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Exposure to online hate speech is positively associated with post-traumatic stress disorder symptom severity

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Post-traumatic stress disorder (PTSD) after traumatic events is prevalent and can lead to negative consequences. While social media use has been associated with PTSD, little is known about the specific association of online hate speech on social media networks and PTSD, and whether such association is stronger among those with difficulties in emotion regulation, who may have a harder time coping with hate speech. In a general population sample of Jewish adults (aged 18–70) in Israel ($N=3,998$), assessed about two months after the wide-scale terror attacks of October 7, 2023, regression analysis was used to explore the association of online hate speech and self-reported PTSD symptomology. Difficulties in emotion regulation (DER) was explored as a moderator of the association. Greater frequency of hate speech was significantly associated with increased PTSD symptomology, adjusting for problematic use of technology, terror and war exposure, and prior mental health issues. The association differed significantly by DER; as difficulties increased, the association was stronger. Public health campaigns could educate about the potential harms of hate speech to help individuals make informed choices, and clinicians could discuss possible hate speech effects with patients more vulnerable to PTSD, for example, those with emotion dysregulation.

Keywords PTSD, Online hate speech, Trauma exposure, Problematic social media use, Difficulties in emotional regulation

Posttraumatic stress disorder (PTSD), a common result of trauma exposure, is prevalent worldwide, and can be severely disabling¹. Thus, it is important to understand factors that are associated with increased vulnerability to PTSD. One such factor may be social media use, as many studies have explored the role of social media use in psychological distress, including PTSD². Results suggest that specific aspects of social media use, such as problematic use or addiction and exposure to graphic depictions of traumatic events through social media are associated with psychological distress or PTSD^{3,4}. Another aspect of social media that may be associated with psychological distress is online hate speech⁵. Hate speech is often defined as hostile communication against an individual or group based on a group characteristic, such as nationality, ethnicity, or religion^{6,7}. Online forums can rapidly amplify hate speech by widening the range of exposure and removing inhibitions, as well as provide new forms such as trolling (persistent, deliberate harassment) and degrading memes⁸. Much has been written about the increasingly high prevalence of exposure to hate speech online worldwide⁹ and its potential to cause a wide range of negative consequences^{6–8} similar to the harms associated with other forms of hate speech, including psychological effects such as PTSD^{10,11}.

In general population samples, only a few studies directly assessed the association of exposure to online hate speech and psychological distress, with most studies carried out in adolescents or young adults⁸. For example, in adolescents, experiencing online hate speech was associated with more depression symptoms; this effect was mitigated by resilience factors¹². In a study of college students, online hate speech was positively associated with students' stress¹³. Yet, large-scale studies in general adult population samples assessing the contribution of online hate speech to psychological distress, specifically PTSD symptomology, are lacking.

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PTSD has also been shown to be associated with difficulties in emotion regulation^{14,15}. Emotion regulation refers to the ability to influence emotion generation and experience^{16,17}. The extended process model of emotion regulation posits that emotions can be affected by avoiding or modifying situations that generate emotions, distracting attention from the situation or emotions, cognitive reappraisal of the situation's emotional meaning, or modifying the emotional response. Within this model, there is a 4-step framework for emotion regulation: (1) *Identification* of the need for regulation; (2) *Selection* of a regulatory strategy; (3) *Implementation* of the selected strategy; and (4) *Monitoring* the implementation, to determine efficacy and what should be changed. Difficulties in emotion regulation (DER) can occur in the processes delineated above, resulting in the failure to regulate effectively or using inappropriate regulatory strategies¹⁸. Lack of regulation can lead to emotional problems, either in type, intensity, frequency, or duration. Such difficulties may influence an individual's reaction to stress and ability to deal with trauma, increasing risk for PTSD¹⁸. For example, PTSD symptoms, such as intense emotional distress, hyperarousal/persistent emotional state, or inability to express positive emotions may indicate emotional problems (overall dysregulation); intrusive distressing memories and flashbacks may limit ability to avoid or modify the situation or distract from emotion generating cues; physiological reactions may reflect problems with response modulation; and engagement in reckless behaviors may indicate selection and implementation of maladaptive regulatory strategies.

One study showed that adolescents' ability to cope with online hate was related to emotional well-being¹⁹ suggesting that those with DER may cope less well with hate speech. Hate speech may evoke stronger, unregulated emotions, as well as more intense re-experiencing of previously unprocessed emotions, among those individuals, further increasing risk for PTSD. Thus, online hate speech may show a greater association with PTSD among those with higher levels of DER. Additionally, emotion dysregulation was found to predict problematic social media use at a daily level²⁰ which could be associated with increased exposure to online hate speech, and then further contribute to psychological distress.

