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## Risk factors for chronic post-traumatic stress disorder (PTSD) in SARS survivors

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### Abstract

**Background:** Post-traumatic stress disorder (PTSD) is one of the most prevalent long-term psychiatric diagnoses among survivors of severe acute respiratory syndrome (SARS).

**Objectives:** The objective of this study was to identify the predictors of chronic PTSD in SARS survivors.

**Design:** PTSD at 30 months after the SARS outbreak was assessed by the Structured Clinical Interview for the *DSM-IV*. Survivors' demographic data, medical information and psychosocial variables were collected for risk factor analysis.

**Results:** Multivariate logistic regression analysis showed that female gender as well as the presence of chronic medical illnesses diagnosed before the onset of SARS and avascular necrosis were independent predictors of PTSD at 30 months post-SARS. Associated factors included higher-chance external locus of control, higher functional disability and higher average pain intensity.

**Conclusion:** The study of PTSD at 30 months post-SARS showed that the predictive value of acute medical variables may fade out. Our findings do not support some prior hypotheses that the use of high dose corticosteroids is protective against the development of PTSD. On the contrary, the adversity both before and after the SARS outbreak may be more important in hindering recovery from PTSD. The risk factor analysis can not only improve the detection of hidden psychiatric complications but also provide insight for the possible model of care delivery for the SARS survivors. With the complex interaction of the biopsychosocial challenges of SARS, an integrated multidisciplinary clinic setting may be a superior approach in the long-term management of complicated PTSD cases.

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**Keywords:** Severe acute respiratory syndrome; SARS survivors; Post-traumatic stress disorder; Risk factors

### 1. Introduction

Infectious diseases have become one of the major global public health threats in the 21st century. These diseases appear to be spreading more rapidly and emerging more quickly than ever before [1]. Severe acute respiratory syndrome (SARS) was the first massive infectious disease outbreak in this century, but it is not expected to be the last.

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Thus, the knowledge and experience gained from SARS should be regarded as a dress rehearsal for the catastrophe that could emerge from an influenza pandemic or similar emergent infectious disease [2].

The SARS epidemic of 2003 spread rapidly to over 30 countries with more than 8000 reported cases, resulting in 774 deaths worldwide [3]. In Hong Kong (HK), SARS affected up to 1755 individuals and caused 299 deaths. Patients were confronted with a novel and deadly infectious disease, a need for compulsory isolation treatments and fears of cross-infection to their family and friends. There was also a risk of the subsequent development of avascular necrosis (AVN) of the bones, which was found to be associated with the culminative steroid dosage prescribed for acute control of SARS illness [4–6].

The SARS epidemic has been described as a bio-disaster [7] with a psychological impact comparable to other major disasters. Being infected with SARS can be a traumatic experience [8]. A study of the long-term psychiatric morbidities among SARS survivors by Mak et al. [9] revealed that PTSD was the most prevalent long-term psychiatric condition. The cumulative proportion of patients with PTSD is 47.8%, while 25.5% continue to meet PTSD criteria at 30 months post-SARS. Therefore, PTSD deserves special attention even though it is not the only psychological response to SARS.

SARS and its associated psychiatric problems may cause stigmatisation [10]. Risk factor analysis can improve the detection of hidden psychiatric complications. Previous reported predictors of acute psychiatric complications include sociodemographic variables [e.g., being a health care worker (HCW)] [11–13]; illness-related variables [e.g., the severity of disease and the administration of high-dose corticosteroids [11], lowest level of arterial oxygen saturation (SaO<sub>2</sub>) during hospitalisation] [14]; and psychosocial variables including social support, cognitive appraisal and coping style [13,15]. There are various methodological problems with these studies, including high attrition rates, the use of convenience sampling methods and the use of self-administered questionnaires as the primary measuring instrument. The predictors for long-term psychiatric complications have yet to be investigated.

The present study was aimed at identifying the risk factors for post-traumatic stress disorder among SARS survivors at 30 months post-SARS.

## 2. Method

### 2.1. Study design

The research design and detailed methodology have been previously reported [9]. The following is a brief summary of the study.

