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Research paper

Anxiety, depression and PTSD in children and adolescents following the Beirut port explosion

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ABSTRACT

Background: On August 4, 2020, Beirut's port experienced one of the strongest non-nuclear explosions in history, killing approximately 200 people, displacing 300,000 persons, and injuring more than 1000 children.
Methods: An online anonymous survey assessed the prevalence of probable mental health disorders (MHDs) and impact of blast-related and other factors controlling for sociodemographics in 801 children aged 8 to 17 years old.
Results: About two thirds (64%) were screened positive for probable anxiety using the Screen for Childhood Anxiety Related Disorder, 52% for probable PTSD using CRIES-13, and 33% for probable depression using the Mood and Feelings Questionnaire (MFQ). Children who resided farthest way from the explosion site or were not in Beirut during blast had a significantly lower odds of anxiety and PTSD. Children who sustained any physical injury (vs. none) or witnessed casualties (vs. not) were at higher odds for PTSD. Children of parents who reported that their homes sustained minor damages (vs. no damages at all) were at higher odds for anxiety and PTSD, and temporary displacement (vs. none) increased odds of PTSD only. Poorer perceived economic status, poorer academic performance, having a family member injured in the blast, and prior mental health care seeking were associated with higher odds for all MHDs.
Conclusion: Our study, the only one to document the mental health impact of the Beirut Port explosion on children, highlights the critical need for an emergency mental health response, prioritizing disadvantaged communities and children with prior mental health problems.

On August 4, 2020, Beirut's port was ravaged by one of the strongest non-nuclear explosions in history (Amos and Rincon, 2020). As a result, 200 people died, more than 6000 were injured including over 1000 children who were in urgent need of basic assistance, shelter, and medical care (UNICEF, 2020) and 300,000 people were displaced (American Red Cross, 2020). This catastrophic explosion left many families devastated at a time when Lebanon was and is still witnessing a political turmoil, an economic crisis, and the COVID-19 pandemic.

"A disaster is a severe ecological and psychosocial disruption that exceeds the coping capacity of the affected community" as defined by the World Health Organization (WHO, 1992). Various risk factors may increase the risk for ill mental health outcomes after a disaster, including the level of traumatic exposure, severity of injury, previous psychiatric history, as well as the unexpectedness of the occurrence of the event (Norris et al., 2002). Children and adolescents are particularly vulnerable and disasters can leave deleterious impact on their development (Wang et al., 2013), particularly since they are generally less equipped to cope with disasters compared to adults (Norris et al., 2002). Children may also be negatively impacted by the associated separation from family members and/or pets, destruction of homes, and interruption of schooling (Belfer, 2006).

While many studies focused extensively on post-traumatic responses among adult victims of catastrophic events and combat veterans, only a limited number have investigated the mental health outcomes of child and adolescent survivors of disasters (Hiromi Tsujii et al., 2017). These studies have found that the most common maladaptive psychological

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responses to disasters reported in children include acute stress reaction, adjustment disorder, depression, panic disorder, post-traumatic stress disorder (PTSD), and anxiety disorders (Hiromi Tsujii et al., 2017).

The estimated rates of PTSD among child and adolescent survivors vary greatly across studies, ranging from 1.0 to 95%; the same applies for rates of depression which vary from 1.6 to 81% respectively (Wang et al., 2013). Differences may be attributed to variations in exposure to trauma, demographic characteristics of the population, environmental and cultural factors of the affected area, or due to methodological differences across the studies.

Two months following the September 11 attack on the United States, one study found that 60% of adults living in New York City had at least one child in their household who displayed distress symptoms such as sleeping difficulties, irritability, grouchiness, being upset, and fear of being separated from parents (Schlenger et al., 2002). Six months after the attack, another city-wide study showed that around 30% displayed symptoms of anxiety and depression based on children's self-report (Greene et al., 2018).

Research has confirmed that several factors can further exacerbate psychopathology in children and adolescents following a disaster, including injury or death of a family member, exposure to other life trauma, familial financial difficulties, and exposure to distressing media coverage (Greene et al., 2018; Yeung et al., 2016). Some studies found that children whose experience of a disaster include a broader impact, such as the injury or death of a family member or friend are more likely to suffer from psychopathology, specifically PTSD, as compared to those who experience direct exposure (e.g., witnessing or being harmed in the event, being near cloud of dust and smokes, or being evacuated to safety,) (Greene et al., 2018; Lubit and Eth, 2003). The latter suggests the importance of broader/indirect exposure that could potentially carry longer-term impact of psychopathology following the event (Hoven et al., 2005). Indeed, exposure of a child's family member to the 9/11 attack was more strongly associated with psychopathology than direct exposure in a large sample of school students in NYC 6 months after the attack (Hoven et al., 2005).

