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Factors associated with PTSD and partial PTSD among first responders following the Paris terror attacks in November 2015



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ABSTRACT

During the evening of 13 November 2015, the deadliest terror attacks in France in recent times occurred in the Paris area. Overall, 130 people were killed, 643 were physically injured and several thousands were psychologically impacted. Thousands of first responders, including health professionals, firefighters, affiliated volunteers and police officers were mobilized that night and during the subsequent weeks. The aims of our study were to measure the psychological impact on first responders in terms of post-traumatic stress disorder (PTSD) and partial PTSD as well as associated factors 12 months after the 13 November 2015 terrorist attacks. First responders who had intervened during the night and/or the aftermath of the terror attacks had the possibility of answering a web-based study 8–12 months after the attacks. They satisfied criterion A of the DSM 5 definition of PTSD. PTSD and partial PTSD were measured using the PCL-5. Gender, age, educational level, exposure, first responder category, mental health and traumatic event history, training and social support were all analysed as potential factors associated with PTSD and partial PTSD, using multinomial logistic regression. Overall, 663 participants were included in this analysis. Prevalence of PTSD in our sample went from 3.4% among firefighters to 9.5% among police officers and prevalence of partial PTSD from 10.4% among health professionals to 23.2% among police officers. Low educational level and social isolation were associated with PTSD and partial PTSD. Intervention on unsecured crime scenes and lack of training were associated with PTSD. Special attention should be given to first responders living in social isolation, those with low educational levels and those who intervene in unsecured crime scenes. Education and training about the potential mental health consequences of mass trauma intervention should be developed.

1. Introduction

In France, an act of terrorism is defined by the penal code as an act attached to “an individual or collective enterprise whose purpose is to seriously disturb public order by intimidation or terror”. People exposed to intentional trauma such as terror attacks can develop psychological distress that can be enduring and disabling in terms of their

mental health, their social relationship and their quality of life (Chipman et al., 2011; Li et al., 2018; Neria et al., 2011). Most of the literature has focused on direct victims but less is known about other populations such as the bereaved, people living close to places where attacks happened, the general population or first responders.

Because of their exposure to potentially traumatic events, first responders are at risk of developing post-traumatic stress disorder

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(PTSD). A recent meta-analysis found a worldwide pooled current PTSD prevalence of 10% among first responders (Berger et al., 2012). In comparison, 12-months PTSD prevalence in general population in different countries were lower: 1.1% in Europe (Darves-Bornoz et al., 2008), 1.3% in Australia (Creamer et al., 2001) and 3.5% in the USA (Kessler et al., 2005). Few studies to date have investigated the risk of developing PTSD after terror attacks for first responders with most focusing on the 2001 World Trade Centre terrorist attack (9/11) (Wilson, 2015). PTSD prevalence in all these studies differed across first responder categories and between terror attacks. For example, two years after 9/11, the overall prevalence of PTSD in people involved was 12.4%, ranging from 6.2% among police officers to 21.2% among unaffiliated volunteers (Perrin et al., 2007). Five to 12 weeks after the 2004 Madrid terror attacks, the prevalence of PTSD among police officers was estimated at 1.3% (Gabriel et al., 2007) while two months after the 2005 London bombings, PTSD prevalence among ambulance personnel was 6% (Misra et al., 2009). Eight to 12 months after the Paris terror attacks in January 2015, prevalence of PTSD in first responders was 3% (Vandentorren et al., 2018).

Furthermore, people exposed to potentially traumatic events can develop PTSD symptoms without satisfying all the criteria for PTSD diagnosis (subsyndromal or partial PTSD) (Berger et al., 2007) and suffer from substantial functional impairment (Bergman et al., 2017). As pointed out by Pietrzak et al. (2012), using only PTSD diagnosis may underestimate the real psychological burden in certain professional categories such as police officers. Very few studies have focused on both PTSD and partial PTSD. Four years after 9/11, PTSD and partial PTSD prevalence among police officers were estimated at 5.4 and 15.4%, respectively (Pietrzak et al., 2012). After the terror attacks in Norway on 22 July 2011 (in Oslo and the island of Utøya), PTSD prevalence was estimated at between 0.3% (professional personnel) and 15% (unaffiliated volunteers), and between 2% (professional personnel) and 24% (unaffiliated volunteers) for partial PTSD (Skogstad et al., 2016).