This is a retrospective cohort study designed to investigate psychiatric complications among SARS survivors treated in United Christian Hospital (UCH) 30 months

after the SARS outbreak. Phase I of the study defined the pattern of long-term psychiatric complications [9]. Phase II of this study focused on the diagnosis of PTSD and the identification of its associated risk factors. The study was reviewed and approved by the Hong Kong Hospital Authority Research Ethics Committee.

### 2.2. Participants

Criteria for inclusion were as follows: a history of SARS infection according to World Health Organization (WHO) criteria [16,17], hospitalisation at UCH for the index SARS infection, Chinese race and age  $\geq 18$  years at the time of the SARS infection. Patients with severe communication problems (e.g., deafness, dementia, mental retardation) were excluded from the study. Patients who also received treatment for SARS infection in other hospitals and were transferred back to UCH for follow-up were also excluded due to possible differences in hospital management and the likelihood that these patients represented a biased group with fewer complications. A total of 119 adult patients were admitted to UCH for treatment of suspected or confirmed SARS infection. All of them were offered subsequent follow-ups at UCH according to the government policy. Of these patients, 17 failed to fulfill WHO criteria for SARS infection, 4 had also received SARS infection treatment in other hospitals, 4 were of Filipino ethnicity, and 1 had a history of a cerebrovascular accident with severe dysphasia and communication problems. Of the remaining 93 eligible subjects, 2 refused to participate and 1 returned to his home country. The cohort consisted of 90 subjects, representing a response rate of 96.8%. The subjects were relatively young (mean age=41.1 years, S.D.=12.1), predominantly female (62.2%) and relatively well educated (80% had received education to the level of secondary school or above). More than two thirds (68.9%) were either cohabiting or married at the time of the SARS outbreak. However, five subjects' spouses died of SARS, and one subject divorced after the SARS outbreak. Twenty-seven (30%) subjects were HCW. Among them, nursing staff constituted 55.6% ( $n=15$ ), followed by health care assistants (22.2%,  $n=6$ ) and doctors (14.8%,  $n=4$ ).

### 2.3. Procedures

In order to maximise the response rate, the interviews for the recruited cases were conducted on the same day of their scheduled medical follow-ups between September 2005 and March 2006 (i.e., around 30 months post-SARS on average). The Chinese version of the Structured Clinical Interview for DSM-IV (SCID) was administered. Self-administered questionnaires were used to collect the socio-demographic data, pre-SARS traumatic event information and cross-sectional biopsychosocial factors. Finally, the acute medical variables and the pre-SARS medical or psychiatric variables were extracted from the computerised database created during the SARS outbreak.

#### 2.4. Assessment of PTSD and other Axis I psychiatric disorders

The SCID was used to diagnose PTSD and other Axis I disorders, including depressive disorder and other anxiety disorders. The patient edition of the SCID was translated into a bilingual Chinese/English version for use with Chinese (Cantonese)-speaking subjects with satisfactory reliability and validity [18,19]. All subjects were assessed by a psychiatrist (I.M.) who has received standard training in the use of this instrument.

#### 2.5. Assessment of predictors and association factors related to outcome of PTSD

The variables were grouped into two blocks: (1) potential predictive factors and (2) association factors. The potential predictive factors involved pre-SARS demographic factors or objective, SARS-related clinical data that preceded the outcome of interest (30 months post-SARS PTSD). The association factors included variables gathered during the interview 30 months post-SARS.

#### 2.6. Predictive factors

The predictive factors could be further categorised into four groups: sociodemographic characteristics, medical and psychiatric background, SARS-related acute medical variables and subsequent complications. The sociodemographic characteristics included age, gender, marital status, and residential status, Amoy Gardens residency (Amoy Gardens is a private housing complex where the largest local SARS outbreak occurred), educational level, income, employment, occupation, employment as a HCW, and religious background.

The medical and psychiatric background included pre-SARS chronic medical illness, distressing pain, psychiatric disorders, traumatic events, and a family history of psychiatric illness.

The SARS-related acute medical variables included days of hospitalisation, intensive care unit admission, intubation, desaturation during the course of SARS infection, initial and peak viral load from nasopharyngeal specimens, total steroid dosage and whether or not a family member(s) died from SARS. SARS-related complications were indicated by the development of AVN as detected by magnetic resonance imaging.

