Improved social services and the burden of post-traumatic stress disorder among economically vulnerable people after a natural disaster: a modelling study

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Summary

Background **Hurricanes and other natural disasters produce public health and economic consequences that last well beyond their immediate aftermath. Resource loss is a core driver of post-traumatic stress disorder (PTSD) after large-scale traumatic events. We examined the effect of restoration of residential and housing-related financial resources on recovery from PTSD in post-disaster contexts.**

Methods **We built an agent-based model, empiricised with observational and experimental data, to test the effects of differing health service approaches on PTSD recovery, measured by prevalence and persistence. We tested a social services case management (SSCM) approach similar to Psychological First Aid, featuring shelter-based social service provision and linkage to mental health treatment for people who were displaced and had income loss, by comparing the treatment effectiveness of usual care alone, usual care with SSCM, stepped care alone, and stepped care with SSCM.**

Findings **An SSCM approach to restore housing and provide linkage to mental health services among people who were displaced and had income loss after a large-scale natural disaster resulted in between 1·56 (95% CI 1·55–1·57) and 5·73 (5·04–6·91) times as many remitted PTSD cases as non-SSCM conditions at the end of the first year, and between 1·16 (1·16–1·17) and 2·28 (2·25–2·32) times as many remitted cases at the end of the second year.**

Interpretation **Restoring economic and housing resources to populations affected by a natural disaster would significantly reduce the mental health burden in populations, particularly those with resource loss, after a disaster.**

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Introduction

Hurricanes and other natural disasters produce public health and economic consequences that last well beyond the immediate aftermath.[1] Post-traumatic stress disorder (PTSD) is the sentinel mental health consequence of disaster exposure, and includes symptoms of re-experiencing of trauma, avoidance, emotional numbing, hyperarousal, and social and occupational disability.[2,3] The prevalence of PTSD following disasters typically ranges from 5% to 40%, depending on proximity and degree of traumatic exposure.[2] Costs of treatment for PTSD are substantial, with an average excess yearly medical cost of between $2500[4] and $4000 per person in the USA.[5] Although most people with PTSD return to pre-event or close to pre-event function in time, about 13–22% experience chronic and severe symptomatology.[6,7]

One of the core drivers of PTSD after large-scale traumatic events is resource loss. The Conservation of Resources Theory[8] posits that loss of resources (including economic, residential, and psychological resources) is primary in the stress process and that resource loss begets further loss, whereas resource gain begets further gain. Maslow's Hierarchy of Needs[9] argues that needs for shelter and financial stability precede the management of psychological stress reactions and that inability to meet those more basic needs might perpetuate psychopathology. Several studies provide empirical support for these theories. Resource loss (social and material) after Hurricane Hugo, in 1989, was the most influential predictor of post-traumatic distress, with affected individuals approximately four to seven times more likely to experience psychological distress.[10] A study[11] of residents of Mississippi who were exposed to Hurricane Katrina found that income loss was associated with twice the odds of developing hurricane-related PTSD, whereas hurricane-related stressors, including displacement, were associated with 2·5 times the odds of PTSD. People with housing-related adversity, including repeated relocation and poor housing quality, were 60% less likely to recover from PTSD about 2 years after Hurricane Katrina.[12] Displacement of populations after large-scale traumatic events frequently compounds individual-level resource loss and is a determinant of population-level PTSD burden.[2,8]

An Institute of Medicine report[1] notes that "further research is needed to understand how early identification

Research in context

Evidence before this study

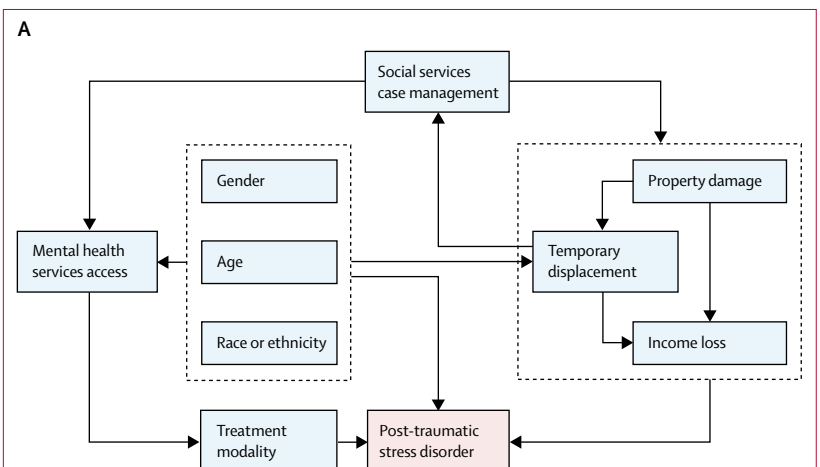
We searched PubMed and Google Scholar using the terms "(PTSD OR Posttraumatic Stress Disorder OR Post-traumatic Stress Disorder)," "Disaster," "(Earthquake OR Flood OR Hurricane)," "Social Services," "(Income OR Income Loss)," "Housing," and "Displacement." There were no language or date restrictions on our search. One of the core drivers of post-traumatic stress disorder (PTSD) after large-scale traumatic events is resource loss, including income loss, displacement, and housing-related adversity. Few studies have examined how the restoration of resources among people who have been displaced or had housing-related income decline is associated with PTSD burden and recovery.