PTSD after terror attacks has been associated with the degree of terror exposure (Berninger et al., 2010a; Misra et al., 2009; Perrin et al., 2007), female gender (Bowler et al., 2010; De Stefano et al., 2018; Skogstad et al., 2016), older age, a greater number of prior life stressors, educational level, social isolation (Pietrzak et al., 2012), lower degree of previous training or experience (De Stefano et al., 2018; Skogstad et al., 2016) and mental health history (Pietrzak et al., 2014). However, as the contexts between attacks differ and because data until now have been sparse, there is still a need for more research which can be used to develop strategies to reduce the psychological burden of terror attacks on first responders (Wilson, 2015). This is all the more true given the spate of continued terror attacks worldwide in recent years and the consequent high mobilization of first responders. France has been particularly affected by such attacks, one example being in the Paris area, when only 9 months after a terror attack in January 2015 (Vandentorren et al., 2018), the same city suffered the deadliest terror attacks in France in recent years. More specifically, several coordinated terror attacks were perpetrated on the 13 November 2015 in central Paris and the neighbouring Saint-Denis district: 3 bombings in Saint-Denis near a football stadium, 3 shootings and 1 bombing in restaurants and cafés in Paris, as well as a massive shooting and hostage situation during a rock concert in the Bataclan Theatre, also in Paris. Overall, 130 people were killed, 643 people were physically injured, 2148 medico-psychological consultations were held in the aftermath (Philippe et al., 2016) and even more people were psychologically impacted (Vandentorren et al., 2016). These specific immediate psychological assistances, referred to as a “defusing process” by the medico-psychological unit (CUMP), are mostly devoted to provide the victims with an entry point to a psychological healthcare relationship and give them a first sense of soothing and relief (Prieto et al., 2018). Medico-psychological consultations are provided by mental health professionals and victims are invited to be re-evaluated a few days later.

Thousands of first responders (some of them had already been

mobilized during the Paris terror attacks in January 2015) intervened during that night and were mobilized in the subsequent weeks, including a police assault on the terrorists involved 5 days later in Saint-Denis (18 November 2015). On the night of the terror attacks, police forces were mobilized to secure the crime scenes and the Bataclan Theatre. Forty-five medical teams from the emergency medical services and the Paris fire brigade were immediately divided between the attack sites (Hirsch et al., 2015). Given the nature of the attacks, prehospital damage control was implemented through the civil application of wartime medical measures (Lesaffre et al., 2017). Within the first 24 h, 302 absolute or relative emergency cases were admitted to 16 hospitals while a psychological support centre was set up in a central hospital in Paris (Hirsch et al., 2015). Affiliated volunteers from several associations were also dispatched to the different crime scenes. Some of these emergency personnel intervened directly in or next to unsecured crime scenes. In the days and weeks that followed, the police pursued their investigations, and medical and psychological care continued.

The *ESPA 13 November* survey (*Enquête de Santé Publique post-Attentats du 13 Novembre*) is a longitudinal study of both civilians and first responders involved in the terrorist attacks of 13 November 2015 in Paris and Saint-Denis. It is part of a transdisciplinary research programme (“*programme 13-Novembre*”) focusing on the construction and evolution of individual and collective memory after the terror attacks that month, and funded by the “*Programme investissements d’avenir*” via the French National Research Agency (ANR). The objective of the survey is to gain insight into the psychosocial consequences and use of healthcare services related to the attacks over time.

The present paper aimed to 1/measure the impact of the November 2015 attacks on first responders in terms of PTSD and partial PTSD one year after the events; 2/analyse the factors associated with PTSD and partial PTSD among first responders.

2. Method

2.1. Participants and population recruitment

To participate in the *ESPA 13 November* survey, potential participants had to first fill out an online inclusion questionnaire and provide informed consent with names and email address. Inclusion criteria were as follows: aged 16 or older, intervened during the night of 13 November and/or during the following three weeks in contexts specifically linked to the terrorist attacks, and satisfied criterion A of the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition) definition of PTSD. Eligible participants then answered the epidemiological survey, in the form of an online questionnaire. The survey was made available to various first-responder categories, specifically health professionals, volunteers from civil protection associations, Paris fire brigade members, police officers and city hall staff. First responders (except firefighters and police officers) who gave social or medical support to people exposed to the 18 of November 2015 police assault in Saint-Denis (directed against terrorists who had participated in the 13 November terror attacks) were also eligible to participate.

