Medicine®

OPEN

Assessing the psychological impact of Beirut Port blast
A cross-sectional study

Moustafa Al Hariri, PhD[a,b], Hady Zgheib, MD[b], Karen Abi Chebl, MD[c], Maria Azar, MD[c], Eveline Hitti, MD[b], Maya Bizri, MD[d], Jennifer Rizk, MD[b], Firas Kobeissy, PhD[e], Afif Mufarrij, MD[b,*]

Abstract

Beirut Port blast's magnitude is considered the third after Hiroshima and Nagasaki atomic bombings. This blast occurred in the densely populated section of Beirut, leaving more than six thousand injured patients. The psychological disturbances were assessed in the blast survivors who presented to the Emergency Department (ED) at the American University of Beirut Medical Center (AUBMC). This was a cross-sectional study at the ED of AUBMC. Identified patients were contacted and consented to participate in the study. Post-Traumatic Stress Disorder (PTSD) was selected as an outcome. Depression, PTSD, and concussion were assessed using patient health questionnaire (PHQ)-9, PTSD checklist for DSM-5 (PCL5), and brain injury symptoms (BISx) tools, respectively. The association of patients and injury characteristics with the study outcome was assessed using logistic regression. 145 participants completed the study procedures. The participants' average age was 39.8 ± 15.4 years, and 60% were males. Almost half of the participants showed depression on PHQ, and 2-thirds had PTSD. The participant's age was negatively associated with PTSD, whereas being a female, having depression, and having a concussion were positively associated with PTSD. The results of this study were in line with the previous literature report except for the association between younger age and PTSD, which warrants further investigations to delineate the reasons.

Abbreviations: aOR = adjusted odds ratio, AUBMC = American university of Beirut medical center, BISx = brain injury symptoms, ED = emergency department, IRB = institutional review board, PCL-5 = PTSD checklist for DSM-5, PHQ = patient health questionnaire, PTSD = post-traumatic stress disorder, TBI = traumatic brain injury.

Keywords: Beirut Port blast, Post-traumatic stress syndrome, psychological disturbance, PTSD

1. Introduction

On August 4, 2020, at 6:07 P.M, a devastating chemical blast, now ranked as the 3rd largest urban explosion in history after the Hiroshima and Nagasaki atomic bombings[1] struck the Lebanese capital: Beirut. A rampant fire caused by fireworks stored in Hangar 12 of the Port of Beirut triggered igniting around 2.7-kilo tons of Ammonium Nitrate in a nearby warehouse.[1,2] The detonation resulted in a "white mushroom pressure cloud" whose strength caused a 3.3 magnitude earthquake perceived as far as 200 km away in Cyprus.[2] The resulting pressure and seismic waves instantaneously led to the demolition of the port and urban destruction spanning at least 10 km in the distance.[2] The blast claimed an estimated 6720 injured patients, 220 of whom were immediately killed.[1] The area also suffered massive destruction, and almost 50,000 houses and 178 schools were severely damaged, with nearly 300,000 people left homeless.[1] The healthcare sector suffered significant setbacks after 9 hospitals in Beirut were extensively damaged, 3 of which were entirely inoperative.[1] In addition, 800 hospital and 130 Intensive Care Unit admissions were reported,[3] and almost 160,000 people could not access medical care.[2] Considering the nation's preexisting health and financial burden due to the coinciding economic crisis and COVID-19 pandemic, the blast's infrastructural losses were estimated at more than 10 billion USD,[1] and the COVID-19 cases doubled exactly 10 days after the blast.[2] There were reports of lung, ocular, auditory, penetrating injuries, traumatic fractures, amputations, burns, intoxications, and traumatic brain injuries.[2]

The psychological health of the survivors is a crucial aspect of blast traumatic brain injury (TBI) that has been repeatedly reported in the literature. In fact, troops returning from war zones who suffer from blast-induced brain injuries experience

post-concussive symptoms (PCS) such as irritability, fatigue, anxiety, and cognitive and memory impairment. PCS can continue long after TBI exposure and result in significant functional deficits and psychological disturbance such as post-traumatic stress disorder (PTSD).[4,5] Moreover, a systematic review by Phipps et al (2020) demonstrated that mental health conditions such as PTSD, anxiety, depression, sleep, and attention and cognitive disorders, were the most commonly reported comorbid and preexisting conditions associated with U.S. military blast-related TBI.[6]

Similarly, Taymur et al in a prospective study on 197 victims of an industrial explosion in Ankara, revealed that; 1 month after the explosion, 37.1% of the survivors suffered from acute stress disorder, and 40% developed PTSD, while 8.9% of subjects who witnessed the event from afar (through the shake, visual, and auditory effects) developed PTSD.[7] Of interest, in a study surveying 438 participants, Raker et al reported that less than 1 year after Hurricane Katrina, 43.8% of the victims suffered from PTSD. Even though this number has been decreasing, 1 in 6 survivors (16.7%) still experienced post-traumatic symptoms twelve years after the storm. Moreover, psychological distress also remained high and did not return to pre-hurricane levels.[8]

This study aimed to assess the psychological disturbances of the patients who presented to the Emergency Department (ED) of the American University of Beirut Medical Center (AUBMC): a tertiary care center. Although there are some recently published reports investigating the impact of the Beirut Port blast on a population of pediatrics and adolescents who witnessed the event,[9] there are no reports to assess the psychological impact of this event on adult survivors affected by the blast.