Lebanon had been enduring a prolonged history of conflict, economic and political uncertainty even before the Beirut port explosion. In 2012, a study from Greater Beirut (the capital and its surrounding areas) showed that one out of four adolescents suffer from a psychiatric disorder, 50% of whom had an anxiety condition. Alarmingly, up to 94% of the participants with one or more mental health disorder had not sought treatment for their condition (Maalouf et al., 2016). More recently, a national survey, the Psychopathology in Children and Adolescents in Lebanon Study (PALS), conducted by our team before the recent explosion showed that a third of the participating children and adolescents (aged 5 to 17) screened positive for a psychiatric disorder; again, only 5% of those screened positive had sought help for their mental health symptoms (Maalouf et al., 2022).

In an effort to estimate the mental health impact of the Beirut explosion on children and adolescents and to better inform mental health response, we aimed in the present study to assess the prevalence of depression, PTSD and anxiety disorders and to identify the blast-related and other important risk factors that exacerbated this prevalence, using reports from parents of children and adolescents exposed to the explosion. In a country with never-ending sources of distress and stressors, it is important to investigate the mental health outcomes following a major manmade disaster, to ensure proper, evidence-informed locally relevant responses.

1. Methods

1.1. Participants

Data was collected 3 to 4 months post explosion using an online survey that ran between November 15th, 2020 and December 18th, 2020. The online survey targeted parents of children between 8 years and 17 years old who were exposed to the explosion. Exposure was not defined strictly as being physically present near the explosion; but was rather defined using the definition of Criterion A in the DSM-V that recognizes witnessing the event and learning of others being affected as exposure sufficient to induce a traumatic response.

Following approval of the institutional review board (IRB) of the academic institution, the study was publicized on television and radio programs. The convenient sample of parents, however, was recruited using diverse and various social media platforms including Facebook and Instagram accounts (personal and departmental), Twitter, as well as WhatsApp messages forwarded to contact lists). Interested parents provided online consent and then completed the survey for up to four of their children.

2. Measures

The questionnaire included questions on *sociodemographics*, including questions on parental marital status, employment, perceived social status, child's age, gender, as well as perceived academic performance. A question on whether mental health care was ever sought was also included in this section. Children's *depression* was measured using the parent short-version validated Mood and Feelings Questionnaire (MFQ), which consists of 13 self-report items assessing parent-report of depressive symptoms in their child; the previously validated and established cut-off score of 11 for clinically significant depressive symptoms was used to denote probable major depressive disorder (Thapar and McGuffin, 1998). Children's *anxiety* symptoms were measured using the parent short-validated version of the Screen for Childhood Anxiety Related Disorder (SCARED), consisting of 5items assessing parent report of symptoms of anxiety in their child; a child was considered to have a probable anxiety disorder if she/he received a score 3 and above (Birmaher et al., 1999). *PTSD* was measured using the CRIES-13 parent measure, which is a 13-item questionnaire designed to screen for post-traumatic stress disorder in children and adolescents aged 8 years and above; 31 was used as the cut-off for probable PTSD (Verlinden et al., 2014). The last set of questions assessed several facets of experiencing the blast *(blast-related factors)*. The questions, developed by our research team, assessed proximity to the blast (how close was the child/adolescent to the site of the explosion); whether the child/-adolescent or his/her loved ones sustained injuries whether they lost any family member and/or friend; whether they witnessed casualties; whether they were exposed to media coverage; whether the family property was damaged; whether the family vehicle was damaged; and whether the family was displaced due to the explosion.

3. Statistical analysis

Data was analyzed using Stata (version 15.1). In addition to the descriptive analysis, binary logistic regression models were used to estimate the association between our main mental health outcomes (PTSD, depression and anxiety) and the various stressors and risk factors, controlling for potential confounders [including age, gender, nationality, perceived socioeconomic status, academic performance, parental marital status, and mother and father's working status potential confounding factors] determined a priori based on published literature. Given that in some families, parents reported on more than child, all regression models accounted for clustering of children within families for more accurate standard errors [cluster = *familyID*]

4. Results

4.1. Sociodemographic characteristics of parents and children

Table 1a provides an overview of parents' and children's sociodemographic characteristics. Most parents (86.0%, $n = 690$) were married at the time of the survey. Half of the mothers (52.6%, $n = 422$)

Table 1a
Parental and child sociodemographic distribution ($N = 802$).

Age of responding parent (yrs.)	Valid% (n)
25–29	3.74 (30)
30–39	32.04 (257)
40–49	53.99 (433)
50–59	10.22 (82)
Parents marital status	
Married	86.03 (690)
Not married	13.97 (112)
Mother's working status	
Full-time job	30.92 (248)
Part-time job	16.46 (132)
Unemployed	52.62 (422)
Father's working status	
Full-time job	53.99 (433)
Part-time job	21.95 (176)
Unemployed	24.06 (193)
Perceived socioeconomic status	
A lot poorer than most	14.96 (120)
A little poorer than most	17.21 (138)
About the same as most	46.88 (376)
A little/ A lot richer than most	20.95 (168)
Child Age (in years)	
8–11	57.11 (458)
12–17	42.89 (344)
Child biological sex	
Male	50.87 (408)
Female	49.13 (394)
Child's Nationality	
Lebanese/ dual citizen	83.04 (666)
Non-Lebanese	16.96 (136)
Child's academic performance	
Good	64.59 (518)
Acceptable	29.05 (233)
Sub-optimal	6.36 (51)

were unemployed and almost one third had a full-time job (30.9%, $n = 248$). One in four (24.1%, $n = 193$) of the fathers were unemployed at the time of the survey. When asked to report on their perceived socioeconomic status, 20.9% ($n = 168$) considered themselves a little or a lot richer than most, 46.9% ($n = 376$) reported being about the same, and the remaining third (32.2%) perceived themselves as being a little or a lot poorer than most families.