Exposure to traumatic events is a pre-condition for PTSD, with PTSD severity related to the type and extent of the trauma. On October 7, 2023, Israel suffered one of the most severe mass casualty terror attacks in modern history, perpetrated by Hamas-led militants, with greater than 1200 fatalities, 9000 injured and 250 hostages taken^{21,22}. Additionally, Hamas engaged in digital terror, using digital technology to quickly spread graphic images and videos to millions of people, causing widespread horror and fear^{4,23}. This exposure, which was mainly via social media, could also increase exposure to online hate speech. The terror attacks led to an ongoing war, with life-threatening situations and continuing traumatic exposures, both in real and digital life. As expected, these terror and war exposures were associated with increased post-traumatic stress symptomology and PTSD^{24–26} and emotion regulation was shown to be important for dealing with the psychological effects of the war²⁴. Thus, the Israel-Hamas war provides an opportunity to explore the unique effects of online hate speech and DER on PTSD symptoms, in the context of additional factors that may be involved in these associations, i.e., war exposures, problematic use of technology (internet, smartphone, social media) and prior mental health issues^{4,27}.

Therefore, in data from a cross-sectional, quasi-representative general population sample of Jewish adults in Israel, collected about two months after October 7th, three objectives were addressed. (1) Association of online hate speech and PTSD symptomology: we predict that increased exposure to online hate speech will be associated with increased PTSD symptom severity, even after accounting for other potentially related predictors (sociodemographic variables; exposure to the October 7th terror attacks; ongoing war exposures; problematic use of technology; and prior self-perceived mental health problems). (2) Moderation by difficulties in emotion regulation: we predict that the association between online hate speech and PTSD symptom severity will be stronger for those with greater difficulties in emotion regulation. (3) Other risk factors for PTSD: we predict that the predictors (listed above) will also be associated with PTSD severity. Providing further understanding of the risk factors for PTSD can inform prevention and intervention strategies on the population and individual level.

Methods

Sample and procedures

Data collection was described previously²⁸ and is summarized here. Cross-sectional data were collected from a general population sample of adults in Israel, November 27–December 12, 2023, as the baseline timepoint for a planned longitudinal study of the effects of October 7th and the subsequent war on mental health issues, using methodology similar to a previous epidemiological study in Israel²⁹. A quasi-representative sample of the adult (ages 18–70; mean = 41.4 years, SD = 14.8), Hebrew-speaking, Jewish population was constructed, by drawing a convenience sample from an online survey panel³⁰ utilizing quotas based on Israel Census Bureau data for 2023³¹ for age, gender, geographic area, and religiosity. Respondents were aged 18–70, since older people are less likely to participate in online surveys, and Jewish and Hebrew speaking, as different cultural groups require substantial adaptations. Invitations to participate were sent to all respondents surveyed previously²⁹ and to a random sample of other panel members. Invitation acceptances were screened against the quotas until the target numbers were met. Identifying information was not available to the researchers and the survey company did not have access to survey responses, maintaining confidentiality. Survey methodology was consistent with the ICC/ESOMAR International Code on Market and Social Research³². Electronic informed consent was provided by all participants. The Institutional Review Board of the Reichman University approved the study. All experiments were performed in accordance with the Declaration of Helsinki.

The online survey assessed sociodemographics, substance use and other addictive behaviors, psychopathology, and risk and protective factors, utilizing valid, widely used instruments. Confidential online surveys may be better for collecting sensitive information such as addictions³³. Participants received online gift cards worth 20 ILS upon finishing the survey. Quality was assured by: inviting registered individuals; excluding respondents who failed any of 4 attention checks; and removing incomplete surveys. Of those invited (17,267), 6,765 agreed,

1,318 were excluded because of quotas, and 1,445 did not finish the survey (638 failed attention checks, 807 dropped out), for a sample of 4,002.

