BJPsych | The British Journal of Psychiatry (2025)
1–9. doi: 10.1192/bjp.2025.10342

Original Article

Longitudinal changes in the mental health of those affected by the 2017 Manchester Arena attack: 3-year follow-up of adults seeking support from the Resilience Hub

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Background

The Resilience Hub was established to support people in need of psychological/psychosocial support following the 2017 Manchester Arena terrorist attack.

Aims

To use mental health screening measures over 3 years following the Arena event to examine the variation in symptoms reported by adults registered with the Hub, and whether this was associated with treatment access characteristics.

Method

Adults engaging with Hub services were separated into eight cohorts depending on when they registered post-incident. Participants completed screening measures for symptoms of trauma, depression, generalised anxiety and work/social functioning. Baseline and follow-up scores over 3 years were compared among the eight admission groups. All types of appointment were recorded in terms of the number of minutes of clinical 'contact time' involved, to explore associations with time taken to register.

Results

Overall, baseline screening scores increased as time to register post-event increased. Over the 3 years of follow-up, a decrease in scores was observed for all 4 screening measures, indicating improvement in mental well-being. Those taking longer to register had higher follow-up scores. However, they showed a slightly stronger decrease in average change of score per follow-up month. Mean contact time per month was greater (apart from the 18-months admission group) in individuals delaying registration. Increased contact time was associated with decreased follow-up screening scores for depression and anxiety.

Conclusions

People who registered earlier were less symptomatic, suggesting there may be a potential beneficial impact of early engagement with support services following traumatic events. All who registered showed improvement in symptoms, including those delaying registration, with increased contact time being beneficial. This reinforces the benefits of encouraging early and sustained engagement with services as soon as possible post-incident.

Keywords

Child and adolescent psychiatry; longitudinal data; mental health services; service development; trauma- and stressor-related disorders.

On 22 May 2017, an improvised explosive device (IED) was detonated as concert-goers were leaving an event at the Manchester Arena, UK. Twenty-two members of the public were killed and 239 physically injured. Approximately 19 500 people were present at the Arena, including concert attendees, staff, parents/guardians and emergency responders.[1] Terrorism can be distinguished from natural disasters in its capacity to generate a greater sense of fear, unpredictability and loss of sense of safety, and is therefore associated with increased risk of the development of mental health conditions.[2] Significant differences have been found in the prevalence rates of post-traumatic stress disorder (PTSD) in victims of terrorist attacks, with rates varying from 11% among individuals on Utøya Island, Norway[3] to 60% of UK nationals affected by the 2015–2016 terrorist attacks in Tunisia, Paris and Brussels.[4] This variation is likely to be secondary to differences in methodology such as the sampling approaches, screening and assessment tools used. A systematic review found that 33–39% of people present at a terrorist attack met PTSD diagnostic criteria within 1 year.[5] Diagnosis of major depressive disorder (MDD) was found to range from 20 to 30% in the first few months following a terrorist attack, with high PTSD and MMD comorbidity.[6] Significant risk factors for developing mental health difficulties in adults following terrorist attacks in the USA and Kenya included those recorded as being of female gender, previous history of mental health difficulties or physical illness and severity of exposure to the attack.[7]

Greater Manchester Resilience Hub, outreach and screening

Mental health screening was introduced in the wake of the 2005 London Transport terrorist attacks, following concerns from previous major incidents on the reliance of usual care pathways in identifying those affected. Brewin et al showed that a proactive programme of outreach and screening, linked to provision of evidence-based treatments, was associated with a clinically significant improvement in depression and trauma scores.[8] The Greater Manchester Resilience Hub ('the Hub')[9] was established within a few weeks of the Arena attack by four NHS trusts within Greater Manchester, including Pennine Care NHS Foundation Trust which hosted the service. Although based in Greater Manchester, the majority (80%) of those seeking help from the Hub lived outside the region.[10] After a 12-week 'watchful waiting' period (as recommended by the National Institute of Health and Care Excellence (NICE)),[11] the Hub used a proactive outreach model to engage with those

https://doi.org/10.1192/bjp.2025.10342 Published online by Cambridge University Press

impacted by the event and information about the support offered. Once registered, online screening was used to support clinical triage with a stepped-care approach (universal, targeted and specialist support).[1,10,12] Following registration, and subsequently at regular intervals, assessment of each Hub registrant's clinical need was made using validated screening measures (and clinical cut-off scores).[10,11,13] Contact with the Hub provided direct therapeutic support (including 1:1 contact, workshops and family days), psychoeducation on trauma responses, signposting to other self-help information/services and referral to other treatment providers.[1,10] An initial paper,[1] comparing those who registered early with the Hub (between 3 and 6 months post-event) with those registering later (between 6 and 12 months), found that people who registered earlier were less symptomatic and demonstrated greater improvement across a range of psychological measures. However, further research is necessary to ascertain whether the changes observed were sustained over time.

Aims

We aimed to describe the change in mental health of registrants of the Greater Manchester Resilience Hub to better understand the Hub's role in supporting people's recovery journey following the 2017 Manchester Areana Attack. Specifically, we wished to understand how time taken to seek help from this support service is associated with mental health at baseline and during follow-up. This study will replicate some of the methodology previously published,[1] and is specifically aimed at answering the following questions: Was the time taken to register with the Resilience Hub after the Arena event associated with patient-reported mental health screening outcomes? Specifically, was the time taken to register associated with change in mental health screening outcome during a follow-up since first assessment within the Hub, and does the rate of change in follow-up score differ between those who took longer to register?

