Distress six years after the Great Earthquake: Two, Multi-Level Prospective Analyses.

Brief Title: Six years after the Earthquake

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Relevance to practicing psychiatrists

Two surveys following a major Japanese earthquake show post-disaster psychological distress as no higher than pre-disaster and decreased significantly over time. Clinicians need to be wary of assuming increased distress following trauma. Distress was not associated with family or housing loss but was predicted by support from spouse and friends. Such support should be enabled where possible, particularly for those in temporary residences. Survivors with pre-existing disorders remain vulnerable to distress several years after a disaster, suggesting the need for particular attention to this group. Maintenance of everyday daily activities should be encouraged post-disaster to enhance resilience over time.

Abstract

Background: Studies following disasters focus primarily on data collected in the immediate aftermath and neglect the influence of wider community factors. The March 11th 2011 Great East Japan Earthquake led to the relocation of 300,000 survivors. We report a comprehensive three-level prospective study of psychological distress in the years following a complex disaster.

Methods: We drew on two multi-wave data collections in the six years after the earthquake, using residents from different forms of housing. Sample 1 included six waves of private housing residents from 2011-2016 (N=1084 per wave), Sample 2 five waves of residents living in prefabricated housing from 2012-2016 (N=1515 per wave). We analysed prospective associations between distress and time (level 1), pre-existing disorders and disaster experiences and behaviours (level 2) and city-wide measures of support and physical activity (level 3).

Results. Multi-level models with random coefficients demonstrated greater distress in earlier waves (adjusted *b*s -15, -.16 for samples 1, 2; P <.001), amongst female respondents (*b*s .58 p=.01; 1.74, P=.001), in those with a previous psychiatric history (*b*s 2.76, 2.06, P<.001) with diminished levels of activity post-earthquake (*b*s 1.40, 1.51, P<.001) and lacking in social support (*b*s 1.95, 1.51, P<.001). Support from spouses and friends was most protective of psychological health. City-level support was negatively associated with distress, but only amongst those in prefabricated housing.

Conclusions: Psychological distress diminished with time, but varied across sex, psychiatric history, housing, levels of activity and availability of social support. Practitioners should consider individual and city-level factors when devising effective interventions.

(250 words)

Key words: disasters, multi-level analyses, psychological distress, Japan

Distress Six Years After The Great East Japan Earthquake: Two, Multi-Level Prospective Analyses.

Introduction.

A considerable body of research has examined the impact of natural disasters on psychological health. Most of this work has focused on earthquakes and accompanying tsunamis, or major weather events such as floods and hurricanes, and illustrated the long-term psychological toll of these disasters[1, 2]. Studies have considered associations between distress and recovery and existing vulnerabilities, with work following earthquakes in Japan [3] and New Zealand [4] showing a positive association between pre-incident psychiatric disorders and later distress. Other work has indicated associations between post-disaster exposure, demographic factors and distress: family and housing loss were associated with greater distress following a hurricane[5], while women suffered greater posttraumatic stress following the 2004 Southeast Asian tsunami[6]. Subsequent resources and behaviours, such as the provision of social support [7] and the maintenance of daily activities[8-10], have also been shown to be protective of future events across different natural disasters, while temporary, prefabricated housing was associated with greater distress following the Niigata-Chuetsu earthquake[11]. However, much of the data collected has been cross-sectional, or has followed modest samples over time[1]. Furthermore, work has been primarily conducted at a single level, despite evidence that losses and opportunities are unevenly distributed across communities following disaster[5, 7], and that shared environments are critical to the accumulation of resources over time[12]. Indeed, city-wide maintenance or enhancement of activities post disaster provide positive opportunities that can ameliorate the disruption often experienced post-disaster[8, 9]. Drawing on two substantial data sets, collected by Miyagi Prefecture in the six years following The Great East Japan Earthquake, tsunami and Fukushima nuclear leak (GEJE), we conducted longitudinal multi-level analyses examining associations between survivors' psychological distress and time (level 1), previous psychiatric disorders, disaster exposure, demographics and individual support and activity (level 2) and wider, city-level activity levels and social support (level 3). Combining these individual

and social-level factors across two large samples allowed for a rare analysis of the differential influences of these factors over time.

