866 (0.14)
Number of individuals	561	561

Robust standard errors in parentheses; \* $p < 0.1$ , \*\* $p < 0.05$ , and \*\*\* $p < 0.01$ .

(95% CI: 0.89–1.91) for personal loss, and the odds ratio for living a normal life was 0.47 (95% CI: 0.28–0.79) for economic loss and 0.63 (95% CI: 0.40–0.97) for personal loss.

Females were significantly more likely to report having changed their outlook on life as a result of the tsunami and non-Sinhalese minorities were significantly more likely to report having changed their outlook on life as a result of the tsunami and less likely to report they felt they were living a normal life. Socioeconomic status was not found to have a significant association with mental health 3–4 months after the tsunami, with odds ratios for both education and pre-tsunami income per capita both close to one. Age, household size, and marital status also had insignificant associations with each mental health measure.

Fig. 1 shows the trajectory of the mental health recovery for the two measures, along with 95% confidence bands. Return to normalcy is seen to occur relatively rapidly, with the directly affected and unaffected groups having insignificantly different proportions agreeing they live a normal life at 10 months after the tsunami.<sup>5</sup> In contrast, while the tendency to agree that one has changed one's outlook on life falls with time since the tsunami,

<sup>5</sup>We do not plot the means for the group of individuals classified as indirectly affected, since the addition of three more lines makes the figures harder to read. The indirectly affected group have trajectories which lie between the directly affected and unaffected groups.

significant differences between the directly affected and unaffected groups of individuals remain 16 months later.

Fig. 2 examines how the tendency to view the tsunami as changing one's outlook on life varies according to individual characteristics, for those individuals who saw the tsunami directly. Males and females exhibit similar fall-off in agreement. Likewise, while individuals who experienced personal or economic loss have higher initial levels of agreement with this statement, the rate of decay in agreement is similar for all three groups.

Fig. 3 considers only firm owners whose business profits fell 20% or more between November 2004 (the month before the tsunami) and March 2005 (our first post-tsunami measure). It presents stark visual evidence that economic recovery is not synonymous with mental health recovery. We split the sample of those who saw the tsunami by whether they are above the median profits growth (fast growth) or below the median (slow growth). Despite large differences in log profit growth (Fig. 3A), the levels and change in agreement with the statement on living a normal life (Fig. 3B) and on how the tsunami has changed one's outlook (Fig. 3C) are very similar for both groups, with the confidence intervals always overlapping.

Table 6 presents results from the panel logistic regressions for agreeing they are living a normal life among those who saw the tsunami. Columns 1 through 3 show random effects specifications, and columns 4 through 9 fixed effects.<sup>6</sup> There is a significant upward linear trend in agreeing that one is living a normal life, consistent with the increase in this measure for the directly affected group in Fig. 1A. Similar linear trends are found in both the random effects and fixed effects specification. The speed of recovery does not vary with gender, household size, marital status or minority status, since none of the interactions of these variables with the time trend are significant. However, individuals with more education are relatively less likely to see improvements in feeling they are living a normal

<sup>6</sup>Recall that in a fixed effects logistic regression, identification of coefficients is only based on individuals who change their dependent variable over the course of the panel. Thus, the number of effective observations drops. For example, out of the 350 individuals who saw the tsunami, only 196 changed their agree/disagree response to "I feel I am living in a normal everyday life", and thus it is only these 196 individuals who are being used to identify the effect of months since tsunami in column 4 of Table 6.

