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Psychological Resilience and Dysfunction Among Hospitalized Survivors of the SARS Epidemic in Hong Kong: A Latent Class Approach

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Objective: To examine trajectories of psychological functioning using latent class analysis on a sample of hospitalized survivors of the 2003 severe acute respiratory syndrome (SARS) epidemic in Hong Kong. ***Design***: A longitudinal study of 997 survivors, recruited from among 1,331 individuals hospitalized for SARS, were interviewed at 6, 12, and 18 months after hospitalization. ***Main Outcome Measures***: Psychological and physical functioning at each time point was measured using the 12-item Medical Outcome Study Short-Form Health Survey (SF-12). ***Results***: Four latent classes were identified—chronic dysfunction, delayed dysfunction, recovery, and resilience. All groups had better physical health than the chronic group. Resilient and recovered individuals had greater social support and less SARS-related worry, and resilient individuals were more likely to be male. The resilient group also had greater social support than the delayed group and better physical functioning than the recovered group. ***Conclusion***: This study demonstrated that longitudinal outcome trajectories following a major health-threat event in an Asian sample bear close resemblance to prototypical trajectories observed in trauma studies using Western samples. Unique predictors of the trajectories included factors observed in previous studies, such as social support, as well as factors of particular relevance to a major disease outbreak, such as SARS-related worry.

Keywords: SARS, resilience, disaster, epidemic

The threat of a global pandemic from microbial infection and bioterrorism has become a dominant international health concern (Ursano, 2005). The global outbreak of severe acute respiratory syndrome (SARS) in 2003 suggests a prototype of such a pandemic and one that potentially offers vital insights into ways the world might better prepare for future outbreaks. SARS is a highly contagious respiratory illness first reported in Guangdong Province, People's Republic of China, toward the end of 2002. Unknown prior to its first appearance, SARS spread rapidly and broadly, and by the spring of 2003 more than 8,000 individuals were infected in more than 30 different countries. Moreover, SARS was potentially lethal. When it was finally contained in the summer of 2003, through a combination of stringent hygiene precautions and quarantine measures, SARS had claimed 800 lives (Ho, Kwong-Lo, Mak, & Wong, 2005; W. Ho, 2003; Peiris et al., 2003).

Initial research on SARS in China revealed high levels of fear and distress, both among health care providers (e.g., S. M. Y. Ho et al., 2005; Tam, Pang, Lam, & Chiu, 2004) and among the general population in the most highly exposed areas (Huang, Dang, & Liu, 2003; Qian, Ye, & Dong, 2003; Shi et al., 2003). Although most of this research was cross-sectional, several prospective studies in Hong Kong compared psychological adjustment before and during the outbreak. These studies associated the SARS epidemic with increased depression and emotional distress in the general population (Yu, Ho, So, & Lo, 2005) and with greater rates of suicide (Chan, Chiu, Lam, Leung, & Conwell, 2006).

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The psychological toll was particularly severe for people who had been infected and hospitalized for SARS but survived. For example, hospitalized survivors of the SARS epidemic in Hong Kong experienced significantly more stress than a matched group of healthy controls from the same geographic area (Chua et al., 2004). One study reported that 35% of hospitalized survivors experienced moderate to severe levels of anxiety and depression (Cheng, Wong, Tsang, & Wong, 2004). Another study reported that 16% of hospitalized survivors met criteria for depression and that 10% met criteria for posttraumatic stress disorder (PTSD; Yan, Dun, & Li, 2004).

Beyond these initial findings, however, little is known about the range of psychological functioning among hospitalized survivors or the extent that hospitalized survivors may have shown resilience. There has also been relatively little research on changes in psychological functioning among hospitalized survivors over time or on the factors that may have fostered and impeded survivors' psychological functioning during and after the crisis.

The current study was designed to address this deficit. Specifically, we first identified trajectories of psychological functioning across time using latent class growth curve analyses on data from a large sample (N = 997) of hospitalized survivors of the SARS epidemic in Hong Kong. As discussed later, we anticipated that the data would reveal four prototypical trajectories observed in previous studies of highly stressful and potentially traumatic life events (Bonanno, 2004, 2005). In subsequent analyses, we then examine possible predictors of these trajectories by including covariates in the model.

