

# Post-traumatic stress disorder following myocardial infarction: Prevalence and risk factors

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**BACKGROUND:** Post-traumatic stress disorder (PTSD) is associated with negative impacts on physical health. Victims of a myocardial infarction (MI) who develop PTSD may be particularly affected by these impacts due to their cardiovascular vulnerability. Post-traumatic reactions in this population are not well known.

**OBJECTIVES:** To examine the prevalence of PTSD after MI and its risk factors, and to validate a prediction model for PTSD symptoms.

**METHODS:** Patients hospitalized for MI (n=477) were recruited in three hospitals. The Structured Clinical Interview for the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, and questionnaires concerning PTSD symptoms and general measures were administered to patients during hospitalization and at one-month follow-up.

**RESULTS:** Four per cent of the patients had PTSD and 12% had partial PTSD. The perception of a threat to life, the intensity of acute stress disorder and depression symptoms several days after the MI, a history of referral to a psychologist or psychiatrist, and female sex were risk factors for the intensity of PTSD symptoms in a sequential multiple regression analysis (R=0.634). The prediction model was validated by applying the regression equation to 48 participants who were not included in the initial regression (R=0.633).

**CONCLUSIONS:** The risk factors for development of PTSD symptoms identified in the present study could be used to facilitate the detection of patients at risk for developing PTSD symptoms so they can later be offered psychological interventions as needed.

**Key Words:** Myocardial infarction; Post-traumatic stress disorder; Prevalence; Risk factor

## Le trouble de stress post-traumatique après un infarctus du myocarde : La prévalence et les facteurs de risque

**HISTORIQUE :** Le trouble de stress post-traumatique (TSPT) a des conséquences négatives sur la santé physique. Les victimes d'un infarctus du myocarde (IM) qui ont un TSPT peuvent être particulièrement touchées en raison de leur vulnérabilité cardiovasculaire. Les réactions post-traumatiques au sein de ces populations sont mal connues.

**OBJECTIFS :** Examiner la prévalence de TSPT après un IM et les facteurs de risque s'y rapportant, et valider un modèle prédictif des symptômes de TSPT.

**MÉTHODOLOGIE :** On a recruté des patients hospitalisés en raison d'un IM (n=477) dans trois hôpitaux. Les patients ont répondu à l'entrevue clinique structurée du *Manuel diagnostique et statistique des troubles mentaux, quatrième édition*, et à des questionnaires sur les symptômes du TSPT et sur des mesures générales pendant leur hospitalisation et dans le cadre d'un suivi un mois plus tard.

**RÉSULTATS :** Quatre pour cent des patients avaient un TSPT et 12 %, un TSPT partiel. Selon une analyse de régression multiple séquentielle, la perception d'une menace à la vie, l'intensité d'un trouble de stress aigu et des symptômes de dépression quelques jours après l'IM, des antécédents d'aiguillage vers un psychologue ou un psychiatre et le sexe féminin étaient des facteurs de risque liés à l'intensité des symptômes de TSPT (R=0,634). Les chercheurs ont validé le modèle prédictif en appliquant l'équation de régression à 48 participants exclus de l'analyse de régression initiale (R=0,633).

**CONCLUSIONS :** Les facteurs de risque de présenter les symptômes de TSPT repérés dans la présente étude pourraient servir à faciliter la détection des patients vulnérables à ces symptômes afin qu'on puisse leur offrir des interventions psychologiques, au besoin.

A myocardial infarction (MI) is experienced as a traumatic event by some of the people who suffer from one, and may result in post-traumatic stress disorder (PTSD). To meet the diagnostic criteria for PTSD according to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV-TR) (1), a person must perceive a threat to his or her life or physical integrity at the time of the MI (criterion A1), and feel intense fear, a feeling of helplessness or horror in response to the MI (criterion A2); constantly re-experience the MI in one or more of the following ways (criterion B): images, thoughts, dreams, sense of reliving the MI, psychological distress or physiological reactivity when reminded of the MI; avoid things that remind him or her of the MI and/or present a blunting of general reactivity as evidenced by the presence of at least three of the following symptoms (criterion C): efforts to avoid thoughts, feelings, activities, places or people that remind him or her of the MI, decreased interest in activities, restricted affect, a feeling of detachment from other people or sense of a foreshortened future; and present with autonomic hyperactivation as evidenced by at least two of the following symptoms

(criterion D): disturbed sleep, irritability, concentration problems, hypervigilance or exaggerated startle reaction (1). The symptoms must be present for a minimum of one month. The symptoms experienced in the first month after the MI may give rise to acute stress disorder (ASD) – a condition that is similar to PTSD but has partially different criteria, particularly with regard to symptoms of dissociation, which are required only for the diagnosis of ASD (1).