Added value of this study

This study examines, in silico, whether the restoration of residential and financial resources mitigate the mental health consequences of large-scale traumatic events. Restoration of material resources through a social services case management intervention augments mental health treatment efforts to reduce the burden of post-disaster PTSD among economically vulnerable people.

Implications of all the available evidence

Meeting the social services needs of people exposed to a natural disaster would significantly benefit population mental health in post-disaster contexts. Future research should confirm the treatment effectiveness and cost-effectiveness of social services case management in real-world settings and across post-disaster contexts.



B

Treatment effectiveness	Shelter	Temporary housing	Home	Income decline
0·60				
0·63				
0·77				
0·95				
1·00				

Figure 1: **Hurricane Sandy model overview (A) and schematic of mental health treatment effectiveness (B)**
Arrows indicate associations between model variables (A). Effectiveness is ranked according to combinations of an agent's current housing conditions and income decline; shaded boxes represent the presence of a given condition (B).

of and support for vulnerable populations reduce long-term psychological consequences or recovery needs". A secondary prevention approach that aims to mitigate initial resource loss by providing financial relief and housing resources might therefore be an efficient strategy for limiting associated mental health symptoms. This approach is broadly consistent with the goals of Psychological First Aid, an evidence-informed programme designed to reduce distress and enhance adaptive functioning in the hours and days following disaster exposure.[13] Psychological First Aid is centred on immediate stabilisation and reduction of secondary stressors, including practical assistance, linkage to services, and provision of information on coping strategies.[13]

To our knowledge, only one study[14] has explored how the restoration of resources among people with displacement or housing-related income decline is associated with PTSD burden and recovery. Although several studies have examined how changes in resources among those with initial loss relate to psychiatric symptoms, all but one[14] are focused on psychological, rather than material, resources.[15] The paucity of data addressing economic and residential resource loss is understandable given the logistical difficulty of doing such work among vulnerable populations in the post-disaster period and ethical challenges accompanying randomisation of resource delivery.

One way to overcome these barriers and still provide empirical data is to do experiments in silico.[16] Agent-based models provide an approach to deal with such challenges, while creating counterfactuals that can test experimental designs.[16] We used an agent-based model to create discrete stochastic simulations to estimate treatment effects under varying assumptions and counterfactual comparisons.[16] We examined the effect of a social services case management (SSCM) package, provided in a shelter setting, intended to expedite the return home to permanent housing and provide direct linkage to mental health services on prevalence and persistence of PTSD. Additionally, we combined the SSCM package with one of two mental health treatment approaches: usual care, which consisted of skills for psychological recovery, and

stepped care, which consisted of a triage screening followed by referral to skills for psychological recovery for people without PTSD or cognitive behavioural therapy (CBT) for people with PTSD.

Building on previous research, we examined two central questions. First, how effective is usual care alone compared with usual care with SSCM, stepped care alone, and stepped care with SSCM in reducing the prevalence of PTSD over a 2-year period? Second, how effective is usual care alone compared with usual care with SSCM, stepped care alone, and stepped care with SSCM in reducing the persistence of PTSD over a 2-year period? We explored these questions among the full population affected by a large-scale traumatic event and among only those with income loss and displacement due to the event.

Methods

Model structure

We built a model that was empiricised with data collected during Hurricane Sandy, which made landfall in New York City, NY, USA in 2012, as a post-tropical cyclone and resulted in approximately 6800 residents of New York City being evacuated.[17] Our model simulates the effect of differing population health approaches to disaster survivors' resource needs on recovery from PTSD during 2 years of follow-up. Our initial model, including findings and technical documentation has been published.[18] In this iteration of the model, we added features and parameters to simulate shelter-based social service provision and linkage to mental health services for displaced people with income loss. Our model design further assumes that wealth is associated with higher probabilities of transitioning out of PTSD symptom and case states by buffering income loss and facilitating a faster return home from displacement and temporary shelter.

An overall model schematic is shown in figure 1. People in the simulation (referred to as agents) were assigned a PTSD symptom score, derived from Hurricane Sandy survey data (HSSD),[19] based on demographic composition and exposure to hurricane-related stressors, including housing damage, temporary displacement, and income loss. PTSD symptom scores were collapsed into positive or negative case status to generate effectiveness measures. Agents were further classified into an ordered set of mental health states encompassing post-hurricane housing-related stressors and income decline. These mental health states were each associated with a corresponding effectiveness parameter related to mental health treatment and natural symptom decay (figure 1). Every timestep approximated 1 week, and agents could access or discontinue health services and social services, including usual care, stepped care, and SSCM, with discontinuation disrupting mental health treatment effects or access to housing and income resources. Over time, agents might transition out of PTSD status because of receipt of mental health services, SSCM, natural symptom decay, or a combination thereof. A model timeline is provided in the appendix.