Prototypical Outcome Trajectories

Although most people are exposed to at least one highly aversive and potentially traumatic event (PTE) during their lives (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995), there are marked individual differences in how people respond to such events over time. A growing body of longitudinal studies has indicated that most people's long-term psychological reactions to PTEs can be reliably captured by four prototypical outcome patterns or trajectories across time (Bonanno, 2004, 2005). Previous studies have identified these trajectories using a normative comparison approach that defines health and dysfunction in relative terms based on the mean and standard deviation for a comparable group of participants (Bonanno, Moskowitz, Papa, & Folkman, 2005) or in relation to established norms for the specified outcome measure (Bonanno, Rennicke, & Dekel, 2005; Foa, Zoellner, Feeny, Hembree, & Alvarez-Conrad, 2002). Prototypical trajectories defined this way are represented graphically in the top half of Figure 1.

A pattern of chronic psychological dysfunction is characterized by consistently low levels of psychological functioning (i.e., psychological functioning more than 1 *SD* below the normative mean) that endure for at least 1 or 2 years after the traumatic event. Typically only a small subset of exposed individuals, usually around 5% to 10%, will experience chronic dysfunction (Kessler et al., 1995). However, these proportions have tended to be higher, sometimes reaching one third of the sample, following more severe PTEs, such as sexual or physical assault (Resnick, Kilpatrick, Dansky, Saunders, & Best, 1993), injury due to motor vehicle accidents (Bryant, Harvey, Guthrie, & Moulds, 2000), or direct exposure to terrorist attack (Galea et al., 2003).

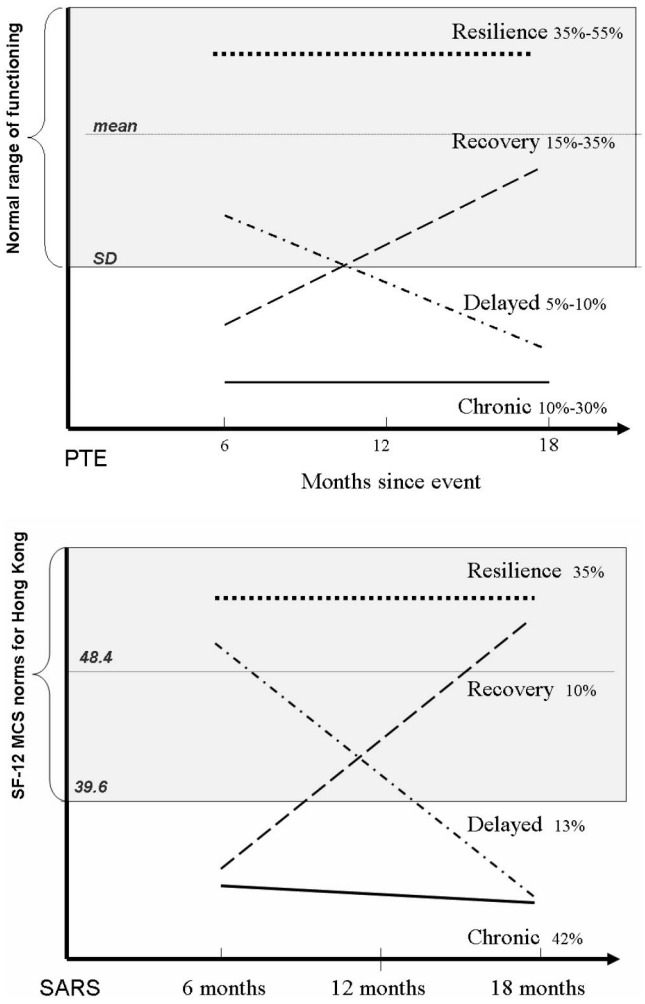

Figure 1. Hypothesized prototypical outcome trajectories (top) and trajectories identified by latent class modeling (bottom) of psychological functioning 6, 12, and 18 months after hospitalization from severe acute respiratory syndrome (SARS). SF-12 MCS = Medical Outcome Study Short-Form Health Survey psychological functioning; PTE = potentially traumatic event.

Among the majority of exposed individuals who do not experience chronic dysfunction, many will exhibit a classic trajectory of psychological recovery, characterized by an initial decrement or drop in psychological functioning to a level below the normal range that endures for several months or longer and then gradually returns to normal population levels, usually over the course of the first year after the event (Bonanno et al., 2002; Bonanno, Rennicke, & Dekel, 2005). There is also a growing body of research showing that large numbers of exposed individuals, and sometimes as many as half the sample or more, manage to endure PTEs with little or no disruption in their normal levels of functioning (i.e., their level of functioning remains within 1 *SD* of the normative mean across time). These individuals appear to be psychologically resilient.