An increasing number of researchers are interested in post-traumatic symptoms after MI (2,3). Prevalence rates varying between 4% and 24% for PTSD one month after the MI have been observed by studies using self-administered questionnaires (4-6).

PTSD symptoms after an MI, which are underdiagnosed and often not recognized by health care providers, can have significant repercussions on patients' recoveries. In fact, such symptoms appear to have a negative impact on the overall and cardiovascular health of patients exposed to various traumatic events, including MI (7,8). Boscarino and Chang (9) observed a risk of MI that was four times greater in veterans who met the criteria for PTSD than in those without PTSD.

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MI patients, whose cardiovascular vulnerability is greater (10), are particularly likely to be affected by PTSD. This disorder has been associated with a higher rate of hospitalization for cardiovascular causes and appears to have a negative impact on patients' adherence to their pharmacological treatment (8,11). On the other hand, Pedersen et al (12) did not observe any association between PTSD and post-MI prognosis in a smaller sample.

The identification of factors related to the development of PTSD may help clinicians detect patients who will develop post-traumatic symptoms and prevent the consequences that seem to be associated with it (13). With regard to pretraumatic risk factors, studies have shown that a history of PTSD (13), cardiovascular disease (14) and substance abuse (15) may be associated with the development of PTSD. However, a history of psychological disorder (15-18), past traumatic event or MI (16,18,19), and demographic variables (including sex) generated limited or nonsignificant results (5,14-16,19-21).

Among peritraumatic risk factors (16,21,22), symptoms of dissociation, re-experiencing the MI, autonomic hyperactivation (21,22) and depression (22), as well as perceived severity of the MI (21), awareness of having an MI at the time it happened (23) and poor access to positive social support (6,15,22,23) have been found to be associated with the development of PTSD symptoms. No relationship between PTSD and various indicators of the objective severity of the MI (left ventricular ejection fraction, type of MI and mean creatine kinase level) has been indicated (16,19,21,22,24).

Post-traumatic factors that have been found to be associated with the development of PTSD include time elapsed since the MI, poor physical health (14), fatigue (18), anxiety (6,25), negative affect (5,6,23) and repressive coping style (16). No relationship has been observed between the development of PTSD symptoms and pain (14), alcohol consumption (18), anticipation of permanent disabilities (19), or variables related to personality and coping styles other than repression.

A good knowledge of the symptoms of PTSD and the predictors of their development after MI would make it possible to identify patients at risk, with the intention of implementing intervention strategies (13). Few studies have been performed, and none have prospectively assessed the prevalence of and risk factors for PTSD after MI with a large sample, including a high proportion of women, and using a diagnostic interview. The external validity of existing studies is limited and only a few risk factors for PTSD have been explored. The importance of the risk factors for the development of PTSD symptoms has never been validated. The present study had the following objectives: to determine the prevalence of PTSD after MI, to identify the variables predicting PTSD symptoms and to validate a prediction model for PTSD symptoms.

## METHODS

### Participants and procedure

The participants were recruited between June 2002 and April 2005 in three Montreal (Quebec) hospitals. Patients who met the following criteria were eligible for the study: admitted with a diagnosis of MI; age 18 years or older; functional spoken and written French or English; absence of any moderate to severe cognitive deficit that could interfere with participation in the study; and absence of any severe comorbid health problem. The MI diagnosis was confirmed by the treating physicians on the basis of electrocardiogram and enzyme changes (elevated troponin levels). The research protocol was approved by the ethics committees of the three institutions.