See Online for appendix

	Model population (n=1 000 000)	American Community Survey, 2008–12 (n=2 642 713)	Hurricane Sandy Survey (n=1000)*
Borough			
Bronx	12·18	321 988 (12·2%)	..
Brooklyn	23·09	610 125 (23·1%)	..
Manhattan	33·62	888 692 (33·6%)	..
Queens	20·29	536 230 (20·3%)	..
Staten Island	10·82	285 678 (10·8%)	..
Sex			
Female	52·56	1 389 369 (52·6%)	..
Male	47·44	1 253 344 (47·4%)	..
Age, years			
18–34	33·95	721 798 (34·1%)	..
35–64	48·94	1 035 234 (48·8%)	..
≥65	17·11	361 961 (17·1%)	..
Race or ethnicity			
White non-Hispanic	42·84	1 132 009 (42·8%)	..
Black non-Hispanic	17·72	468 164 (17·7%)	..
Other non-Hispanic	12·37	326 957 (12·4%)	..
Hispanic	27·07	715 583 (27·1%)	..
Income, US$			
≤40 000	48·80	..	324 (47·2%)
>40 000–80 000	21·09	..	191 (20·6%)
>80 000	30·11	..	325 (32·2%)
Household size			
1	77·03	..	757 (77·4%)
2	12·96	..	166 (13·0%)
3	5·05	..	42 (4·8%)
≥4	4·96	..	34 (4·7%)

Data are n (%). *Hurricane Sandy Survey frequencies are unweighted whereas the percentages are weighted.

***Table*: Comparison of simulated agent population with New York City American Community Survey and Hurricane Sandy Survey estimates**

Agent demographics, household predictions, and stressor exposures

Borough of residence and agent demographics such as age, race or ethnicity, and gender were derived from the American Community Survey 2008–12.[20] Agent distributions of household size and income were derived from HSSD.[19] Agents were assigned to households by matching them according to household size, borough, household income, and race or ethnicity. Demographic characteristics of our input data and agent pseudo-population are shown in the table.

Household income was calculated by summing individual income reported in HSSD among household members. Individual wealth was estimated as saved income and calculated by multiplying an agent's employment duration (ie, number of years lived over

