

ORIGINAL ARTICLE

Peritraumatic tonic immobility is associated with PTSD symptom severity in Brazilian police officers: a prospective study

Deborah B. Maia,¹ Augusta Nóbrega,² Carla Marques-Portella,¹ Mauro V. Mendlowicz,³ Eliane Volchan,⁴ Evandro S. Coutinho,⁵ Ivan Figueira¹

¹Institute of Psychiatry, Universidade Federal do Rio de Janeiro (UFRJ), Rio de Janeiro, RJ, Brazil. ²Polícia Militar do Estado de Goiás (PMGO), Goiânia, GO, Brazil. ³Department of Psychiatry and Mental Health, Universidade Federal Fluminense (MSM-UFF), Niterói, RJ, Brazil. ⁴Instituto de Biofísica Carlos Chagas Filho (IBCCF), UFRJ, Rio de Janeiro, RJ, Brazil. ⁵Escola Nacional de Saúde Pública (ENSP), Fundação Oswaldo Cruz (FIOCRUZ), Rio de Janeiro, RJ, Brazil.

Objective: Peritraumatic reactions feature prominently among the main predictors for development of posttraumatic stress disorder (PTSD). Peritraumatic tonic immobility (PTI), a less investigated but equally important type of peritraumatic response, has been recently attracting the attention of researchers and clinicians for its close association with traumatic reactions and PTSD. Our objective was to investigate the role of PTI, peritraumatic panic, and dissociation as predictors of PTSD symptoms in a cohort of police recruits ($n=132$).

Methods: Participants were asked to complete the following questionnaires during academy training and after the first year of work: Posttraumatic Stress Disorder Checklist - Civilian Version (PCL-C), Physical Reactions Subscale (PRS), Peritraumatic Dissociative Experiences Questionnaire (PDEQ), Tonic Immobility Scale (TIS), and Critical Incident History Questionnaire.

Results: Employing a zero-inflated negative binomial regression model, we found that each additional point in the TIS was associated with a 9% increment in PCL-C mean scores ($RM = 1.09$), whereas for PRS, the increment was 7% ($RM = 1.07$). As the severity of peritraumatic dissociation increased one point in the PDEQ, the chance of having at least one symptom in the PCL-C increased 22% ($OR = 1.22$).

Conclusions: Our findings highlight the need to expand investigation on the incidence and impact of PTI on the mental health of police officers.

Keywords: Posttraumatic stress disorder; peritraumatic reactions; police

Introduction

Police officers are routinely exposed to occupational situations involving risk of death, and are thus more susceptible to developing posttraumatic stress disorder (PTSD). The current prevalence of PTSD in this population ranges from 7 to 19% and, the presence of PTSD symptoms is associated with impairments in psychosocial functioning and physical health.¹⁻³ It is known, however, that trauma exposure alone is not sufficient to trigger development of the disorder. Pretrauma, peritrauma, and posttrauma risk factors impact on the onset and severity of symptoms.⁴

Peritraumatic responses – emotional, cognitive and physical reactions that occur during or immediate after exposure to trauma – feature prominently in the development of PTSD in adults in general and among police officers as well.⁵⁻⁷ Although less studied, peritraumatic tonic immobility (PTI) has been recently attracting the

attention of researchers and clinicians for its close association with traumatic events and PTSD.⁸ Tonic immobility is a state of involuntary immobility, analgesia, and unresponsiveness to external stimulation presented by some animals when trapped by a predator with no possible escape.⁹ Suarez & Gallup suggested that the experience of the so-called “rape-induced paralysis” bore a striking resemblance to animal tonic immobility.¹⁰ Galliano et al. were the first to employ a more systematic assessment of tonic immobility in victims of rape/sexual assault by asking the victims to rate the degree to which they froze and felt paralyzed during the assault, and were unable to move even though not restrained.¹¹ More recently, tonic immobility in humans was assessed through retrospective reports of traumatic events in a more systematic way using psychometric instruments in female victims of sexual assault,¹²⁻¹⁴ female and male students exposed to different types of trauma,^{15,16} and mixed-gender patients with PTSD secondary to urban violence.¹⁷⁻¹⁹ The latter studies investigated the occurrence of tonic immobility in a cohort of victims of urban violence with PTSD. When the association of peritraumatic reactions (tonic immobility, panic, and dissociation) with PTSD symptom severity was investigated,

tonic immobility was the only reaction that remained statistically significant after controlling for potential confounders.¹⁹ Moreover, tonic immobility was the best predictor of poor response to pharmacological treatment, showing a greater undesirable impact on PTSD prognosis than peritraumatic panic or dissociation.¹⁷