Potential participants were informed about the online survey by institutional colleagues, hierarchy, doctors or psychologists via email, meeting, posters or videos. Due to legal considerations, the investigators of the *ESPA 13 November* survey did not have access to any roster. When a roster or a partial roster of the people involved was available (firefighters, affiliated volunteers, and some of the health professionals) an email was sent to each people of the roster by the institution that detained the roster. In addition to the roster or when no roster was available (police officer, some of the health professionals) information was given more broadly through e.g. meetings, posters, videos, information on the intranet. Furthermore, a media campaign and social networks posts (Facebook and twitter) were created during the survey.

The first wave of the survey was carried out between 8 and 12

months after the attacks, specifically between 7 July and 10 November 2016.

2.2. Ethical considerations

This survey was approved by the French authority for data protection (*Commission nationale informatique et libertés* - CNIL - authorization demand n°915262v2, deliberation n°2016–209 of 7 July 2016) as well as a French ethics committee (*Comité de protection des personnes* - CPP - amendment number 7035/3/3283). Data regarding personal information (names and email addresses) were stored in a separate database of the survey data. Data of the epidemiological questionnaire were analysed anonymously.

A recent meta-analysis found that participants generally find their involvement in trauma-related research to be a positive experience and do not regret it. However, as such research can lead to immediate, low-to-moderate distress (Jaffe et al., 2015), a free telephone support hotline with trauma-trained psychologists was made available to participants in the *ESPA 13 November survey* from Monday to Saturday between 10am and 10pm. Information on posttraumatic disorders, healthcare and available support, as well as information on the study itself was accessible on the Santé publique France website.

2.3. Data collection

Data were collected via a very secure web-based questionnaire available on the Santé publique France website. Participants could complete the questionnaire over several sessions if desired. The filling time was estimated at between 20 and 45 min depending on the type of exposure and healthcare use.

2.3.1. Outcomes

PTSD and partial PTSD were measured by a widely used self-report measure of PTSD: the PTSD Checklist for DSM-5 (named the PCL-5) (Weathers et al., 2013). Criterion A of DSM-5 stipulates having a very stressful experience. For the *ESPA November 13 survey*, this was defined as the November 2015 terror attacks during which all participants had intervened. Then, each item of the PCL-5 with a rating of 2 (i.e., “moderately” or higher) was defined as a PTSD symptom. We applied the DSM-5 diagnostic rule for PTSD which requires at least: 1 B item (questions 1–5), 1 C item (questions 6–7), 2 D items (questions 8–14), 2 E items (questions 15–20). When applying the DSM-5 rule, Bovin et al. (2016) found a good diagnostic utility for predicting a CAPS-5 (Clinician-Administered PTSD Scale for DSM-5) PTSD diagnosis (sensitivity of 0.81, specificity of .71 and efficiency of 0.78) in Veteran. Krüger-Gottschalk et al. (2017) found similar results with the German version of the PCL-5 in various trauma-exposed individuals. Ashbaugh et al. (2016) showed that the French version of the PCL-5 demonstrated psychometric properties akin to those observed for both the original English-language version of the 17-item PCL (the former version based on the DSM-IV) and the English PCL-5 and recommended to use DSM-5 rule. In our sample, Cronbach's alpha for the 20 PCL-5 items was 0.94, indicating a high internal consistency. Partial PTSD was defined as meeting two or three of the DSM-5 Criteria B, C, D or E (McLaughlin et al., 2015).

2.3.2. Independent variables

Sociodemographic characteristics including age, gender and educational level were assessed. To have an exposure indicator that is generic enough to be adequate for all types of first responders, exposure to the event was classified into three mutually exclusive categories: i) intervention in unsecured crime scenes during the night of 13 November or during the police assault on 18 November, ii) intervention in secured crime scenes or scenes distant from the events during the night of November 13 or November 18, and iii) intervention the day after the 13 November or 18 November events and/or in the three

following weeks. This indicator reflects the specificity of the attacks that were ongoing during almost 4 h, the unusual and demanding tasks during and in the aftermath of the attacks as well as the repeated exposure to aversive details of the events.

Mental health history was assessed by asking participants whether they had had any previous mental health follow-up (i.e., previous to 13 November 2015) with a psychologist or a psychiatrist which lasted 6 months or more and/or prior antidepressant medication for at least 6 months (Jehel et al., 2003; Verger et al., 2004).

Prior traumatic events was assessed using the following yes/no question “were you confronted to potentially traumatic events during your life where you felt brutally threatened or that your life was in danger (severe accident, fire, explosion, illness that threaten your life, physical assault, sexual assault, rape, military combat or experience in area of war, prison, natural disaster, sexual contact in the childhood with an older person)”. Difficult life event in 2015 (divorce, loss of a close relative, serious disease, etc.) was evaluated using a yes/no question. Previous interventions during the terror attacks in January 2015 in Paris were also assessed.