Of the 802 children/adolescents, 57.1% ($n = 458$) were 8 to 11 years old, and 42.9% ($n = 344$) were 12 to 17 years old, with an almost equal proportion of male (50.9% $n = 408$) vs. female (49.1%, $n = 394$). In addition, most participants were Lebanese/ dual citizens (83.1%, $n = 666$). Around two-thirds of children (64.6%, $n = 518$) were in good academic standing (as reported by their parent) while 29.1% ($n = 233$) and 6.4%($n = 51$) were reported to have acceptable or sub-optimal academic performance, respectively.

4.2. Prevalence of probable depressive disorder, anxiety disorder, and PTSD

Around one third of children and adolescents (33.08%, $n = 265$) had a probable major depressive disorder as per the MFQ, two third (63.58%, $n = 508$) had a probable anxiety disorder as per the SCARED, and half (51.5%, $n = 412$) had a probable PTSD as per the CRIES-13. About two-third of the participants (61.5%, $n = 493$) did not seek mental health treatment after the explosion, 21.8% ($n = 175$) sought non-professional help (friends/family/social media) and 16.7% ($n = 134$) sought professional help (medical doctor/psychiatrist/psychologist/hotline).

4.3. Blast-related factors and mental health seeking after explosion

As shown in Table 1b, 82.0% ($n = 658$) of children and adolescents in this sample were in Beirut at the time of the explosion; among those, 13.0% ($n = 104$) were situated in district 1 (nearest point to the port,

Table 1b
Blast related factors and health care seeking post explosion ($N = 802$).

Child in Beirut at the time of the Explosion	Valid% (n)
Yes	82.04 (658)
No	17.96 (144)
Child District* at time of explosion	
Beirut District 1	12.97 (104)
Beirut District 2	27.43 (220)
Beirut District 3	41.65 (334)
Not in Beirut	17.96 (144)
Child injured	
Yes	10.85 (87)
No	89.15 (715)
Child Lost parent/ sibling/ relative	
Yes	2.87 (23)
No	97.13 (779)
Child Witnessed casualties	
Yes	24.81 (199)
No	75.19 (603)
Child Contact with media coverage	
Yes	65.84 (528)
No	34.16 (274)
Child Sought mental health support after Explosion	
No treatment	61.47 (493)
Yes, non-professional treatment	21.82 (175)
Yes, professional treatment	16.71 (134)
Parent Family member injured	
No	70.20 (563)
Yes	29.80 (239)
Parent Family member killed	
No	89.53 (718)
Yes	10.47 (84)
Parent Friend injured	
No	72.82 (584)
Yes	27.18 (218)
Parent Friend killed	
No	90.40 (725)
Yes	9.60 (77)
Family residence impacted	
No, it was not impacted	20.45 (164)
Yes, minor damages	71.20 (571)
Yes, major damages	8.35 (67)
Cars/ large vehicles damaged	
We do not have any cars/ vehicles	22.44 (180)
One or more car/ vehicle damaged/ unusable	18.08 (145)
Cars/ vehicles were not damaged	59.48 (477)
Displaced due to explosion	
No, not at all	69.08 (554)
Yes, and we are still living elsewhere	9.48 (76)
Yes, temporarily, but we returned home	21.45 (172)

* District 1 (nearest point to the port, including the following areas: Port, Medawar, Rmeil, Saifi); district 2 (Minet El Hosn, Zkak El Blat, Bachoura, Ahsrafieh); district 3 (farthest from explosion site, including Dar Mreisseh, Ras Beirut, Mousseitbeh, Mazraa).

Table 1c
Previous trauma exposure and mental health care ($N = 802$).

Child Exposed to maltreatment	Valid% (n)
Yes	5.24 (42)
No	94.76 (760)
Child Exposed to previous manmade Disaster	
Yes	2.37 (19)
No	97.63 (783)
Child Exposed to previous natural disaster	
Yes	1.87 (15)
No	98.13 (787)
Child Exposed to previous War Events	
Yes	15.09 (121)
No	84.91 (681)
Child Mental health care seeking before August 4th	
No	78.18 (627)
Yes	17.58 (141)
Prefer not to answer	4.24 (34)

including the following areas: Port, Medawar, Rmeil, Saifi), 27.4% (n = 220) in district 2 (Minet El Hosn, Zkak El Blat, Bachoura, Ahsrafieh), and 41.6% (n = 334) in district 3 (farthest from explosion site, including Dar Mreisseh, Ras Beirut, Mousseitbeh, Mazraa). The parents were asked to report on whether their children experienced any injuries and the majority (89.1%, n = 715) did not sustain any; similarly, most children/adolescents (97.1%, n = 779) did not lose a parent, sibling, relative, friend, neighbor or a significant person in their life due to the explosion. Still, 24.8% (n = 199) witnessed casualties, and 65.8% (n = 528) were exposed to media coverage (i.e. witnessed disturbing images or videos).