2. Methods

2.1. Study design and setting

This study was an Institutional Review Board (IRB)-approved cross-sectional study. The patients who presented to the ED of AUBMC post the Beirut Port blast were identified. Patient recorded details were extracted from the Electronic Health Records (EPIC system), including the patients' names, ages, and phone numbers. The IRB at AUBMC reviewed and approved this study under IRB protocol ID BIO-2020-0357. This study conforms with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines and a complete checklist has been uploaded as supplemental file, http://links.lww.com/MD/H611.

2.2. Patient and public involvement

Study participants were not involved in the development of the study for the acute nature of the exposure they sustained.

2.3. Patient recruitment and data collection

Patients who presented to the ED of AUBMC on the day of the blast and the next 3 days were identified through their medical health records. Patients were contacted over the phone and orally consented to participate in the study. Participants' details pertaining to their previous medical history and clinical characteristics of their presentation were collected from the medical charts. In addition, participants answered questions through the phone related to the details that were not present in the medical charts and responded to the questionnaires of the psychological assessment, such as the patient health questionnaire (PHQ)-9,[10] PTSD Checklist for DSM-5 (PCL-5),[11] and Brain Injury Symptoms (BISx).[12] For the bivariate analysis, we used the participants' distance from the blast (1 km cutoff) as the dependent variable. The PTSD score was used as a dependent variable for the multivariable analysis.

Data collection started in November 2020; 3-month post the Beirut Port blast. All data were entered into REDCap[13] and combined with the data collected from the participants' medical charts. We relied on Google Earth to evaluate the participants' distance from the blast's location (ground zero). The participants were instructed to give as many details as they recall for the area they were in before the blast.

2.4. Statistical analysis

Categorical data are presented as frequencies and percentages, and the continuous data as mean ± SD. Distance from ground zero was considered a dependent variable to stratify the participant's data at the bivariate analysis level. As applicable, Chi-square and Fisher exact tests were used to assess the statistical difference for categorical variables. Student t test was used to assess the statistical difference for continuous variables. A score of 31 and above on the PCL-5 was considered PTSD positive, whereas a score of 10 and above on the PHQ-9 score was considered depression positive.

The PTSD variable was used as a dependent variable for multivariable logistic regression analysis. We included all the clinically and statistically significant variables to build up the logistic regression model.

3. Results

During the study period (August 4–7, 2020), 370 patients were identified from the medical charts for presenting to the ED at AUBMC for Beirut Port blast-related injuries. Among these patients, 248 patients had phone numbers listed on their charts and were approached and consented through the phone. 145 participants (58.8% of the eligible patients) consented to participate and completed the study-related questionnaires (Fig. 1).

The average age of these patients was 39.8 ± 15.4, of which 87 (60%) were males. The highest reason for presentation to the ED was head trauma (46.9%), followed by altered mental state (45.5%) and pre- or post-blast amnesia (25.5%). As for types of injuries, the highest incidence was reported in those presenting with cuts (29.8%), followed by bruises (19.9%), shoulder/arm (19.9%), and head/face injuries (19.1%). However, upon comparing scores of patients depending on their location from the blast, only head and face injuries showed a statistically significant difference. The injury was reported in 28.6% of the participants ≤1 km away from the blast, compared to 12.9% in those situated >1 km away (Table 1).
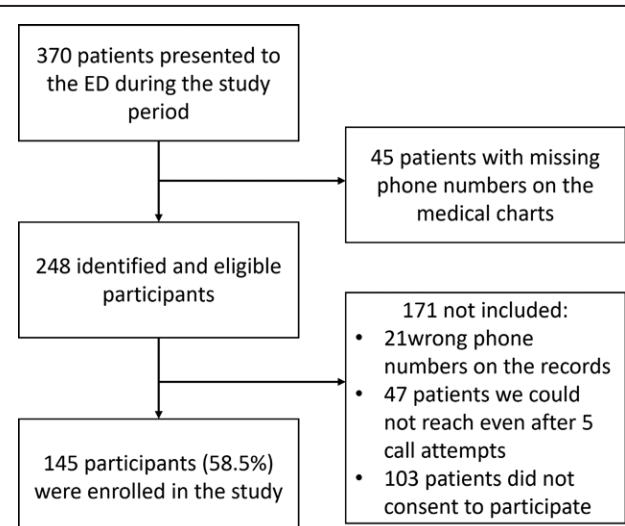
Figure 1. Flow chart describing the identification and enrollment of patients into the study.

Table 1

General demographic and injury characteristics of the participants.