Preparedness to cope with terror attack-related traumatic interventions was evaluated with four yes/no questions: previous training for psychosocial risks, knowing someone that could help them deal with psychosocial risks and consequences before or after exposure, having been informed about potential psychological risks of such traumatic interventions, and having been trained to provide psychological first aid.

Participants were asked about their perceived feeling of social isolation using the following question “in general, would you say that you feel: very alone, alone, surrounded or very surrounded”. People who answered “very alone” or “alone” were considered in social isolation. The perceived quality of their moral, financial and everyday social support were also asked (Robert et al., 2017).

2.4. Analysis

Chi-square tests or Fisher's exact tests (when expected frequencies were under 5) were used to compare proportions of the variables listed above according to first responder category, and ANOVA was used to compare mean ages. PTSD and partial PTSD prevalence according to first responder category were computed with Wald 95% confidence interval limits. To analyse the factors associated with PTSD and partial PTSD, a multinomial logistic regression model was computed, giving estimates of odds ratios (OR) and their Wald 95% confidence interval limits. The outcome variable fell into 3 modalities: PTSD, partial PTSD, neither PTSD nor partial PTSD, with the latter chosen as the reference. The introduction in the multivariate model of the independent variables presented above was built as follows. Based on existing literature, we put gender, first responder category, educational level and exposure to attacks, into the model. For other independent variables, to keep the model as parsimonious as possible and because they measured close issues, we chose to keep only one variable for each of the 4 following dimensions: mental health history, prior traumatic or difficult events, training and social support. Criteria to choose the retained variables were based on the significance of the association in the multivariate model and/or on expert advice when several variables were of interest. Intervening during the January 2015 Paris terror attacks and age were also tested. Analyses were carried out using SAS enterprise Guide version 7.11.

3. Results

3.1. Participation and participant characteristics

The inclusion questionnaire was completed by 837 people who also provided their informed consent. Of these, 802 started to answer the survey questionnaire. Three of the latter were secondarily excluded as

Table 1

Demographics, exposure, mental health history, prior traumatic or difficult event, training and social isolation according to first responder category (ESPA 13 November Survey), N = 663.

	Total		Health professionals		Firefighters		Affiliated volunteers		Police officers		p
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	
Gender (2 MV#)											< 0.0001
Female	251	(38.0)	147	(64.2)	19	(9.4)	60	(44.8)	25	(26.3)	
Male	410	(62.0)	82	(35.8)	184	(90.6)	74	(55.2)	70	(73.7)	
Mean age (SD)	37.5	(10.3)	42.8	(10.8)	32.2	(7.3)	34.0	(9.9)	40.8	(7.4)	< 0.0001
Educational level											< 0.0001
No high-school diploma	57	(8.6)	11	(4.8)	31	(15.2)	12	(9.0)	3	(3.2)	
High-school diploma	151	(22.8)	21	(9.1)	84	(41.2)	16	(11.9)	30	(31.6)	
Graduate or post-graduate degree	455	(68.8)	198	(86.1)	89	(43.6)	106	(79.1)	62	(65.2)	
Intervention category (exposure)											< 0.0001
1- in unsecured crime scenes *	280	(42.2)	19	(8.3)	153	(75.0)	72	(53.7)	36	(37.9)	
2- in secured crime scenes or at distance **	180	(27.1)	64	(27.8)	45	(22.1)	41	(30.6)	30	(31.6)	
3- only during the 3 weeks following the attacks	203	(30.7)	147	(63.9)	6	(2.9)	21	(15.7)	29	(30.5)	
History of anti-depressant consumption (17 MV)	32	(5.0)	13	(5.8)	3	(1.5)	12	(9.0)	4	(4.4)	0.02
History of mental health follow-up (19 MV)	64	(9.9)	35	(15.6)	8	(4.1)	12	(9.2)	9	(9.8)	0.001
Prior traumatic events (15 MV)	286	(44.1)	89	(39.6)	95	(48.5)	46	(34.6)	56	(59.6)	0.0006
Difficult life event in 2015 (not including terror attacks) (14 MV)	155	(23.9)	55	(24.3)	45	(22.8)	28	(21.2)	27	(28.7)	0.60
Intervention during January 2015 terror attacks (12 MV)											< 0.0001
Yes and listed this as a difficult situation	46	(7.1)	5	(2.2)	12	(6.0)	11	(8.3)	18	(19.1)	
Yes but did not list this as a difficult situation	151	(23.2)	41	(18.1)	35	(17.6)	46	(34.9)	29	(30.9)	
No	454	(69.7)	180	(79.7)	152	(76.4)	75	(56.8)	47	(50.0)	
Training on psychological risks of this type of traumatic intervention (14 MV)	375	(57.8)	133	(59.1)	119	(60.4)	94	(70.7)	29	(30.9)	< 0.0001
Training on psychosocial risks (14 MV)	391	(60.2)	142	(63.4)	121	(61.4)	105	(79.0)	23	(24.2)	< 0.0001
Knowing someone who could help regarding psychosocial risks (13 MV)	507	(78.0)	188	(83.2)	148	(75.1)	117	(88.6)	54	(56.8)	< 0.0001
Psychological first aid training (18 MV)	217	(33.6)	109	(48.2)	40	(20.8)	65	(49.2)	3	(3.2)	< 0.0001
Low moral support (21 MV)	22	(3.4)	9	(4.0)	6	(3.1)	3	(2.4)	4	(4.3)	0.83
Low financial support (22 MV)	117	(18.2)	45	(20.1)	27	(13.7)	22	(17.3)	23	(24.7)	0.12
Low everyday social support (24 MV)	72	(11.3)	30	(13.4)	13	(6.6)	13	(10.2)	16	(17.4)	0.03
Social isolation (20 MV)	67	(10.4)	17	(7.5)	13	(6.6)	18	(14.2)	19	(20.6)	0.0006
Total	663	(100.0)	230	(34.7)	204	(30.8)	134	(20.2)	95	(14.3)	