#### 2.7. Association factors

The association factor block was grouped into physical, social and psychological factors. Physical factors involved subjective, distressing pain after SARS as determined by a maximum and average pain scale in the month before the interview (10-point scale). Functional impairment was measured by the Functional Impairment Checklist score (FIC), which is a self-reported instrument designed as a functional assessment tool for SARS survivors. It consists of

the FIC symptoms score, which focuses on physical impairment, and the FIC disability score, which indicates limitations on daily life [20].

Social factors included the perceived inadequacy of social support during SARS (six-point Likert scale), involvement in litigation and compensation and whether or not the subjects were on social allowance.

Psychological factors involved the subjective perception of danger during SARS infection, the subjective usefulness of religious or spiritual support in coping with SARS and the subjective feeling of being stigmatised during the worst period of SARS illness, all of which were measured by a six-point Likert scale. The appraisal of locus of control was assessed by the Multidimensional Health locus of Control scale (MHLC) [21]. The scale consists of three independent subscales: the “internal health locus of control,” “chance–external locus of control” or “powerful others–external locus of control” subscales. The scale was translated into Chinese with acceptable internal consistency [22]. The Chinese Ways of Coping Questionnaire (CWCQ) [23] was used to assess coping style. The questionnaire covers a broad range of cognitive and behavioral coping activities based on the Ways of Coping Questionnaire [24]. It includes four subscales: “rational problem solving,” “seeking support and ventilation,” “resigned distancing” and “passive wishful thinking.”

#### 2.8. Statistical analysis

All statistical analyses were performed using SPSS 13.0 (Chicago, SPSS). The chi-square test, Fisher’s Exact test (for categorical variables), *t* test (for continuous variables) and Mann–Whitney *U* test (for highly skewed data) were used to identify the potential predictive and association factors for PTSD at 30 months post-SARS.

Multiple logistic regression analysis (stepwise forward) was performed by including variables found as significant at the level of  $P < .25$  by univariate analysis. The variables were grouped into predictor and association factor blocks as described above. Finally, the statistically significant association factors were examined after controlling for the factors that were found to be significant in the predictive factor blocks. Hierarchical regression analysis was also used to examine whether an addition of the association factors to the predictor variables would change the odds ratio of predictor variables significantly, as the association factors could be potential mediating factors on the causal pathway between the predictor variables and the psychiatric outcome of interest.

### 3. Results

There were 1394 SARS survivors in HK at the time of our study. No statistically significant differences concerning the mean age, gender distribution or the proportion of HCWs were found between our sample and the SARS survivor population in HK [9].

3.1. Pre-SARS and post-SARS PTSD

Only one subject had experienced a pre-SARS trauma with nature fulfilling the definition of *DSM-IV* criteria [25]. No subject was diagnosed as having pre-SARS PTSD. A total of 47.8% of the subjects had PTSD at some time point after the SARS outbreak and all of these subjects identified the SARS outbreak as the index trauma. Twenty-three out of 90 subjects (25.6%) still suffered from PTSD at 30 months post-SARS.

3.2. Univariate analysis for PTSD

In the univariate analysis, variables significantly associated with current PTSD in the predictor block included female gender ( $P=.019$ ), being a HCW ( $P=.031$ ), pre-SARS chronic medical illness ( $P=.044$ ) and having AVN as a complication ( $P=.035$ ) (Table 1).

For the association factors block (Table 2), reports of higher average pain in the past month ( $P<.001$ ), higher functional impairment checklist scores ( $P<.001$ ), higher