		Total (145)	Distance from blast		P value
			≤1 km	>1 km	
Age	Yrs	39.8 ± 15.4	40.8 ± 14.9	39.2 ± 15.8	.55
Gender	Female	58 (40)	26 (46.4)	32 (36)	.23
	Male	87 (60)	30 (53.6)	57 (64)	
Head trauma?	Yes	68 (46.9)	28 (50)	40 (44.9)	.61
Loss of consciousness?	Yes	29 (20)	15 (26.8)	14 (15.7)	.14
Pre or post-blast amnesia?	Yes	37 (25.5)	17 (30.4)	20 (22.5)	.33
Any alteration in mental state at the time of the accident?	Yes	66 (45.5)	29 (51.8)	37 (41.6)	.24
Other neurological deficits?	Yes	26 (17.9)	10 (17.9)	16 (18)	1.00
Diagnosed with a concussion?	Yes	15 (10.3)	9 (16.1)	6 (6.7)	.09
Any head injury or neurological complaints	0	42 (29)	17 (30.4)	25 (28.1)	.24
	1	38 (26.2)	9 (16.1)	29 (32.6)	
	2	26 (17.9)	11 (19.6)	15 (16.9)	
	3	16 (11)	7 (12.5)	9 (10.1)	
	4	15 (10.3)	7 (12.5)	8 (9)	
	5	6 (4.1)	3 (5.4)	3 (3.4)	
	6	2 (1.4)	2 (3.6)	0 (0)	
Any head injury or neurological complaints	Continuous	1.7 ± 1.6	1.9 ± 1.8	1.5 ± 1.4	.14
Head and face injury	Yes	27 (19.1)	16 (28.6)	11 (12.9)	**.03**
Spine injury	Yes	2 (1.4)	0 (0)	2 (2.4)	.52
Shoulder and arm injury	Yes	28 (19.9)	11 (19.6)	17 (20)	1.00
Hip and leg injury	Yes	21 (14.9)	9 (16.1)	12 (14.1)	.81
Blast ear injury	Yes	3 (2.1)	2 (3.6)	1 (1.2)	.56
Abdomen and pelvic content Injury	Yes	1 (0.7)	1 (1.8)	0 (0)	.40
External skin Injury	Yes	17 (12.1)	6 (10.7)	11 (12.9)	.80
Fracture	Yes	18 (12.8)	7 (12.5)	11 (12.9)	1.00
Cuts	Yes	42 (29.8)	18 (32.1)	24 (28.2)	.71
Bruises	Yes	28 (19.9)	12 (21.4)	16 (18.8)	.83
Sprain strain or dislocation	Yes	3 (2.1)	2 (3.6)	1 (1.2)	.56
Organ system injury	Yes	1 (0.7)	0 (0)	1 (1.2)	1.00
Concussion	Yes	12 (8.5)	7 (12.5)	5 (5.9)	.22

Upon assessing patients for depression using the PHQ9 scale, PHQ 1, 2, and 4 ranked above average (1.5). Contrarily, the lowest score (0.2) was reported in PHQ9 related to suicidal thoughts (Table 2). Out of 145 patients, 48.3% showed a clinical score of depression. Furthermore, 60.7% of those located within 1 km from the blast showed depression compared to 40.4% in the >1 km group, thus showing significant categorization. Moreover, only the former group showed a PHQ score of more than 10 (11.1), indicating a clinical score of depression. The difference between the 2 groups was statistically significant in PHQ 6 and 7, showing a higher incidence (0.9 and 1.3 respectively) in the ≤1 km group compared to the >1 km group (0.5 and 0.9, respectively).

Upon assessing participants for anxiety using the Generalized Anxiety Disorder scale, Generalized Anxiety Disorder 1, 2, 3, 6, and 7 ranked above average (1.5). In addition, 95.1% of the participants showed a clinical score of anxiety (>10) with no statistically significant difference when comparing the distance from the blast (Table 2).

Patients were also evaluated for PTSD using the PCL-5 score. A score above average (2.0) was reported in PCL1, 4, 9, 10, and 11. 66.2% of the participants showed a clinical score of PTSD (33.2 ± 15.4), but a difference between both groups could not be observed (Table 3).

Regarding the BISx score assessment, no findings were reported above average (1.5). The highest incidence was reported in the questions related to fatigue or tiring more easily, sensitivity to noise, restlessness, difficulty falling or staying asleep, feeling anxious or tense, and feeling depressed or sad (Table 4). The difference between the 2 groups was only significant in BISx14 (taking longer to think), showing a higher incidence (1.3) in the ≤1 km group compared to the >1 km group (0.8).

Furthermore, the logistic regression assessing the association between PTSD score and participants' characteristics showed that distance from the blast had a positive trend for an association with the PTSD score (aOR = 1.480, P = .47, 95% CI [0.557, 5.099]); however, the association did not reach a significance. Moreover, our data showed that being young (aOR = 0.968, P = .05, 95% CI [0.931, 1.000]) and male (aOR = 0.226, P = .01, 95% CI [0.073, 0.702]) are negatively associated with PTSD score. Furthermore, our data showed that participants who scored higher than 10 on PHQ-9 (aOR = 8.934, P < .001, 95% CI [2.842, 28.089]) or high score on BISx score (aOR = 1.075, P = .001, 95% CI [1.029, 1.123]) are associated with PTSD (Table 5).