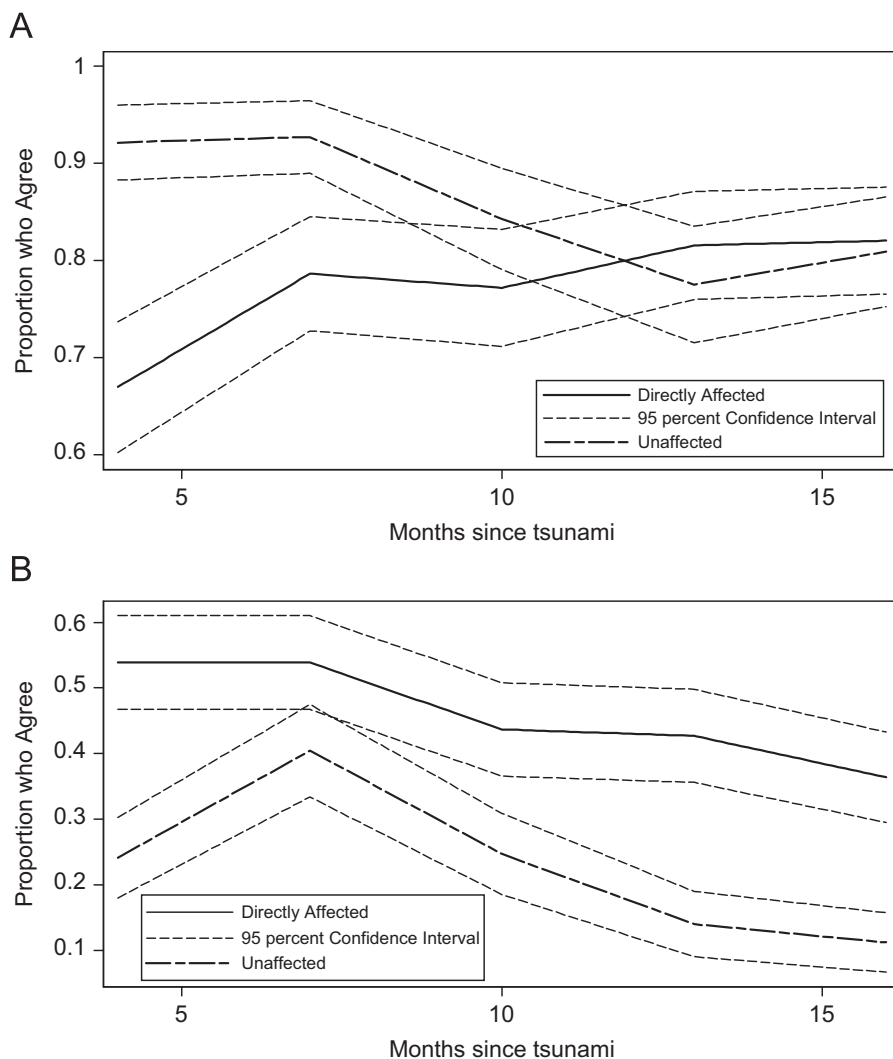


Fig. 1. (A) I feel I am living a normal everyday life; and (B) I have changed my outlook on life as a result of the tsunami.

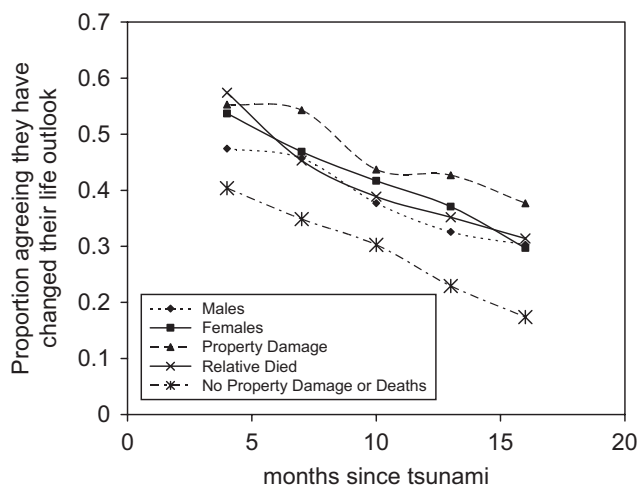


Fig. 2. Change in life outlook by time since tsunami and individual characteristics.

life, although the size of this effect is not large (odds ratio: 0.99).

Column 5 shows no significant impact of business profits on feeling one is living a normal life, confirming the visual pattern in Fig. 3B. Since the estimation includes firm fixed effects, it is only changes in profits (i.e. profit growth or profit decline) that is identifying the impact of profits. One possible explanation for the insignificant effect is that the regression is over-fitted, so that nothing is significant. This can be ruled out in Column 6, where we drop the interactions between socio-economic characteristics and the linear time trend, and see no change in the size or significance of the profit coefficient.