When the parents were asked whether they themselves had a family member or friend injured or killed, their responses were: 29.8% (n = 239) had a family member who was injured, 10.5% (n = 84) had a family member who was killed, 27.2% (n = 218) had a friend who was injured and 9.6% (n = 77) a friend who was killed. Most parents reported either minor (71.2%, n = 571) or no damages at all (20.5%, n = 164) to their family residence; 18.1% (n = 145) reported one or more vehicles damaged. While the majority (69.1%, n = 554) were not displaced after the explosion, 21.4% (n = 172) reported temporarily leaving their homes, and an additional10.0% (n = 76) were still displaced at the time of the survey.

4.4. Previous trauma and mental health care seeking

Of the total sample of children/adolescents, 15.1% (n = 121) had in their lifetime (prior to the explosion) been exposed to war events (bombing, shooting and raids), 5.2% (n = 42) to maltreatment (sexual assault, physical assault, or domestic violence), 2.4% (n = 19) to other manmade disasters, and 1.9% (n = 15) to natural disasters. When asked about previous mental health care seeking, 17.6% (n = 141) of the parents reported that their child had previously sought care for mental health concerns.

5. Factors associated with depression, anxiety and PTSD

5.1. Sociodemographic characteristics

Table 2a presents the results of the adjusted binary logistic regression models examining the association between all sociodemographic characteristics (in one model) and surveyed child mental health outcomes, accounting for clustering of children within families. Perceived social class was a consistent statistically significant predictor of all three mental health outcomes. More specifically, children of parents who perceived themselves as a little or a lot richer than most were at lower odds of screening positive for depressive, anxiety, and PTSD while those who perceived themselves as a little/a lot poorer than most were at higher odds for anxiety [OR: 1.81 (1.10–2.99)] and PTSD [OR: 1.77 (1.12–2.80)]; results for depression were consistent but borderline significant [OR: 1.57 (0.97–2.56)]. Children of unemployed mothers (compared to mothers with a full-time job) were more likely to have depression [OR: 1.62 (1.04–2.54)], and children with fathers with a part-time job were at higher odds of PTSD [OR: 1.59 (1.04–2.44)]. Children of a non-Lebanese citizenship (vs. Lebanese/dual citizenship) were also more likely to have depression [OR: 1.79 (1.09–2.95)]. Children's age was statistically significantly associated with anxiety only; older children aged 12 to 17 years old (vs. 8–11 years) showed a much lower odds of screening positive for an anxiety disorder [OR: 0.32 (0.22–0.45)]. Similar to perceived SES, perceived academic performance was associated with all three mental health outcomes; lower academic performance was specifically associated with higher odds of depression, PTSD and anxiety (Table 2a).

5.2. Blast-related factors

Table 2b presents the unadjusted and adjusted (controlling for sociodemographic characteristics) associations between each assessed

Table 2a
Adjusted associations between sociodemographic factors and depression, anxiety, and PTSD (N = 802).

	Depression (MFQ) A-OR* (95% CI)	p-value	Anxiety (SCARED) A-OR* (95% CI)	p-value	PTSD (CRIES) A-OR* (95% CI)	p-value
Responding parent's Age						
20–29	1.00	—	1.00	—	1.00	—
30–39	0.59 (0.22–1.58)	0.29	0.70 (0.21–2.09)	0.49	0.68 (0.267–1.70)	0.40
40–49	0.52 (0.19–1.42)	0.20	0.76 (0.24–2.36)	0.63	0.61 (0.25–1.51)	0.29
50–59	0.58 (0.19–1.84)	0.36	0.58 (0.17–1.94)	0.38	0.44 (0.16–1.33)	0.15
Parents' Marital Status						
Married vs not married	1.23 (0.69–2.19)	0.46	1.10 (0.67–1.81)	0.70	1.01 (0.61–1.70)	0.96
Mother's Working Status						
Full-time job	1.00	—	1.00	—	1.00	—
Part-time job	1.63 (0.94–2.81)	0.08	0.75 (0.46–1.20)	0.23	1.20 (0.73–1.98)	0.47
Unemployed	1.62 (1.04–2.54)	**0.03**	1.02 (0.70–1.51)	0.89	1.33 (0.88–2.01)	0.18
Father's Working Status						
Full-time job	1.00	—	1.00	—	1.00	—
Part-time job	1.09 (0.67–1.78)	0.73	1.3 (0.84–1.99)	0.25	1.59 (1.04–2.44)	**0.03**
Unemployed	0.96 (0.57–1.63)	0.90	1.1 (0.66–1.83)	0.70	1.06 (0.65–1.73)	0.81
Perceived family SES						
About the same	1.00	—	1.00	—	1.00	—
A little/ a poorer	1.57 (0.97–2.56)	0.07	1.81 (1.10–2.99)	**0.02**	1.77 (1.12–2.80)	**0.01**
A little/ a lot richer	0.35 (0.20–0.60)	**<0.01**	0.56 (0.38–0.83)	**0.01**	0.52 (0.32–0.84)	**0.01**
Child's age						
8–11 yrs.	1.00	—	1.00	—	1.00	—
12–17 yrs.	1.05 (0.73–1.51)	0.79	0.32 (0.22–0.45)	**<0.01**	0.82 (0.60–1.14)	0.24
Child's biological sex						
Male vs female	1.11 (0.81–1.53)	0.51	1.11 (0.84–1.56)	0.40	1.05 (0.78–1.41)	0.72
Child's Nationality						
Non-Lebanese (vs. Lebanese/dual citizens)	1.79 (1.09–2.95)	**0.02**	0.95 (0.56–1.59)	0.83	0.88 (0.53–1.44)	0.61
Child's Academic performance						
Good	1.00	—	1.00	—	1.00	—
Acceptable	1.87 (1.28–2.72)	**<0.01**	1.25 (0.86–1.83)	0.24	1.58 (1.10–2.27)	**0.01**
Sub-optimal	3.18 (1.58–6.43)	**<0.01**	1.94 (0.98–3.86)	**0.06**	1.75 (0.89–3.43)	0.10