Table 1  
Univariate analysis of current PTSD for predictive factors

	No current PTSD (n=67)		Current PTSD (n=23)		P <sup>a</sup>
	N	%	n	%	
Socio-demographic background					
Age (mean±S.D.)	40.46	±11.64	42.78	±13.39	.43 <sup>b</sup>
Gender					
Male	30	44.8	4	17.4	*.019
Female	37	55.2	19	82.6	
Educational level					
No education	1	1.5	2	8.7	.216
Primary	9	13.4	5	21.7	
Secondary	35	52.2	9	39.1	
Tertiary or above	22	32.8	7	30.4	
Employment as a HCW					
Non-HCW	51	76.1	12	52.2	*.031
HCW	16	23.9	11	47.8	
Amoy Gardens residential status (during SARS)					
Non-Amoy Gardens resident	28	41.8	14	60.9	.114
Amoy Gardens resident	39	58.2	9	39.1	
Medical and psychiatric background					
Presence of chronic medical illness					
No	63	94	18	78.3	*.044
Yes	4	6	5	21.7	
SARS related variable (acute)					
Cumulative steroid dosage <sup>c</sup>	4.29	±1.93	4.58	±2.31	.556
Family members died of SARS					
No	62	92.5	19	82.6	.226
Yes	5	7.5	4	17.4	
SARS related variables (delayed)					
AVN or not					
No	53	79.1	13	56.5	*.035
Yes	14	20.9	10	43.5	

<sup>a</sup> Chi-square.  
<sup>b</sup> Two-sided independent sample *t* test.  
<sup>c</sup> Methylprednisolone equivalent in grams.  
\*  $P<.05$ .

Table 2  
Univariate analysis of current PTSD for association factors

	No current PTSD (n=67)		Current PTSD (n=23)		P
	n	%	n	%	
Physical factors					
Distressing pain after SARS					
No	29	43.3	0	0	**<.001 <sup>a</sup>
Yes	38	56.7	23	100	
Pain scale (average in past 1 month)	2	(0–6)	7	(5–8)	**<.001 <sup>b</sup>
Functional Impairment Checklist Median (IQR)					
Symptom score	2	(0–3)	4	(3–7)	**<.001 <sup>b</sup>
Disability score	1	(0–2)	5	(4–7)	**<.001 <sup>b</sup>
Social factors					
Perceived inadequacy of support	0	(0–3)	2	(0–4)	** .004 <sup>b</sup>
Litigation or insurance compensation					
No	50	74.6	14	60.9	.127 <sup>c</sup>
Completed	14	20.9	5	21.7	
Pending	3	4.5	4	17.4	
Psychological factors:					
Subjective perception of dangerousness during SARS	3	(1–3)	3	(3–3)	*.007 <sup>b</sup>
Subjective feeling of being stigmatized	3	(0–4)	5	(3–5)	** .001 <sup>b</sup>
<sup>e</sup> Chinese Way of Coping Scale, mean±S.D.					
Rational problem solving	5.81	±12.56	5.05	±2.19	.215 <sup>d</sup>
Resigned distancing	4.03	±2.08	5.64	±2.01	** .002 <sup>d</sup>
Seeking support and ventilation	5.61	±3.06	3.55	±2.46	*.005 <sup>d</sup>
Passive wishful thinking	3.96	±2.34	5.14	±2.44	*.045 <sup>d</sup>
<sup>e</sup> Multidimensional Health Locus of Control scales					
Internal	23.18	±4.81	21.73	±4.79	.222 <sup>d</sup>
Chance	19.07	±5.64	24.86	±5.29	**<.001 <sup>d</sup>
Powerful others	23.81	±5.05	25.32	±3.85	.202 <sup>d</sup>

Values are median (IQR), mean±S.D.

IQR, interquartile ratio.

<sup>a</sup> Chi-square test.  
<sup>b</sup> Mann-Whitney U test.  
<sup>c</sup> Fisher's Exact test.  
<sup>d</sup> Two-sided independent sample *t* test.  
<sup>e</sup> One-subject with missing variable.  
\*  $P<.05$ .  
\*\*  $P<.005$ .

perceived inadequacy of social support ( $P=.004$ ), higher subjective perception of danger during the SARS outbreak ( $P=.007$ ) and higher subjective perception of being stigmatized during the SARS outbreak ( $P=.001$ ) were associated with PTSD.

For coping strategies and the health locus of control measures, the current PTSD group tended to report more frequent use of the avoidant coping mechanism [e.g., resigned distancing ( $P=.002$ ) and passive wishful thinking ( $P=.045$ )] with less use of active coping mechanisms, such as seeking support and ventilation ( $P=.005$ ). The chance

subscale score of the Multi-dimensional Health Locus of Control Scale for the current PTSD group was also significantly higher than for the group without a current PTSD diagnosis ( $P=.001$ ).