Participants were identified at the coronary unit through consultation of medical files. The research protocol and the consent form were explained to eligible patients, and a consent form was read and signed by those who agreed to participate. They were met at the hospital (a minimum of two days and a maximum of 14 days after the MI) for the first interview and for a second interview one month after the MI. The recruitment and interviews were performed by research assistants with degrees in psychology who were specifically trained to administer the

structured interview; interviews were audiotaped. Questionnaires to be completed and returned were given to the participants in a pre-addressed, prestamped envelope at both evaluation periods. Weekly telephone reminders were given until the questionnaires were returned.

### Measurement instruments used during hospitalization

**Sociodemographic and medical data:** Data collected during the interview included age, sex, marital and employment status, parental status, annual income, educational level, religious beliefs, history of referral to a psychologist or psychiatrist, personal and family history of cardiovascular disease, comorbid health problems, tobacco and alcohol consumption, physical and relaxation activities, body mass index and subjective experience of the MI. The left ventricular ejection fraction, clinical events and surgical interventions during hospitalization, creatine kinase measurements and number of days hospitalized were obtained from the medical file.

**Structured Clinical Interview for DSM-IV, ASD Module (SCID-IV-ASD) (26):** The SCID-IV-ASD is an interviewer-administered instrument that allows ASD to be diagnosed according to DSM-IV criteria. It has been validated and is used frequently (27,28).

**Modified PTSD Symptom Scale – Self-Report (MPSS-SR) (29,30):** The MPSS-SR is a validated self-administered 17-item questionnaire (31) that measures the intensity of post-traumatic stress symptoms on two scales, which respectively measure the frequency and severity of symptoms. The total score is obtained by adding the scores of both scales.

**Beck Depression Inventory, Second Edition (BDI-II) (32):** The BDI-II is a self-administered 21-item scale that has been validated and is frequently used to measure depression symptoms.

**Life Events Stress Scale (LESS) (33,34):** This inventory comprises 10 items that correspond to categories of stressful events. The level of stress experienced for each category over the past six months is ranked on an intensity scale.

**Modified Medical Outcomes Study (MOS) Social Support Survey (M-MSSS) (33,35):** The M-MSSS is a validated instrument (33) that was adapted from the MOS Social Support Survey. It is composed of seven items and measures of perceived social support. Perceived access to each kind of support is ranked on a frequency scale.

### Measurement instruments used at follow-up

At follow-up, one month after the MI, participants again completed the MPSS-SR and BDI-II, as well as two other instruments listed below.

**Structured Clinical Interview for DSM-IV, PTSD (SCID-IV-PTSD) and Past PTSD Modules (SCID-IV-PPTSD) (26):** These modules enable one to diagnose current PTSD as well as PPTSD that is currently in remission (27,28).

**Trauma Assessment for Adults (36,37):** This validated inventory is administered during an interview that enables one to identify past traumatic events.

### Statistical analyses

Participants were divided into two samples, used respectively for the development and validation of a prediction model of the intensity of PTSD symptoms. The development and validation samples were recruited consecutively to ensure the validity of the model when applied to patients who had an MI after the development sample was recruited. Based on the average weekly recruitment of four patients, a date was set to start building the validation sample, which was planned to be composed of 100 MI patients (20% of the expected total of 500 participants). Even though that number was not reached when the recruitment was stopped as planned in April 2005, both sample sizes provided sufficient statistical power. Univariate analyses were performed to compare the characteristics of both samples. Descriptive statistics were performed with the model development sample to verify the prevalence of PTSD and to identify the participants' characteristics. A kappa coefficient was calculated to document inter-rater