In addition, we aimed to examine the impact of Hub interventions on the mental health outcomes of the adult registrants, with an assessment of the time in, and nature of, contact with the Hub.

Method

Study population

Adults (16 years and over) registering with the Resilience Hub were asked to complete online mental health screening questionnaires at baseline entry (at time of registration). This did not include the early complex cases. A portion of the most significantly physically injured and bereaved were already engaged with the Hub and receiving bespoke packages of care before the screening programme commenced. As such, they were not subjected to the additional burden of completing further measures at the start of the screening programme while remaining in hospital or in the early stages of grief. Furthermore, many of the bereaved, seriously injured and witnesses were assisting with the ongoing police investigation and direct outreach was prohibited. Anyone registering with the Hub and completing at least one screening questionnaire within the first 3 years after the attack was included in the study. Because the mental health screening measures were completed on a voluntary basis, the number of questionnaires submitted was dependent on the level of support required and time engaged with the Hub. Hub registrants were invited to complete the screening questionnaires every 3 months in the first year post-incident and then every 6 months thereafter. This enabled Hub clinicians to triage registrants for telephone assessments and plan packages of care. These ranged from guided self-help, telephone support and psychoeducation through to directly delivered, NICE-approved psychological therapies or referral to other specialist mental health support. Additionally, the Hub provided clinically facilitated peer and family support, clinical advocacy and a range of activities aimed at minimising secondary stressors (e.g. support with police investigation, criminal trial and the subsequent public enquiry). To assess timely registration with the support service, clients were grouped according to the time period post-incident within which they first registered. This time period of first registration is also the time period of each admission group's baseline mental health screening measurements. These 'admission groups' started from 3 months post-incident, with dates of the registration time periods defined as follows:

Admission group 1: 3–6 months (3- to 6-month period), 9 September 2017–20 November 2017

Admission group 2: 6–9 months (6- to 9-month period), 21 November 2017–15 February 2018

Admission group 3: 9–12 months (9- to 12-month period), 16 February 2018–10 May 2018

Admission group 4: 12–18 months (12- to 18-month period), 11 May 2018–15 October 2018

Admission group 5: 18–24 months (18- to 24-month period), 16 October 2018–10 April 2019

Admission group 6: 24–30 months (24- to 30-month period), 11 April 2019–8 October 2019

Admission group 7: 30–36 months (30- to 36-month period), 9 October 2019–9 June 2020

Admission group 8: 36+ months (36- to 42-month period), 10 June 2020–31 December 2020.

Measures

Adults completed four measures: for depression (Patient Health Questionnaire (PHQ-9)),[14] anxiety (Generalised Anxiety Disorder 7 (GAD-7)),[15] trauma symptom severity and post-traumatic stress (PTS; Trauma Screening Questionnaire (TSQ))[16] and functioning (Work and Social Adjustment Scale (WSAS)).[17] For all screening measures, a higher score indicates more severe symptomology. Demographic and event-related information was also recorded. All screening scores for each registrant were extracted with a unique anonymised client identification from the Hub's patient clinical management information system (PCMIS). In addition to screening scores, a full case note screen was carried out by mental health practitioners to extract demographic and other event-related information that was missing from the data-set. This included age at registration, gender, present at the Arena (yes/no) and a measure of the individual's exposure to physical injury (no, yes – some minor injury, yes – significant major injury). A record of previous mental health condition (yes/no) reported in case notes was also noted; this could be based on either self-reported information or clinical assessment.

Analyses

To investigate whether the mental health screening scores were associated with time to post-event registration across the eight admission groups, we compared scores during the 3-year follow-up period. For each individual mental health score we fitted a multilevel, mixed-effects linear regression model with a random intercept mixed model using the 'mixed' command in Stata (version 16.0 for Windows 11; StataCorp LLC, College Station, Texas, USA; https://www.stata.com/). The random effects intercept accounts for between versus within variation in mental health scores for each individual, by clustering responses using unique participant identification. A set of predefined fixed-effects covariates were included for each mental health score, the dependent variable in the model: (a) admission group (1–8), (b) follow-up time (in months) to each follow up mental health score and (c) mental health score

https://doi.org/10.1192/bjp.2025.10342 Published online by Cambridge University Press

recorded at baseline. These were adjusted further for a set of predefined confounders determined from the available data and identified by the study team: gender, age at registration, presence at the Arena and previous recorded mental ill health. In order to investigate whether any change in mental health score over follow-up differed among admission groups, an interaction term between follow-up time and admission group was added.

Contact time

Mental health professionals conducted structured clinical triage via initial telephone contact to determine who required a clinical service. Some callers to the Hub simply wanted advice regarding the provision of support to a family member rather than requiring direct mental health support themselves. All types of appointment and forms of contact with the Hub were recorded, in terms of the number of minutes of clinical 'contact time' involved. We examined these data to describe the intervention provided by the Hub, to explore any association with change in mental health outcomes. Appointment types were recorded as follows: assessment/triage, treatment only (NICE-approved psychological therapy), assessment and treatment, review appointment only, review and treatment and group therapy sessions/family days. Group therapy sessions included specialist group therapy, where parents were supported with managing the trauma symptoms of a family member, and family days (a clinically facilitated day-long workshop). For all appointments attended, the number of cumulative minutes was calculated and included as an explanatory variable in the mixed-effects linear regression modelling described above.