Missing Value.

*for people who both intervened in unsecured crime scenes (1) and intervened during the 3 following weeks (3), exposure category (1) is retained.

** for people who both intervened in secured crime scenes or were distant from the crime scene during the night of the attack (2) and intervened during the 3 following weeks (3), exposure category (2) is retained.

they did not meet the inclusion criteria, 1 person did not provide his first responder category and 116 had missing values either regarding their exposure or PTSD. As only 17 city hall staff members and only 2 others from first-responder categories other than the ones listed in the methods section participated in the study, they were excluded from the analyses. Consequently, descriptive analyses were performed for 663 people and the final multinomial logistic regression model was computed for 614 people.

Firefighters and affiliated volunteers were younger than health professionals and police officers ($p < 0.0001$) and the proportion of women was higher among healthcare professionals ($p < 0.0001$) (Table 1). Education level was quite high as only 8.6% did not have a high-school diploma. Health professionals were the most educated category with 86.1% of them having a graduate or post-graduate degree. Half of the police officers had already been involved in the January 2015 terror attacks.

Few first responders lived in social isolation (10.4%), this proportion being higher among affiliated volunteers (14.2%) and police officers (20.6%, $p = 0.0006$). Seventy-one percent of the affiliated volunteers declared they had been informed about potential psychological risks of such traumatic interventions. This proportion was lower among

health professionals (59.1%), firefighters (60.4%) and police officers (30.9%; $p < 0.0001$).

In our study sample, firefighters were the category most exposed to unsecured crime scenes (75.0%), followed by affiliated volunteers (53.7%), police officers (37.9%) and health professionals (8.3%). Among people who intervened in unsecured crime scenes, 57.1% went directly inside the cafes/restaurants or inside the Bataclan theatre, 17.1% saw a terrorist, 88.6% saw dead bodies, 91.1% touched dead or injured people and 65.0% heard gunshots. Among those who intervened in secured crime scenes or at distance during the night of the events, 25% saw dead bodies, 60.6% took care of or had been in contact with injured people, 68.3% provided psychosocial support to victims and 52.8% declared they had been shocked by the distress of victims. Among those who intervened only during the three followings weeks, 35.5% took care of injured people, 47.3% had phoned to victims or relatives of victims, 57.1% provided psychological support to victims and 61.1% declared they had been shocked by the distress of victims or family of victims.

Table 2
Prevalence of PTSD and partial PTSD by first responder category (ESPA 13 November Survey), N = 663.