In the present study, we sought to compare PTI, panic symptoms, and dissociation as prospective predictors of PTSD symptoms in a sample of police officers. We have expanded the scope of previous studies on PTI by investigating a cohort of young male police officers during their first year after graduation from the police academy. More precisely, we hypothesized that officers who reported more severe peritraumatic responses, particularly tonic immobility, would show higher scores on PTSD scales after 1 year of exposure to the critical incidents that are associated with police work.

Method

Study design

This is a prospective cohort study with a 1-year follow-up.

Participants

All cadets graduating from a Brazilian Midwestern state police academy (n=500) were invited to participate in the study and asked to complete a specifically created sociodemographic questionnaire and self-report psychometric scales. Three hundred and thirty (66%) cadets agreed to take part in the study. One year later, working as police officers, they were contacted again and asked to fill out the research questionnaires. Forty-seven (13%) participants declined to continue in the study, for a final sample of 287 subjects.

Measures

Sociodemographic data included age, educational attainment, and marital status. Participants were asked to fill out the Brazilian Portuguese version of the Posttraumatic Stress Disorder Checklist - Civilian Version (PCL-C). The PCL-C is a five-point Likert-type scale¹⁻⁵ containing 17 items based on DSM-IV criteria, and is one of the most widely used self-report instruments for screening post-traumatic stress symptoms in adults. Respondents indicate to what degree they have been disturbed by these symptoms during the last month, on a scale ranging from not at all¹ to very much.⁵ PCL-C scores range from 17 to 85, with higher values denoting more severe PTSD symptoms. The Brazilian Portuguese version of the PCL-C has been shown to have sound psychometric properties.²⁰⁻²²

The scales used to assess the type and severity of peritraumatic responses were: 1) the Physical Reactions Subscale (PRS) for peritraumatic panic symptoms comprises 10 items regarding the severity of physical panic symptoms, which are scored on a Likert-type format ranging from 1 (not at all) to 4 (extreme)²³; 2) the Peritraumatic Dissociative Experiences Questionnaire

(PDEQ) evaluates 10 dissociative symptoms which occurred during or immediately after the exposure to a critical incident²⁴ (scores range from 1 [not at all true] to 5 [extremely true]); 3) as in other works,^{18,19,25} we selected four items from the Tonic Immobility Scale - Child Form (TIS-C)²⁶ which specifically evaluate motor features of PTI, namely "I froze or felt paralyzed," "was unable to move even though not restrained," "felt unable to call out or scream," and "felt unable to escape," so as to avoid including items which are identical to those found in the panic and dissociation scales. This four-item subscale showed good internal consistency, with a Cronbach's alpha of 0.83.¹⁹ Moreover, another study found that the scores obtained using these four items were associated with the body sway measures of 33 trauma-exposed subjects on a force platform.²⁷

To assess the characteristics of the critical incidents experienced by the police officers during their first year of work, we used the Critical Incident History Questionnaire (CIHQ), a 34-item self-report measure designed to identify the frequency and severity of critical incidents in the line of police duty.²⁸ All participants signed an informed consent and the study was approved by the Ethics Committee of the Institute of Psychiatry of Universidade Federal do Rio de Janeiro, Brazil.

Statistical analysis

As the score of each of the 17 PCL-C items ranges from 1 to 5, individuals without symptoms scored a minimum of 17 points. To attribute a score of zero to those without PTSD symptoms, we initially subtracted 17 points from all PCL-C final scores. We then investigated the frequency distribution of the PCL-C scores. As data were very asymmetrically distributed, with about half of the participants reporting no symptoms (PCL-C = 0), we fitted four types of regression models: Poisson (PRM),