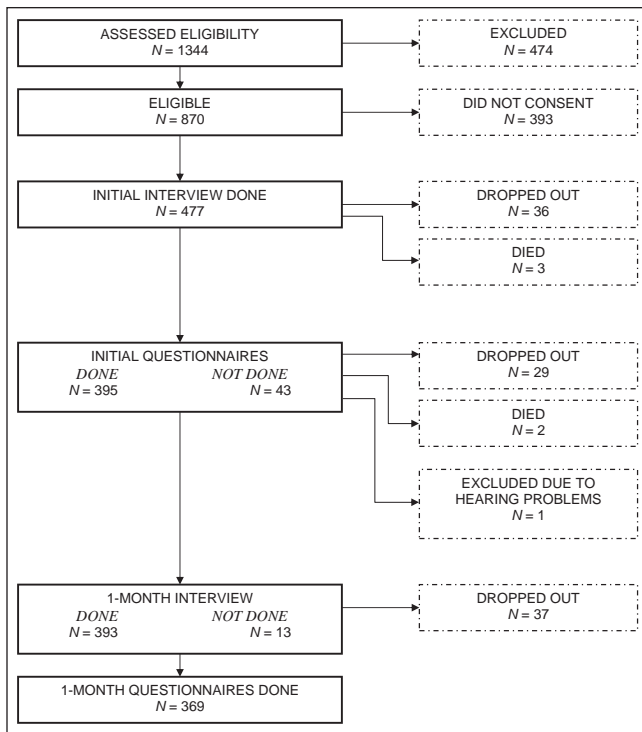


Figure 1) Flow chart for patients

agreement on 25% of the interviews selected randomly (SCID-IV-PTSD). Univariate analyses (correlations, analyses of variance and *t* tests for independent samples) were used to select the independent variables (measured at the initial evaluation period) associated with the intensity of PTSD symptoms, as measured by the MPSS-SR at the one-month follow-up ( $P < 0.05$ ). A logarithmic transformation was applied to this variable. Multiple stepwise regression analyses and a sequential multiple regression analysis were executed to develop a prediction model of the intensity of PTSD symptoms. Finally, the regression equation for the prediction model of the intensity of PTSD symptoms was applied to the validation sample, and the Fisher's *Z* test for the difference between two independent correlations was used to verify its validity. To explore the role of the overlapping symptoms between PTSD and depression in the association found between the symptoms of both disorders, a secondary multiple regression analysis was performed after removing the items corresponding to the overlap in the BDI-II score. The analyses were performed using SPSS version 10.0.1 (SPSS Inc, USA).

**RESULTS**

**Participants**

A total of 477 patients agreed to participate and completed a first interview (mean [± SD] 4±2.73 days post-MI). The sample used to develop the prediction model (n=389) and the validation sample (n=88), made up of the last patients to be recruited, were compared based on the different variables measured in the study. The only significant difference observed between the two samples was that the former met criterion B for ASD more often ( $\chi^2=5.86, P=0.02$ ). Forty-four of the 88 participants in the validation sample completed all the instruments and were included in the analyses. The attrition rate and the number of participants who completed each assessment are presented in Figure 1. The participants' characteristics are presented in Table 1. Participants who did not complete the follow-up interview one month after the MI were younger than those who did ( $t[476]=5.47, P < 0.001$ ). This interview was completed by telephone for 80% of the patients (who refused or were unable to come back to the hospital for that purpose). Those who did not complete the

**TABLE 1**  
**Characteristics of participants**

Characteristic	
Men, n (%)	293 (75.1)
Age, years	59.22±11.27
Education ≥ college or equivalent, n (%)	145 (37.3)
Annual income <\$30,000, n (%)	125 (33.4)
Working, n (%)	172 (46.0)
Engaging in physical activity, n (%)	217 (55.8)
History of myocardial infarction, n (%)	75 (20.6)
History of cardiovascular disease, n (%)	136 (37.6)
Family history of cardiovascular disease, n (%)	288 (74.6)
Smoking, n (%)	92 (23.7)
Alcohol (consumption ≥1 drink/week), n (%)	169 (43.4)
Social support (M-MSSS, total/28)	21.33±6.76
Stress level related to life events (LESS, total/5)	1.63±1.40
Depression (BDI-II, total/63)	
Time 1	8.44±7.74
Time 2	7.20±7.21

Data presented as mean ± SD unless otherwise indicated. BDI-II Beck Depression Inventory, Second Edition; LESS Life Events Stress Scale; M-MSSS Modified Medical Outcomes Study Social Support Survey

follow-up questionnaires were younger ( $t[476]=3.24, P < 0.001$ ), had higher scores on the BDI-II ( $t[394]=2.44, P=0.02$ ) at the first measurement time and were more likely to be women ( $\chi^2[1, n=478]=10.62, P < 0.001$ ). The 31 participants who completed the MPSS-SR less than four weeks after the MI at the one-month follow-up (mean of 33.53±5.42 days post-MI) were excluded from the analyses based on this questionnaire because PTSD can only be diagnosed at least one month after the traumatic event. PTSD symptoms did not differ between hospitals.