A-OR depicts the adjusted odds ratio of a model including all of the sociodemographic variables.

Table 2b
Unadjusted and adjusted associations between blast-related factors and depression, anxiety, and PTSD ($N = 802$).

	Depression (MFQ) U-OR (95% CI)A-OR* (95% CI)	p-value	Anxiety (SCARED) U-OR (95% CI)A-OR* (95% CI)	p-value	PTSD (CRIES) U-OR (95% CI)A-OR* (95% CI)	p-value
Child District* at time of explosion						
Beirut District 1	1.00	—	1.00	—	1.00	—
Beirut District 2	0.94 (0.53–1.67)	0.83	0.74 (0.42–1.30)	0.30	0.61 (0.35–1.06)	0.08
	1.22 (0.67–2.25)	0.51	0.85 (0.47–1.52)	0.58	0.73 (0.41–1.31)	0.30
Beirut District 3	0.75 (0.44–1.29)	0.30	0.49 (0.28–0.85)	**0.01**	0.37 (0.22–0.61)	**<0.01**
	1.01 (0.59–1.74)	0.97	0.56 (0.32–0.98)	**0.04**	0.43 (0.25–7.42)	**0.01**
Not in Beirut	0.55 (0.30–1.03)	0.06	0.43 (0.23–0.79)	**0.01**	0.26 (0.15–0.46)	**<0.01**
	0.96 (0.51–1.83)	0.91	0.54 (0.28–1.02)	**0.06**	0.36 (1.20–0.66)	**0.01**
Child injured						
No vs Yes	1.57 (0.97–2.56)	0.06	2.06 (1.18–3.57)	**0.01**	2.73 (1.67–4.48)	**<0.01**
	1.44 (0.85–2.43)	0.18	2.02 (1.17–3.50)	**0.01**	2.53 (1.50–4.29)	**0.01**
Child lost parent/ relative						
No vs Yes	0.42 (0.14–1.25)	0.12	0.43 (0.16–1.12)	0.08	0.86 (0.34–2.16)	0.75
	0.39 (0.13–1.14)	0.09	0.63 (0.25–1.58)	0.32	1.07 (0.41–2.80)	0.89
Child witnessed casualties						
No vs Yes	1.39 (0.97–1.99)	0.07	1.28 (0.89–1.84)	0.17	1.84 (1.29–2.64)	**0.01**
	1.41 (0.96–2.1)	0.08	1.35 (0.93–1.97)	0.18	1.95 (1.32–2.90)	**0.01**
Child contact with media coverage						
No vs Yes	1.12 (0.79–1.60)	0.51	1.09 (0.80–1.49)	0.59	1.21 (0.88–1.66)	0.23
	1.22 (0.83–1.80)	0.31	1.04 (0.75–1.44)	0.82	1.24 (0.89–1.71)	0.20
Child sought MH after explosion						
No treatment	1.00	—	1.00	—	1.00	—
Non-professional treatment	2.12 (1.42–3.18)	**<0.01**	1.99 (1.34–2.94)	**0.01**	2.50 (1.70–3.68)	**<0.01**
	2.08 (1.37–3.15)	**0.01**	1.75 (1.17–2.63)	**0.01**	2.40 (1.58–3.64)	**<0.01**
Professional treatment	2.73 (1.77–4.22)	**<0.01**	3.64 (2.23–5.96)	**<0.01**	4.24 (2.68–6.70)	**<0.01**
	2.84 (1.77–4.54)	**<0.01**	3.55 (2.13–5.90)	**<0.01**	4.46 (2.74–7.26)	**<0.01**
Parent Family member injured						
Yes vs No	1.52 (1.05–2.19)	**0.02**	1.41 (0.99–2.00)	**0.05**	1.52 (1.06–2.19)	**0.02**
	1.49 (1.00–2.21)	**0.05**	1.49 (1.03–2.14)	**0.03**	1.50 (1.02–2.12)	**0.04**
Parent Family member killed						
Yes vs No	1.69 (0.97–2.93)	0.06	1.59 (0.87–2.92)	0.13	1.70 (0.96–2.99)	0.07
	1.19 (0.65–2.16)	0.57	1.21 (0.66–2.22)	0.52	1.29 (0.69–2.41)	0.43
Parent Friend injured						
Yes vs No	1.37 (0.93–2.01)	0.11	1.14 (0.80–1.65)	0.45	1.09 (0.76–1.59)	0.62
	1.36 (0.92–2.03)	0.12	1.21 (0.84–1.76)	0.30	1.10 (0.76–1.61)	0.61
Parent Friend killed						
Yes vs No	0.97 (0.52–1.80)	0.92	0.94 (0.54–1.65)	0.84	0.68 (0.38–1.22)	0.20
	0.71 (0.37–1.35)	0.30	0.82 (0.45–1.48)	0.51	0.53 (0.30–0.93)	**0.03**
	Depression (MFQ) U-OR (95% CI) A-OR* (95% CI)	p-value	Anxiety (SCARED) U-OR (95% CI) A-OR* (95% CI)	p-value	PTSD (CRIES) U-OR (95% CI) A-OR* (95% CI)	p-value
Family residence impacted						
No, it was not impacted	1.00	—	1.00	—	1.00	—
Yes, minor damages	1.57 (1.03–2.37)	**0.03**	1.44 (0.99–2.10)	0.06	1.82 (1.23–2.72)	**0.01**
	1.36 (0.88–2.09)	0.17	1.63 (1.10–2.44)	**0.02**	1.72 (1.13–2.60)	**0.01**
Yes, major damages	0.66 (0.31–1.38)	0.27	1.19 (0.67–2.10)	0.56	1.35 (0.75–2.46)	0.31
	0.58 (0.24–1.40)	0.22	1.55 (0.79–3.00)	0.20	1.44 (0.72–2.88)	0.30
Cars/ large vehicles damaged						
No car	1.00	—	1.00	—	1.00	—
Car damaged	0.46 (0.27–0.77)	**0.01**	0.84 (0.50–1.41)	0.51	0.71 (0.43–1.17)	0.18
	0.96 (0.53–1.74)	0.88	1.18 (0.65–2.14)	0.59	0.15 (0.64–2.10)	0.63
Car not damaged	0.27 (0.18–0.41)	**<0.01**	0.42 (0.28–0.63)	**<0.01**	0.39 (0.25–0.60)	**<0.01**
	0.71 (0.42–1.22)	0.21	0.66 (0.39–1.14)	0.14	0.81 (0.47–1.41)	0.47
Displacement due to explosion						
No, not at all	1.00	—	1.00	—	1.00	—
Yes, still living elsewhere	1.11 (0.61–2.02)	0.72	0.99 (0.59–1.67)	0.97	1.09 (0.61–1.95)	0.77
	1.04 (0.56–1.95)	0.89	1.05 (0.59–1.84)	0.87	1.03 (0.55–1.93)	0.91
Yes, temporarily but returned home	1.60 (1.05–2.43)	**0.03**	1.37 (0.92–2.04)	0.12	1.93 (1.29–2.90)	**0.01**
	1.30 (0.84–2.03)	0.24	1.34 (0.90–2.02)	0.15	1.71 (1.12–2.62)	**0.01**