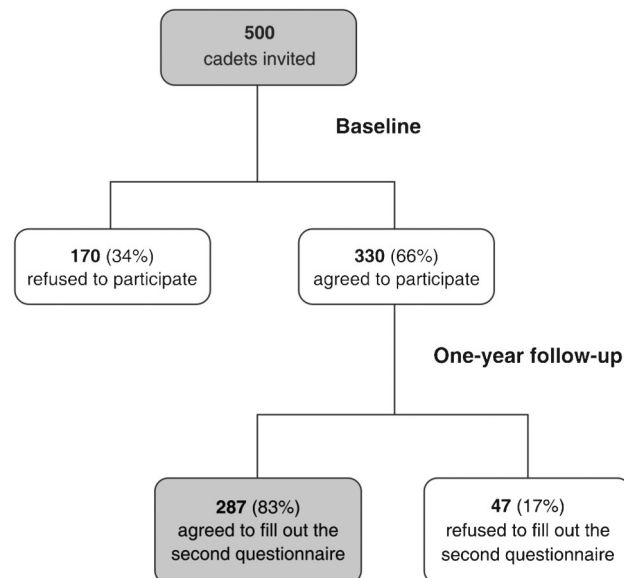


Figure 1 Flowchart of participant selection.

negative binomial (NBRM), zero-inflated Poisson (ZIP), and zero-inflated negative binomial (ZINB).²⁹ The ZINB model was chosen because the proportion of cases with no symptoms in the PCL scale was excessive and data were overdispersed (Figure 1). This model assumes that the studied population has two types of zero scores: structural zeroes and sampling zeroes. The first group is formed of subjects with a high propensity to have no PTSD symptoms, while the second is characterized by individuals who scored zero but could have had PTSD symptoms plus all subjects that had experienced at least one symptom. The ZINB model considers that different underlying processes can be involved in producing zero and non-zero counts.³⁰

Following this principle, the ZINB model generates two separate models and then combines them. First, a logit model was generated for the “certain/structural zero” cases (officers with no symptoms) and the regression coefficients describe the logarithms of the odds ratios (OR) associated to the included covariates. As we sought to describe the impact of increasing peritraumatic reaction scores on the chance of presenting at least one PTSD symptom, we depicted the data by inverting the OR (1/OR) of the logistic component of the ZINB model. Secondly, a NBRM model was generated predicting the mean number of symptoms for officers that had or could have symptoms (“not certain/sampling zero” cases) dependent to the relevant covariates. At this point, regression coefficients represent the natural logarithm of the ratio of mean values of the dependent variable per unit change in the covariate.^{30,31}

The alpha dispersion parameter was calculated for the count model. If this parameter is close to zero, the model converges to a Poisson distribution. The Vuong test was used to compare the ZINB to the standard NBRM model.³¹

During the modeling process, variables were included one by one (univariate analysis) in both components of the ZINB model. Those reaching p-values < 0.20 were entered in a multivariate model and retained if p-values

were ≤ 0.05. All analyses were controlled for baseline PCL scores.

The analysis was carried out in Stata 10.0.

Results

Of the 287 male officers, 132 (46%) reported being exposed to critical incidents during the 1-year follow-up period after police academy graduation. The complete process of recruitment and dropouts is summarized in Figure 1. The mean age of the exposed group was 23.3±2.8 years. The average PCL score at endpoint was 21.5±7.7, with a skewness of 2.3 and kurtosis of 8.0. Sixty-three officers (48%) reported no PTSD symptoms. Figure 2 presents the distribution of PCL scores (Figure 2).

Peritraumatic reactions showed different degrees of correlation among themselves. Dissociation correlated strongly with panic ($r = 0.89$) and less strongly with tonic immobility ($r = 0.63$), while the correlation coefficient between the latter and panic was 0.55. All p-values were < 0.001.

Table 1 shows the results of multivariate analysis. The logistic component (extra-zeroes part) depicts the OR of subjects having at least one symptom compared with those presenting no PTSD symptom. As the intensity of peritraumatic dissociation increased one point in the PDEQ, the chance of scoring at least one point in the PCL-C increased 22% (OR = 1.22).

The NBRM component of the model in Table 1 shows the ratio of means (RM) of PCL scores for officers with PTSD symptoms. PTI was associated with these symptoms. For each additional point on the TIS-4 scale, there was a 9% increment in the mean PCL score (RM = 1.09). For panic reaction, the increment was 7% (RM = 1.07). These analyses were controlled for baseline PCL scores.

Figure 3 shows the fit obtained from the four different models described in the Methods section and highlights the fact that ZINB produced a better fit than ZIP, since its curve was closer to the horizontal zero line.