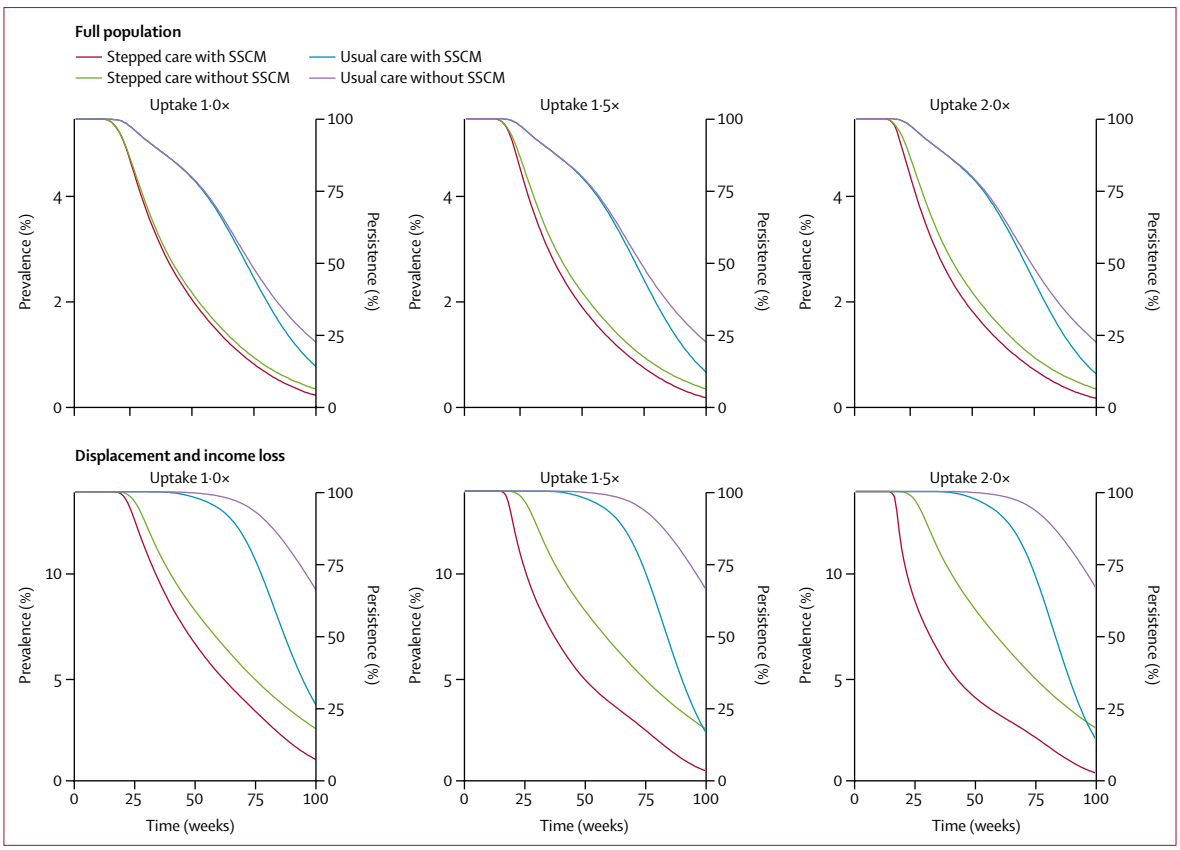


Figure 2: **Prevalence and persistence of post-traumatic stress disorder among the full population and agents with displacement and income loss**
SSCM=social services case management.

age 18) by their income and expense-to-income ratio. Household wealth was calculated by summing individual wealth among household members. Data for the US average annual expenditure by income level was derived from the 2012–13 Consumer Expenditure Survey.[21]

HSSD were used to predict the severity of housing damage. Damage was categorised into three groups: no damage, moderate damage, and severe damage. We assumed that damage categories observed within our HSSD aligned with Federal Emergency Management Agency (FEMA) individual assistance claims from Hurricane Sandy,[22] such that moderate damage was associated with claims of US$1–$25 000 and severe damage was associated with claims of $25 001–$40 000. Within each category of damage, the specific dollar amount was randomly assigned, achieved with a random number generator.

Displacement was predicted in two steps. First, we predicted the loss of three types of utilities (ie, electricity, heat, and water), on the basis of damage severity and borough of residence. Second, we predicted displacement on the basis of utility loss, damage severity, and age. Displaced agents spent 1–4 weeks staying in a shelter, after which they moved to temporary housing or back home, depending on their wealth. Those with enough wealth to offset housing damages moved back home following their shelter stay, whereas those without enough wealth moved to temporary housing.

Symptoms and prevalence estimates

We used HSSD to estimate a suitable cutoff point for the number of symptoms that corresponds to a probable PTSD diagnosis. By use of a receiver operating characteristic curve, with a PTSD checklist symptom score of 44 as a gold standard for the Diagnostic and Statistical Manual of Mental Disorders 4th edition definition of PTSD,[23] we determined that six symptoms was the optimal cutoff point for caseness, maximising sensitivity (1·00) and specificity (0·96). Within this current simulation, agents with six symptoms were true cases and we set our base-case screening sensitivity and specificity to 0·80 each. We parameterised our model with distributions of PTSD symptoms and prevalence observed in HSSD, based on cross-classifications of stressors (housing damage, temporary displacement, and income decline) and age. These parameters are shown in the appendix.

Resource loss and mental health states

We created an ordered classification of mental health states based on current exposure status for income

decline, and current housing type—ie, shelter, temporary housing or home (figure 1). We derived assumptions about the decrement in effectiveness of mental health treatment and natural decay based on data that track the persistence of PTSD symptoms among Hurricane Katrina survivors from Mississippi through the first 2 years after the hurricane.[24] Using these data to estimate hazard ratios of time to symptom remission, we set effectiveness parameters for mental health states as follows: home with no housing-related income loss (1), home with housing-related income loss (0·95), shelter without housing-related income loss (0·63), and finally shelter with housing-related income loss (0·60). We did not have data to estimate the parameter for time spent in temporary housing with no income decline and set it to 0·81, approximately the midpoint between the effectiveness parameters for being home with no housing-related income loss (1) and time spent in shelter without housing-related income loss (0·63); similarly, we set the effectiveness parameter for temporary housing with income decline to 0·77. The possible mental health state change paths of agents are shown in the appendix.

Usual care versus stepped care

In an earlier study,[18] we showed stepped care to be superior to usual care in terms of reach and effectiveness, while being cost-effective. Usual care refers to the provision of skills for psychological recovery, a moderate strength, five-session treatment aimed at reducing stress and improving coping and functioning.[25] A full course of skills for psychological recovery was set to reduce an agent's symptoms by a proportion of 0·20. Stepped care combines a case-finding screening process with referral to the appropriate level of care, with cases referred to an upper treatment step (ie, CBT for PTSD) and non-cases referred to a lower treatment step (ie, skills for psychological recovery).[26] A full course of CBT, which consists of eight to 12 sessions, was set to reduce an agent's symptoms by a proportion of 0·36.[27] Probabilities of accessing mental health services, including skills for psychological recovery and CBT, were estimated for cases of PTSD and non-cases separately, using race or ethnicity, sex, and age. Equations used to calculate uptake probabilities were estimated from World Trade Center data[28] (appendix). A natural decay function, set to reduce symptoms by a proportion of 0·14 over 12 weeks, independent of treatment, was also used and affected 30% of untreated agents.[29]