Methods

Data Sources and Participants

We report results from two prospective cohort studies examining predictors of psychological distress across time (waves). These studies used on-going panel data collected by the health department of Miyagi Prefecture from all registered earthquakes in Miyagi Prefecture to examine predictors of longitudinal health status from Miyagi-based survivors of the GEJE. Details from the first stages of this data collection have been reported elsewhere.[7, 13] Following the earthquake all survivors living in Miyagi Prefecture were randomly assigned into either private rented or prefabricated housing, paid for by the Prefecture. Questionnaires were initially distributed to 12,826 families living in private housing the 35 municipalities (from December 2011) and 15,979 families resident in prefabricated housing in 10 municipalities (from September 2012). Respondents returned questionnaires through (postal) mail or to administrative offices. The Prefecture allocated data linkage codes to respondents according to name, date of birth, sex and pre-disaster address, allowing individuals to be identified across waves. Subsequently, the Prefecture deleted personal information to form an anonymised data set for our analyses. Ethical approval for both samples was obtained from the Prefecture as well as the relevant Ethics Committees of Warwick and Tohoku Universities.

We utilized two related samples, distinguished by timing and the housing arrangements of participants. The first sample included data from respondents in privately rented housing (N=1084 for all six waves). The second sample was from survivors living in prefabricated housing (N=1,515 for five waves). Table 1 reports responses per wave, by sample; Table 2 sample baseline characteristics. Response rates ranged from 50% to 70% over the waves. Supplementary Figures S1 & S2 describe data retention, supplementary Table S1 provides survival analyses, contrasting those who did or did

not respond to all waves. Those who moved were lost to follow-up, thus number of households delivered by mail or to administrative officers decreased over the years.

Insert Tables 1 and 2 about here

Measures

Measures were taken from previous work on earthquakes in Japan[3,7]. All participants provided their sex, age (at time 2: grouped into quintiles), current city of residence and whether or not they had someone to listen to their concerns (yes or no). They also indicated previous history of psychiatric illness (yes or no) and level of activity post-earthquake (less vs. the same or more). City-level indicators of support and activity amongst our samples were aggregated using individual scores; consistent with previous multilevel work after the earthquake we included both individual and community-level scores simultaneously in our models[7]. We drew data from 30 cities for sample 1, 37 cities for sample 2, all located in Miyagi Prefecture. We adjusted for the size of some of the cities by applying Bayesian estimations to provide more stable community-level variables by using EB estimation for Poisson software[14]. In the first sample only we assessed the use of a range of supporters (spouse, child, sibling, friend, each *yes* or *no*): because of the average age of our sample we excluded support from elder family members. For this sample only respondents were also asked whether they had lost a family member during the earthquake/ tsunami (yes/no) and level of house damage (four points, from *none* to *complete collapse*).

Our outcome variable (psychological distress) was measured using the Japanese version of the six item Kessler Psychological Distress Scale (K6)[15], intended to detect non-specific psychological distress and widely employed in Japan [16, 17]. Items were scored on five-point scales ranging from 0 (no distress) to 4 (maximum stress), with possible scores ranging from 0 to 24. Scores from 8-12 indicate probable mild-moderate mental illness (MMI), 13-24 severe mental illness (SMI). The scale showed good reliability in our data (overall Cronbach's α=.91).

Statistics

For each sample we report findings for all respondents aged ⩾ 18 years who completed all items of the K6 and all waves of the data collection. For each sample we conducted multi-level linear modelling using SAS software v. 9.4 (PROC MIXED procedure) with maximum likelihood estimation. Data were structured with each respondent consisting of five (prefabricated housing) or six-wave (private housing) self-report scores. The variable wave served as a level-1 predictor, variables at individual level (e.g., gender) as level-2 predictors, and variables at city level as level-3 predictors (e.g., averaged level of support). All reported P values are 2 sided.