An evaluation strategy was agreed with the Manchester Health and Social Care Partnership during Hub development. This analysis supports the evaluation of that strategy using routinely collected data and, as such, ethical approval and patient consent were not sought.

Results

Demographics

Between May 2017 and August 2020, 3600 people registered with the Hub, 710 (27%) of whom were children/young people assessed using different measures and analysed in a separate study.[18] In addition, 263 did not complete any of the adult screening measures. This resulted in 2627 (72% of those registered) study participants.

We were unable to ascertain the gender of many (1545 (59%)) of the Hub participants through data records and case note screening; however, among those for whom information could be found, the majority were women (906/1082 (84%)) (Table 1). There were proportionally more men registering as time since the event increased. The age of registrants increased with longer time to register, and most frequently fell within the 20–29 years (763 (29%)) and under 20 years (651 (25%)) age groups. The mean age was 31.32 years and median age 26 years. A tenth (263 (10%)) of the population had information pertaining to previous mental health difficulties recorded in their case notes, and the majority (2335 (89%)) were known to have been present at the Arena. There was a general increase in the proportion of individuals with evidence of a pre-existing mental health condition as time to register with the Hub increased, and there was also a slight increase in the proportion of registrants categorised as having experienced 'significant major injury'. Conversely, for those registering later, there was a general decrease in the proportion of people present at the Arena.

The full regression models, including effects of covariates, are illustrated in Supplementary Table 1 available at https://doi.org/10.1192/bjp.2025.10342. Scores for depression and anxiety disorder decreased with increase in age. Gender was not significantly associated with a change in follow-up score for any of the screening measures. Individuals present at the Arena had a TSQ score that was on average 1.96 higher than those that were not. Evidence of a pre-existing mental health condition and major injury were associated with a significant increase in screening score for all outcome measures.

Admission groups

Figure 1 and Supplementary Table 2 show the eight admission groups and the change in scores as time registered with the Hub increased. Generally, as the time to register post-event increased, there was a significant increase in the mean baseline screening score for PHQ-9, GAD-7 and WSAS; however this pattern is less clear for the measure of symptoms of trauma (TSQ).

The results of the multilevel, mixed-effects regression model adjusted for time since baseline entry and the five covariates (detailed in Table 1) are shown in Table 2 (the results from the unadjusted model are shown in Supplementary Table 3). In addition, the model in Table 2 also includes an interaction effect between change in follow-up and time to register with the Hub, in order to assess whether any differential effect is present.

During follow-up the PHQ-9 screening score decreased by −0.03 (95% CI −0.05, −0.02) per month since registrants joined the Hub. Compared with those registering within the 3- to 6-month admission period, the average depression score at follow-up was greater for those registering during the periods of 6–9, 9–12, 12–18, 18–24 and 24–30 months (0.45, 0.54, 0,71, 0.27 and 0.21, respectively). All (except the 30- to 36-months admission group) indicated a slightly larger decrease in average change per month of follow-up compared with the 3- to 6-months group, suggesting that the PHQ-9 score for the former fell at a slightly greater rate. The main effect of the time to join Hub (difference between admission groups) within the interaction model indicates that those registering between 6–9 and 24–30 months post-incident had a higher baseline score on registration compared with the 3- to 6-months group.

The screening score for measuring the severity of anxiety symptoms (GAD-7) was observed to decrease significantly, by −0.05 (95% CI −0.06, −0.04) per month, following registration with the Hub. Compared with the 3- to 6-months group, the average follow-up score was higher for those joining the Hub within the first year post-incident, although not statistically significant. All admission groups indicated a slightly greater decrease in average change per month follow-up compared with the 3- to 6-month group, suggesting that the GAD-7 score of the former fell at a slightly greater rate.

There was also a significant decrease in follow-up screening score used to assess symptoms of trauma (TSQ) (−0.05 (95% CI −0.06, −0.04)). For those joining the Hub within the first year, the average follow-up score was greater than that of the 3- to 6-months group. There was a less discernible pattern in screening instrument social/work functionality (WSAS). However, once again, the follow-up score decreased significantly, by −0.05 (95% CI −0.07, −0.03), as time since registration with the Hub increased.

Contact time

There was a total of 10 909 attended clinical contacts recorded for all adult clients included in the data-set. The majority of these points of contact were for assessment/triage (6272 (57.5%)). Sessions coded as 'group therapy' (including family days) were by far the longest forms of contact with the Hub, at 285.75 min (approximately 4 h 45 min), followed by 'treatment only' appointments (48.07 min).

https://doi.org/10.1192/bjp.2025.10342 Published online by Cambridge University Press

https://doi.org/10.1192/bjp.2025.10342 Published online by Cambridge University Press

Table 1 Demographic and covariates included in analysis, by admission group of adult Hub registrants