Social services case management

FEMA Individual Disaster Assistance claim reimbursements were randomly distributed to qualifying agents over a time period of 4–78 weeks, in accordance with the proportions of loans approved by FEMA.[30] Under SSCM, 100% of agents who were displaced and had income loss were provided with expedited access to personal relief loans of up to $10 000 that are non-FEMA based, over simulation weeks 1–8. Agents with access to SSCM were

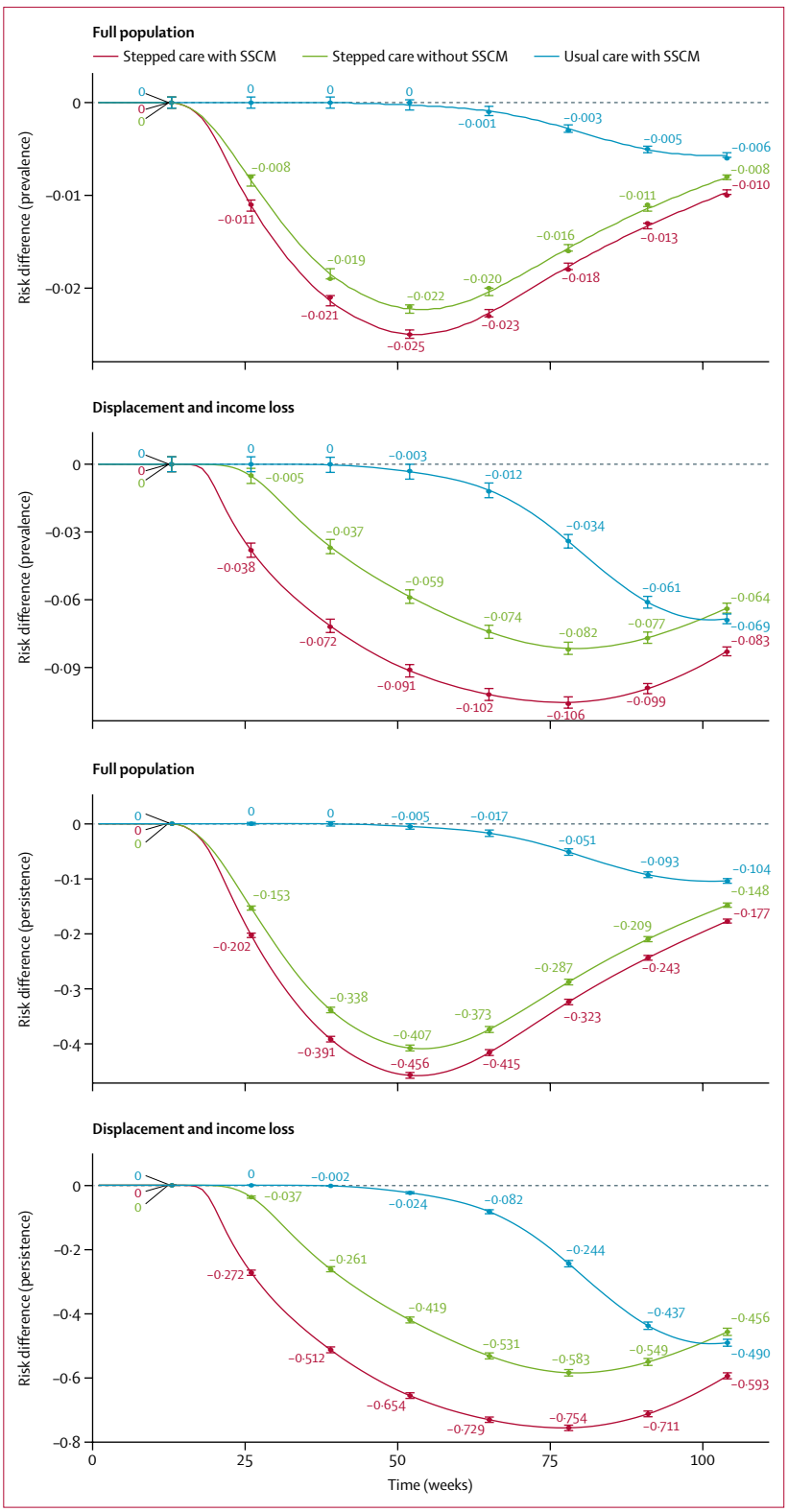


Figure 3: **Risk differences for prevalence and persistence of post-traumatic stress disorder among the full population and agents with displacement and income loss**
SSCM=social services case management.