### 3.3. Regression analysis for PTSD

#### 3.3.1. Logistic regression of predictor and association factor block

Multivariate logistic regression analysis showed that being of the female gender ( $P=.003$ ), the presence of chronic medical illness before SARS ( $P=.014$ ) and having AVN as a physical complication ( $P=.01$ ) were predictors of PTSD at 30 months post-SARS (Table 3).

Higher “Functional Impairment Checklist disability score” ( $P<.001$ ), “chance external locus of control of MHLC scales” ( $P<.001$ ) and “average pain intensity in the past month” ( $P=.019$ ) were found to be associated with PTSD at 30 months post-SARS (Table 4).

#### 3.4. Controlling for comorbidity

In order to deal with the extensive comorbidity in subjects with PTSD, the status of “current depressive disorder” and “current anxiety disorders other than PTSD, including panic disorder, agoraphobia, generalised anxiety disorder and social phobia” as measured by SCID were controlled by adding these diagnostic variables into the existing logistic regression model. All of the previously significant variables in the predictor and association factors blocks remained significant after adding these variables, thus indicating that the identified variables were specifically related to the outcome of current PTSD, independent of other psychiatric diagnostic categories.

#### 3.5. Issues of litigation and compensation

The variables of litigation and compensation were recorded and taken into consideration in the data analysis. No statistically significant association between litigation and compensation and psychiatric morbidities was found. The factors also did not affect the final logistic regression model when these variables were controlled.

Table 3  
Multiple logistic regression model for predictors of current PTSD<sup>a</sup>

Variable	Univariate OR (95% CI)	<i>P</i>	Multiple logistic regression, adjusted OR (95% CI)	<i>P</i>
Gender:				
Female	3.85 (1.18–12.54)	.019	6.13 (1.60–23.47)	.003
Male (reference)				
Pre-SARS presence of chronic medical illness	4.38 (1.06–18.02)	.044	7.44 (1.44–38.59)	.014
Yes				
No (ref)				
Presence of AVN	2.91 (1.06–8.02)	.035	4.53 (1.41–14.50)	.010
Yes				
No (ref)				

<sup>a</sup> Factors to enter to stepwise forward multiple logistic regression include age, gender, educational level, HCW status, Amoy Gardens residency, pre-SARS chronic medical illness, presence of family member(s) died from SARS, development of AVN.

Table 4  
Multiple logistic regression model for association factors of current PTSD<sup>a</sup>

Variable	Univariate OR (95% CI)	<i>P</i> value	Multiple logistic regression, adjusted OR (95% CI)	<i>P</i> value
Functional impairment checklist–disability score	2.44 (1.66–3.56)	<.001	3.82 (1.71–8.51)	<.001
Chance locus of control	1.22 (1.09–1.37)	<.001	1.52 (1.16–1.97)	<.001
Average pain	1.69 (1.31–2.19)	<.001	1.66 (1.01–2.71)	.019

<sup>a</sup> Factors to enter to stepwise forward multiple logistic regression include average pain scale in the past months, functional impairment checklist, perceived inadequacy of social support, involvement in litigation and compensation, subjective perception of dangerousness during the SARS outbreak, subjective perception of being stigmatized during the SARS outbreak, CWCQ scales and MHLC scales.

#### 3.6. Combining the predictor and the association factor block into one model

After combining the significant factors of the two blocks into one model (Tables 3 and 4), all association factors (Table 4) were still statistically significant while the predictors (Table 3) become insignificant. This may be because the association factors of Table 4 may be the mediating factors of the causal pathway between the potential predictors and PTSD.

#### 3.7. Hierarchical logistic regression by combination of the two blocks

In order to further examine whether the effect of the predictive factors in Table 3 on PTSD were mediated by the association factors shown in Table 4, sequential regression was employed. The adjusted odds ratios did not change significantly from the simpler models with the exception of the adjusted odds ratio for AVN, which became considerably smaller (from 4.52 to 1.35) when “functional impairment checklist-disability score” was included. This result would

suggest that functional impairment is a possible explanation for the higher rates of PTSD among those with AVN.