When we controlled for the influence of the frequency of critical incident exposure, the findings did not change substantially. Nevertheless, it is important to point out that, although the ratio of means (RM = 1.08) for tonic immobility remained exactly the same, the p-value varied from 0.05 to 0.08, probably due to the sample size.

Discussion

This prospective study of male police officers found two main results: 1) PTSD symptom severity was associated with PTI and peritraumatic panic; 2) peritraumatic dissociation was associated with presenting or not presenting PTSD symptoms, independently of severity. In other words, those experiencing peritraumatic dissociation were more likely to exhibit PTSD symptoms, although the severity of these symptoms was influenced by reported tonic immobility and panic reactions.

To the best of our knowledge, this is the first prospective study to look into the role of PTI as a risk

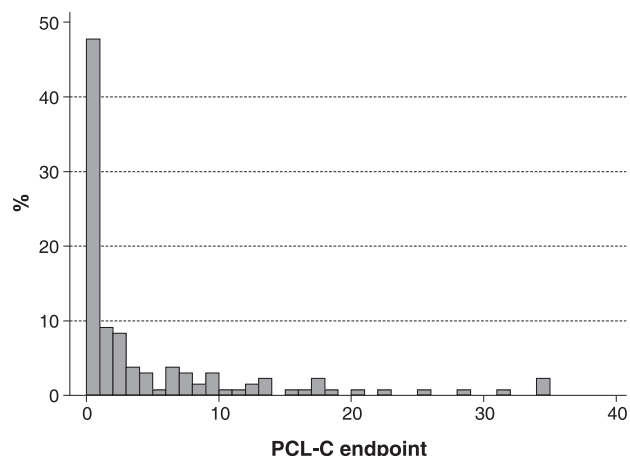


Figure 2 Posttraumatic Stress Disorder Checklist (PCL-C) scores at endpoint of 132 officers exposed to critical incidents.

Table 1 ZINB regression of PCL scores* for Brazilian officers according to peritraumatic reactions (nonzero obs = 64; zero obs = 61)

	RM	95%CI	p
Negative binomial component			
Tonic immobility reaction	1.09	1.00-1.19	0.05
Panic reaction	1.07	1.01-1.13	0.03
PCL score at baseline	1.03	1.00-1.06	0.06
Logistic component (extra zeroes)			
Peritraumatic dissociation	1.22 [†]	1.01-1.47	0.04

95%CI = 95% confidence interval; OR = odds ratio; PCL = Posttraumatic Stress Disorder Checklist; RM = ratio of means; ZINB = zero-inflated negative binomial.

Vuong test of ZINB vs. standard negative binomial: $z = 1.57$ ($p = 0.06$); $\alpha = 0.73$ (0.38-1.39).

* PCL score minus 17.

[†] Result presented as OR. As mentioned in the statistical analysis section, the reciprocal of the OR (1/OR) of the logistic component of the ZINB model is presented to express the impact of increasing scores of peritraumatic reactions on the odds of presenting at least one PTSD symptom.

factor for the development of PTSD symptoms in a cohort of male police officers exposed to duty-related critical incidents. Previous research with police officers has focused on peritraumatic responses such as distress, dissociation, and panic reactions, but did not systematically investigate motor reactions in response to critical incidents.^{1,5,6} Our findings may be important in view of the theoretical and clinical implications of PTI for the development and prognosis of PTSD.

Theoretical considerations

From an evolutionary perspective, tonic immobility has been conceptualized as the final defense in a chain of anti-predator responses. It is thus considered the last-ditch defense against entrapment by a predator within a sequence of defensive responses – namely, freeze, flight, fight, and tonic immobility.³² The adaptive value of tonic immobility is supported by the fact that the absence of movement increases the odds that a captured animal will escape, because a predator may loosen its grip if it assumes that the prey is indeed dead.³³

A report from informal interviews with trauma survivors also provides hints toward the adaptive value of tonic immobility in humans.³⁴ Under other scenarios, however, the occurrence of tonic immobility may be detrimental to the victims of a traumatic event. Leach reviewed witness testimonies, survivor debriefings, and official inquiry reports from shipwreck and aircraft emergencies for information on motor behavior and found that immobility was a frequently cited response by witnesses to a disaster (up to 15% of disaster survivors).³⁵ For the author, it was clear that the danger of death was made more critical by evacuation delays caused by behavioral freezing of the victims.