	Admission group (time of registering with Hub post-Arena event), *n* (%)								
Registrants	3–6 months	6–9 months	9–12 months	12–18 months	18–24 months	24–30 months	30–36 months	36–42 months	Total
All Hub registrants	1735 (66.0)	282 (10.7)	188 (7.2)	135 (5.1)	123 (4.7)	85 (3.2)	57 (2.2)	22 (0.8)	2627 (100)
Gender									
Female	600 (34.6)	116 (41.1)	75 (39.9)	49 (36.3)	46 (37.4)	18 (21.2)	2 (3.5)	0 (0)	906 (34.5)
Male	103 (5.9)	27 (9.6)	13 (6.9)	9 (6.7)	13 (10.6)	10 (11.8)	1 (1.8)	0 (0)	176 (6.7)
Not known	1032 (59.5)	139 (49.3)	100 (53.2)	77 (57.0)	64 (52.0)	57 (67.1)	54 (94.7)	22 (100.0)	1545 (58.8)
Total	1735 (100.0)	282 (100.0)	188 (100.0)	135 (100.0)	123 (100.0)	85 (100.0)	57 (100.0)	22 (100.0)	2627 (100.0)
Age group (years)									
<20	442 (25.5)	60 (21.3)	59 (31.4)	35 (25.9)	26 (21.1)	21 (25.0)	8 (14.0)	0 (0)	651 (24.8)
20–29	583 (33.6)	60 (21.3)	40 (21.3)	30 (22.2)	28 (22.8)	16 (19.0)	6 (10.5)	0 (0)	763 (29.0)
30–39	244 (14.1)	51 (18.1)	27 (14.4)	14 (10.4)	15 (12.2)	20 (23.8)	2 (3.5)	1 (4.5)	374 (14.2)
40–49	342 (19.7)	81 (28.7)	42 (22.3)	37 (27.4)	31 (25.2)	15 (17.9)	3 (5.3)	1 (4.5)	552 (21.0)
50–59	113 (6.5)	22 (7.8)	13 (6.9)	12 (8.9)	20 (16.3)	12 (14.3)	3 (5.3)	0 (0)	195 (7.4)
60–75	11 (0.6)	8 (2.8)	7 (3.7)	7 (5.2)	3 (2.4)	0 (0)	0 (0)	0 (0)	36 (1.4)
Not known	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	35 (61.4)	20 (90.9)	56 (2.1)
Total	1735 (100.0)	282 (100.0)	188 (100.0)	135 (100.0)	123 (100.0)	85 (100.0)	57 (100.0)	22 (100.0)	2627 (100.0)
Previous mental health difficulties									
Yes	154 (8.9)	29 (10.3)	28 (14.9)	21 (15.6)	19 (15.4)	9 (10.6)	3 (5.3)	0 (0)	263 (10.0)
No	1197 (69.0)	221 (78.4)	121 (64.4)	101 (74.8)	91 (74.0)	63 (74.1)	18 (31.6)	1 (4.5)	1813 (69.0)
Not known	384 (22.1)	32 (11.3)	39 (20.7)	13 (9.6)	13 (10.6)	13 (15.3)	36 (63.2)	21 (95.5)	551 (21.0)
Total	1735 (100.0)	282 (100.0)	188 (100.0)	135 (100.0)	123 (100.0)	85 (100.0)	57 (100.0)	22 (100.0)	2627 (100.0)
Present at the Arena									
Yes	1656 (95.4)	248 (87.9)	167 (88.8)	105 (77.8)	80 (65.0)	58 (68.2)	19 (33.3)	2 (9.1)	2335 (88.9)
No	66 (3.8)	25 (8.9)	14 (7.4)	19 (14.1)	38 (30.9)	23 (27.1)	2 (3.5)	0 (0)	187 (7.1)
Not known	13 (0.7)	9 (3.2)	7 (3.7)	11 (8.1)	5 (4.1)	4 (4.7)	36 (63.2)	20 (90.9)	105 (4.0)
Total	1735 (100.0)	282 (100.0)	188 (100.0)	135 (100.0)	123 (100.0)	85 (100.0)	57 (100.0)	22 (100.0)	2627 (100.0)
Exposure to trauma									
Yes – significant major injury	9 (0.5)	8 (2.8)	2 (0.9)	2 (1.4)	2 (1.6)	1 (1.2)	0 (0)	0 (0)	24 (0.9)
Yes – some minor injury	16 (0.9)	15 (5.3)	7 (3.8)	4 (2.8)	1 (0.8)	2 (2.4)	0 (0)	1 (4.3)	45 (1.7)
No	1672 (96.3)	225 (79.7)	142 (75.6)	104 (76.8)	105 (85.6)	10 (11.8)	1 (1.8)	1 (4.3)	2259 (86.0)
Not known	39 (2.2)	34 (12.2)	37 (19.7)	26 (19.0)	15 (12.0)	72 (84.7)	56 (98.2)	20 (91.3)	299 (11.4)
Total	1735 (100.0)	282 (100.0)	188 (100.0)	135 (100.0)	123 (12.0)	85 (100.0)	57 (100.0)	22 (100.0)	2627 (100.0)