We compared the efficacy of models using AIC and BIC statistics. For each sample we first examined a baseline (random intercept only) model which allowed us to perform a step-by-step model comparison and compute variance (percentages) for later models. Compared to the baseline model, Model 1 added the predictor wave (as a fixed effect) in addition to the effect of a random intercept. Model 2 added level two variables alongside wave. Model 3 included all level 3 terms (fixed effects only) but no interactions. Model 4 tested whether effect of wave varies across individuals (random coefficient model); we considered moderator (cross-level interaction) effects of this in Model 5. Model 6 included random intercepts at both level 1 and level 2, comparing this to a baseline model with random intercept at level 1. The poorer fit of the final model precluded the need to further model random effects at level 2. We compared the baseline model with models 1-5, computing the variance explained at each level for each model.

For our private housing sample only (Sample 1), we also reported an additional two-level random effect model for the association between individual supporters and psychological distress, over time.

Results

25.1% respondents reported indications of moderate mental illness in wave 1 (2011), declining to 16.9% at year 6 (2016). 8.5% reported risk of severe mental illness in 2011, 4.8% in 2016. 8.1% of those living in private housing reported having had lost a family member, 52% had suffered partial or complete destruction of their house as a consequence of the earthquake/tsunami.

Survival analyses compared those who completed all waves of the survey to those who participated in a specific wave, on psychological distress (Supplementary Table S1). There were no differences between respondents versus contemporaneous responses for all completing that wave, with the exception of wave 1 (sample 1), where those responding throughout the study reported greater distress.

Multilevel analyses

Because we conducted analyses over different periods of time, and included additional variables in our first sample, we conducted separate analyses for the two samples.

Sample 1 (six waves of private housing residents, 2011-2016)

Multi-level findings (Table 3) show distress declining over time (Model 1: random intercept variance = -.27 P<.001). For fixed-level Models 2 and 3 the significance of wave remains, as does being female, having a psychiatric history, and (lacking) individual support (all positively associated with distress). Neither age, family loss nor household damage were related to distress, nor were city-level support or activity levels. Allowing for random coefficients (Model 4) increased overall variance explained by 9.47%; however, introducing cross-level interactions (Model 5) did not improve model fit.

Subsidiary analyses considered associations between support from different supporters in the year following the GEJE and psychological distress, across waves (Supplementary Table 2). Initial support from the spouse, and to a lesser extent friends, was most strongly associated with psychological distress, controlling for psychiatric history, wave, sex, and age. Further analyses

(available from the first author) revealed no interaction between wave and individual support types, suggesting a similar pattern for each supporter across time.

Insert Table 3 about here

Sample 2 (five waves of prefabricated housing residents, 2012-2016)

In this Sample distress also decreased over time, with the same additional predictors (sex, individual activity, social support and psychiatric history) remaining significant across Models 2-4, although overall variance explained is smaller for each Sample (Table 4). For this Sample only higher levels of city-level support were associated with less distress (P<.01), but there was no city-level effect for activity (P=.28). As with Sample 1, cross-level interactions produce no improvement in variance explained.

Insert Table 4 about here

Discussion

Natural disasters, such as the GEJE, can have considerable implications for mental health, with consequences likely to fluctuate over time and across communities. While there is a substantial literature on resilience and recovery following such events, in Japan and elsewhere, we present, to our knowledge, the first attempt to ascertain drivers of post-disaster distress over a substantial period of time, with a broad population sample of survivors and across multiple levels of analysis. Two independent longitudinal samples of earthquake survivors, living in different housing conditions and with more than 1,000 participants in each, produced both consistent and sample-specific findings. In both samples psychological distress declined over time: (lack of) pre-disaster psychological illness, (male) sex and post-disaster support and activity maintenance, was negatively associated with psychological distress. Age effects, however, were small. City-level support was

negatively associated with distress but only amongst residents of prefabricated homes; for our privately housed survivors support from friends and the spouse, but not children or siblings, negatively predicted psychological distress across waves. These findings, we believe, address important theoretical questions about the impact of both individual and socio-cultural factors on mental health. They also have significant clinical implications for practitioners in the field, and the organization and distribution of resources following a major disaster.