Measures (Table 1)

Outcome: Post-traumatic stress disorder (PTSD) symptomology

The Posttraumatic Stress Disorder Checklist – DSM-5 version (PCL-5)^{34,35} was used to assess past month PTSD symptoms, due to the October 7th attacks and the ongoing war. The PCL-5 includes 20 items assessing how much respondent was bothered by PTSD-related problems (e.g., “Unwanted, recurring, and disturbing memories of the difficult experience”; “Strong negative emotions such as fear, terror, anger, guilt, and shame”), with 5 response

	<i>n</i>	Percent (%)
Gender		
Men	1981	49.5
Women	2017	50.5
Age		
18–25	756	18.9
26–34	746	18.7
35–49	1239	31
50–70	1257	31.4
Religiosity		
Secular	1742	43.6
Traditional	1264	31.6
Religious	486	12.2
Ultra-Orthodox	506	12.7
Residence Area		
Jerusalem Area	416	10.4
Tel Aviv/Center area	2028	50.7
Haifa/North	828	20.7
South	570	14.3
Yehuda & Shomron	156	3.9
Post-traumatic stress disorder ^a	1004	25.1
Hate speech on social media networks ^b	1569	39.2
Difficulties in emotion regulation ^c	36.3 (mean)	29.9 (SD)
Problematic technological behaviors		
Internet ^d	332	8.3
Smartphone ^e	1129	28.2
Social media ^f	319	8
Exposure to October 7th attacks^g		
Self	1560	39
Family	1084	27.1
Someone respondent knew	2203	55.1
Ongoing war exposure		
Direct ^h	2487	62.2
Indirect ⁱ	1820	45.5
Self-perceived mental health problems prior to October 7th		
Mood, anxiety, stress problems ^j	2043	51.1
Substance use problems ^k	813	20.3
Addictive behavior problems ^l	2081	52.1

Table 1. Sample descriptives ($N=3,998$). a score of ≥ 33 on the Post-traumatic stress disorder DSM-5 version Checklist (PCL-5)³⁵. b at least weekly. c Difficulties in Emotion Regulation Scale³⁶. d score of ≥ 50 or more on the Internet Addiction Test⁴². e score of ≥ 31 (men) or ≥ 33 (women) on the Smartphone Addiction Scale-short version (SAS-SV)³⁹. f often or very often for more than half of items from the Bergen Social Media Addiction Scale³⁷. g responded yes to at least one experience to that person. h Heard sirens or explosions, at least weekly. i Read or viewed uncensored war materials, at least weekly. j any of: depression, anxiety, PTSD, other mood disorder. k any of: alcohol, cannabis, prescription sedatives, stimulants, opioid painkillers, other illicit drugs. l any of: pornography, compulsive sexual behavior, electronic gaming, gambling, social media, smartphone, internet.

options: (0) not at all; (1) a little bit (2) moderately; (3) quite a bit; (4) extremely. Cronbach's alpha was 0.96, and items were summed for an overall score (range: 0–80).

Main predictor: online hate speech

Respondents were asked how often they experienced hate speech on social media networks since the start of the war, with a Likert scale of the following responses: 1 (not at all); (2) once/twice; (3) a few times; (4) each week; 5) few times a week; 6) (almost) every day; (7) (several times a day).

Moderator: difficulties in emotion regulation

The 18-item Difficulties in Emotion Regulation Scale (DERS-18³⁶) was used. Respondents rated how often statements about emotion regulation were true about them (e.g., "I have no idea how I feel"; "When I am upset, it is hard for me to concentrate on other things"), with 5 response options: (1) almost never; (2) sometimes; (3) about half the time; (4) most of the time; (5) almost always. Cronbach's alpha was 0.91, and an overall score was calculated by summing all 18 items (range: 18–90), with higher scores indicating greater emotion dysregulation.

Other predictors

Problematic technological behaviors

Problematic social media use was assessed using the Bergen Social Media Addiction Scale (BSMAS)^{37,38} with 6 items assessing frequency of social media behaviors in the past 12 months (e.g., "You felt the urge to use social media more and more"; "You used social media to forget about your problems"), from (1) very rarely to (5) very often. Cronbach's alpha was 0.91, and items were summed for an overall score (range: 6–30). Problematic smartphone use was assessed using the Smartphone Addiction Scale, short version (SAS-SV)^{39,40} with 10 items assessing degree of agreement with statements about current smartphone use (e.g., "I feel impatient and anxious when I don't have my smartphone with me"; "I cannot bear the thought of not having a smartphone at my disposal"), with 6 response options, from very strongly disagree (1) to very strongly agree (6). Cronbach's alpha was 0.91, and items were summed for an overall score (range: 10–60). Problematic internet use was assessed using the Internet Addiction Test (IAT)^{41,42} with 20 items assessing frequency of internet use behaviors in the past month (e.g., "How often do you find yourself online more than you intended?"; "How often do you block troubling thoughts about your life with calming thoughts about the internet?"), from (0) not relevant to (5) always. Cronbach's alpha was 0.95, and items were summed for an overall score (range: 0–100).