	PTSD			Partial PTSD		
	n	%	95% CI	n	%	95% CI
Firefighters	7	3.4	0.9–5.9	32	15.7	10.7–20.7
Health professionals	10	4.4	1.7–7.0	24	10.4	6.5–14.4
Affiliated volunteers	6	4.5	1.0–8.0	26	19.4	12.7–26.1
Police officers	9	9.5	3.6–15.4	22	23.2	14.7–31.6
Total	32	4.8	3.2–6.5	104	15.7	12.9–18.4

Table 3
Multivariate analysis of associated factors with PTSD and partial PTSD among first responders (ESPA 13 November survey), N = 614.

	PTSD		Partial PTSD	
	OR	95% CI	OR	95% CI
Gender				
Male	1.00	-	1.00	-
Female	1.30	0.48–3.57	1.14	0.64–2.00
First responder category				
Firefighters	1.00	-	1.00	-
Affiliated volunteers	2.78	0.62–12.43	1.84	0.91–3.75
Police officers	3.29	0.74–14.60	2.37	1.11–5.06
Health professionals	4.54	0.91–22.57	1.22	0.53–2.83
Educational level				
Graduate or post-graduate degree	1.00	-	1.00	-
Without high-school diploma	2.46	0.60–10.04	1.69	0.76–3.76
High-school diploma	3.18	1.13–8.93	1.82	1.03–3.23
Intervention category (exposure)				
On secured crime scenes or at distance	1.00	-	1.00	-
On unsecured crime scenes	7.26	1.91–27.54	1.77	0.98–3.19
Only during the 3 following weeks	1.90	0.44–8.23	0.51	0.24–1.07
History of anti-depressant consumption				
No	1.00	-	1.00	-
Yes	1.43	0.25–8.19	2.40	0.98–5.91
Difficult life event in 2015 (not including terror attacks)				
No	1.00	-	1.00	-
Yes	1.71	0.66–4.38	1.80	1.07–3.03
Intervention in January 2015 terror attacks				
No	1.00	-	1.00	-
Yes and listed this as a difficult situation	1.86	0.47–7.39	0.99	0.42–2.33
Yes but did not list this as a difficult situation	0.89	0.30–2.62	0.43	0.23–0.83
Training on psychological risks of this type of traumatic intervention				
Yes	1.00	-	1.00	-
No	4.88	1.65–14.42	1.62	0.99–2.64
Social isolation				
No	1.00	-	1.00	-
Yes	8.36	3.23–21.62	2.27	1.14–4.52

3.2. PTSD, partial PTSD, and associated factors

Overall PTSD and partial PTSD prevalence in our study sample were, respectively, 4.8 and 15.7%, ranging from 3.4% among firefighters to 9.5% among police officers for PTSD, and from 10.4% among health professionals to 23.2% for police officers for partial PTSD (Table 2).

In multivariate analysis (Table 3), gender was not associated with either full or partial PTSD. Age was not associated neither with PTSD nor partial PTSD and was not retained in the model. Being a police officer was associated with partial PTSD (OR = 2.37; 95% CI = 1.11–5.06, compared with firefighters). Exposure to an unsecured crime scene was associated with PTSD (OR = 7.26; 95% CI = 1.91–27.54). Having a high-school diploma (*versus* graduate or post-graduate degree) and social isolation were associated with both PTSD and partial PTSD. Not having training on the potential psychological consequences of this type of traumatic intervention (*i.e.*, terror attacks) was associated with PTSD (OR = 4.88; 95% CI = 1.65–14.42).

Experiencing a difficult life event in 2015 was associated with partial PTSD (OR = 1.80; 95% CI = 1.07–3.03). Being mobilized for the January 2015 Paris terror attacks but not listing that intervention as a difficult life event in 2015 was negatively associated with partial PTSD (OR = 0.43; 95% CI = 0.23–0.83). Other associations were observed, although not significant at a p-value threshold of 0.05. In particular, exposure to an unsecured crime scene, lack of training and a history of anti-depressants seemed all associated with partial PTSD.

4. Discussion

4.1. Main findings

Between eight months and one year after the 13 November 2015 terror events in the Paris area, PTSD prevalence among firefighters, health professionals, affiliated volunteers and police officers was, respectively, 3.4, 4.4, 4.5 and 9.5%. In comparison, 2–3 years after the 2001 World Trade Centre terrorist attack higher prevalences were found for firefighters (12.2%), volunteer organizations (7.2%) and emergency medical services, medical and disaster personnel (17.8%) but a lower prevalence for police officers (6.2%) (Perrin et al., 2007). Prevalence among ambulance personnel 2 months after the 2005 London bombings was estimated at 6% (Misra et al., 2009), and at 13% among rescue workers (mainly firefighters) 34 months after the Oklahoma city bombing in 1995 (North et al., 2002). Lower prevalences were found after other recent terror attacks in Europe: the 2004 Madrid terror attacks (1.3% among police officers 5–12 weeks after the attacks) (Gabriel et al., 2007), the 2011 attacks in Oslo and Utøya (0.3% among professional personnel 10 months later) (Skogstad et al., 2016) and the January 2015 Paris terror attacks (3% among first responders 6 months later) (Vandentorren et al., 2018).