Bonanno (2004) defined resilience among adults as

> the ability of adults in otherwise normal circumstances who are exposed to an isolated and potentially highly disruptive event such as the death of a close relation or a violent or life-threatening situation to maintain relatively stable, healthy levels of psychological and physical functioning. as well as the capacity for generative experiences and positive emotions. (pp. 20–21)

A key distinction is that even though many resilient individuals experience transient distress reactions (e.g., several weeks of distress, intrusive thoughts, difficulty concentrating, or sleeplessness; (Bisconti, Bergeman, & Boker, 2006; Bonanno, Wortman, & Nesse, 2004), they nonetheless still manage to maintain relatively stable levels of normal healthy functioning across time (Bonanno, Galea, Bucciarelli, & Vlahov, 2006; Bonanno, Rennicke, & Dekel, 2005; Bonanno et al., 2002; Bonanno et al., 1995; Deshields, Tibbs, Fan, & Taylor, 2006). Previous studies indicate that this type of resilient outcome is evidenced in 35% to 55% of people exposed to PTEs (Bonanno, 2005).

Finally, some exposed individuals exhibit what appear to be delayed reactions. The frequency of delayed dysfunction tends to vary greatly across studies, usually occurring in less than 10% of exposed individuals but sometimes ranging as high as 25% (Bonanno, 2004). There is some evidence to suggest that exposed individuals who eventually manifest delayed reactions tend to have had moderate to high levels of symptoms in the immediate aftermath of the stressor event that grow only somewhat worse over time (e.g., Buckley, Blanchard, & Hickling, 1996).

The Current Investigation

In the current study, we explored the predictive utility of the prototypical outcome trajectories discussed previously in a large group ($N = 997$) of hospitalized survivors from the SARS epidemic in Hong Kong. The data from Hong Kong were particularly well-suited for this type of longitudinal investigation. Because of its function as major port city and locus of international travel contiguous with the Chinese mainland, Hong Kong was hard hit by the epidemic. Although comparatively small in size and population, Hong Kong was nonetheless second only to mainland China in total number of infected individuals ($N = 1{,}755$) and total number of SARS-related deaths ($N = 299$; World Health Organization, 2003). Moreover, because most hospital care in Hong Kong is managed by a central public institution, the Hospital Authority, it was possible to follow the majority of the hospitalized survivors over time and to examine factors that most clearly predicted long-term psychological outcome. The demographic makeup of the sample closely approximated that of the Hong Kong adult population recorded in the 2001 census with the exception that the current sample had a somewhat higher proportion of women (59.2%) relative to the Hong Kong population (51.7%). We controlled for gender when examining predictors of the outcome trajectories.

Our primary measure for outcome was a global scale for psychological functioning, the Medical Outcome Study Short-Form Health Survey (SF-12; Ware, Kosinski, & Keller, 1996). The SF-12 also provides a measure of physical functioning; in the current study, we used this scale to control for any enduring physical effects of having been infected with SARS. Participants in our sample were administered the SF-12 at 6, 12, and 18 months after hospitalization, and these data were used to identify latent outcome trajectories. Normative data were available for the SF-12 for both U.S. (Ware & Kosinski, 2001; Ware et al., 1996) and Hong Kong samples (Lam, Tse, & Gandek, 2005). Because the results were comparable using norms from either culture, only results using the Hong Kong norms are reported.

The normative comparison approach used in previous studies to identify outcome trajectories has several inherent limitations, most notably participants with missing data are excluded from the analysis and the resulting trajectories typically do not account for 100% of the participants. For these reasons, in the current study we initially estimated the best- fitting trajectories using latent class growth curve modeling. In a subsequent analysis, we examined predictors of the trajectories by repeating the latent class modeling and including potential predictors of class membership as covariates within the model (discussed later). This approach advances previous research in several important ways. First, longitudinal outcome trajectories after potential trauma have not previously been examined in an Asian sample. The very idea of prototypical outcome trajectories emerged from research limited almost exclusively to at-risk samples in North America and Europe. Second, with the exception of a recent study by Deshields et al. (2006) that examined trajectories of psychological outcome following treatment for breast cancer, no research had examined the prevalence of different outcome trajectories following a health-related stressor event. Third, no study had examined the diversity of outcome patterns among an exposed population following a potentially serious disease epidemic, such as SARS, or predictors of those outcome patterns. Our expectation was that hospitalized survivors of the SARS epidemic would in fact exhibit the psychological outcomes within the same range as observed in Western samples exposed to highly aversive stressors. Accordingly, we anticipated that somewhere between one third and slightly more than one half of the sample would exhibit psychological resilience and that 5% to 33% would evidence chronic psychological dysfunction.