A second set of possible explanations for the lack of significance of business profits is that either business profits were not hit that hard by

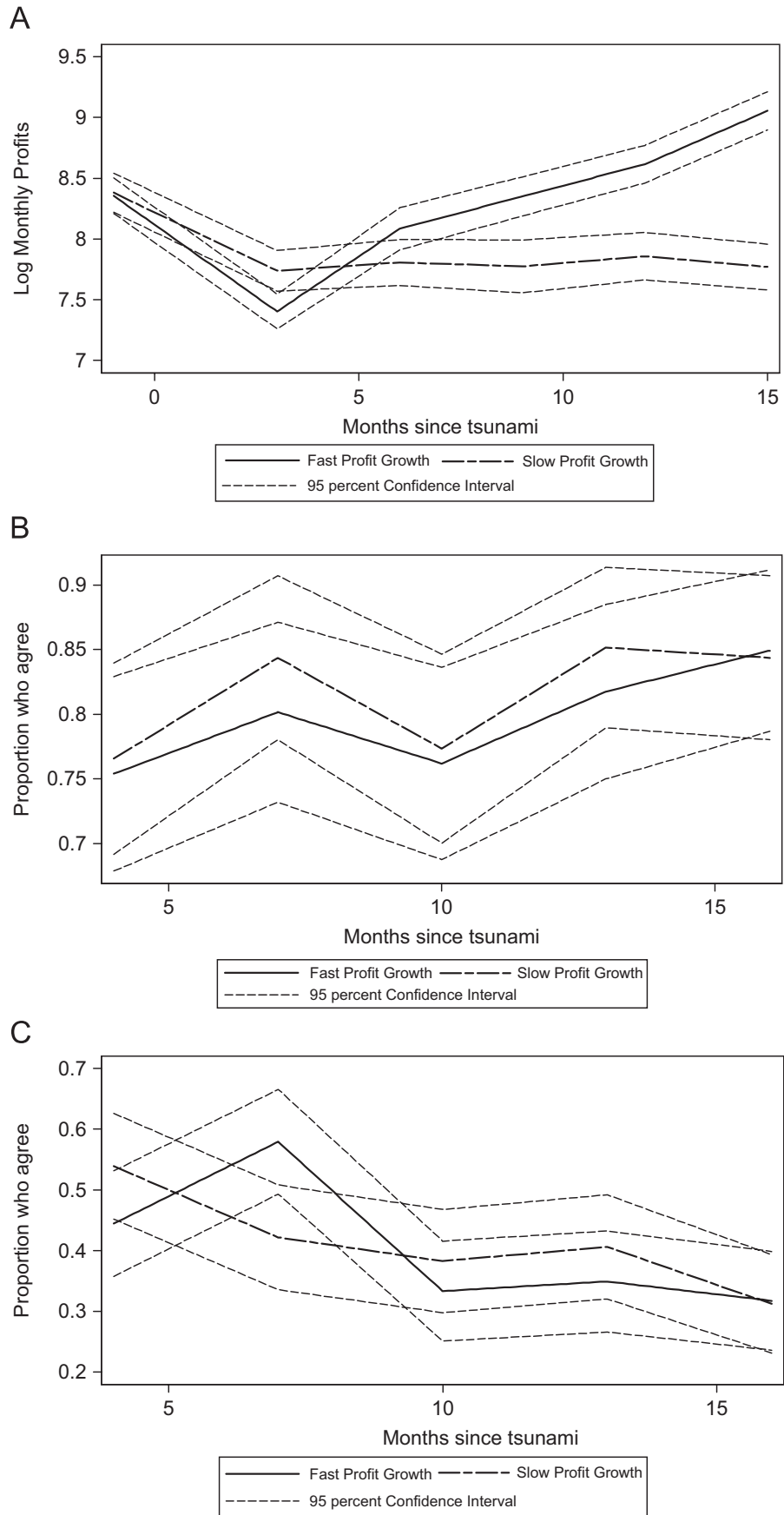


Fig. 3. (A) Profit recovery among firms whose profits fell 20% or more with tsunami; (B) feel they are living a normal life among firms whose profits fell 20% or more; and (C) change in outlook due to tsunami among firms whose profits fell 20% or more with tsunami.