Across both samples we found relatively low levels of psychological distress, particularly considering the high levels of household destruction suffered by our samples and the already high levels of distress recorded in Miyagi Prefecture prior to the earthquake[17]. Studies in Fukushima after over a period of three years after the GEJE[18], and Niigata in the five years consecutive to the 2004 earthquake in that Prefecture[19], showed decreases in distress over time, and in our prospective multi-level models time was also the major contributor to variance in post-disaster distress. As elsewhere, effects for sex, and previous psychiatric disorders persisted across waves: in previous studies women carried the heavier emotional burden post-disaster[19], potentially as a result of their lesser access to positive social support[20]. Age effects, however, were minimal, reflecting mixed findings in the literature: there was no age effect for amongst Norwegian survivors of the 2004 Southeast Asian tsunami[6], but older age was associated with higher distress following a major hurricane[5.] Despite the potential vulnerability of older refugees it is possible that experiences of previous earthquakes inoculated against further distress in our samples. Consistent with previous research on both received and perceived social support following other earthquakes, hurricanes and floods[21], individual level support was important for psychological health even when controlling for demographic factors. Previous research typically sums social support across supporters: in our analyses it was support from spouses and friends that was most frequently noted by our respondents (from spouses, 26%; friends, 23%), with this support also the most protective against psychological distress. Conservation of Resources Theory (COR) argues that maintenance of daily activities post disaster can ameliorate the “lifeway disruptions” frequently associated with post-

disaster recovery[10, 12]. While there was no notable change in levels of activity post-disaster, with approximately half of our survivors maintaining their pre-disaster activity levels across waves (48-51%, by sample), positive associations between individual activity and low distress suggested that the maintenance of stable daily activities is important for resilience over time[9]. However, contrary to COR, actual loss of family members or physical housing did not have a significant impact on psychological distress, when considered alongside demographic, social support and activity indicators.

Relatively little research has combined individual and community-level factors on post-disaster recovery, although both are important in avoiding the cycles of loss and threats to resources that often accompany disaster[10]. In a study examining post-traumatic symptoms and depression following Hurricane Sandy community-level factors (social capital) interacted with individual-level exposure to influence resilience[5]. In a further example, using data from the first two waves of our data living in prefabricated housing[7], individual level support and social participation combined with community-level support to prospectively predict psychological distress one year later. In contrast, other work on flooding has suggested that the effects of individual-level resources may be subsumed by community-level social support[20]. In our larger longitudinal analysis we find a unique effect for support at the city level, but only amongst residents of prefabricated (rather than private) housing. This finding may reflect the greater concentration of survivors into one area amongst members of this housing sample - sharing a community setting may be critical for leveraging social capital[9]. Despite the challenges of prefabricated housing, with its greater noise and extreme temperatures[13], the close proximity of these homes can make it easier for those in these dwellings to obtain both municipal and voluntary support[13]. In addition, those in close proximity settings such as the prefabricated housing in our study benefit from being able to meet and work together to resolve common problems[7], making such settings 'competent communities'[12] with 'collective efficacy'[22] in which there are opportunities for involvement and social cohesion. In more dispersed communities (such as in our private housing sample), collective support can be difficult to sustain, with such

support taxing (and therefore less beneficial) for both individuals and broader societal organisations[5]. At the same time, our findings show the continuing significance of individual-level support, over and beyond community-level aid. This underlines the importance of considering both individual and community-level variables in tandem, and recognising the complex interplay between these two[22].