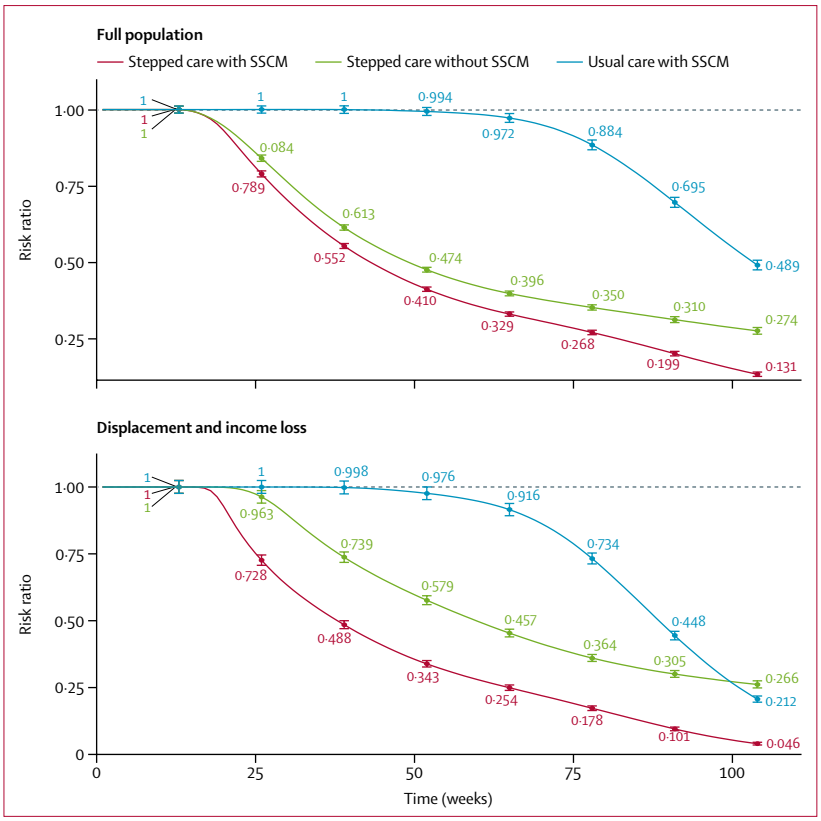


Figure 4: **Risk ratios for prevalence and persistence of post-traumatic stress disorder among the full population and agents with displacement and income loss**
SSCM=social services case management.

screened during their shelter stay to assess their financial resources needs by evaluating the extent of their housing damage and related income loss. Among agents not assigned to SSCM, 20% of agents could access private personal loans of $10 000 over simulation weeks 1–14. A secondary SSCM feature assumed in our models was that accessing SSCM potentiated mental health services uptake, as referral is part of the SSCM package. We present three scenarios for the strength of potentiation of mental health services uptake under SSCM: no effect, 1·5 times increased uptake (base case), and two times increased uptake.

Model scenarios and details

Starting immediately after the hurricane, each of the four models (usual care alone, usual care with SSCM, stepped care alone, and stepped care with SSCM) was run for 104 timesteps, representing 2 years. Mental health services were not available to agents until week 5. Results from these models are presented for the hurricane-affected areas of NYC and among the subset of those who were displaced with income loss.

The model was developed using C++ and implemented in Microsoft Visual Studio 2012. Stochasticity was accounted for in the modelling process by running each model scenario 50 times and reporting mean statistical effect measures. We computed the 2·5th and 97·5th percentiles calculated across those 50 simulations. In the appendix, we provide an overview of the model and submodels, pseudocode, and an elaboration of design concepts and model details in the form of an overview, design concept, and details protocol.[31]

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

Prevalence and persistence of PTSD under usual care without SSCM, usual care with SSCM, stepped care without SSCM, and stepped care with SSCM are shown in figure 2 for the full population and among agents with displacement and income loss, with SSCM mental health services uptake potentiation scenarios of no effect, 1·5 times, and two times increased uptake. Among the full population, prevalence and persistence were lowest under stepped care with SSCM, followed by stepped care without SSCM, usual care with SSCM, and usual care without SSCM. Among agents with displacement and income loss, prevalence and persistence for stepped care without SSCM and usual care with SSCM came closer together, and even crossed over, at the very end of the simulation period, under 1·5 times and two times potentiation.

Risk differences (RDs) between usual care without SSCM (the reference category) and the other three conditions for PTSD prevalence, and PTSD persistence over 2 years of follow-up, under a base-case SSCM potentiation of mental health services of 1·5 times increased update, are shown in figure 3. Among the full population, a U-shaped pattern of RDs occurred between the stepped care conditions and usual care without SSCM, with monotonic increases in effect plateauing around week 50, followed by monotonic decreases in effect measure through the end of the simulation. For prevalence, the maximum benefit for usual care with SSCM was RD –0·006 (95% CI –0·006 to –0·005), whereas that for stepped care without SSCM was RD –0·022 (–0·023 to –0·022), and that for stepped care with SSCM was RD –0·025 (–0·025 to –0·025). For persistence, the maximum benefit for usual care with SSCM was RD –0·104 (–0·108 to –0·100), whereas that for stepped care without SSCM was RD –0·407 (–0·412 to –0·402), and that for stepped care with SSCM was RD –0·456 (–0·462 to –0·451). Among those with displacement and income loss, the RD effect measure lines for stepped care conditions compared with usual care alone curve downward, with parallel and monotonic increases in RDs plateauing around week 80, followed by