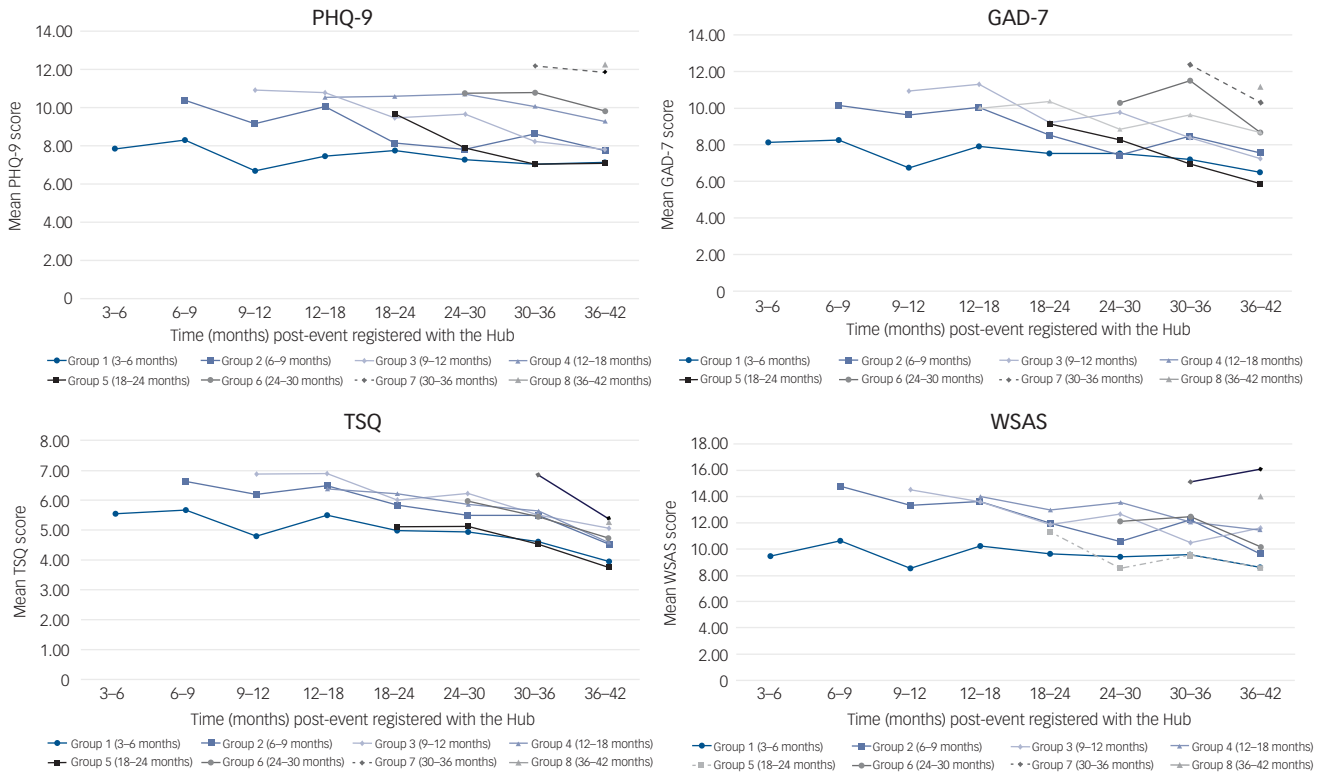

Fig. 1 Mean Patient Health Questionnaire (PHQ-9), Generalised Anxiety Disorder 7 (GAD-7), Trauma Screening Questionnaire (TSQ) and Work and Social Adjustment Scale (WSAS) score at each follow-up, by admission group.

We calculated the mean contact time per person and divided this by the number of months actively registered (time between first and last date of contact with the service). There was a gradual increase in mean contact time by admission group (Table 3). This pattern seems fairly consistent, except for the 18- to 24-months group, which had a much higher average contact time of 41.69 min per month. This group had the highest proportion (out of all appointments within each admission group) of group therapy sessions and treatment-only appointments. However, the 18- to 24-months group still had a higher average contact time (38.88 min per person) when these longer appointment types were removed from analyses. On average, the 6- to 9-months admission group had the highest mean number of appointments per person (8.58). Analysis of the number of cumulative minutes (for all appointment types) using mixed-effects, linear regression modelling showed that increased contact time with the Hub was significantly associated with a decrease in anxiety and depression scores (Supplementary Table 4). This showed that, for every additional minute of appointment attended, PHQ-9 at follow-up decreased by 0.0014 ($\beta = -0.0014$, 95% CI −0.0024, −0.0004, $P = 0.008$) and by 0.001 for GAD-7 ($\beta = -0.0010$, 95% CI −0.0019, −0.00004, $P = 0.04$). A decrease in scores was also shown for PTS and functioning measures, although this was not found to be significant.

Discussion

Summary of main findings

The majority of people accessing the Hub registered in the first 3 months of the service launch, followed by an expected fall in the numbers newly registering with each admission cycle. Overall, there was an increase in baseline screening scores as time to register with the Hub post-event increased, showing that people who had registered earlier were less symptomatic at entry. Over the 3-year follow-up there was a decrease in scores for all four screening measures, indicating an improvement in mental well-being. When compared with those who were first to register with the Hub, those who registered later had higher follow-up scores. Once registered, they showed a slightly stronger decrease in average change of score per month. This suggests that individuals who registered later were increasingly more symptomatic; however, once they engaged with the service, they showed a greater rate of symptomatic improvement/decrease in symptoms over time. The mean contact time per month increased (apart from the 18- to 24-months admission group) the later an individual registered with the Hub. This is probably a reflection of the fact that those who registered later were more symptomatic and possibly more motivated to attend. Those who registered within the 6- to 9-months admission window had the greatest number of appointments per person; however those who registered at 18–24 months had the highest proportion (of total within-group appointments) of treatment and group therapy sessions compared with other groups, which perhaps partly accounts for the increased mean contact time. Increased contact time was significantly associated with a decrease in follow-up screening measure scores (and therefore improved mental well-being) for measures of symptoms of depression and anxiety.