Limitations and Future research

We recognize a number of limitations to our work. First, our design did not allow us to identify pre-disaster characteristics of our populations beyond self-reports of prior psychiatric disorders. A range of pre-disaster experiences are likely to be important in predicting resilience to disasters with pre-disaster support reducing exposure to the threat, as well as encouraging individuals to stay rather than leave an area following a disaster[5]. Within the broader disaster literature these include the presence of children, pre-existing parental distress and personality factors[21]. Our use of a simple binary indicator of pre-existing mental illness failed to allow us to further identify the nature of this illness. Second, data was self-reported and we relied on a single measure of distress (K6). Although widely used in Japan, this measure is not necessarily equivalent to clinical interviews for diagnosing mental health risk. Third, we lacked several important socioeconomic details, such as income and education, and our brief measurement of social support did not allow us to identify the quality of this support. Our data did not allow us to consider further stressors between rounds, such as further family loss. The older age of our sample meant it was not meaningful to include employment rates in our analysis: both employment and occupation may be significant predictors of distress following disaster[10]. Fourth, our first wave of data did not include participants from prefabricated housing respondents limiting us to a five-wave analysis in Sample 2. Finally, one possible reason for our failure to find further associations between city-level variables and distress may be because the units of measurement in our study (cities) were comparatively

large. Further research could model the impact of a variety of community indicators, using communities from a range of sizes.

We identify several avenues for future work. While mass stressors can have significant negative impacts such trauma has also been associated with personal growth across three different types of disaster[23]. Given the significance of social support for psychological distress future research should seek to assess in more detail mechanisms for such support and growth over time, taking into account the possible enhancement of relationships both within families and across communities. Second, our work focused on natural disasters: we also need to consider the significance of factors such as family/housing loss over time following more deliberate actions (including terror attacks or civil conflicts). Third, we were not able to conduct Prefecture-level analyses. Given that high levels of distress have been reported elsewhere in Japan[24], using non-clinical populations not facing an imminent disaster, it is possible that the findings reported in Miyagi are unrepresentative. Indeed initial evidence suggests particularly high rates of psychological distress amongst survivors from Fukushima Prefecture, arising from a combination of public stigma, disruption to social networks, and family dissension over any decision to return[25]. Given uncertainties about the long-term health prospects for those impacted by such events further work should explore prospective changes in psychological distress following ambiguous, and potentially stigmatic, events (such as radiation leaks or chemical spills).

Clinical implications

We believe our findings have several significant clinical implications. First, levels of psychological distress in our study were relatively low (overall 8.5% in our first wave). There is evidence that prevalence of severe mental illness was already high in Miyagi Prefecture in the months before the GEJE (estimated at 9.1% in February 2011), and was therefore not necessarily significantly augmented by these subsequent events[17]. The lack of significant increase in mental illness may partly result from a culturally fatalistic belief in *shouganai* ('it cannot be helped') often attributed to

an affected population's familiarity with natural disasters in Japan. It is also consistent with the wider finding, across the research literature on mass trauma, that only a minority of those affected are severely distressed[26]. Clinicians need to be aware of the risk of assuming high levels of distress following a traumatic event and should focus their attention primarily towards those most likely to be at risk. Second, our findings challenge assumptions that family or household loss is necessarily a major factor in the prediction of psychological distress. Instead, other variables, such as the availability of social support, may be equally important when designing and implementing interventions, suggesting a 'forward looking' orientation as individuals seek to rebuild their lives following the disaster. Forms of support are, however, not all equal, with provision of support from friends and spouses likely to be more efficacious than that from others (such as siblings). The adequate provision of couple and family therapy may become of particular importance following a disaster. Third, there has been little clinical evidence on the long-term influence of housing type on recovery post disaster. Our data suggests that community support is particularly significant for those living in temporary residences, and continuing interventions to provide support amongst temporarily located communities may be of particular import for psychological health. This might involve dedicated outreach services targeting those living in these new communities, providing community residents to meet together to work to resolving common issues. It also suggests the need for opportunities for such social gatherings amongst those more widely dispersed - some sub-groups (e.g. men, who are generally less willing to seek support) may particularly benefit from such interventions[7]. Fourth, those with pre-existing psychiatric disorders were more likely to report psychological distress. Ecological analyses conducted shortly before the earthquake suggest particularly vulnerability amongst inpatients with mental illness[17]. Given that many of these institutions were severely disrupted during the GEJE, special care must be taken to support those with enduring clinical vulnerabilities in newly dispersed communities. Where records survive clinicians may seek out those with pre-existing diagnoses and offer targeted support if required. Finally, evacuees may benefit from increased opportunities to participate in physical activity; daily

routines form part of the fabric of everyday life but are too frequently neglected in investigating links between trauma and health[9]. Significant shared trauma makes it often difficult to maintain daily activities such as the leisure practices key to the fabric of daily life - and the maintenance of positive mental health[9]. The identification and potential provision of such for meaningful daily engagement may form an important part of a clinician's armory following major trauma. Governmental and other formal and informal agencies need to be aware of these persistent influences in planning longer-term aid and interventions, even a number of years after a major disaster.