a decrease through the end of the simulation. For prevalence, the maximum benefit for usual care with SSCM was RD –0·069 (–0·071 to –0·066), whereas that for stepped care without SSCM was RD –0·082 (–0·084 to –0·079), and that for stepped care with SSCM was RD –0·106 (–0·108 to –0·103). For persistence, the maximum benefit for usual care with SSCM was RD –0·490 (–0·501 to –0·479), whereas that for stepped care without SSCM was –0·583 (–0·593 to –0·573), and that for stepped care with SSCM was RD –0·754 (–0·763 to –0·746).

Risk ratios (RRs) that compare usual care with SSCM, stepped care without SSCM, and stepped care with SSCM to usual care without SSCM (reference category) for the full population, and for agents who were displaced and experienced income loss, over 2 years of follow-up, under the SSCM base case of 1·5 times mental health services uptake potentiation, are shown in figure 4. Among agents with income loss and displacement, RRs for stepped care conditions strengthened monotonically in parallel, starting between weeks 12·5 and 25. RRs for usual care with SSCM began to strengthen monotonically starting between weeks 37·5 and 50 and continued to get stronger throughout the simulation, eventually crossing over the RR effect measure line for stepped care without SSCM. Among those displaced with income loss, the maximum RR for usual care with SSCM (0·212, 95% CI 0·200–0·223) exceeded that for stepped care without SSCM only in the final weeks of the simulation (0·266, 0·253–0·280), but never exceeded that for stepped care with SSCM (0·046, 0·041–0·051). The pattern of RRs among the full population was similar to that among those displaced with income loss, although the effects of the SSCM were weaker.

The number of agents with PTSD who remitted per 100 initial cases under each treatment condition, in 3-month increments over the simulation, is shown in figure 5. Stepped care with SSCM was superior to all other conditions. Cases remitted under stepped care without SSCM showed a pattern of increase that paralleled stepped care with SSCM. Cases remitted under usual care without SSCM and usual care with SSCM were similar through about weeks 39–52, but began to separate clearly at 65 weeks, with much greater divergence among agents who were displaced with income loss, relative to the full population.

We did sensitivity analyses that halved the decrement in treatment and natural decay effectiveness imposed by stressor combinations in our base-case analysis (appendix). The ordering of effectiveness in both the full population and among those with displacement and income loss was the same as in the base-case scenario. Risk differences showed the same shape patterns as their base-case counterparts. RRs for the SSCM conditions were weakened relative to the base-case scenario (appendix). In each of these sets of results, the difference between SSCM and non-SSCM conditions were minimised but still strong.