**Prevalence of PTSD and symptomatology**

The prevalence of PTSD on the SCID-IV-PTSD according to the DSM-IV-TR criteria was 4.1%. Twelve per cent of participants met the criteria for a diagnosis of partial PTSD; that is, they had at least one symptom of re-experiencing the MI (criterion B), avoidance or blunting of general reactivity (criterion C) and autonomic hyperactivation (criterion D) in addition to having perceived a threat to their life, and felt fear, helplessness or horror during the event (criterion A). The kappa coefficient obtained for inter-rater agreement was 0.78.

Use of the cut-off points suggested in the literature allowed for the determination of the severity of the symptoms of PTSD detected with the MPSS-SR at the one-month follow-up (38). Thus, 9% of participants had low-intensity symptoms, 6% had moderate-intensity symptoms and 5% had high-intensity symptoms (indicative of PTSD). The score on the MPSS-SR at follow-up was associated with the number of symptoms identified on the SCID-IV-PTSD ( $r=0.62, P < 0.001$ ). The symptoms on the ASD, PTSD and PPTSD modules of the SCID-IV, and the MPSS-SR score at both evaluation times are presented in Table 2.

**Prediction model of the intensity of PTSD symptoms**

The variables significantly associated with the intensity of PTSD symptoms in univariate analyses were entered in the multiple regression analyses by category of variable. With regard to the psychological variables measured at the hospital, the perceived threat to life during the MI, and the feeling of fear, helplessness or horror (criterion A for ASD; semipartial  $R=0.13, P=0.03$ ) and the intensity of depression symptoms (semipartial  $R=0.45, P < 0.001$ ) were significant. With regard to psychological history, only the presence of a history of referral to a psychologist or psychiatrist was significant (semipartial  $R=0.23, P < 0.001$ ). None of the medical variables were significant. Among sociodemographic variables, only sex was significant (semipartial  $R=-0.22, P < 0.001$ ).

The selected variables were entered in the first step of the sequential multiple regression analysis presented in Table 3. The intensity of symptoms on the MPSS-SR at the first measurement time, which was introduced in the second step to avoid masking the effect of the other independent variables, added 10.7% to the variance explained in the first step according to the adjusted  $R^2$ . The final regression model explained 38.6% of the variance. Finally, the nonsignificant independent variables excluded in the univariate analyses were introduced in an additional step in the sequential multiple regression analysis to test their contribution after the other variables were entered. They remained nonsignificant.

#### Validation of the prediction model of the intensity of PTSD symptoms

To validate the final prediction model of the intensity of PTSD symptoms, the observed scores in the validation sample were correlated with the predicted scores obtained from the regression equation of the prediction model. Then, this correlation ( $R=0.63$ ;  $n=48$ ) was compared with the multiple  $R$  ( $0.63$ ;  $n=194$ ) obtained in the initial sample. The two correlations were not significantly different ( $Z$  score =  $-0.012$ ;  $P=0.99$ ). The validation of the first step of the prediction model, which did not include the MPSS-SR score at the first evaluation, also revealed no difference between the correlations (initial prediction model  $R=0.54$ ,  $n=194$ ; validation  $R=0.44$ ,  $n=48$ ;  $Z$  score =  $-0.811$ ,  $P=0.42$ ).

#### Secondary analysis

Because depression emerged as a predictor of the intensity of PTSD symptoms in the first step of the sequential multiple regression analysis, a secondary multiple regression analysis was performed to control for the overlap between depression and PTSD symptoms. A modified depression score was obtained by removing the five overlapping items from the BDI-II (eg, loss of interest, pessimism about future, difficulty sleeping, poor concentration and irritability). The first step of the sequential multiple regression analysis used to create a model of estimation of the intensity of PTSD symptoms was reproduced using this depression score (modified depression score: unstandardized beta = 0.36, standardized beta = 0.031, 95% CI 0.02 to 0.04,  $P<0.001$ , semipartial  $r=0.34$ ; model: adjusted  $R^2=0.25$ ).