Discussion of results in relation to published literature

Time taken to seek support and trajectory of distress post-event

Our findings suggest that individuals who registered with the Resilience Hub earlier were less symptomatic than those who joined later. This is consistent with earlier findings from the first 12–18 months post-incident.[1] It was also observed that those who registered earlier had proportionally fewer previously reported mental health difficulties. This may be due to differences in health-seeking behaviour, and also that those with more severe mental health difficulties experience more barriers to seeking help.[19] However, it is not known whether those registering later had sought help elsewhere. Previous mental health difficulties were also

https://doi.org/10.1192/bjp.2025.10342 Published online by Cambridge University Press

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Table 2 Mixed-regression models examining association of admission group (i.e. time between Arena event and joining Resilience Hub (screening group)) with total PHQ-9, GAD-7, TSQ and WSAS scores during follow-up (months since baseline)

Admission group (time of registering with Hub post-Arena event)	PHQ-9			GAD-7		
	Adjusted	Adjusted plus interaction		Adjusted	Adjusted plus interaction	
	Coefficient (95% CI)	Coefficient (95% CI)		Coefficient (95% CI)	Coefficient (95% CI)	
Average difference in follow-up	−0.03 (−0.05, −0.02)	−0.02 (−0.04, −0.01)		−0.05 (−0.06, −0.04)	−0.03 (−0.05, −0.02)	
	Effect	Effect	Interaction	Effect	Effect	Interaction
6–9 months	0.45 (−0.22, 1.13)	0.79 (−0.03, 1.62)	−0.03 (−0.07, 0.01)	0.44 (−0.17, 1.06)	1.25 (0.50, 2.00)	−0.07 (−0.11, −0.03)
9–12 months	0.54 (−0.37, 1.45)	1.61 (0.35, 2.85)	−0.08 (−0.15, −0.02)	0.23 (−0.60, 1.05)	1.32 (0.18, 2.45)	−0.09 (−0.15, −0.03)
12–18 months	0.71 (−0.43, 1.84)	1.59 (−0.17, 3.34)	−0.07 (−0.18, 0.04)	0.42 (−0.62, 1.45)	1.46 (−0.16, 3.07)	−0.08 (−0.19, 0.02)
18–24 months	0.27 (−1.07, 1.60)	2.01 (−0.20, 4.23)	−0.17 (−0.35, 0.01)	−0.55 (−1.76, 0.66)	2.23 (0.23, 4.24)	−0.27 (−0.43, −0.11)
24–30 months	0.21 (−1.80, 2.22)	0.70 (−3.44, 4.85)	−0.05 (−0.45, 0.34)	−0.05 (−1.87, 1.87)	1.95 (−1.81, 5.71)	−0.22 (−0.58, 0.14)
30–36 months	−1.11 (−6.16, 3.95)	−7.77 (−18.44, 2.91)	1.16 (−0.48, 2.79)	−0.40 (−4.55, 3.78)	2.23 (−4.89, 9.35)	−0.55 (−1.76, 0.66)
Cons	3.01 (2.44, 3.95)		2.88 (2.30, 3.47)	3.27 (−4.54, 3.73)		3.05 (2.49, 3.60)
ICC	0.445	0.445		0.437	0.439	
Global *P*-value*		0.029			<0.001	
	TSQ			WSAS		
Average difference in follow-up	−0.05 (−0.06, −0.04)	−0.05 (−0.52, −0.04)		−0.05 (−0.07, −0.03)	−0.04 (−0.06, −0.02)	
	Effect	Effect	Interaction	Effect	Effect	Interaction
6–9 months	0.41 (0.13, 0.70)	0.51 (0.17, 0.86)	−0.01 (−0.03, 0.01)	0.39 (−0.57, 1.34)	0.86 (−0.29, 2.01)	−0.04 (−0.10, 0.01)
9–12 months	0.18 (−0.20, 0.56)	0.50 (−0.03, 1.01)	−0.02 (−0.05, 0)	−0.20 (−1.48, 1.08)	0.65 (−1.12, 2.41)	−0.07 (−0.16, 0.03)
12–18 months	0.18 (−0.30, 0.66)	1.04 (0.29, 1.78)	−0.07 (−0.11, −0.02)	−0.13 (−1.79, 1.53)	0.92 (−1.71, 3.55)	−0.08 (−0.24, 0.08)
18–24 months	−0.04 (−0.60, 0.52)	0.67 (−0.25, 1.60)	−0.07 (−0.14, 0)	−0.13 (−1.96, 1.70)	1.45 (−1.67, 4.58)	−0.13 (−0.35, 0.08)
24–30 months	−0.77 (−1.61, 0.08)	−0.94 (−2.51, 0.70)	0.02 (−0.12, 0.16)	−1.30 (−4.05, 1.45)	0.10 (−4.97, 5.18)	−0.14 (−0.57, 0.29)
30–36 months	−1.99 (−4.15, 0.17)	−2.47 (−7.03, 2.10)	0.08 (−0.62, 0.78)	−5.27 (−12.20, 1.65)	−7.26 (−21.83, 7.32)	0.34 (−1.89, 2.57)
Cons	2.12 (1.82, 2.42)		2.06 (1.76, 2.36)	3.78 (3.00, 4.55)		3.61 (2.80, 4.40)
ICC	0.447	0.448		0.481	0.481	
Global *P*-value*		0.021			0.403	

Cons, the intercept term for the model indicating the predicted value of the outcome variable when all other predictor variables are set to zero; ICC, interclass correlation coefficient: the ratio of within-subject variation to total variation, i.e. the amount of variation explained by differences in data subjects; global *p*-value for the interaction, indicates whether there was a significant improvement in the model when the interaction was included; PHQ-9, Patient Health Questionnaire 9; GAD-7, Generalised Anxiety Disorder 7; TSQ, Trauma Screening Questionnaire; WSAS, Work and Social Adjustment Scale.
Adjusted for predefined confounders: age at registration, gender, presence at the Arena, exposure and previous recorded mental ill health, interaction between admission group and time in months since entry.
*Global *P*-value for the interaction indicates whether or not there was a significant improvement in the model when the interaction was included.