In exploring possible predictors of these trajectories, we considered that adjustment following extreme adversity is typically informed by multiple risk and protective factors (Bonanno, 2005; Brewin, Andrews, & Valentine, 2000; Werner, 1995). Based on previous studies of both potentially traumatic events and SARS, in the current study we examined the possible role of demographic factors (age, gender, employment, income, education, marital status, and number of children), prior trauma experiences, and supportive social relations (perceived social support and social network size; Bonanno, Galea, Bucciarelli, &Vlahov, 2007; Chan et al., 2006;Wu, Chan, & Ma, 2005; Yu et al., 2005). In addition, to control for the actual physical impact of SARS infection, we included in our analyses a measure of physical health.

Finally, to explore the role of stress specific to SARS, we included a measure of SARS-related worry. We anticipated that SARS-related worry would be greatest among hospitalized survivors exhibiting chronic psychological dysfunction and lowest among resilient survivors. In the earliest stages of disease outbreak, before effective biological deterrents can be developed, countermeasures are usually limited to behavioral interventions, such as isolation and quarantine. Although these measures can be effective in containing an infection, they also accelerate threat and fear among the general population (Ursano, 2005). In a cross-

sectional study of health care workers in Hong Kong during the SARS epidemic, worries related to SARS were associated with increased posttraumatic stress (S. M. Y. Ho et al., 2005). A study of middle-aged women in Hong Kong likewise associated worries about SARS with elevated distress and depression (Yu et al., 2005). Event-related worries and fears have also been implicated in postevent adjustment to natural disasters, such as earthquakes (e.g., Livanou et al., 2005). The current study was the first to examine the relationship of SARS-related worry to long-term psychological adjustment and whether the relative absence of worries might characterize resilience among hospitalized survivors of the epidemic.

Method

Participants and Procedure

Ethics approval was obtained from the institutional review board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster. Participants were recruited from among 1,331 hospitalized SARS survivors tracked by the Hong Kong Hospital Authority. Potential participants from this pool were invited for interviews at 6, 12, and 18 months after hospitalization, with 951, 977, and 856 responding at each time point, respectively. A total of 997 participants (75% of the possible sample) completed at least one interview, 962 participants completed at least two interviews, and 765 participants completed all three interviews. All measures were administered at the first completed interview, and the psychological and physical functioning variables were administered at each interview. There were no statistically reliable differences on any of the measures used in the study for participants who completed the 6-month interviews ($n = 951$) and the small subset who began the study after 6 months ($n = 46$). The majority of the sample was female (61%), married (59%), and employed full time (62%). There was a moderately wide range in age ($M = 42$ years, $SD = 14$ years), education (22% had only a primary school education, and 27% had reached university level), and annual income (13% earned less than 60,000 HK$, and 21% earned more than 300,000 HK$).

Measures

In addition to standard demographic information, the following measures were used.

Psychological and physical functioning was measured using a 12-item self-report scale, the SF-12 (Ware et al., 1996). The SF-12 measures eight domains of health status: physical functioning, role limitations due to physical health problems, bodily pain, general health, vitality (energy/fatigue), social functioning, role limitations due to emotional problems, and mental health (psychological distress and psychological well-being). These items produce separate weighted averages for psychological functioning (MCS) and physical functioning (PCS), with higher scores implying better functioning. The instrument showed a good test–retest reliability (0.76; Ware et al., 1996) and has shown adequate construct validity (e.g., Jenkinson, Chandola, Coulter, & Bruster, 2001).

Norms on the SF-12 for Chinese respondents was recently obtained using a randomly selected sample ($N = 2,410$) from the Chinese population of Hong Kong (Lam et al., 2005). The demographics of the sample were highly representative of the Hong Kong adult population. The findings supported the content and criterion validity of the SF-12 for use in the Chinese population of Hong Kong. Of particular importance for the current study, the mean and standard deviation for both the MCS and PCS in Hong Kong differed only slightly from established means and standard deviations for these scales in U.S. populations (Ware & Kosinski, 2001; Ware et al., 1996), thus allowing for reliable cross-cultural comparisons.