4. Discussion

On August 4, 2020, Beirut experienced an unprecedented explosion in its port located in a highly-populated city area. This explosion caused a flood of injured patients to present to the different EDs in the hospitals close to the explosion location. The ED at AUBMC received more than 370 patients during the first 4 hours post the explosion. The accurate number of the patients who presented to AUBMC could not be recorded for multiple reasons, among which are that our facilities were affected by the blast and the registration process of the ED crashed due to the massive surge of patients flooding into it.[14,15]

We conducted this study to evaluate the psychological disturbances of the survivors of the Beirut Port explosion who presented to the ED of AUBMC. The study findings showed a negative association between the participants' age (aOR = 0.968, P = .05, 95%CI [0.931, 1.000]) and the PCL-5 score. On the other hand, the patients who scored higher than 31 on the PCL-5 score were positively associated with being female (OR = 4.42, P = .01,

Table 2

Assessment of depression and anxiety scores of the participants stratified by the distance from the blast location.

			Distance from blast		
		Total	≤1 km	>1 km	P value
PHQ1- Little Interest or pleasure in doing things?		1.5 ± 1	1.5 ± 1	1.5 ± 1	.89
PHQ2 - Feeling down, depressed or hopeless?		1.6 ± 1	1.6 ± 1	1.6 ± 1	.78
PHQ3 - Trouble falling or staying asleep or sleeping too much?		1.4 ± 1.1	1.6 ± 1.1	1.3 ± 1.1	.12
PHQ4 - Feeling tired or having little energy?		1.6 ± 1	1.8 ± 1	1.5 ± 1	.06
PHQ5 - Poor appetite or overeating?		1.2 ± 1	1.3 ± 1	1.1 ± 1	.11
PHQ6 - Feeling bad about yourself - or that you are a failure or have let yourself or your family down?		0.7 ± 0.9	0.9 ± 1.1	0.5 ± 0.8	**.02**
PHQ7 - Trouble concentrating on things, such as reading the newspaper or watching television?		1 ± 1	1.3 ± 1	0.9 ± 0.9	**.03**
PHQ8 - Moving or speaking so slowly that other people could have noticed? Or so fidgety or restless that you have been moving a lot more than usual?		0.7 ± 0.9	0.8 ± 1	0.7 ± 0.9	.27
PHQ9 - Thoughts that you would be better off dead, or thoughts of hurting yourself in some way?		0.2 ± 0.6	0.3 ± 0.7	0.1 ± 0.5	.13
PHQ-9 score		9.9 ± 5.4	11.1 ± 5.6	9.1 ± 5.3	**.03**
PHQ-9 categories (score ≥ 10)	No depression	75 (51.7)	22 (39.3)	53 (59.6)	**.03**
	Depression	70 (48.3)	34 (60.7)	36 (40.4)	
GAD1 - Feeling nervous, anxious or on edge		1.9 ± 0.5	1.9 ± 0.6	2 ± 0.4	.34
GAD2 - Not being able to stop or control worrying		2 ± 0.4	1.9 ± 0.5	2 ± 0.4	.64
GAD3 - Worrying too much about different things		2 ± 0.5	1.9 ± 0.6	2 ± 0.3	.59
GAD4 - Trouble relaxing		1.1 ± 0.5	1.1 ± 0.5	1 ± 0.4	.30
GAD5 - Being so restless that it is hard to sit still		1 ± 0.3	1 ± 0.2	1 ± 0.4	.24
GAD6 - Becoming easily annoyed or irritable		2 ± 0.3	2 ± 0.3	2 ± 0.2	.99
GAD7 - Feeling afraid as if something awful might happen		1.8 ± 0.5	1.8 ± 0.6	1.9 ± 0.5	.18
GAD score		11.8 ± 2	11.6 ± 2.2	11.9 ± 1.9	.42
GAD-7 categories	No anxiety	5 (4.9)	3 (7.3)	2 (3.2)	.38
(score ≥ 10)	Anxiety	98 (95.1)	38 (92.7)	60 (96.8)	

GAD = generalized anxiety disorder, PHQ = patient health questionnaire.

Table 3

Assessment of post-traumatic stress syndrome score of the participants stratified by the distance from the blast location.