U-OR depicts the unadjusted bivariate odds ratio; A-OR depicts the adjusted odds ratio of a model including each factor with all of the sociodemographic variables.
* District 1 (nearest point to the port, including the following areas: Port, Medawar, Rmeil, Saifi); district 2 (Minet El Hosn, Zkak El Blat, Bachoura, Ahsrafieh); district 3 (farthest from explosion site, including Dar Mreisseh, Ras Beirut, Mousseitbeh, Mazraa).

blast-related factor and child mental health outcomes. Proximity to the blast was a risk factor for anxiety and PTSD. Compared to children who resided in district 1 (closest to the blast), children who resided in district 3 (farthest away from the explosion site) or were not in Beirut at the time of the blast had a significantly lower odds of anxiety and PTSD (even after controlling for all sociodemographics) (Table 2b). Children who sustained any physical injury (vs. none) were more likely to screen positive for anxiety and PTSD (but not depression), whereas children who witnessed casualties (vs. did not) were at higher odds for PTSD [OR: 1.95 (1.32–2.90)]. In addition, children who sought mental health support whether from non-professionals (friends, family, social media) or professional help (medical doctor, psychiatrist, psychologist, hotline) were more likely to screen positive for depression, anxiety and PTSD (Table 2b). The odds of screening positive for all three mental health outcomes was also higher for children whose parents had one or more family members (vs. none) injured due to the blast. Children's odds of

PTSD were however lower when parents reported having a friend who was killed (vs. not) [OR: 0.53 (0.30–0.93)]. Finally, children of parents who reported that their homes sustained minor damages (vs. no damages at all) were at higher odds for anxiety and PTSD, while temporary displacement (vs. no displacement) increased odds of PTSD only [OR: 1.71 (1.12–2.62)].