## DISCUSSION

#### Prevalence of PTSD and predictive variables

A small proportion of patients presented with PTSD. Previous studies (4-6) had suggested equal or higher prevalences at the same measurement time. It is possible that the use of a structured interview (SCID-IV-PTSD) rather than self-report questionnaires, as used in previous studies, may be more restrictive in detecting PTSD. Criterion A for PTSD, which requires the experience of an event during which the physical integrity of the individual or of another

**TABLE 2**  
Prevalence and symptomatology of acute stress disorder (ASD), post-traumatic stress disorder (PTSD) and past PTSD

Post-MI hospitalization	
ASD (SCID-IV-ASD)	
Clinical diagnosis (criteria A, B, C, D and E met)	14 (3.6)
Partial diagnosis (criterion A met and 1 symptom of criteria B, C, D and E)	5 (1.3)
MPSS-SR, mean $\pm$ SD	14.47 $\pm$ 16.15
Mild symptoms (22 to 31/119)	24 (6.2)
Moderate symptoms (32 to 49/119)	24 (6.2)
Severe symptoms ( $\geq 50/119$ )	18 (4.6)
1-month post-MI	
Past PTSD (SCID-IV-PPTSD)	
PTSD (SCID-IV-PTSD)	9 (2.8)
Clinical diagnosis (criteria A, B, C and D met)	13 (4.1)
Partial diagnosis (criterion A met, and 1 symptom of criteria B, C and D)	38 (12.0)
Perceived threat and fear, helplessness or horror (criterion A met: 2/2 symptoms)	139 (43.4)
Re-experiencing (criterion B met: $\geq 1/5$ symptoms)	118 (36.9)
Avoidance and blunting of general reactivity (criterion C met: $\geq 3/7$ symptoms)	39 (12.2)
Autonomic hyperactivation (criterion D met: $\geq 2/5$ symptoms)	81 (25.3)
MPSS-SR, mean $\pm$ SD	11.05 $\pm$ 13.11
Mild symptoms (22 to 31/119)	27 (9.0)
Moderate symptoms (32 to 49/119)	13 (4.3)
Severe symptoms ( $\geq 50/119$ )	6 (2.0)

Data presented as  $n$  (%) unless otherwise indicated. MI Myocardial infarction; MPSS-SR Modified PTSD Symptom Scale – Self-Report; SCID-IV-ASD Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV), ASD Module; SCID-IV-PPTSD Structured Clinical Interview for DSM-IV, Past PTSD Module; SCID-IV-PTSD Structured Clinical Interview for DSM-IV, PTSD Module

person is threatened and there is a reaction of fear, helplessness or horror, constitutes another possible explanation for the low prevalence rate (only 43% of participants met this diagnostic criterion in our study). Thus, the impact of the MI as a potentially traumatic event might be subjectively experienced as a less intense threat to life than other types of events (eg, war or sexual assault).

We observed that 36.9% of patients met diagnostic criterion B (re-experiencing the MI) for PTSD according to the DSM-IV-TR (1), 12% met criterion C (avoidance/blunting of general reactivity) and

**TABLE 3**  
Summary of sequential multiple regression analysis for variables associated with intensity of post-traumatic stress disorder symptoms on the Modified PTSD Symptom Scale – Self-Report (MPSS-SR) ( $n=194$ )

	Beta	Semipartial R	P	Total R	Adjusted $R^2$
Step 1			<0.001	0.542	0.279
Perceived threat during myocardial infarction	0.156	0.151	0.014		
Intensity of depression symptoms (BDI-II)	0.404	0.381	<0.001		
History of referral to psychologist or psychiatrist	0.140	0.135	0.028		
Sex*	-0.116	-0.110	0.072		
Step 2			<0.001	0.634	0.386
Perceived threat during myocardial infarction	0.096	0.091	0.108		
Intensity of depression symptoms (BDI-II)	0.114	0.083	0.142		
History of referral to psychologist or psychiatrist	0.162	0.157	0.006		
Sex	-0.131	-0.124	0.029		
Intensity of ASD symptoms (MPSS-SR at hospital)	0.443	0.329	<0.001		