			Distance from blast		
		Total	≤1 km	>1 km	P value
PCL1 - Repeated, disturbing, and unwanted memories of the stressful experience?		2 ± 1.4	1.9 ± 1.4	2 ± 1.4	.62
PCL2 -Repeated, disturbing dreams of the stressful experience?		0.9 ± 1.1	0.9 ± 1.1	0.9 ± 1.1	.73
PCL3 -Suddenly feeling or acting as if the stressful experience were actually happening again (as if you were actually back there reliving it)?		1.2 ± 1.2	1.3 ± 1.3	1.2 ± 1.2	.64
PCL4 -Feeling very upset when something reminded you of the stressful experience?		2.3 ± 1.3	2.2 ± 1.3	2.3 ± 1.2	.76
PCL5 -Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)?		1.8 ± 1.4	2 ± 1.4	1.7 ± 1.4	.15
PCL6 -Avoiding memories, thoughts, or feelings related to the stressful experience?		1.7 ± 1.3	1.8 ± 1.4	1.6 ± 1.3	.52
PCL7 -Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects, or situations)?		1.2 ± 1.3	1.2 ± 1.3	1.3 ± 1.4	.71
PCL8 -Trouble remembering important parts of the stressful experience?		1 ± 1.3	1.2 ± 1.4	0.8 ± 1.1	.15
PCL9 -Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)?		2.1 ± 1.5	2.4 ± 1.5	1.9 ± 1.5	.11
PCL10 -Blaming yourself or someone else for the stressful experience or what happened after it?		2.7 ± 1.4	2.8 ± 1.4	2.6 ± 1.5	.42
PCL11 -Having strong negative feelings such as fear, horror, anger, guilt, or shame?		2.1 ± 1.4	2.1 ± 1.4	2.1 ± 1.4	.81
PCL12 -Loss of interest in activities that you used to enjoy?		1.5 ± 1.4	1.4 ± 1.4	1.6 ± 1.4	.49
PCL13 -Feeling distant or cut off from other people?		1.2 ± 1.3	1.4 ± 1.3	1.1 ± 1.3	.23
PCL14 -Trouble experiencing positive feelings (for example, being unable to feel happiness or have loving feelings for people close to you)?		1.8 ± 1.3	1.6 ± 1.3	1.9 ± 1.3	.15
PCL15 -Irritable behavior, angry outbursts, or acting aggressively?		1.8 ± 1.4	2 ± 1.4	1.7 ± 1.4	.19
PCL16 -Taking too many risks or doing things that could cause you harm?		0.7 ± 1.1	0.7 ± 0.9	0.8 ± 1.2	.67
PCL17 -Being super alert or watchful or on guard?		2.19 ± 1.3	2.45 ± 1.4	2.03 ± 1.3	.07
PCL18 -Feeling jumpy or easily startled?		1.8 ± 1.4	.9 ± 1.4	1.7 ± 1.3	.44
PCL19 -Having difficulty concentrating?		1.4 ± 1.3	1.6 ± 1.3	1.2 ± 1.2	.15
PCL20 -Trouble falling or staying asleep?		1.8 ± 1.4	1.9 ± 1.3	1.7 ± 1.4	.54
PCL score		33.2 ± 15.4	34.7 ± 16.4	32.3 ± 14.7	.35
PCL-5 (score ≥ 31)	No PTSD	49 (33.8)	18 (32.1)	31 (34.8)	.86
	PTSD	96 (66.2)	38 (67.9)	58 (65.2)	

PCL = PTSD Checklist for DSM.

Table 4

Assessment of brain injury score of the participants stratified by the distance from the blast location.

		Distance		
	Total	≤1 km	>1 km	P value
BISx1 - Headaches	0.9 ± 1.1	1.1 ± 1.3	0.8 ± 1	.24
BISx2 - Feeling dizzy	0.7 ± 1	0.6 ± 1	0.7 ± 1	.77
BISx3 - Loss of balance	0.6 ± 0.9	0.6 ± 0.9	0.6 ± 0.8	.97
BISx4 - Poor coordination, clumsy	0.3 ± 0.7	0.2 ± 0.6	0.3 ± 0.7	.40
BISx5 - Nausea	0.4 ± 0.8	0.5 ± 0.9	0.4 ± 0.8	.56
BISx6 - Fatigue, tiring more easily	1.4 ± 1.2	1.5 ± 1.3	1.4 ± 1.2	.69
BISx7 - Vision problems, blurring, trouble seeing	0.5 ± 0.9	0.7 ± 1	0.5 ± 0.9	.25
BISx8 - Being irritable, easily angered	0.5 ± 1	0.6 ± 1	0.5 ± 1	.69
BISx9 - Sensitivity to light	0.2 ± 0.7	0.4 ± 0.9	0.2 ± 0.5	.09
BISx10 - Feeling frustrated or impatient	1.2 ± 1.3	1.2 ± 1.3	1.3 ± 1.3	.78
BISx11 - Sensitivity to noise	1.4 ± 1.3	1.4 ± 1.3	1.3 ± 1.3	.76
BISx12 - Poor concentration	0.4 ± 0.8	0.5 ± 1.1	0.3 ± 0.6	.19
BISx13 - Change in taste and/or smell	1.1 ± 1.2	1.1 ± 1.2	1.1 ± 1.2	.91
BISx14 - Taking longer to think	1 ± 1.2	1.3 ± 1.2	0.8 ± 1.1	**.05**
BISx15 - Loss of appetite or increased appetite	0.3 ± 0.7	0.4 ± 0.9	0.3 ± 0.6	.48
BISx16 - Blurred vision	0.8 ± 1.1	1 ± 1.1	0.7 ± 1	.10
BISx17 - Forgetfulness, can't remember things	0.7 ± 1.1	0.8 ± 1.1	0.7 ± 1	.59
BISx18 - Double vision	0.8 ± 1.1	0.8 ± 1.1	0.9 ± 1.1	.79
BISx19 - Difficulty making decisions	0.7 ± 1	0.8 ± 1.1	0.6 ± 0.9	.13
BISx20 - Restlessness	1.3 ± 1.2	1.4 ± 1.2	1.2 ± 1.2	.36
BISx21 - Difficulty falling or staying asleep	1.3 ± 1.3	1.5 ± 1.3	1.3 ± 1.3	.38
BISx22 - Feeling anxious or tense	1.4 ± 1.3	1.5 ± 1.3	1.4 ± 1.3	.69
BISx23 - Feeling depressed or sad	1.3 ± 1.3	1.2 ± 1.2	1.3 ± 1.3	.48
BISx Score	19.3 ± 14.6	20.8 ± 14.7	18.4 ± 14.5	.34