5.3. Previous trauma and mental health care

Table 2c reports on the associations between previous trauma exposure and current child mental health. Adjusted findings (controlling for sociodemographics) show that children who were exposed to trauma prior to the explosion (vs. not), including sexual abuse, physical abuse or domestic violence were more likely to have probable depression [OR: 2.57 (1.24–5.30)] but not PTSD or anxiety. Exposure to other types of trauma (manmade, natural or even war events) was not associated with any of the mental health outcomes after adjusting for the sociodemographics characteristics of the parents/child. Children and adolescents who had sought mental health care prior to the blast were at higher odds for current depression, anxiety and PTSD (Table 2c). It is important to note that upon further controlling for previous mental health care, all the results in Table 2b remained unchanged (results available upon request).

6. Discussion

This study investigated the mental health impact of the Beirut Port explosion on children and adolescents, a disaster that was characterized as one of the strongest non-nuclear explosions in history. The blast destroyed major neighborhoods of the capital and neighboring towns, with severe human, material, and economic casualties. It is important to note that the blast, besides its magnitude, happened at a precarious time for the Lebanese capital as the country has been witnessing a series of calamities since 2019 including the most severe economic crisis in its recent history, mounting political unrest, and much like the rest of the world, a pandemic.

This study characterized the adversities experienced by children and adolescents following this disaster, specifically assessed the prevalence of depression, anxiety, and PTSD, and delineated factors that may have increased the odds of these mental health conditions. Our findings showed an elevated burden of mental health conditions, with about a third of the children and adolescents whose parents participated in our online survey had a probable depressive disorder, half had probable PTSD and two-third had a probable anxiety disorder. Our estimates largely exceed our most recent national prevalence rates of 6%, 23% and 20% for depression, anxiety and PTSD respectively (Maalouf et al., 2022,), which could be indicative of the immediate acute mental health effects on a subgroup of the population. Our estimates are also much higher than what has been reported in previous studies investigating the mental health impact of man-made and natural disasters on children's mental health (Greene et al., 2018; Fairbrother et al., 2003; Hiromi Tsujii et al., 2017; Hoven et al., 2005). For methodological reasons, it may be difficult to compare rates from different studies conducted post disasters given their variations by person, time and place. One review (Hoven et al., 2003), for example, found that PTSD-related symptoms ranged from 3% to 90% in children following exposure to a hurricane.

In the present study, severity of exposure (being physically injured, witnessing casualties) and proximity to the site of explosion were associated with increased likelihood of anxiety and PTSD but not depression. While our findings on proximity align with those of a similar study conducted on adults (El Khoury et al., 2022), they are in contrast to findings from a study out of New York City conducted after the September 11 attack, which showed that children who went to school closer to the World Trade Center were at lower risk for mental health problems compared to those who went to school farther away (Hoven et al., 2005). The authors attributed this finding to the fact that children in the immediate vicinity of the attack were more likely to receive mental health support which may have mitigated the impact of the attack. In the present study, however, children and adolescent who sought or received mental health support after the explosion had increased odds of depression, anxiety, and PTSD. This is probably because in our context, mental health support was individually sought by families of children who were most symptomatic, rather than being provided as a blanket intervention (i.e. delivered to all exposed individuals regardless of their risks to develop mental health problems).

As expected, children who had a family member injured were at increased risk for PTSD, depression, and anxiety. When further controlling for proximity in our study (results not shown), having a family member injured was no longer statistically significantly related to PTSD or anxiety, except for depression with borderline statistical significance [OR: 1.47, p-value: 0.06]. Some studies have shown that having a close family member negatively affected is more strongly associated with risk

Table 2c
Unadjusted and adjusted associations between previous mental health trauma/care and child current mental health wellbeing ($N = 802$).

	Depression (MFQ) U-OR (95% CI)A-OR* (95% CI)	p-value	Anxiety (SCARED) U-OR (95% CI)A-OR* (95% CI)	p-value	PTSD (CRIES) U-OR (95% CI)A-OR* (95% CI)	p-value
Child exposed to previous trauma						
Yes vs No	2.86 (1.43–5.73)	**0.01**	01.45 (0.73–2.91)	0.28	1.56 (0.75–3.27)	0.23
	2.57 (1.24–5.30)	**0.01**	1.48 (0.74–2.93)	0.26	1.34 (0.67–2.68)	0.40
Child exposed to previous manmade Disaster						
Yes vs No	0.72 (0.26–1.96)	0.52	1.24 (0.43–3.58)	0.68	0.84 (0.29–2.48)	0.76
	0.38 (0.99–1.47)	0.16	1.37 (0.60–3.12)	0.45	0.54 (0.13–2.20)	0.39
Child exposure to previous natural Disaster						
Yes vs No	1.35 (0.49–3.75)	0.56	1.14 (0.33–4.01)	0.83	0.82 (0.26–2.59)	0.74
	2.03 (0.74–5.54)	0.17	1.19 (0.26–5.43)	0.82	1.03 (0.34–3.13)	0.95
Child exposure to previous war events						
Yes vs No	2.67 (1.74–4.12)	**<0.01**	1.05 (0.69–1.59)	0.83	1.65 (1.07–2.55)	**0.02**
	1.59 (0.96–2.62)	0.07	1.05 (0.64–1.73)	0.83	1.30 (0.79–2.12)	0.30
Child's mental health care seeking before 4th August						
No	1.00	–	1.00	–	1.00	–
Yes	2.91 (1.98–4.28)	**<0.01**	1.93 (1.29–2.89)	**0.01**	1.98 (1.34–2.92)	**0.01**
	3.24 (2.14–4.91)	**<0.01**	2.37 (1.52–3.70)	**<0.01**	2.09 (1.37–3.20)	**0.01**
Prefer not to answer	3.34 (1.57–7.08)	**0.01**	2.98 (1.23–7.22)	**0.01**	1.90 (0.89–4.05)	0.09
	1.62 (0.75–3.51)	0.22	2.19 (0.83–5.77)	0.11	1.10 (0.47–2.57)	0.82