SARS-related worries were measured using a scale that was specifically designed for the 2003 epidemic in Hong Kong (S. M. Y. Ho et al., 2005). Instructions for the scale asked respondents to indicate how true each item was for them after they learned that they had contracted SARS. The scale consisted of the following six items: "fear that I will infect others," "worry if family members will be infected," "feel very unsafe about yourself," "feel that life is threatening," "feel that I have loss control of life," and "think about death-dying" ($\alpha = .92$).

Prior PTEs. Participants were given a series of yes–no questions to determine whether they had previously experienced a number of PTEs (serious accident, natural disaster, bodily attack/violent incident, sexual abuse, etc.). Participants were also provided the opportunity to report exposure to PTEs not specified by the questionnaire. A total score was computed by summing up the number of prior PTEs experienced by the participants, where high score reflected more PTEs experienced.

Perceived social support and network size. The perceived quality of emotional support from the social network was measured by averaging two items: "Do you think the emotional support given to you is adequate?" and "Do you think the emotional support given to you is helpful?" ($\alpha = .86$). The size of participants' available social network consisted of the sum of two items: "How many relatives are on intimate terms with you (excluding your children)?" and "How many intimate friends do you have?"($\alpha = .61$).

Statistical Models

We examined the data using latent class growth curve modeling in Mplus Version 4.2 (Muthén & Muthén, 2006). This procedure identifies different latent trajectory classes and tests potential predictors of class membership within the same analysis. It is capable of handling incomplete data using all available observations to compute full information maximum likelihood parameter estimates without either imputing or removing data.

Results

As expected, given the stressful nature of the SARS epidemic, means for the MCS and PCS were below population norms at each assessment (6 months: MCS = 43.17, PCS = 38.35; 12 months: MCS = 42.34, PCS = 36.41; 18 months: MCS = 41.78, PCS = 35.51). Using mean data only would suggest that SARS has ubiquitous and long-lasting psychological costs. Accordingly, we next examined individual differences in psychological functioning across time.

Latent Class Growth Analysis: Simple Model

We first examined simple outcome trajectories using latent class growth curve modeling of psychological functioning (SF-12 MCS)

Table 1
Parameter Estimates and Model Fit for the Simple and Full Models

Parameter	Simple model (n = 997)	Full model (n = 890)[a]
Class 1: Chronic		
Proportion of sample	42%	42%
Intercept *M* (*SE*)	34.04 (0.45)	31.10 (2.42)
Slope *M* (*SE*)	–0.33 (0.25)	–0.40 (0.26)
Class 2: Recovered		
Proportion of sample	10%	10%
Intercept *M* (*SE*)	35.16 (1.21)	23.78 (9.17)
Slope *M* (*SE*)	7.81 (0.77)	7.85 (1.14)
Class 3: Delayed		
Proportion of sample	13%	12%
Intercept *M* (*SE*)	50.54 (0.91)	41.36 (13.17)
Slope *M* (*SE*)	–8.43 (0.62)	–8.45 (0.72)
Class 4: Resilient		
Proportion of sample	35%	36%
Intercept *M* (*SE*)	52.99 (0.46)	41.82 (2.74)
Slope *M* (*SE*)	–0.15 (0.27)	–0.13 (0.37)
Model fit and entropy		
N free parameters	17	58
Akaike (AIC)	19975.95	17738.79
Bayesian (BIC)	20059.33	18016.67
Entropy	0.733	0.775

[a]Full model estimates included 6-month physical health, age, gender, social network, social support, and severe acute respiratory syndrome (SARS)-related fear as covariates. Association of these variables with class membership are show in Table 2.

at 6, 12, and 18 months after SARS (see Table 1). Both the Bayesian information criterion (BIC) and Akaike information criterion indicated a model with four latent classes. A graph of the intercept and slope for each class (see bottom of Figure 1) evidenced a high level of similarity to the prototypical trajectories derived in previous research (top of Figure 1). One class started with a high mean and a slope that was essentially zero. This class had a high level of functioning and maintained that level over time, which suggests a resilient trajectory. Thirty-five percent of the sample (n = 349) were in this class. A second class started at a low level and maintained that level over time, which suggests a chronic dysfunction trajectory. This class encompassed 42% (n = 422) of the sample. Two other classes emerged, each capturing considerably smaller portions of the sample. One of these classes that included 10% (n = 95) of the sample had initially low levels of functioning and a steep positive slope. This class evidenced a pattern of psychological recovery. The other class included 13% (n = 130) of the sample, began with a high mean, and had a steep negative slope. This class suggested delayed psychological dysfunction.