Exposure to terror and war

Four items asked about exposure to the October 7th attacks: (1) being in an attacked area in the South; (2) exposure during duty in the security forces or emergency services; (3) being somewhere with widespread missile attacks; (4) severe injury or death due to the events. Three response options assessed whom exposure happened to: (1) respondent; (2) a close family member; or (3) someone respondent knew; it was possible to choose more than one response. Three scores were calculated (for respondent, close family, and friend) as a sum of the four items (1 = happened; 0 = didn't happen, range 0–4), which were summed to a total October 7th exposure score (range 0–12).

Two items assessed direct war exposure, since October 7th, based on frequency of: (1) alarms, due to rocket or missile attacks, terrorist infiltration, or hostile aircraft infiltration; and (2) hearing explosions. Two items assessed indirect war exposure, based on frequency of (1) reading and (2) viewing uncensored materials about the October 7th attacks or the ongoing war. Uncensored materials would most likely have been accessed via online platforms, as most offline sources would be subject to censorship. For each war exposure measure, responses were on a 7 point Likert scale ranging from 1 (not at all) to 7 (several times a day), and both items were summed to form a composite measure (range, 2–14).

Self-perceived mental health problems prior to October 7th

Respondents were asked if before October 7th, they had mental health problems in three categories. First, they were asked about (1) depression; (2) anxiety; (3) PTSD; and (4) other mood disorders; a positive response to any one was considered "yes" for mood, anxiety, or stress problems. Second, they were asked about problems with use of (1) alcohol; (2) cannabis; (3) prescription sedatives; (4) stimulants; (5) opioid painkillers; and (6) other illicit drugs; a positive response to any one was considered "yes" for substance use problems. Third, they were asked about problems with engagement in (1) gambling; (2) electronic gaming; (3) pornography; (4) compulsive sexual behaviors; (5) smartphone; (6) social media; (7) and internet; a positive response to any one was considered "yes" for addictive behaviors problems.

Sociodemographics included age, gender, religiosity, and area of residence.

Statistical analysis

Four respondents answered "other" for gender and were excluded from the analysis, for an analytical sample of 3,998. Sample descriptives were calculated. Cronbach's alpha was estimated for score variables.

Linear regression analysis was carried out using the *process* package in R⁴³. In primary analyses, the association of hate speech with PTSD symptomology (PCL-5 score) was estimated in a series of models, each adding more adjustments (Table 2), to distill the unique contribution of hate speech, after accounting for potential confounders or mediators. Since the goal in each model was to test significance of one predictor (hate speech), $p < 0.05$ was considered significant, as indicated by 95% confidence interval (CI) not overlapping with 0. To test if the association of hate speech and PCL-5 score was moderated by difficulties in emotion regulation, an interaction term for hate speech by DERS-18 score was added to the regression models, and the

	Main effects model					Moderation model				
	Overall model		Hate speech			Overall model		Interaction of hate speech and difficulties in emotional regulation		
	R ²	F	Regression coefficient	95% CI	R ²	F	F	p-value	Regression coefficient	95% CI
1. Unadjusted	0.2	707.9 ^c	6.78	6.28, 7.28						
Adjusted for:										
2. Difficulties in emotional regulation	0.3	898.5 ^c	5.33	4.87, 5.79	0.3	602.3 ^c	8	0.0081	0.59	0.13, 1.02
3. And sociodemographic variables ^d	0.4	381.8 ^c	5.32	4.87, 5.77	0.4	328.6 ^c	6	0.0132	0.53	0.11, 0.94
4. And problematic technological behaviors ^e	0.4	339.8 ^c	3.51	3.06, 3.97	0.4	306.9 ^c	7	0.0099	0.52	0.12, 0.91
5. And exposure to terror and war ^f	0.5	291.7 ^c	2.27	1.76, 2.78	0.5	270.0 ^c	6	0.0164	0.47	0.09, 0.85
6. And previous mental health problems ^g	0.5	254.6 ^c	2.19	1.69, 2.69	0.5	239.3 ^c	6	0.0148	0.47	0.09, 0.84

Table 2. Models of association of hate speech and PTSD symptomology^a, with moderation by difficulties in emotion regulation^b. CI = confidence interval. Continuous predictors (except age) were standardized before analysis. a Posttraumatic Stress Disorder Checklist – DSM-5 version^{34,35}. b Difficulties in Emotion Regulation Scale³⁶. c p-value ≤ 0.0001 . d age, gender, religiosity, area of residence. e problematic use of internet (Internet Addiction Test⁴¹, smartphone (Smartphone Addiction Scale, Short version³⁹, social media (Bergen Social Media Addiction Scale³⁷. f exposure to October 7th attacks, ongoing exposure to war: direct (sirens, explosions) or indirect (reading or viewing uncensored materials). g prior to October 7th, self-perceived problems with: anxiety, depression, PTSD, other mood disorder; substances (alcohol, cannabis, prescription sedatives, stimulants, opioid painkillers, other illicit drugs); addictive behaviors (pornography, compulsive sexual behavior, electronic gaming, gambling, social media, smartphone, internet).