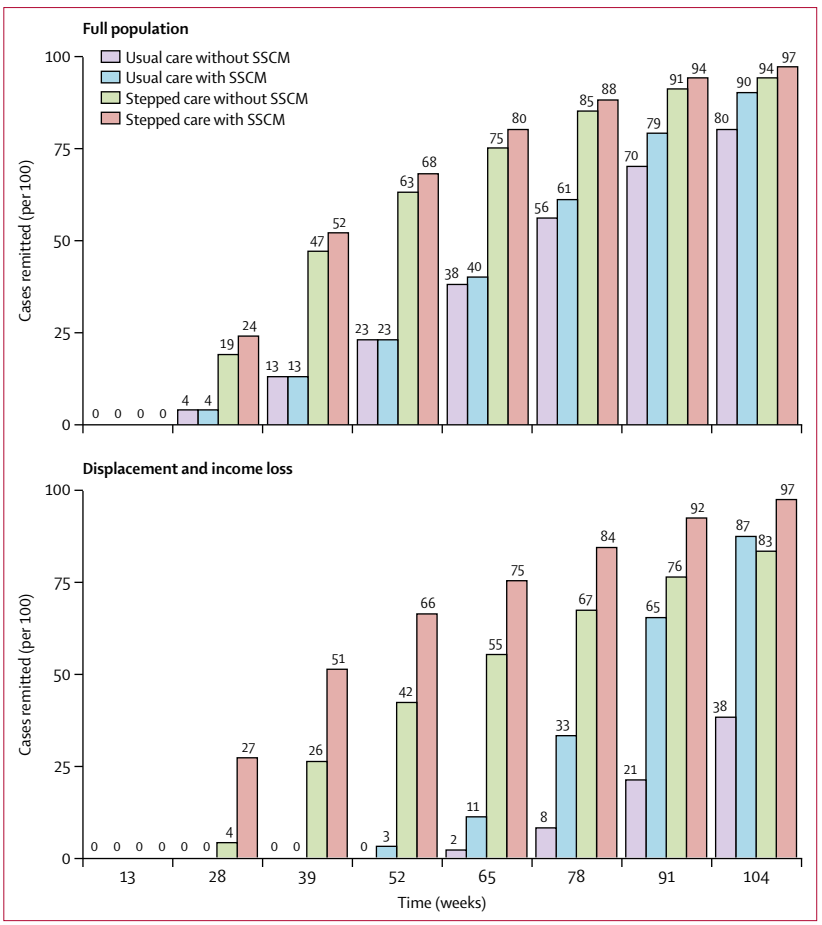


Figure 5: **Post-traumatic stress disorder cases remitted per 100 cases under each treatment condition, among the full population and agents with displacement and income loss**
SSCM=social services case management.

Discussion

Using in silico experiments, we showed that an SSCM approach to restore housing and provide mental health services linkage among those who were displaced and had income loss after a large-scale natural disaster was associated with substantially greater recovery from PTSD compared with non-SSCM conditions in the first 2 years after the event. SSCM was associated with 1·6–5·7 times as many remitted PTSD cases compared with non-SSCM conditions in the first year, and 1·2–2·3 times as many remitted cases at the end of the second year. This effect was diluted in the general population, proportional to the number of individuals who were not eligible for SSCM (ie, agents without income loss and displacement).

The finding that resource gain after initial loss, experienced through an SSCM intervention, augments mental health services efforts to reduce the prevalence and persistence of PTSD among those who are displaced and have income loss is consistent with both psychological theory and empirical findings. Specifically, our study is consistent with both conservation of resources[8] and Maslow's Hierarchy of Needs.[9] To our

knowledge, only one empirical study[14] has examined the effect of socioeconomic resource gain following initial loss on mitigating the mental health consequences of mass traumatic events. Examining a sample of survivors of Taiwan's Chi-Chi earthquake, researchers found that 1 year after the event, people with no change in economic resources had the lowest PTSD symptom severity, followed by those with resource gain, those with a mixture of resource loss and gain, and those with resource loss alone.[14] Notably, most studies on resource gain after traumatic events focus on psychological and social, rather than economic, resources.[15]

The persistence of disaster-related PTSD[6,32] and stressors[24,32] years after earlier events has suggested a need for policy makers to expand post-disaster systems of mental health care to focus on a broader set of contextual treatment targets, and leverage a range of funding sources and service providers.[33] The results of this study, which expands that focus to include housing-related and income-related stressors, provide evidence that such an approach could be superior to standard treatment programmes in reducing the population burden of post-disaster PTSD, particularly in economically disadvantaged communities. Future research should confirm the treatment effectiveness and cost-effectiveness of SSCM in real-world settings and across post-disaster contexts.

This study has several limitations. First, this study was done using a simulation and is necessarily constrained by the quality of our model assumptions and inputs. These limitations are offset by our use of high quality inputs via population-based samples from Hurricane Sandy,[19] augmented by data from other mass traumatic events.[11,28] Second, although our study is centred on the effect of an SSCM package on the mental health of those with displacement and resource loss, we did not model other hurricane-related social and economic factors that could influence mental health, such as housing or income resources provided as in-kind support by friends or family, or changes in employment. Despite this limitation, our focus was narrowly on housing-related income loss as a first step towards understanding how restoration of social services can mitigate the consequences of large-scale traumatic events; future work might fruitfully explore a wider range of resource loss and how best to buffer vulnerable populations from these challenges. Third, we did not include a PTSD relapse function in our model, because of challenges in calibrating this model element after introducing housing status, housing-related income loss, and their corresponding mental health states to our simulation, resulting in stronger relative treatment effects (RRs). However, our findings show similar absolute effects (RDs) of stepped care compared with usual care relative to our earlier version of this model.[18] Future work should incorporate the modelling of relapse with that of hurricane-related stressors. Fourth, providing SSCM would increase service provision costs, but we did not model costs in this simulation. Nonetheless, we have shown the cost-effectiveness of stepped care in an earlier simulation;[18] and the treatment effectiveness of SSCM in the present simulation suggests that the costs of SSCM would be offset by reducing the need for mental health services.

Notwithstanding the above limitations, we found that restoring services to populations affected by a natural disaster could significantly benefit the mental health of exposed populations, in particular those with resource loss. This is, as far as we know, the first experimental demonstration, albeit in silico, of the potential value on mental health recovery of population health approaches broadly addressing resource needs and provides a strong endorsement of such approaches in the post-disaster context.

Contributors

GHC, ST, SL, LS, and SG designed the study. GHC, ST, SL, and LS did the statistical analysis. GHC, ST, SL, and SG drafted the manuscript. SL and SG obtained funding for the study. ST, LS, CE, and SG provided administrative, technical, or material support. SG supervised the study. All authors interpreted the data and provided critical revision of the manuscript for important intellectual content.

Declaration of interests

We declare no competing interests.

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