Correlation Among Possible Predictor Variables

Most predictor variables were uncorrelated or only mildly correlated with other predictor variables, with the exception of demographic variables. Participant age showed substantial positive associations with having only a primary school education, $r = .61$, $p < .001$, and number of children, $r = .75$, $p < .001$, and an inverse association with full-time employment, $r = -.42$, $p < .001$. Having only a primary school education was also positively correlated with number of children, $r = .55$, $p < .001$, and inversely correlated with full-time employment, $r = -.43$, $p < .001$. Full-time employment in turn was inversely correlated with being in the lowest income group, $r = -.54$, $p < .001$, and with number of children, $r = -.41$, $p < .001$.

Latent Class Growth Analysis: Full Model

We extended the latent class growth model to include possible predictors of class membership. The predictor variables we considered were age, gender, employment, income, education, marital status, number of children, prior trauma experiences, supportive social relations, social network size, SARS-related worry, and 6-month levels of physical functioning. We first included the predictors of the greatest theoretical relevance and then tested whether further predictors could be added to the model. Although the final model included several predictors, not all of the possible predictors could be included because as often occurs in complex models with multiple predictors there were problems with model convergence. The final model included 6-month physical health, age, gender, social network size, social support, and SARS-related worry.

A comparison of the parameter estimates and model fit for the simple and full models is presented in Table 1. Because of missing data on covariates, the full model used a somewhat smaller sample (n = 890) than the simple model (n = 997). However, the samples used in each analysis did not differ significantly on any of the measures used in the models. More important, the proportions of class membership and the slopes of change were highly similar in each model. The sole difference was that the intercepts were lower and more variable for the resilient (41.82) and delayed (41.36) groups in the full model.

Predicting Class Membership

In the analysis to predict latent class membership, one of the latent classes serves as a reference category. In the current study, we used the chronic dysfunction trajectory as the reference class, because it is conceptually salient as the least desirable outcome and because it was the most prevalent class. Mean scores and odds ratios for each comparison and each predictor variable are listed in Table 2. The results indicated a mixed pattern of predictors across class comparisons. The only consistent predictor across each comparison was physical health. The resilient, delayed, and recovered groups each had significantly better physical functioning 6 months after hospitalization than did the chronic group. The difference from the chronic trajectory was largest for the resilient group. Both the resilient and recovered groups also had higher levels of social support and lower levels of SARS-related worry than the chronic group. Finally, the resilient group was less likely to be female than the chronic group.

We explored additional comparisons using the resilient group as the reference category. This analysis revealed that the delayed group had significantly lower social support than the resilient group and that the recovered group had significantly poorer physical functioning at 6 months relative to the resilient group.

Because not all of the predictors could be included in the model (due to convergence problems, as noted previously), we also explored whether a separate multinomial regression con-

Table 2
Multinomial Logistic Regression for Predictors of Class Membership (in Reference to Chronic Dysfunction)

	Resilient		Delayed		Recovered		Chronic
	M^a	Exp(B)	M^a	Exp(B)	M^a	Exp(B)	M^a
6-month physical health	45.9	1.11***	40.9	1.08*	36.9	1.04*	31.9
Age	40.0	0.99	43.1	1.03	42.4	1.01	41.3
Gender (female)	52%	0.46**	58%	0.69	54%	0.59	70%
Social network	8.1	1.01	6.8	0.99	6.5	0.97	6.2
Social support	7.1	1.47***	5.8	1.10	6.3	1.34**	5.3
SARS-related worry	34.8	0.96*	40.8	0.98	39.3	0.96**	46.8

Note. Exp(B) indicates that the odds of being in the class is B times as likely with a one-unit increase of the independent variable. SARS = severe acute respiratory syndrome.
[a] Gender is presented in percentages. Gender was entered in the regression as a binary (0/1) variable.
*$p < .05$. **$p < .01$. ***$p < .001$.

ducted independent of the latent class model might reveal effects of other predictors. This analysis included all possible predictor variables available for the current study. The same predictor variables observed in the full model also emerged in the independent logistic regression, but no additional predictors reached statistical significance. This result, which is most likely attributed to covariation among predictors, lends further support to the full model solution.