Table 3 Contact time with the Hub, by type of appointment and admission group

Admission group	Mean number of months actively registered per person Mean (s.d.)	Mean contact time per person (min) Mean (s.d.)	Mean contact time per person without group therapy (min) Mean (s.d.)	Mean number of appointments per person Mean (s.d.)	Appointment type (number of appointments)						
					Assessment/ triage *n* (%)	Treatment only *n* (%)	Assessment and treatment *n* (%)	Review only *n* (%)	Review and treatment *n* (%)	Group therapy session *n* (%)	Total *n* (%)
Number of Hub registrants in admission group											
3–6 months (1735)	11.88 (13.4)	9.90 (12.9)	9.83 (12.9)	5.11 (7.2)	3109 (59.3)	33 (0.6)	68 (1.3)	1568 (29.9)	287 (5.5)	181 (3.5)	5246 (100.0)
6–9 months (282)	14.98 (16.3)	16.50 (15.9)	16.09 (14.9)	8.58 (11.3)	1127 (60.5)	24 (1.3)	23 (1.2)	541 (29.1)	75 (4.0)	72 (3.9)	1862 (100.0)
9–12 months (188)	14.54 (15.3)	16.77 (26.5)	16.81 (26.6)	7.21 (9.25)	830 (62.6)	4 (0.3)	18 (1.4)	366 (27.6)	64 (4.8)	44 (3.3)	1326 (100.0)
12–18 months (135)	12.11 (12.4)	21.93 (41.3)	18.58 (23.8)	6.06 (9.3)	405 (52.6)	8 (1.0)	25 (3.2)	238 (30.9)	48 (6.2)	46 (6.0)	770 (100.0)
18–24 months (123)	10.6 (12.5)	41.69 (65.5)	38.88 (62.4)	6.23 (8.3)	332 (46.3)	15 (2.1)	15 (2.1)	230 (32.1)	59 (8.2)	66 (9.2)	717 (100.0)
24–30 months (85)	9.71 (12.4)	23.99 (30.9)	23.99 (30.9)	6.58 (8.7)	203 (39.6)	3 (0.6)	23 (4.5)	217 (42.3)	52 (10.1)	15 (2.9)	513 (100.0)
30–36 months (57)	6.36 (8.5)	24.81 (28.1)	24.81 (28.1)	6.90 (6.45)	178 (53.8)	0 (0)	4 (1.2)	142 (42.9)	7 (2.1)	0 (0)	331 (100.0)
36–42 months (22)	7.39 (11.9)	34.30 (33.2)	34.30 (33.1)	8.00 (8.4)	88 (61.1)	1 (0.7)	0 (0)	52 (36.1)	3 (2.1)	0 (0)	144 (100.0)
All adults (2627)	12.12 (13.7)	15.33 (26.8)	14.81 (24.4)	6.02 (8.4)	6272 (57.5)	88 (0.8)	176 (1.6)	3352 (30.7)	595 (5.5)	424 (3.9)	10909 (100.0)

found to be associated with a higher average score for all screening measures. This is consistent with other research in which pre-trauma psychological ill health has been shown to be associated with distress post-trauma.[20,21] It is not known whether poorer mental health leads to later engagement with services or whether the delay in registration contributed to a decrease in mental health. Because the effects of psychological trauma may be worse if left untreated, those with greater symptom severity may register later but also experience worsening of symptoms the longer they take to seek help.[22] Research has also shown that there are five different trajectories of response post-trauma. These later registrants may be individuals that would be classified as having a delayed or worsening trajectory.[23] Our results suggest that, once these more symptomatic individuals registered, they experienced improvement in symptom scores at an increased rate compared with those who registered earlier, possibly because they had greater scope for improvement given the higher baseline measurements. The mean contact time per month also increased with the length of time taken to register, again suggesting that those registering later were more symptomatic and required more support. The results for all four screening measures showed similar patterns over the 36-month follow-up, although they were less clear regarding the measurement of psychological trauma (TSQ) and functioning (WSAS). It is possible that PTS and recovery from trauma have a different trajectory than depression, with some studies supporting hypotheses that depression onset precedes PTS whereas others suggest that PTS may be a causal risk for anxiety and depression.[24]

Engagement with Hub services

The mean length of time for which individuals were actively engaged with the Hub generally decreased over time, simply due to the fact that time available in the 'study' observation period decreases. However, this was not the case for those registering earliest. The 3- to 6-months group had on average less time actively involved in the Hub than other groups registering within the first year post-Arena incident; they also had the lowest mean number of appointments per person and the highest proportion of individuals (96%) classified as having no physical trauma. The proactive outreach model could have encouraged people to register,[8,24] but then many of these early registrants may not have wanted or needed to engage in further support beyond completing the initial screening measures.