Table 6  
Dynamics of “I feel I am living in a normal everyday life” for those who saw the tsunami odds ratio from logistic model estimated over all five rounds of SLMS

	Random effects			Fixed effects					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Months since tsunami	1.051 (3.28)***	1.077 (1.57)	1.049 (2.99)***	1.052 (3.27)***	1.154 (1.58)	1.058 (3.34)***	1.062 (2.72)***	1.111 (2.95)***	1.057 (3.24)***
Female × months since tsunami		0.989 (0.66)			1.003 (0.11)				
Education × months since tsunami		0.997 (1.12)			0.985 (2.41)**				
Dead/injured × months since tsunami		0.980 (1.23)			1.011 (0.31)				
Property damage × months since tsunami		1.015 (0.88)			1.119 (3.11)***				
Household size × months since tsunami		1.002 (0.37)			1.000 (0.01)				
Married × months since tsunami		1.013 (0.67)			0.970 (0.75)				
Minority × months since tsunami		0.959 (1.53)			1.033 (0.58)				
Log profits		1.062 (0.81)	1.063 (0.87)		0.952 (0.47)	0.947 (0.53)	0.933 (0.55)	0.894 (0.51)	
Log household income									0.910 (0.64)
Sample size: individuals × time periods	1750	1698	1698	980	936	936	561	258	979
Sample size: individuals	350	350	350	196	192	192	114	78	196

Note: Sample size for fixed effects models is sample size of individuals who changed whether they felt they were living a normal life during the five survey rounds. Column 7 restricts sample to firms which suffered a fall in profits of 20% or more between November 2004 and March 2005. Column 8 restricts sample to firm owners whose business profits constitute 50% or more of household income. Robust z-statistics in parentheses. \*, \*\*, and \*\*\* indicate significance at the 10%, 5% and 1% levels, respectively.

the tsunami, or that they do not contribute that much to overall household income. In Column 7 we therefore restrict analysis only to firms with a 20% or more drop in profits between November 2004 and March 2005, while in Column 8 we restrict analysis only to firms for which the business profits constitute at least 50% of total household income for their owners. In both cases, the odds ratio on business profits remain insignificant. Furthermore, the point estimates are below one, indicating that, if anything, higher business profit recovery makes owners *less* likely to feel they are living a normal life. Finally, Column 9 shows a similar result for recovery of total household income of the owner: an insignificant association with feeling one is living a normal life.

Table 7 shows similar results for the dynamics of changing ones outlook on life as a result of the tsunami. In accordance with Fig. 1B, there is a strong negative linear trend (odds ratio: 0.91; 95% CI: 0.88–0.93), showing individuals are less likely to agree that the tsunami has changed their outlook on life with time since the tsunami. However, as shown graphically in Figs. 2 and 3C, this downward trend does not vary significantly with most socioeconomic characteristics, nor with business profit recovery. Columns 7 through 8 again show that the lack of relation between business profit growth and mental health recovery is robust to restricting the analysis to firms where business profits fell at least 20%, and to firms where business profits are at least 50% of household income. Column 9 shows no significant association between the dynamics of change in life outlook and total household income recovery.

### Discussion

Our findings identify the degree of exposure to the tsunami (especially the extent of economic loss from damage to the business and household), gender, and non-Sinhalese minority status all being risk factors for an initial mental health response to the tsunami in Sri Lanka. These factors have all been found to be strongly associated with psychosocial health in other studies of psychosocial health following natural disasters (Norris, 2005), which together with the results of our validation exercise, suggest that return to normalcy and change in life outlook do indeed provide a reasonable measure of general mental health status after the tsunami.

The main strengths of this study lie in our ability to trace the dynamics of the mental health recovery

Table 7  
Dynamics of “I have changed my outlook on life as a result of the tsunami” for those who saw the tsunami odds ratio from logistic model estimated over all five rounds of SLMS

	Random effects			Fixed effects					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Months since tsunami	0.907 (7.08)***	0.907 (2.14)**	0.915 (6.12)***	0.907 (7.08)***	0.867 (1.67)*	0.909 (6.28)***	0.921 (4.23)***	0.890 (3.80)***	0.908 (6.45)***
Female × months since tsunami	0.993 (0.45)	0.998 (0.56)		0.965 (1.20)					
Education × months since tsunami		1.005 (0.32)		1.007 (1.20)					
Dead/Injured × months since tsunami		1.068 (3.89)***		1.022 (0.73)					
Property damage × months since tsunami		1.000 (0.22)		1.021 (0.65)					
Household size × months since tsunami		0.989 (0.55)		1.005 (0.58)					
Married × months since tsunami		0.963 (1.24)		0.949 (1.45)					
Minority × months since tsunami		0.908 (1.37)	0.912 (1.35)	0.900 (1.81)*					
Log profits					1.015 (0.16)	1.033 (0.34)	1.145 (1.17)	1.116 (0.58)	
Log household income									0.996 (0.03)
Sample size: individuals × time periods	1750	1698	1698	1290	1239	1239	791	364	1289
Sample size: individuals	350	350	350	258	255	255	161	106	258