BISx = brain injury symptoms.

Table 5

Logistic regression assessing the association between the participant's characteristics and PCL-5 score greater than 31.

	aOR	P	95% CI
Distance from the blast (reference ≤1 km)	1.480	.47	[0.557, 5.099]
Age (continuous)	0.968	**.05**	[0.931, 1.000]
Gender (Reference is "Female")	0.226	**.01**	[0.073, 0.702]
PHQ-9 score (Reference "PHQ < 10")	8.934	**<.001**	[2.842, 28.089]
BISx score (continuous)	1.075	**.001**	[1.029, 1.123]

Variables excluded from the model are *Any Head or Neurological symptoms and any previous comorbidities*. Model characteristics: Omnibus P = .043, R^2 = 0.560, Hosmer = 0.051.

aOR = adjusted odds ratio, BISx = brain injury symptoms, PCL-5 = PTSD Checklist for DSM-5, PHQ = patient health questionnaire.

95% CI [1.425, 14.285]), the PHQ-9 score (aOR = 8.934, P < .001, 95% CI [2.842, 28.089]), and the BIXs scores (aOR = 1.075, P = .001, 95% CI [1.029, 1.123]) of the participants. Nevertheless, the logistic regression model failed to find any association between the 'articipants' distance from the blast center (aOR = 1.480, P = .47, 95% CI [0.557, 5.099]) and the PCL-5 score.

The association between age and PTSD was previously discussed in the literature on post-natural disasters such as floods and earthquakes. However, there is a paucity of reports discussing the effect of a blast similar to what happened in Beirut, which was man-made erroneous storage and officials' negligence effect. The nature of the causes of the Beirut blast makes this event peculiar and unique compared to other natural disasters because human-related disasters could have been avoided if the causes had been circumvented. Moreover, it was previously reported that the PTSD prevalence among the survivors of man-made disasters exceeds those caused by nature.[16,17] Nevertheless, the psychological impact of disasters could be compared to other previous events that led to casualties and injuries.

For instance, the results showed that more than 2-quarters of our participants' scores fell in the PTSD category of PCL-5. This percentage falls within the range of PTSD prevalence (25%–75%) of previous reports focused on the survivors of man-made disasters.[16–18] It is worth noting that we assessed for PTSD in our participants during a similar timeframe to the aforementioned reports.

The age of the participants in this study showed a negative association with the PCL-5 scores. Guo et al showed a similar association between age and PTSD among 1369 earthquake survivors in China.[19] Nevertheless, other reports either failed to show an association between age and PTSD[20] or showed a positive association,[21–23] which is opposite to the reported results in this study. The latter studies were all conducted post-natural (earthquake or flood) disasters.

Previously, it was reported that previous traumatic encounters could increase the risk of developing PTSD in any consequent traumas.[24,25] During the last 50 years, Lebanon experienced many traumatic events and wars. All these events caused a lot of injured civilians and fatalities. Therefore, we expected the older generation in our cohort to show a higher association with PTSD; however, the results showed the contrary. The negative association between PTSD and age in this sample is worth further investigation into the reasons for such findings.

As for the association between being a female and PTSD, this study showed that females are more than 4 times as likely to have PTSD than males. There is a consensus in the literature that females have higher odds of having PTSD than males, and the prevalence of PSTD among females is higher than that in males.[19,22,23,26,27] Along these lines, multiple reports in the literature showed a high association between depression and PTSD in adults and adolescents.[26,28,29] For instance, in a cohort conducted by Jordan et al, including 36,897 participants, the prevalence of PTSD and depression in survivors of the 9/11 World Trade Center terrorist attacks was 14.3% and 15.6%, respectively.[30] In addition, this study showed that participants with a high PHQ-9 score were at least 8 times more likely to have PTSD than a low PHQ-9 score.