Increased contact time was significantly associated with a decrease in symptoms of depression and anxiety, illustrating the beneficial impact of engagement with Hub services. Hub clinical staff informed us that the increase in contact time with those registering later may well be a result of service developments with time. One of the main early functions of the Hub was to refer clients on to other services. Therefore, it is possible that the Hub made more outward referrals to other services earlier on, compared with later service provision when more therapies/treatments were delivered by the Hub itself. Because the Hub aimed to be responsive to clinical need, if screening scores were mild, individuals may not have received anything more than screening, or possibly assessment and phone support. Those with more severe symptoms would have been referred on to local services for further psychological input. The mean contact time shown in those registering at 18–24 months post-event was particularly high. According to the information we have (as shown in Table 3), these individuals had a higher proportion of sessions coded as 'group therapy' and 'treatment' than other admission groups. These group therapy sessions included 'family days'. Implemented within the second year of the Hub services, these would account for a greater amount of contact time than the other appointment types. These group events aimed to bring families together with a shared experience.

https://doi.org/10.1192/bjp.2025.10342 Published online by Cambridge University Press

Interventions included psychoeducation, trauma skills, grounding techniques and family communication. It was also suggested that, for those registering earlier, the symptoms of a trauma response may have reduced after 12 months once the media intensity associated with the Arena attack had abated, therefore providing fewer triggers.[25] However, other trigger points for increased referrals occurred at other time points, including the criminal trial, the public inquiry and documentaries about the attack. Distress can be triggered by the media for many years post-trauma, with one case study describing the impact of media coverage of 50th anniversary commemorations on Second World War veterans.[26]

Strengths and limitations

The available data had limitations due to the recording and collection being primarily focused on clinical need. Because demographic information was not routinely collected, it was not possible to account for all potential confounding factors (such as ethnicity) impacting symptom severity and treatment outcomes. Mandatory capture of all demographic data at the point of outreach and screening could have reduced the number of individuals receiving support. Legal obstacles existed preventing multiple contacts with concert attendees. Incomplete demographic data collection was influenced, in part, by the small number of professionals responding to hundreds of persons screening daily, and demographic information was not mandatory in submitting mental health measures and receiving help. Information such as gender data was not prioritised over the provision of support. Adults scoring within a subclinical range may not have received more than emailed self-help information, and thus demographic data would remain incomplete. Hub registrants were invited to complete the screening questionnaires every 3 months in the first year post-incident and then every 6 months thereafter. Limited resources, and the number of potential persons in need, prevented more frequent mental health screening. It was not possible to derive individual-level data on referrals and external psychological therapies received from the Hub's clinical records system, or the impact on mental health outcomes. In addition, unlike a preplanned intervention study, we were unable to compare our data with pre-event measures or comparative control groups. This use of a 'convenience sample' (Hub registrants) meant that external validity will be low, due to potential differences in demographics of those impacted by the event and subsequently registering with the Hub. Fewer people registered with the Hub after 2 years post-incident, resulting in limited sample sizes and interpretation of the 30- to 36- and ≥36-months admission groups. Use of multilevel modelling allows for clustering around patient identification and results to be associated with within-person relationships. This allows for the fact that individuals may complete screening measures in the same way each time, but that this may be different to others. Some people registered with the Hub were not present at the Arena on the evening of the attack, but were family members of those affected. Although we have not been able to explore that element in this paper, a subsequent publication concentrating on the children and young people registered with the Hub examines aspects of shared family trauma in more detail.[18]

In conclusion, this paper indicates that registering with the Hub is associated with improvements in mental health over time following the 2017 Manchester Arena attack. Our results show that those who delay seeking care are more symptomatic, indicating the importance of encouraging those affected to engage with services as soon as possible post-incident.[17] It is encouraging, however, to note that a delay in registration does not limit the benefit of intervention. It is hoped that this paper provides further understanding of the factors impacting on psychological support outcomes, and informs mental health service provision for those impacted by traumatic events. Finally, service planning should include the collection of sufficient and robust data to facilitate research and evaluation. This will help provide a better understanding of symptom severity, treatment response and access to mental health support. However, due to the rapid establishment of services in response to urgent clinical need, such as the Resilience Hub, many constraints to data collection often exist, in particular regarding the type and location of future incidents. Planning for future events should take advantage of technological advances to improve the intake of patient demographic data, and also include the use of clinical management systems that allow sharing of information across organisational and geographical boundaries. In addition, patient triage could be assisted with an algorithmic-aided, web-based portal to score and interpret the mental health screening data. Finally, it is recommended that an 'opt-out' rather than 'opt-in' system should be considered to enable more people directly affected to be offered psychological support.

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First received 6 Dec 2024, final revision 9 Jun 2025, accepted 5 Jul 2025

Supplementary material

The supplementary material is available online at https://doi.org/10.1192/bjp.2025.10342

Data availability

Owing to the sensitive nature of the research data, these cannot be shared publicly.

Acknowledgements

The research team thank all those who have been affected in some way by the trauma of the Manchester Arena attack; and also those participants who have completed any screening questionnaires.

Author contributions

Conceptualisation/supervision: P.C. and P.F. Methodology: M.G. and L.H. Analysis: M.G. and L.H. Writing of original draft: L.H. and P.C. L.H., M.G., A.H., K.A., N.P., A.B., G.S., P.C. and P.F. contributed to the interpretation of results and writing of the article.

Funding

L.H. is supported by the National Institute for Health and Care Research (NIHR) Applied Research Collaboration–Greater Manchester (ARC-GM) (no. NIHR200174) and the NIHR Manchester Biomedical Research Centre (no. NIHR203308). P.F., A.B., K.A. and P.C. have received funding from the Greater Manchester Health and Social Care Partnership for their work with the Manchester Resilience Hub as part of its ongoing evaluation.

Declaration of interest

None.

https://doi.org/10.1192/bjp.2025.10342 Published online by Cambridge University Press

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