Note: Sample size for fixed effects models is sample size of individuals who changed whether they felt they were living a normal life during the five survey rounds. Column 7 restricts sample to firms which suffered a fall in profits of 20% or more between November 2004 and March 2005. Column 8 restricts sample to firm owners whose business profits constitute 50% or more of household income. Robust z-statistics in parentheses. \*, \*\*, and \*\*\* indicate significance at the 10%, 5% and 1% levels, respectively.

over multiple time periods, and relate it to economic recovery. We find that a return to normalcy has generally occurred by ten months from the occurrence of the tsunami, with this recovery slightly faster for those who suffered economic loss and had lower initial feelings of normalcy. However, the tendency to feel that the tsunami has changed one’s outlook on life continues to be greater 16 months after the tsunami amongst individuals who were more exposed to the tsunami compared to those who were less exposed.

We find that there is very little heterogeneity in the speed of the recovery process. By far the most important determinant of mental health recovery is the number of months that has past since the tsunami occurred. Individuals who have greater initial mental health effects show similar improvements over time to those with less extensive initial effects. In particular, we find very little relationship between economic recovery of the enterprises run by poor self-employed individuals and their mental health recovery. Individuals with rapid profits growth are not more likely to return to feeling like one is living a normal life or to no longer view their outlook on life as changing due to the tsunami than individuals whose businesses had slow profit growth (or profit decline).

These findings suggest that the risk factors determining initial psychosocial health after a disaster will continue to determine the level of incidence during the recovery stage, but that they do not significantly affect the speed of recovery. For example females will continue to be more likely to feel that their life has changed as a result of the tsunami than males, but a female who feels her life has changed in the initial period will not change her mind about this more slowly than a male who felt his life had changed in the initial period.

The Thailand Post-Tsunami Mental Health Study Group survey re-interviewed participants 9 months after the tsunami, and found that the level of PTSD, prevalence and depression had decreased relative to their baseline survey 2 months post-tsunami (Van Griensven et al., 2006). In their comments they note that little is known about the process of recovery, and suggest a variety of factors which might explain the recovery in mental health, including the restoration of livelihoods. Our results suggest that although both mental health and livelihoods both do recover following a disaster, the speed of mental health recovery does not seem to be related to the

rate of economic recovery when we compare across individuals.

Even if one were to find a positive association between mental health recovery and economic recovery of livelihoods, the direction of causation would still be unclear. Poor mental health could hamper the running of a business, reducing the likelihood of economic recovery. Conversely, a lack of economic recovery could be an additional source of mental stress, delaying mental health recovery. The lack of any sizeable or significant association in our data suggests that neither channel is operating in the post-tsunami recovery context. This finding complements recent work by Das et al. (2007) who find little cross-sectional association between mental health and poverty in five developing countries, in contrast to the stronger linkages between the two often found in developed country contexts.

The present study has some limitations. The first is that it covers only adults who were engaged in self-employment activities prior to the tsunami. However, self-employment covered 28.3% of the employed population in 2004 and accounts for a large share of the employment activities of the poor (Sri Lanka Department of Census and Statistics, 2006). The participants therefore are representative of an important share of the poor affected population.

Secondly, our measures of mental health cover general sociological aspects of the mental health recovery process: return to normalcy, and the struggle for meaning and acceptance. Our validation survey finds both measures to be significantly associated with PTSD and general mental health status as measured by the MHI-5. Moreover, we find similar relationships in the cross-section to post-disaster studies using PTSD, anxiety and depression indices. However, these measures do not allow study of the incidence of and recovery from more serious psychological disorders.

Livelihoods recovery and mental health assistance are both important elements of the international humanitarian response to natural disasters. Coordination of the various relief activities within a sector is usually a challenge in these circumstances, and a finding of strong complementarities between mental health and economic recovery would suggest that coordination of mental health recovery efforts would also need to occur with other recovery activities. Our results do not show much evidence for such a complementarity, and suggest that mental health recovery is largely a function of time since the

disaster, and is not strongly related to individual-level economic recovery.

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