These differences may be partly explained by differences in the design of the studies cited above. First, timing of surveys could have played a role since PTSD prevalence evolves over time (Berninger et al., 2010b; Brackbill et al., 2009; Santiago et al., 2013). Second, several tools exist to estimate PTSD prevalence, which can lead to different results. More specifically, the trauma screening questionnaire (TSQ) (Misra et al., 2009), the PCL (Perrin et al., 2007; Skogstad et al., 2016), the Diagnostic Interview Schedule (North et al., 2002) and the Davidson Trauma Scale (Gabriel et al., 2007) were used in the above cited articles. Third, most related articles are based on the DSM-4 criteria for assessing PTSD. The ESPA 13 November survey used the criteria for PTSD diagnosis in the DSM-5 and this may have led to differences in classification. Nevertheless, at the population level, prevalence seems similar using both the PCL-S and PCL-5 checklists (Hoge et al., 2014).

Differences in tasks and preparedness between countries for the same first responder category and differences in exposure between the attacks might also explain variations in prevalence as may the specific French context. Indeed, the preparedness of French institutions after the January 2015 attacks, together with the strong and continued mobilisation of police forces (a state of emergency was declared from November 2015 to October 2017) and other terror attacks in 2016 targeting in particular police officers and military personnel, may all have influenced PTSD prevalence.

Few studies have analysed the impact of terror attacks on partial PTSD but it is worth noting that our prevalence for partial PTSD in the various first responder categories would appear to be higher than those found in the literature. For instance, four years after 9/11, partial PTSD prevalence among police officers involved in the World Trade Centre rescue and recovery effort was 15.4% (Pietrzak et al., 2012) *versus* 23.2% in our study sample, and the prevalence of sub-threshold PTSD was 9.7% among disaster recovery workers 1–4 years after 9/11 (Cukor et al., 2010). In Norway, partial PTSD prevalence among first responders to the 2011 Utøya massacre was estimated at 2% among health professionals 10 months after the attacks (Skogstad et al., 2016) *versus* 10.4% in our sample. These differences could be explained by

some of the reasons listed above for PTSD as well as differences in measuring partial PTSD.

Just as in our study, most epidemiological studies after terror attacks found that the more people are exposed to the horror of a terror attack the more likely they are to develop PTSD. This was specifically true for those intervening in unsecured crime scenes, those intervening immediately after an attack (Berninger et al., 2010a; Perrin et al., 2007), and those intervening directly at the crime scene who consequently had greater exposure to disturbing stimuli (Misra et al., 2009).

As with some other studies on PTSD, we found an association between PTSD and social isolation (Brewin et al., 2000; Dyb et al., 2014; Pietrzak et al., 2012). Obviously, this association should be interpreted with caution as PTSD can affect social relationships. Whether it constitutes a risk factor for PTSD or is a consequence of PTSD, social isolation should be considered by mental health professionals, particularly for people who have no close family or friends.

As observed in the literature (Pietrzak et al., 2012), compared with people having the highest educational levels (graduate or post-graduate degree), associations were found with partial and full PTSD for people with a high-school diploma. Surprisingly, there were no significant associations between those without a high-school diploma compared with those having the highest educational levels. This may be due to the small number of people in the former group in our study sample.

Of the studies which assessed preparedness and training for traumatic interventions following terror attacks, some used professional seniority or the type of occupation as a proxy of preparedness and training for traumatic interventions (De Stefano et al., 2018) while others assessed experience with similar tasks, previous training by simulation, intervention in an event with more than 5 deceased persons (Skogstad et al., 2016), etc. In our study, an association was found between PTSD and not having been trained up on the psychological risks of such traumatic interventions. Although all the firefighters had this kind of training during their initial instruction, only 60.4% declared having it. This stark difference stresses the importance of people's perception about training.