U-OR depicts the unadjusted bivariate odds ratio; A-OR depicts the adjusted odds ratio of a model including each factor with all of the sociodemographic variables.

for mental health problems than direct exposure (Greene et al., 2018; Hoven et al., 2005).

Higher socioeconomic status and having an employed mother significantly reduced the odds of depression, anxiety and PTSD in our child/adolescent sample, in line with previous research showing the negative effect of lower socioeconomic status (SES) on child mental health (Reiss, 2013). One may think that families with financial means were less likely to be displaced and faster to fix their house damages after the explosion and as a result experienced less distress. Our findings dispute that hypothesis, however, since further analyses shows that controlling for all blast-related factors, and other sociodemographics, children whose parents described themselves as a little or a lot richer than most continued to be at a significantly lesser odds for depression [OR: 0.28 (0.16–0.51)], anxiety [OR: 0.52 (0.34–0.78)] and PTSD [OR: 0.47 (0.29–0.77)]. Understanding the mechanism linking SES to mental health outcomes in this population is important from a research perspective. A comprehensive public health approach advocating for evidence-informed practices and policies is also needed to ensure proper provision of mental health care for vulnerable segments of the population, be it the disadvantaged or the exposed to trauma, or in this case both since the blast hit hardest the poorest communities surrounding the port. Quite importantly, further analyses also showed that children who sought mental health care from a health professional following the blast were at an increased odd of depression [OR: 1.97 (1.13–3.41)], anxiety [OR: 2.39 (1.38–4.14)] and PTSD [OR: 3.07 (1.80–5.25)], controlling for sociodemographics (including perceived SES), blast-related factors, and previous mental health care seeking. This is clearly indicative of the dire need to have an emergency mental health response mechanism in place for similar disasters to ensure proper and immediate provision of care.

Our findings also show that previous traumatic events were associated with depression in children and adolescents after the explosion but not with anxiety and PTSD in contrast with studies showing a cumulative trauma exposure effect on PTSD symptom severity (Suliman et al., 2009)). In our study, it may be that the severity of the blast in children who are already traumatized brought feelings of helplessness that masked PTSD symptoms. In a country, like Lebanon, where traumatic events are not a rare occurrence, it would be important to prioritize children and adolescents with pre-existing mental health problems and those with previous exposure to traumatic events in any preventive effort. Following the Beirut blast, a large number of now "exposed" children and adolescents are at considerably high risk to develop mental health problems if exposed to other traumatic events in the future.

Our results should be interpreted in light of some limitations. Our findings are based on parental reports only as it was not logistically feasible to recruit children online with their parental consent and their assent, and a school-based survey was not possible given the closures due to the pandemic. A number of studies, however, have shown that there is a significant agreement between parental and child reports (Klassen et al., 2006) but some studies showed otherwise especially for internalizing symptoms (van de Looij-Jansen et al., 2011). Future studies should investigate the impact of disasters on children using both parental and child reports, if possible, and allow for linkages and a better understanding of the associations. Another methodological limitation was the use of screening tools rather than diagnostic instruments and generating "probable" rather than "definite" diagnoses. Finally, the limitations of an online survey are also worth noting as our study may have attracted individuals who were more likely to be impacted by the blast than others, resulting in selection bias.

Notwithstanding these limitations, our study is the only one to document the mental health impact of the Beirut Port explosion on children and adolescents. We found an alarming high rate of psychiatric symptoms in exposed children and adolescents, particularly in the disadvantaged subgroups of the affected communities. This requires a concerted coordinated effort, as part of the national mental health strategy, to ensure an emergency mental health response is in place to address future sources of trauma, especially in a country like Lebanon, with a history of political uncertainty and traumatic events. Future research studies should attempt to investigate the long-term mental health impact of the blast and the effectiveness of specific mental health interventions that were dispatched to understand how to be better prepared and more effectively mitigate sequela.

Author statement

Contributors FM and LG were lead the conceptualization and implementation of the survey. RH and FM conducted the analyses and prepared the tables under the supervsion of LG. All authors provided critical input during all stages of the research, and hold themselves jointly and individually responsible for the content of the submitted manuscript.

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All authors declare no conflicts of interest.

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