The apparent paradox that tonic immobility may be protective in certain circumstances and detrimental in others can be explained by the context of modern life. Technological mass accidents, such as shipwrecks and airplane crashes, which played no part in the evolution of defense reactions, are poorly served by a behavioral strategy that essentially requires one to play dead. Police activity is another example of an endeavor that is recent and in which the adoption of tonic immobility as a behavioral strategy is unlikely to yield any benefit.

Professional implications

Police work involves frequent exposure to high-risk situations that often require active response. For police officers facing imminently dangerous situations, such as shootings or high-speed pursuits, to experience tonic immobility could be physically and psychologically damaging. A state of immobility would endanger not only the officers themselves but also those they swore to serve and protect. Furthermore, given the low level of public awareness regarding the existence of tonic immobility in humans, the lack of purposeful action in these contexts could be misinterpreted (and even stigmatized) as cowardice or another major moral flaw by the police officer or by third parties.

Clinical and therapeutic perspectives

PTI may have a significant deleterious impact on the mental health of police officers, leading to potential clinical implications. Comparisons between PTI, dissociation, and panic reactions in victims of urban violence with PTSD suggest that PTI is the strongest predictor of PTSD symptom severity¹⁹ and of poor response to treatment.¹⁷ It is thus reasonable to speculate that paying attention to tonic immobility may help identify susceptible subgroups which would be amenable to specific preventive interventions and treatments.

For instance, subjects with PTSD who respond with motor inhibition might not be the best candidates for exposure therapy treatment.⁹ Furthermore, the tonic immobility reaction itself may be viewed as a traumatic memory, as it unleashes intense feelings of shame and guilt. Psychoeducational interventions designed to raise awareness of the biological singularity of this unconditioned response could lessen the feelings brought on by “not having reacted.” Likewise, new drug trials exploring the role of opioid-, GABA-, and dopaminergic agents in PTSD are warranted inasmuch as these neurotransmitters have been found to play a role in the modulation of tonic immobility in animal models.³⁶

Some limitations of the present study should be addressed. The sample was not representative of the general population, as it was composed of a homogeneous group of mentally healthy and physically fit male police officers, thus compromising the generalizability of

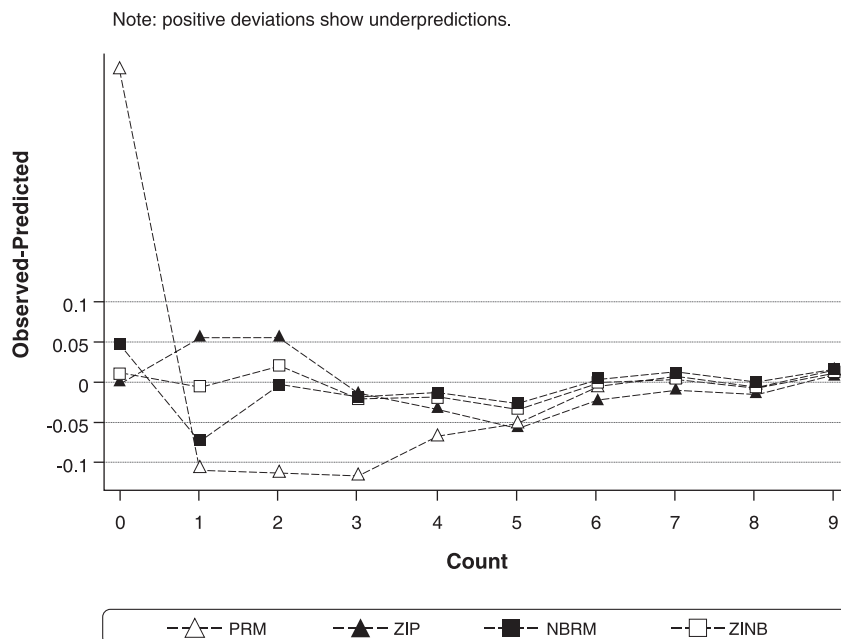


Figure 3 Fitting for Poisson (PRM), negative binomial (NBRM), zero-inflated Poisson (ZIP), and zero-inflated negative binomial (ZINB) regression models.

the study. Although refusal and dropout rates were moderately high, they were comparable to those of other prospective studies with police officers.³⁷ Finally, recall bias is a potential problem, as the participants were asked to recall remote traumatic events.