Discussion

We identified four trajectories of psychological functioning using latent class modeling on a large sample of hospitalized survivors of the SARS epidemic in Hong Kong. The trajectories—chronic psychological dysfunction, recovery, delayed decrements in functioning, and psychological resilience—were highly consistent with prototypical variations in functioning typically observed in the aftermath of a major stressor event (see Figure 1). Significantly, although the prevalence of chronic psychological dysfunction (42%) was somewhat higher than typically observed following PTEs, the prevalence of resilience (35%) remained within the range previously observed in Western countries for the most extreme stressor events (Bonanno, 2005). Typically only 5% to 10% of people exposed to loss or potential trauma tend to experience chronic psychological dysfunction, whereas many and often the majority of exposed individuals exhibit psychological resilience (Bonanno, 2004). However, studies of extreme levels of stress exposure have reported a markedly higher prevalence for psychopathology as well as a lower prevalence for resilience. For example, epidemiological data collected in New York City following the September 11th terrorist attack indicated that among people with extreme levels of exposure (e.g., injured during the attack) approximately one third had elevated levels of psychopathology. Among this same highly exposed sample, however, the proportion of resilient individuals was also observed to be at around 35% (Bonanno, Rennicke, & Dekel, 2005; Bonanno et al., 2006).

Somewhat unanticipated was the relatively high proportion of hospitalized SARS survivors (13%) who exhibited delayed psychological dysfunction. One possible explanation may be that delayed reactions came about due to increased anxiety related to SARS. Many people in Hong Kong believed that the epidemic would occur again in the Winter of 2004, about 12–18 months after the first outbreak in 2003. Such anticipatory anxiety may have influenced the increase in delayed psychological dysfunction observed in this study. Other possible factors including media coverage of the SARS outbreak in Hong Kong and other parts of the world; a social policy of compensation to SARS survivors that may have encouraged symptom reporting; potential outbreak of other diseases, such as avian flu; or the occurrence of other additional stressor events (e.g., death in the family) also may have contributed to this pattern. Unfortunately, analysis of these possibilities was beyond the scope of the current study.

Having established the simple latent class trajectories of psychological outcome following hospitalization for SARS, we next examined predictors that may have informed membership in these trajectories and whether the structure of the trajectories would change with covariates included in the model. The latent structure that emerged in the full model was generally similar to and with similar proportions as the simple model. The sole exception was that the initial adjustment (intercept) of the two classes (the resilient and delayed groups) was somewhat lower and more variable in the full model. This difference is most likely due to the complexity of the full model and to the inclusion of covariates. Nonetheless, even with added complexity of the model, it is important to note that the intercepts for the delayed and resilient group still remained within the normative range of functioning (i.e., within 1 *SD* of the mean) as was observed in the simple model and in previous studies that mapped trajectories using a normative comparison approach (e.g., Bonanno, Moskowitz, et al., 2005). Additionally, because the slope for the resilient group in the full model was very small (−0.13), the trajectory for the resilient group remained within the normal range of functioning at each assessment point.

Consistent with previous research (e.g., Bonanno et al., 2007), analyses of differences in class membership revealed a heterogeneous array of predictors. It is not surprising that resilient individuals had the highest level of initial physical functioning and significantly higher initial physical functioning than both the recovered and chronic groups. Although anticipated, these findings nonetheless suggest that lingering physical problems related to a major disease outbreak may leave survivors at risk for both acute and chronic psychological problems. We should note however that

the data do not make it possible to control for preexisting levels of physical functioning. It is entirely possible that survivors with low levels of physical functioning after hospitalization had lower levels of physical health prior to SARS. By the same token, these findings show that those who experienced a relatively clean physical recovery after hospitalization during a disease outbreak are most likely to show the healthiest profiles and psychological resilience.

We expected that the course of psychological functioning after hospitalization for SARS would be influenced by more than a person's physical health. Consistent with this expectation, with 6-month levels of physical functioning included as a covariate, a number of other predictors emerged to inform class membership. We were particularly interested in the role of SARS-related worry, which as expected was lowest among resilient individuals and highest among participants with chronic psychological dysfunction. Both the resilient and recovered groups had significantly lower SARS-related worry than the chronic group, indicating that reduced worry not only appeared to enhance resilience but also to foster the return to baseline among individuals who may have suffered an initial setback after hospitalization.