On another note, this study showed that the BISx score is associated PCL-5 score. Stein et al indicated that the prevalence of PTSD in TBI cases is more than in non-head trauma controls after 3 to 6 months of their injury.[31] Moreover, Roden-Foreman et al, in their longitudinal cohort study, indicated that an antecedent TBI is a predictor of PTSD among the participants.[32] Furthermore, Hoge et al surveyed 2525 soldiers about mTBI; PTSD was reported in more than 40% of injured soldiers who experienced a loss of consciousness.[5] Another prospective study by Fares et al, reporting 417 injury cases due to cluster munitions, showed that almost all victims of head and face injuries developed PTSD symptoms such as post-traumatic headaches (80%) and depressive symptoms (72%).[33]

This study's results align with the findings of other reports concerning the association between gender, depression, and concussion with PTSD. To our best knowledge, our study is the first to assess the psychological disturbance in the Beirut Port Blast adult survivors. On the other hand, the negative association between age and PTSD in the study participants warrants a further investigation to delineate the reasons for such an association.

As for the study limitation, the participants' pool was from 1 ED where the patients presented after the blast event. This might limit the findings' generalizability for all the blast victims. However, AUBMC ED received a large number of survivors who presented during the first few hours post the blast. Additionally, we conducted the study by calling the survivors through their phone numbers registered on their medical charts. We adopted the data collection over the phone to maintain social distancing, reduce the need for the patients to present to the hospital for research-related visits, and abide by the IRB general COVID-19 regulations to minimize the risk of patient exposure. Unfortunately, many of the patients' charts had missing or wrong phone numbers on the charts, especially the patients who presented for the first time to the AUBMC ED. Additionally, we lost to reach some patients after multiple calling attempts.

Taken together, these data were collected post-Beirut Port blast to assess the psychological disturbances in a cohort of patients who presented to the AUBMC ED. We found that 2-thirds of the survivors of the Beirut Port blast had PTSD, which was associated with being young, being female, and having depression and symptoms of concussion. Further investigations are required to delineate the drivers of the association between young age and PTSD. On another note, we have collected serum samples from some of the study subjects to evaluate brain-specific biomarkers to assess the potential protein changes at chronic time points that are indicative of blast-induced injury in a follow-up study.

Author contributions

Conceptualization: Moustafa Al Hariri, Eveline Hitti, Firas Kobeissy, Afif Mufarrij.
Data curation: Moustafa Al Hariri, Hady Zgheib, Karen Abi Chebl, Maria Azar, Jennifer Rizk.
Formal analysis: Moustafa Al Hariri.
Investigation: Moustafa Al Hariri, Hady Zgheib, Karen Abi Chebl, Maria Azar, Maya Bizri, Firas Kobeissy, Afif Mufarrij.
Methodology: Moustafa Al Hariri, Maya Bizri, Afif Mufarrij.
Project administration: Moustafa Al Hariri, Hady Zgheib, Maria Azar, Eveline Hitti, Firas Kobeissy, Afif Mufarrij.
Supervision: Moustafa Al Hariri, Hady Zgheib, Eveline Hitti, Maya Bizri, Firas Kobeissy, Afif Mufarrij.
Visualization: Moustafa Al Hariri.
Writing – original draft: Moustafa Al Hariri, Hady Zgheib, Karen Abi Chebl, Maria Azar, Eveline Hitti, Maya Bizri, Jennifer Rizk, Firas Kobeissy, Afif Mufarrij.
Writing – review & editing: Moustafa Al Hariri, Hady Zgheib, Karen Abi Chebl, Maria Azar, Eveline Hitti, Maya Bizri, Jennifer Rizk, Firas Kobeissy, Afif Mufarrij.

References

[1] El Sayed MJ. Beirut ammonium nitrate explosion: a man-made disaster in times of the COVID-19 pandemic. Disaster Med Public Health Prep. 2020;1:5.

[2] Al-Hajj S, Dhaini HR, Mondello S, et al. Beirut ammonium nitrate blast: analysis, review, and recommendations. Front Public Health. 2021;9:657996.

[3] Helou M, El-Hussein M, Aciksari K, et al. Beirut explosion: the largest non-nuclear blast in history. Disaster Med Public Health Prep. 2021;1:2.

[4] Kobeissy F, Mondello S, Tümer N, et al. Assessing neuro-systemic & behavioral components in the pathophysiology of blast-related brain injury. Front Neurol. 2013;4:186.

[5] Hoge CW, McGurk D, Thomas JL, et al. Mild traumatic brain injury in U.S. Soldiers returning from Iraq. N Engl J Med. 2008;358:453–63.

[6] Phipps H, Mondello S, Wilson A, et al. Characteristics and impact of U.S. military blast-related mild traumatic brain injury: a systematic review. Front Neurol. 2020;11:559318.

[7] Taymur I, Sargin AE, Özdel K, et al. Possible risk factors for acute stress disorder and post-traumatic stress disorder after an industrial explosion. Noro psikiyatri arsivi 2014;51:23–9.

[8] Raker EJ, Lowe SR, Arcaya MC, et al. Twelve years later: the long-term mental health consequences of Hurricane Katrina. Soc Sci Med 2019;242:112610.