In conclusion, despite these inherent limitations, our observations highlight the need to expand research on the incidence and impact of PTI and on methods to prevent it and to avert its consequences in this population. It is also important to educate police officers, mental health specialists, and the general public about this poorly understood phenomenon.

Acknowledgements

This study received financial support from Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) via a grant awarded to DBM, IF, and ESC.

Disclosure

The authors report no conflicts of interest.

References

- Marmar CR, McCaslin SE, Metzler TJ, Best S, Weiss DS, Fagan J, et al. Predictors of posttraumatic stress in police and other first responders. *Ann N Y Acad Sci.* 2006;1071:1-18.
- Maia DB, Marmar CR, Metzler T, Nobrega A, Berger W, Mendlowicz MV, et al. Post-traumatic stress symptoms in an elite unit of Brazilian police officers: prevalence and impact on psychosocial functioning and on physical and mental health. *J Affect Disord.* 2007;97:241-5.
- Maia DB, Marmar CR, Mendlowicz MV, Metzler T, Nobrega A, Peres MC, et al. Abnormal serum lipid profile in Brazilian police officers with post-traumatic stress disorder. *J Affect Disord.* 2008;107:259-63.
- Violanti JM, Paton D. Who gets PTSD? Springfield: Charles C. Thomas. 2006.
- Maia DB, Marmar CR, Henn-Haase C, Nobrega A, Fiszman A, Marques-Portella C, et al. Predictors of PTSD symptoms in Brazilian police officers: the synergy of negative affect and peritraumatic dissociation. *Rev Bras Psiquiatr.* 2011;33:362-6.
- Martin M, Marchand A, Boyer R, Martin N. Predictors of the development of posttraumatic stress disorder among police officers. *J Trauma Dissociation.* 2009;10:451-68.
- Hodgins GA, Creamer M, Bell R. Risk factors for posttraumatic reactions in police officers: a longitudinal study. *J Nerv Ment Dis.* 2001;189:541-7.
- Volchan E, Souza GG, Franklin CM, Norte CE, Rocha-Rego V, Oliveira JM, et al. Is there tonic immobility in humans? Biological evidence from victims of traumatic stress. *Biol Psychol.* 2011;88:13-9.
- Marx BP, Forsyth JP, Gallup GG, Fulse T, Lexington JM. Tonic immobility as an evolved predator defense: Implications for sexual assault survivors. *Clin Psychology Sci Pract.* 2008;15:74-90.
- Suarez SD, Gallup GG. Tonic immobility as a response to rape in humans - theoretical note. *Psychology Rec.* 1979;29:315-20.
- Galliano G, Noble LM, Travis LA, Puechl C. Victim reactions during rape sexual assault - a preliminary-study of the immobility response and its correlates. *J Interpers Violence.* 1993;8:109-14.
- Bovin MJ, Jager-Hyman S, Gold SD, Marx BP, Sloan DM. Tonic immobility mediates the influence of peritraumatic fear and perceived inescapability on posttraumatic stress symptom severity among sexual assault survivors. *J Trauma Stress.* 2008;21:402-9.
- Heidt JM, Marx BP, Forsyth JP. Tonic immobility and childhood sexual abuse: a preliminary report evaluating the sequela of rape-induced paralysis. *Behav Res Ther.* 2005;43:1157-71.
- Humphreys KL, Sauder CL, Martin EK, Marx BP. Tonic immobility in childhood sexual abuse survivors and its relationship to posttraumatic stress symptomatology. *J Interpers Violence.* 2010;25:358-73.
- Abrams MP, Carleton RN, Taylor S, Asmundson GJ. Human tonic immobility: measurement and correlates. *Depress Anxiety.* 2009;26:550-6.
- Bados A, Toribio L, Garcia-Grau E. Traumatic events and tonic immobility. *Span J Psychol.* 2008;11:516-21.
- Fiszman A, Mendlowicz MV, Marques-Portella C, Volchan E, Coutinho ES, Souza WF, et al. Peritraumatic tonic immobility