## 4. Discussion

### 4.1. Risk factor analysis for PTSD at 30 months post-SARS

#### 4.1.1. Association factors

The study of the association factors of current PTSD was compatible with the suggested theories of PTSD involving both biological and psychological mechanisms [26]. Although the study of the association factors does not permit us to infer any causal relationship, the findings may shed light on future research for understanding the mediating factors or mechanisms in the causation of chronic trauma-related response.

The finding that perceived pain severity was an association factor of PTSD at 30 months post-SARS is consistent with previous disaster studies [27,28]. Another significant association factor of current PTSD was the Functional Impairment Checklist disability score. It was shown that the disability score was a stronger prediction for chronic PTSD compared with the symptoms score, which measures subjective lung function and fatigability.

The interaction between PTSD and biological factors involving pain and functional impairment is complex. On one hand, patients with PTSD may have elevated anxiety, impaired coping strategies and attentional bias to pain and functional deficit. All of these factors may exacerbate pain and cause functional impairment. On the other hand, pain and functional impairment may perpetuate PTSD by serving as a continual reminder of the traumatic event, maintaining arousal, and preventing the return to a normal life. In addition, somatisation in the form of pain may be one potential pathway for trauma to express itself psychologically [29]. Our findings were consistent with the evidence that the optimisation of pain control may reduce the risk of subsequent development of PTSD and be effective for the secondary prevention of PTSD [30].

In addition to physical factors, this study also showed that the perceived control of health may be an important factor, a finding that is consistent with previous SARS studies [12,13]. The clinical course, outcome and treatment methods after contacting this novel virus could have been a threatening, unpredictable and helpless experience to the patients and even to the medical staff. The experience of SARS infection may have threatened the subject's view of the self, the world and the future. There is evidence that diminished perceived control is associated with more severe pain and functional disability [31]. However, appraisal is a dynamic process, and it may change when new dramatic health or illness-related experiences like SARS occur. Whether certain appraisal styles exacerbate the effects of stressor and whether the predominant use of each style is related to the stress process are complex issues [23]. A prospective study may help to explain the relationship between the appraisal style and the

subsequent psychological response. Early intervention to enhance self efficacy in coping with these stressful events may be a potential secondary prevention strategy, a hypothesis that requires further exploration.

#### 4.1.2. Predictive factors

This study was the first to document the relationship between AVN and PTSD in SARS patients. Because AVN is a delayed complication of SARS treatment, it cannot be taken into account in acute-stage studies. By further comparing subjects who have recovered from PTSD with those experiencing chronic PTSD, it was shown that AVN was an important factor in slowing recovery from PTSD. A hierarchical regression analysis demonstrated that residual functional disability might also be a possible mechanism hindering recovery from PTSD. This result is consistent with the findings from studies on other traumas where long-term health problems and loss of function might play an important role in maintaining PTSD [32,33].

AVN is believed to result from the impairment of circulation to bone and is associated with steroid use [4,5]. The femoral head is the most commonly affected area, but other bone areas may be involved as well. AVN might affect recovery from PTSD through the following mechanisms. First, AVN has the potential to cause pain and functional impairment, which are associated with chronic PTSD as previously discussed. Second, the discovery of AVN occurred between six and nine months post-SARS, when patients started to expect improvement of physical function. The delayed and unexpected onset causes a heavy blow to the subject's locus of control system. The unclear likelihood of AVN later progressing to bone collapse may further defeat the subject's belief system of self-efficacy. Thus, AVN demonstrates that the interaction of biopsychosocial consequences might hinder recovery from PTSD. This study also illustrates that unexpected, long-lasting physical complications of SARS might affect recovery from PTSD. The careful detection of psychiatric symptoms is needed when any further physical complication is newly identified.

The presence of pre-SARS chronic medical illness was found to be a factor associated with long-term PTSD. Previous research has revealed that, during the development of a chronic illness, the patients' perceptions of personal control are affected [34,35]. The experience of SARS infection in subjects with pre-SARS chronic physical illnesses might further affect their perceived self-efficacy. The poor physical and psychological conditions might weaken their innate ability to recover from PTSD.