[9] Maalouf FT, Haidar R, Mansour F, et al. Anxiety, depression and PTSD in children and adolescents following the Beirut port explosion. J Affect Disord. 2022;302:58–65.

[10] Kroenke K, Spitzer RL, Williams JB, et al. The patient health questionnaire somatic, anxiety, and depressive symptom scales: a systematic review. Gen Hosp Psychiatry. 2010;32:345–59.

[11] Blevins CA, Weathers FW, Davis MT, et al. The posttraumatic stress disorder checklist for DSM-5 (PCL-5): development and initial psychometric evaluation. J Trauma Stress. 2015;28:489–98.

[12] Vos L, Whiteneck GG, Ngan E, et al. Rasch analysis of postconcussive symptoms: development of crosswalks and the brain injury symptom scale. Arch Phys Med Rehabil. 2019;100:1844–52.

[13] Harris PA, Taylor R, Thielke R, et al. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42:377–81.

[14] Abdul-Nabi SS. Chronicles of an emergency medicine resident in lebanon. J Emerg Med. 2021;61:602–6.

[15] Abdul-Nabi SS, Sawaya RD. Airway breathing circulation: an emergency medicine resident's experience of the beirut explosion. Acad Emerg Med. 2021;28:483–6.

[16] Bromet EJ, Atwoli L, Kawakami N, et al. Post-traumatic stress disorder associated with natural and human-made disasters in the World Mental Health Surveys. Psychol Med. 2017;47:227–41.

[17] Galea S, Nandi A, Vlahov D. The epidemiology of post-traumatic stress disorder after disasters. Epidemiol Rev. 2005;27:78–91.

[18] Hull AM, Alexander DA, Klein S. Survivors of the Piper Alpha oil platform disaster: long-term follow-up study. Br J Psychiatry. 2002;181:433–8.

[19] Guo J, He H, Qu Z, et al. Post-traumatic stress disorder and depression among adult survivors 8 years after the 2008 Wenchuan earthquake in China. J Affect Disord. 2017;210:27–34.

[20] Dai W, Kaminga AC, Tan H, et al. Comorbidity of post-traumatic stress disorder and anxiety in flood survivors: prevalence and shared risk factors. Medicine (Baltim). 2017;96:e7994.

[21] Adhikari Baral I, K C B. Post traumatic stress disorder and coping strategies among adult survivors of earthquake, Nepal. BMC Psychiatry. 2019;19:118.

[22] Rafiey H, Alipour F, LeBeau R, et al. Prevalence and determinants of PTSD 3 years after an Earthquake in Iran. Community Ment Health J. 2019;55:542–7.

[23] Zhen R, Quan L, Zhou X. Co-occurring patterns of post-traumatic stress disorder and depression among flood victims: a latent profile analysis. J Health Psychol. 2020;25:1543–55.

[24] Naomi Breslau PD, Howard D, Chilcoat SD, et al. Previous exposure to trauma and PTSD effects of subsequent trauma: results from the detroit area survey of trauma. Am J Psychiatry. 1999;156:902–7.

[25] Storr CL, Ialongo NS, Anthony JC, et al. Childhood antecedents of exposure to traumatic events and posttraumatic stress disorder. Am J Psychiatry. 2007;164:119–25.

[26] Kilpatrick DG, Ruggiero KJ, Acierno R, et al. Violence and risk of PTSD, major depression, substance abuse/dependence, and comorbidity:

results from the National Survey of Adolescents. J Consult Clin Psychol. 2003;71:692–700.

[27] van Zuiden M, Engel S, Karchoud JF, et al. Sex-differential PTSD symptom trajectories across one year following suspected serious injury. Eur J Psychotraumatol. 2022;13:2031593.

[28] Byllesby BM, Elhai JD, Tamburrino M, et al. General distress is more important than PTSD's cognition and mood alterations factor in accounting for PTSD and depression's comorbidity. J Affect Disord. 2017;211:118–23.

[29] Barbano AC, van der Mei WF, deRoon-Cassini TA, et al. Differentiating PTSD from anxiety and depression: lessons from the ICD-11 PTSD diagnostic criteria. Depress Anxiety. 2019;36:490–8.

[30] Jordan HT, Osahan S, Li J, et al. Persistent mental and physical health impact of exposure to the September 11, 2001 World Trade Center terrorist attacks. Environ Health. 2019;18:12.

[31] Stein MB, Jain S, Giacino JT, et al. Risk of posttraumatic stress disorder and major depression in civilian patients after mild traumatic brain injury: a TRACK-TBI Study. JAMA Psychiatry. 2019;76:249–58.

[32] Roden-Foreman K, Solis J, Jones A, et al. Prospective evaluation of posttraumatic stress disorder and depression in orthopaedic injury patients with and without concomitant traumatic brain injury. J Orthop Trauma. 2017;31:e275–80.

[33] Fares Y, Fares J, Gebeily S. Head and facial injuries due to cluster munitions. Neurol Sci. 2014;35:905–10.