The public health implications of these findings are straightforward and suggest a potentially crucial role for government and media in helping to reduce fear and promote calm following a major disease outbreak (Memon & Goh, 2005; Wallis & Nerlich, 2005). Preliminary reports from various countries in Southeast Asia affirm this point. Shi et al.'s (2003) analysis of 17 cities in China suggested, for example, that providing the public with realistic information about risk and recovery helped assuage SARS-related worry. Also, Ng et al. (2006) reported promising data on a brief group intervention for at-risk populations during the SARS epidemic in Hong Kong that included among its aims to "help participants cope with fear" (p. 56).

Social support also emerged as an important predictor of group membership. Perceived social support is generally associated with health and well-being. Previous studies have also documented its role in promoting adjustment to potential trauma (e.g., Brewin et al., 2000; Davidson, Hughes, Blazer, & George, 1991). However, only one recent study has explicitly linked social support to psychological resilience after potential trauma (Bonanno et al., 2007). In the current study, both the resilient and recovered groups had significantly higher social support than the chronic group. Resilient individuals also had significantly higher social support than participants showing a delayed pattern (i.e., functioning within the normal range initially but reduced psychological functioning at later assessments), suggesting that supportive relations probably also play a crucial role in maintaining resilience beyond the initial months after hospitalization.

Finally, the members of the resilient group were significantly more likely to be male than members of the chronic dysfunction group. Although the relationship between gender and adjustment among children at risk has been variable (e.g., Fergusson & Horwood, 2003), among adults exposed to potential trauma, female gender has consistently emerged as a small but reliable risk factor (Brewin et al., 2000). Conversely, male gender has been associated with a resilient outcome (Bonanno et al., 2007). The current study can offer no further insights into the possible reasons for the gender effect. Clearly, this will be an important research topic for future studies.

Limitations and Conclusion

There were several limitations to the current study that warrant discussion. A primary concern is that the data were restricted to participant self-report. In studies of large community samples, self-report data are both practical and economical. However, it must be acknowledged that self-report instruments have potential drawbacks, most prominent being deliberate self-presentation distortions and unintentional retrospective reporting biases on the part of respondents. A related drawback was that the predictors included in the study were limited in scope and did not include other potentially informative variables, such as those related to personality. It is also worth noting that, because all the variables in this study were measured after hospitalization from SARS, it possible that initial reactions to the infection may have influenced participants' scores on some or all of the predictor variables.

Another potential weakness was that we created the outcome trajectories beginning 6 months after hospitalization, prohibiting analyses of variations in outcome prior to this date. This may be especially problematic in considering individuals evidencing chronic psychological dysfunction. A somewhat greater proportion of participants in the current study evidenced chronic dysfunction than was anticipated. This increase might be due to the particularly caustic impact of being hospitalized during a poorly understood biological epidemic. However, it is also plausible that a sizable portion of these individuals were experiencing enduring emotional difficulties prior to the SARS epidemic. Prospective disaster research has shown for example that preexisting psychological problems predict worse postdisaster mental and physical health (Dirkzwager, Grievink, Van der Velden, & Yzermans, 2006). Similarly, prospective studies of outcome trajectories following bereavement have found that anywhere from one third (Bonanno et al., 2002) to one half (Bonanno, Moskowitz, et al., 2005) of the participants showing chronic dysfunction may have had elevated levels of psychological difficulty prior to the loss. Such effects are not easily captured retrospectively with self-report instruments. For example, when high-exposure survivors of the September 11th attack in New York were asked to assign themselves to a longitudinal outcome trajectory, many indicated that they had experienced chronic psychological symptoms after the attack but none indicated that they had experienced elevated symptoms prior to the attacks (Bonanno, Rennicke, & Dekel, 2005). In contrast, when these participants' friends were recruited to assign them to longitudinal trajectories, the friend-informants indicated that over one third of the participants experiencing chronic difficulties had elevated symptoms prior to the attacks. Although we cannot address this question directly in the current study, these findings suggest that the current study may have overestimated the proportion of the sample whose psychological difficulties arose in direct response to the SARS epidemic.

Within the context of the limitations described previously, the current study advanced previous research in several important ways. As noted previously, this is the first study to examine longitudinal outcome trajectories following a major health-threat event in an Asian sample. The large sample size and scarcity of our data are unique among existing studies on health-related resilience. Having established these trajectories using latent class modeling, we were able to delineate a number of unique predictors of the

different outcomes. These included factors observed in previous studies, such social support, but also new findings of particular relevance to a major disease outbreak, such as the role of SARS-related worry.

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