It is important to note that the association between the acute medical variables and the acute post-traumatic stress and anxiety symptoms in acute-phase studies were no longer significant in the current study [11–14]. While there is evidence that steroid administration may decrease the rate of PTSD [36], the cumulative steroid dosage was not found to be protective in reducing chronic PTSD in the current study. The beneficial effect of steroids, if any, may have been

negated by the subsequent complications of AVN. In contrast to the association between initial viral load and poor acute physical outcome [37], there is no obvious relationship between the initial viral load and long-term PTSD. However, further immunological correlations should be addressed in future studies. This study illustrates how the predisposing experience affects the course of the traumatic event of a medical illness. The relative contributions of the acute stressors seem to diminish progressively [38].

Female gender was found to be an independent risk factor for chronic PTSD in this study. This finding is well documented in numerous trauma-related studies [39–41]. It carries important implications in the health care system, where the majority of the nursing staff and health care assistants are female.

Being a HCW is regarded as one of the most consistent predictors for psychiatric morbidity both in the acute and convalescent phase [14,42,43]. In this study, although being a HCW was found to be significantly associated with PTSD outcome by univariate analysis, it became statistically insignificant after controlling for gender. In fact, a very large proportion of the HCWs in this sample were female ( $N=24/27$ ). This finding suggests that the association between being a HCW and PTSD may be partly explained by the fact that the front-line HCWs who contracted SARS were primarily female.

#### 4.2. Clinical implications

Clinicians who are responsible for the follow-up of SARS patients should be alerted to the possible long-term psychiatric sequelae, especially PTSD. This evaluation requires a tactful enquiry of symptoms due to subjects' fear of stigmatisation. Clinicians can consider the risk factors identified in this study (e.g., having chronic medical illness, having significant pain and functional disability) as indicators for a high risk of hidden psychiatric consequences.

However, clinicians should not be overly dependent on the acute medical variables in predicting long-term psychiatric conditions. Adversity, both before and after the disaster, combined with particular interactions between biopsychosocial factors, can markedly hinder recovery from psychiatric consequences. We have shown that AVN, an unexpected and delayed treatment complication, was associated with persistent psychiatric morbidity. Clinicians should thus be alert to the psychological impact of any other unexpected physical complications, especially if they have a strong biological and psychological impact. The association factors for PTSD included subjective pain perception, functional impairment and the locus of control appraisal. These findings highlight the potential treatment direction for optimization of pain management, physical rehabilitation and cognitive work in promoting self-efficacy.

Because of the need to attend multiple clinics, the stigmatisation of attending specialist psychiatric clinics and the complex interaction of the biopsychosocial challenges of

SARS, an integrated multidisciplinary clinic setting with regular case conferences may be a superior approach in the long-term management of complicated cases.

#### 4.3. Limitations

The findings of this study should be interpreted with consideration of the following methodological limitations. The retrospective design may cause bias for assessment of different psychiatric correlates with PTSD.

Discrimination and stigmatisation were important phenomena in the SARS population. Patients may therefore under-report their psychopathology to avoid the phenomenon of "double stigmatisation." On the other hand, litigation and compensation processes might cause an overexaggeration of the reported psychiatric symptoms. In order to minimise these potential confounding effects, the principal investigator was not involved in the clinical care or medical board assessment of the subjects before the completion of this research. We also stressed that the investigation was used solely for research and that it would not be used for other purposes. The variables of litigation and compensation did not affect the final logistic regression model when these variables had been controlled.

The treatment effect of biological and psychosocial interventions was not evaluated. No general population or other chronic illness control groups were included for comparison. Finally, the relatively small sample size may limit the power of this study to detect risk factors with moderate strength. Further studies with multicentre involvement are required to increase the power of the study and to study the course of psychiatric morbidity.

### 5. Conclusion

Despite its limitations, this study has an exploratory role in revealing the risk factors of chronic PTSD among SARS survivors. The results show that, in addition to gender differences and pre-SARS chronic medical illnesses, subsequent physical complications like AVN are associated with the chronic course of PTSD. The important roles of pain, appraisal and the locus of control may be the future focus for understanding the risk mechanisms and potential treatments of PTSD. Although our findings were based on a cohort of SARS survivors in a general hospital in HK, we hope that the findings can help in exploring the management of comparable infectious disease outbreaks. In case of an unfortunate future massive outbreak, a prospective study with an early baseline and longitudinal assessment should be adopted to study the effects of psychosocial correlates with PTSD.

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