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Ethics.

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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Authors contributions.

RG, SS and KS conducted the data analyses, JA aided in interpretation. JA & MBE helped conceptualise the study and reviewed and revised the report. All authors approved the final manuscript submission.

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Data Availability.

Data access was given under agreement by Miyagi Prefecture to RG, SS and KS for the purposes of this analysis.

Conflict of interest.

The authors declare no conflicts of interest.

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Tables and figure labels

Supplementary materials

Table 1: Responses Per Wave By Sample

	Sample 1: Private housing				Sample 2: Prefabricated housing			
	No. of families distributed	No. of family response (response rate)	Final no. of cases, aged ≥18y	No. of linked	No. of families distributed	No. of family response (response rate)	Final No. of cases, aged ≥18y	No. of linked
wave 1	12,868	9,413 (73.2%)	22,065	1,084				1,515
wave 2	22,172	14,124 (63.7%)	28,696		15,979	9,336 (58.4%)	19,018	
wave 3	18,357	11,536 (62.8%)	22,511		15,106	7,686 (50.9%)	15,005	
wave 4	14,485	8,657 (59.8%)	15,686		13,042	6,551 (50.2%)	11,830	
wave 5	10,148	5,996 (59.1%)	10,235		6,971	3,842 (55.1%)	7,118	
wave 6	4,841	2,490 (51.4%)	4,421		4,034	2,313 (57.3%)	3,938	

Table 2: Baseline Characteristics Of Respondents

	Total	Sample 1: Private housing	Sample 2: Prefabricated housing
No. of participants (%)	2,599	1,084 (58)	1,515 (42)
Psychological distress			
mean K6 score at wave 1 (SD)		5.54 (5.26)	
mean K6 score, wave 2 (SD)	4.72 (5.10)	4.50 (4.80)	4.90 (5.33)
mean K6 score, wave 6 (SD)	3.99 (4.71)	3.95 (4.57)	4.03 (4.81)
Age group (%)			
18-43y	535 (20.6)	280 (25.8)	255 (16.8)
44-55y	513 (19.7)	238 (22.0)	275 (18.2)
56-64y	570 (21.9)	213 (19.6)	357 (23.6)
65-72y	493 (19.0)	183 (16.9)	310 (20.5)
≥73y	488 (18.8)	170 (15.7)	318 (21.0)
Female	1,400 (53.9)	588 (54.2)	812 (53.6)
Household damage (1-4; Mean, SD)		2.45 (1.42)	
Have a supporter (wave 2) (N, %)	1,906 (82.4)	857 (86.0)	1,049 (79.7)
Individual activity (decreased, wave 2, N, %)	1,225 (52.4)	493 (48.2)	762 (55.5)
History of psychiatric disease (N, %)	56 (2.2)	24 (2.2)	32 (2.1)
Suffered family loss (N, %)		88 (8.1)	

Table 3: Multi-level Model Of Psychological Distress Over Time: Sample 1: Private Housing 2011-2016 [Beta Coefficients, (p values)).