\*1 = female, 2 = male. ASD Acute stress disorder; BDI-II Beck Depression Inventory, Second Edition



25% met criterion D (autonomic hyperactivation) one month after the MI. In addition, 12% met the criteria for a diagnosis of partial PTSD. These patients could be susceptible to the harmful consequences that post-traumatic symptoms appear to have on cardiovascular health (7,8), even in the absence of clinical PTSD. Research into the consequences of PTSD for patients with heart disease is in its early stages, but studies of the impact of depression symptoms after an MI indicate that even low-intensity symptoms can have significant negative repercussions on cardiovascular morbidity and mortality (39). This may also be true of PTSD symptoms. In a study by Fortin et al (40), ASD symptoms were found to be associated with the persistence of risk factors for cardiovascular disease, namely smoking and depression symptoms, three months after an MI.

The perception of a threat to life during the MI and the feeling of intense fear, helplessness or horror, the intensity of depression symptoms, the existence of a history of referral to a psychologist or psychiatrist, female sex and the intensity of ASD symptoms a few days after the MI seem to constitute risk factors predicting more intense PTSD symptoms one month after the MI. These factors could be used to detect patients at risk to monitor them closely and assess the development of PTSD symptoms. Female sex is the only variable that had not been associated with the development of PTSD after MI in earlier studies; this may be due to the small samples used and the low proportion of women in them (5,12,14,16,17,20). The intensity of ASD symptoms, which is recognized in the literature as being associated with the development of PTSD symptoms (13,16), is the risk factor that best predicts the development of PTSD symptoms one month after an MI. However, it should be noted that PTSD symptoms were measured with the same instrument used one month before to measure ASD symptoms. The presence of depression symptoms shortly after the MI also suggests that patients should be closely monitored and, possibly, be assessed for PTSD later, because this factor allows one to effectively predict PTSD symptoms when the intensity of ASD symptoms is not included in the model. The strength of the association between depression and PTSD does not seem to be attributable to an overlap between the symptoms of the two disorders (eg, emotional numbing, difficulty sleeping, poor concentration, irritability) because very similar results were obtained when these symptoms were removed from the depression score used. The evaluation of depression symptoms could be particularly useful to facilitate the detection of PTSD

when ASD is not assessed during hospitalization. Moreover, the possibility of comorbid PTSD and major depression should be evaluated when symptoms of both disorders exist. In addition, depression symptoms were associated with ASD symptoms in another study performed using data from the same sample (41). The validation of the model of the intensity of PTSD symptoms with participants who were not included during its development enabled us to confirm its usefulness.

#### Methodological considerations

The present multicentre prospective study included a considerably larger number of participants than previous studies, 25% of whom were women. It used a structured interview to make the diagnosis of PTSD and included the validation of the prediction model of the intensity of PTSD symptoms, which appears to support its internal and external validity. However, it does have some limitations. First, there were high rates of refusal and dropping out, which may have resulted in a bias in the interpretation of the results. The patients who refused to participate in the study or dropped out may have done so because of post-traumatic sequelae resulting in behaviours of avoidance of stimuli that remind them of the MI. Moreover, most of the diagnostic interviews were conducted by phone, whereas the SCID-IV-PTSD was designed to be used in face-to-face interviews.

#### Clinical implications

A better knowledge of the risk factors for development of PTSD symptoms might contribute to better identification of these symptoms and, therefore, favour the creation and implementation of secondary preventive programs for at-risk patients. When patients are in the hospital after an MI, it is an ideal time to perform the initial identification of post-traumatic symptoms and at-risk patients. Intervention strategies adapted to MI patients could be put in place and thereby help to limit the associated medical and psychological consequences.

Further research is necessary to continue studying the etiology of post-traumatic stress symptoms and their risk factors in MI victims. Research should also target the identification of specific medical impacts of post-traumatic symptoms after MI.

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