- predicts a poor response to pharmacological treatment in victims of urban violence with PTSD. *J Affect Disord.* 2008;107:193-7.
- 18 Lima AA, Fiszman A, Marques-Portella C, Mendlowicz MV, Coutinho ES, Maia DC, et al. The impact of tonic immobility reaction on the prognosis of posttraumatic stress disorder. *J Psychiatr Res.* 2010;44:224-8.
 - 19 Rocha-Rego V, Fiszman A, Portugal LC, Garcia Pereira M, de Oliveira L, Mendlowicz MV, et al. Is tonic immobility the core sign among conventional peritraumatic signs and symptoms listed for PTSD? *J Affect Disord.* 2009;115:269-73.
 - 20 Ruggiero KJ, Del Ben K, Scotti JR, Rabalais AE. Psychometric properties of the PTSD Checklist-Civilian Version. *J Trauma Stress.* 2003;16:495-502.
 - 21 Berger W, Mendlowicz MV, Souza WF, Figueira I. Equivalência semântica da versão em português da Post-Traumatic Stress Disorder Checklist- Civilian Version (PCL-C) para rastreamento do transtorno de estresse pós-traumático. *Rev Psiquiatr Rio Gd Sul.* 2004;26:167-75.
 - 22 Passos RB, Figueira I, Mendlowicz MV, Moraes CL, Coutinho ES. Exploratory factor analysis of the Brazilian version of the Post-Traumatic Stress Disorder Checklist: civilian version (PCL-C). *Rev Bras Psiquiatr.* 2012;34:155-61.
 - 23 Resnick H. Acute panic reactions among rape victims: implications for prevention of postrape psychopathology. *NCP Clinical Quarterly/ The National Center of Post-Traumatic Stress Disorder.* 1997;7:41-5.
 - 24 Marmar CR, Weiss DS, Schlenger WE, Fairbank JA, Jordan BK, Kulka RA, et al. Peritraumatic dissociation and posttraumatic stress in male Vietnam theater veterans. *Am J Psychiatry.* 1994;151:902-7.
 - 25 Kunst M, Winkel FW, Bogaerts S. Recalled peritraumatic reactions, self-reported PTSD, and the impact of malingering and fantasy proneness in victims of interpersonal violence who have applied for state compensation. *J Interpers Violence.* 2011;26:2186-210.
 - 26 Fuse T, Forsyth JP, Marx B, Gallup GG, Weaver S. Factor structure of the Tonic Immobility Scale in female sexual assault survivors: an exploratory and Confirmatory Factor Analysis. *J Anxiety Disord.* 2007;21:265-83.
 - 27 Volchan E, Souza GG, Franklin CM, Norte CE, Rocha-Rego V, Oliveira JM, et al. Is there tonic immobility in humans? Biological evidence from victims of traumatic stress. *Biol Psychol.* 2011;88:13-9.
 - 28 Weiss DS, Brunet A, Best SR, Metzler TJ, Liberman A, Pole N, et al. Frequency and severity approaches to indexing exposure to trauma: the Critical Incident History Questionnaire for police officers. *J Trauma Stress.* 2010;23:734-43.
 - 29 Long JS, Freese J. Regression models for categorical dependent variables using Stata. 2nd ed. Texas: Stata Press; 2006.
 - 30 Cheung YB. Zero-inflated models for regression analysis of count data: a study of growth and development. *Stat Med.* 2002;21:1461-9.
 - 31 Ridout MS, Demetrio CGB, Hinde J. Models for count data with many zeros. In: *The XIXth International Biometric Conference*; 1998; Cape Town, África do Sul. p. 179-92.
 - 32 Ratner SC. Immobility of invertebrates: What can we learn? *Psychol Rec.* 1997;27:1-13.
 - 33 Rutting T, Brandt H, Clauß W, Selzer D. Comparative study of predator avoidance behaviour of pheasants (*Phasianus colchicus*) of different genetic origin. *Eur J Wild Res.* 2007;53:171-7.
 - 34 Ripley A. How to get out alive. *Time.* 2005;165:58-62.
 - 35 Leach J. Why people 'freeze' in an emergency: temporal and cognitive constraints on survival responses. *Aviat Space Environ Med.* 2004;75:539-42.
 - 36 da Silva LF, Menescal-de-Oliveira L. Role of opioidergic and GABAergic neurotransmission of the nucleus raphe magnus in the modulation of tonic immobility in guinea pigs. *Brain Res Bull.* 2007;72:25-31.
 - 37 Wang Z, Inslicht SS, Metzler TJ, Henn-Haase C, McCaslin SE, Tong H, et al. A prospective study of predictors of depression symptoms in police. *Psychiatry Res.* 2010;175:211-6.