	Random intercept (Baseline) model (Pr (t))	Model 1 (wave only, fixed effects)	Model 2 (level-2 predictors, fixed effects)	Model 3 (level 3 predictors, fixed effects)	Model 4 (random coefficient)	Model 5 (cross-level interactions)	Three-level model 1 (Model 6)
Wave		-.27 (.001)	-.17 (.001)	-.16 (.001)	-.16 (.001)	-1.59 (.05)	
Sex			1.69 (.001)	1.76 (.001)	1.74 (.001)	1.66 (.001)	
Age group			-0.06 (.60)	-0.07 (.58)	-0.07 (.59)	-0.26 (.17)	
Less activity vs. same/more			-1.54 (.001)	-1.52 (.001)	-1.51 (.001)	-1.59 (.001)	
Psychiatric history			3.13 (.001)	3.13 (.001)	2.96 (.001)	6.01 (.001)	
Individual-level support			-1.54 (.001)	-1.57 (.001)	-1.51 (.001)	-1.31 (.01)	
Family loss			0.09 (.85)	0.17 (.72)	.18 (.70)	0.04 (.95)	
Household damage			-.04 (.86)	0.00 (1.00)	.02 (.95)	.03 (.94)	
City-level activity				0.00 (1.00)	.00 (.99)	.00 (1.00)	
City-level support				-0.04 (.43)	-.04 (.42)	-.04 (.42)	
Wave * sex						.02 (.84)	
Wave * age group						-.05 (.19)	
Wave * psychiatric						.83 (.02)	
Wave * individual support						-.07 (.56)	
Wave * Family loss						.03 (.81)	
Wave * Household damage						.00 (.99)	
Level 1 variance	14.01	14.03	12.44	12.47	19.47	19.01	13.92
Level 2 variance	8.71	8.45	6.48	6.56	5.71	5.71	8.71
Level 3 variance							0.11
Fit statistics- AIC/BIC	31439.0 31454.0	31259.4 31315.3	12180.4 12227.8	11977.0 12032.9	11946.7 12011.2	11953.5 12048.1	31439.5 31445.0
% explained		2.99	25.61	24.68	34.44	34.44	

Note: Cross-level interactions (model 5) are retained for illustrative purposes but did not add to the model. Repeating this Model with city level interactions provided an inferior fit, with no city-level interactions; this is available from the first author.

Table 4: Multi-level Model Of Psychological Distress Over Time: Sample 2: Prefabricated Housing 2012-2016 [Beta Coefficients, (p values)).

	Random intercept (Baseline) model (Pr (t))	Model 1 (wave only, fixed effects)	Model 2 (level-2 predictors, fixed effects)	Model 3 (level 3 predictors, fixed effects)	Model 4 (random coefficient)	Model 5 (cross-level interactions)	Three-level model 1 (Model 6)
Wave		-.18 (.001)	-.16 (.001)	-.16 (.001)	-.15 (.001)	-.74 (.11)	
Sex			.58 (.01)	.59 (.001)	.58 (.01)	.73 (.04)	
Age group			.01 (.91)	-.01 (.87)	-.00 (.93)	-.18 (.17)	
Less activity vs. same/more			-1.41 (.001)	-1.40 (.001)	-1.40 (.001)	-1.62 (.001)	
Psychiatric history			2.85 (.001)	2.84 (.001)	2.76 (.001)	3.88 (.001)	
Individual-level support			-1.98 (.001)	-1.99 (.001)	-1.95 (.001)	-2.36 (.001)	
City-level activity				.07 (.29)	.07 (.28)	.07 (.28)	
City-level support				-0.55 (.01)	-0.56 (.01)	-0.56 (.01)	
Wave * sex						-.03 (.62)	
Wave * age group						-.04 (.11)	
Wave * psychiatric						.25 (.22)	
Wave * individual support						.10 (.25)	
Level 1 variance	15.94	15.94	12.41	12.26	21.42	20.62	15.73
Level 2 variance	9.47	9.40	9.06	9.06	7.99	8.00	9.47
Level 3 variance							0.29
Fit statistics- AIC/BIC	34604.6 34620.6	34567.1 34588.4	31261.7 31309.5	31249.4 31307.9	31186.1 31255.2	31189.8 31285.6	34597.7 34596.1
% explained		0.74	4.33	4.33	15.63	15.63	

Note: Cross-level interactions (model 5) are retained for illustrative purposes but did not add to the model. Repeating this Model with city level interactions provided an inferior fit, with no city-level interactions; this is available from the first author