Compared with respondents who did not intervene in the January 2015 Paris terror attacks, a negative association was found with partial PTSD for those who did intervene but who did not indicate that intervention as difficult in the survey questionnaire. One possible explanation for this is that their intervention both in January and November 2015 led to their gaining greater experience in dealing with this kind of traumatic intervention. Another possibility is that they were more resilient.

We found no association between PTSD or partial PTSD and gender. The results in the literature differ regarding this issue. Female gender was found associated with PTSD in some studies (Bowler et al., 2010; De Stefano et al., 2018; Skogstad et al., 2016; Wesemann et al., 2018) while other found no association (Misra et al., 2009; Pietrzak et al., 2012).

4.2. Strengths and limitations

We estimated a study participation rate of 25% for firefighters and affiliated volunteers. It was not possible to compute the participation rate of police officers or health professionals because numerous brigades and services were involved, but it can be assumed that their participation was lower. Nevertheless, our participation rates would seem to be lower than those in other studies. For police officers, this may be partly explained by the increased workload they faced since the January 2015 attacks.

Some potential biases may have affected our estimates and results. The healthy worker effect (Pearce et al., 2007) cannot be excluded, as part of the information of the study was based on hierarchy, colleagues and occupational medicine. Information about the *ESPA 13 November* survey was provided to all firefighters and affiliated volunteers whatever their working status. Instead, information about the survey might

not have reached police officers and health professionals on sick leave or those who had left the relevant institution in the meantime. Furthermore, in some police and health professional services, chief officers did not transmit the information about the study to their subordinates. However, the social network and media campaigns may have reached some of those people. As the survey was open to all first responders meeting the inclusion criteria, it is possible that people who were less exposed to the attacks did not feel they had a legitimate right to participate, or had less interest in the survey. It is also possible that people who were suffering the most may have been less likely to participate, as demonstrated in previous studies (Stene and Dyb, 2016).

Although selection bias may exist due to the use of an online questionnaire, this tool brings certain benefits. First, unlike face-to-face interviews, it was possible to complete the questionnaire over several sessions, making participation easier. Second, first responders worried about health confidentiality, for fear of being considered “weak” or unable to adequately perform their work duties, could use the online questionnaire in complete confidentiality. Moreover, Schlenger and Silver (2006) pointed out that web-based data collection appears to reduce social desirability bias.

Due to potential recruitment and selection bias and the absence of a sampling frame it is not possible to extrapolate our results to the whole population of first responders. Indeed, it was not possible to compare non-participants and participants or to calibrate the sample.

Prior traumatic events measure was limited to one question that group different traumas and thus did not capture the diversity of prior trauma exposure. Mental health history was assessed with proxy measures (prior mental health service utilization) and therefore only reflect mental health disorders for whom people sought treatment. Because terror attacks are unpredictable, it was not possible to have a control group and to assess PTSD before the attacks. However, it was specified to participants to answer the PCL-5 regarding the terror attacks in November 2015. PTSD is not the only mental disorder caused by terror attacks. Actually, other outcomes were assessed in our study but are not described in this paper.

Despite its limitations, our study also presents strengths. First, stakeholders were involved in the study design, making it more relevant to the issues they had been facing since the attacks. Second, to our knowledge, four studies have been published to date about first responders after terror attacks in France (Bentz et al., 2019; De Stefano et al., 2018; Gregory et al., 2019; Vandentorren et al., 2018), yet the present study had the highest number of participants and included several types of first responders. Third, a second wave of the *ESPA 13 November* survey with an open cohort will be launched four years after the attacks with access to the national health insurance databases, in order to better understand the evolution of the psychological impacts and healthcare trajectories before and after the attacks. Fourth, we used a standardized questionnaire (i.e., PCL-5) and the questions asked were similar to those used in two other studies in France (the *IMPACTS* study (Vandentorren et al., 2018) after the January 2015 Paris terror attacks, and the *ECHOS de Nice* study (Bentz et al., 2019) after the attack in Nice on Bastille Day 2016). This will allow future comparisons to be made.

4.3. Implications

As a result of the several terror attacks which have occurred and others prevented in France since January 2015, first responders have been highly mobilized. This heightened mobilisation may increase the vulnerability of these professionals and volunteers. It is therefore very important to better understand the impact of traumatic interventions when such events occur as well as their associated factors in order to improve prevention and care. Our findings indicate that special attention should be given to first responders in social isolation, those with low educational levels and those intervening in unsecured crime scenes. To avoid stigmatisation, systematic education and training about the potential mental health consequences of traumatic interventions should

be developed.

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Declaration of competing interest

None.

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