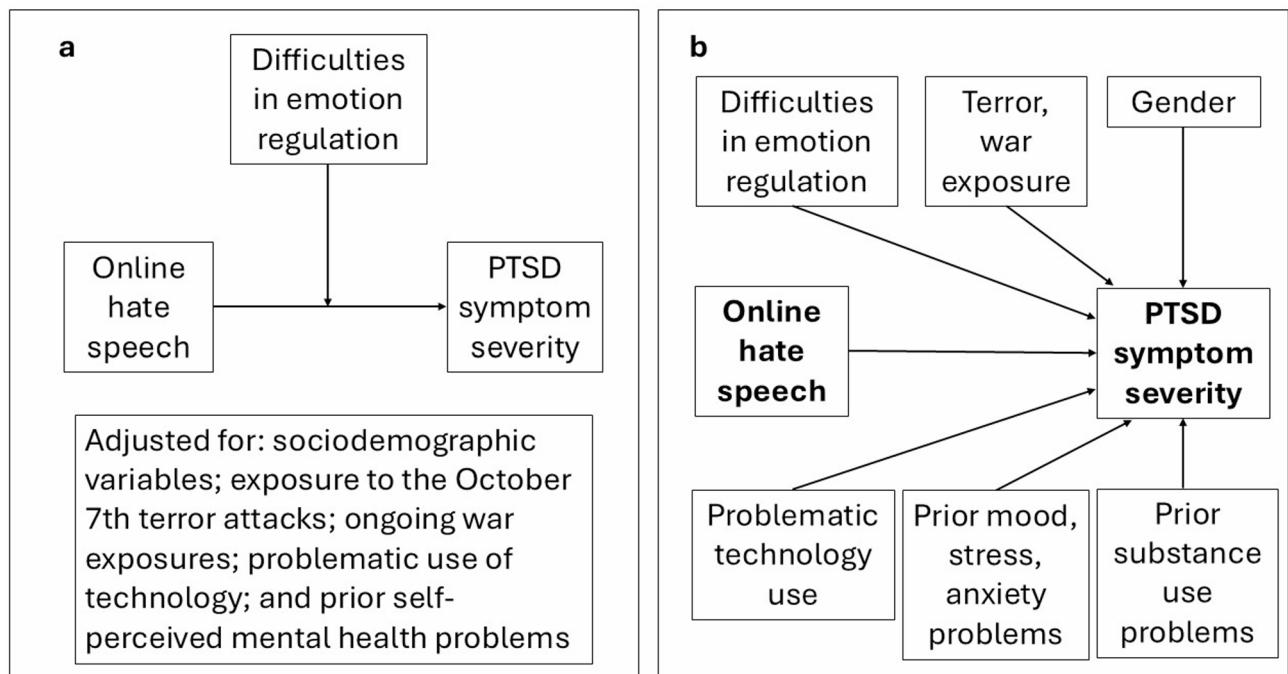


Fig. 1. Conceptual Diagrams of association models. (a) Moderation of the association of online hate speech with PTSD symptom severity by difficulties in emotion regulation. (b) Association of online hate speech and other predictor variables with PTSD symptom severity

magnitude of the association was estimated for three levels of DERS-18 score: low (16th percentile), middle (50th percentile), and high (84th percentile) (Fig. 1a). As the goal in each model was to test significance of one predictor (interaction of hate speech and DER), $p < 0.05$ was considered significant, as indicated by 95% CI not overlapping with 0. In secondary analysis, other potential predictors of PTSD included in the final main effects model (besides online hate speech) were evaluated for association: Sociodemographic variables, DERS-18 score, problematic technology behaviors (BSMAS, SAS-SV, and IAT scores), exposure to October 7th attacks, war exposure, and self-perceived mental health problems prior to October 7th (Fig. 1b). Since that model included 15 predictors, the Bonferroni correction was applied, with significance at $p < 0.05/15 = 0.0033$. Count predictors (except age) were standardized before regression analysis. Multicollinearity was assessed by calculating the

Variance Inflation Factor (VIF) for each predictor, using the `vif` function from the `car` package in R⁴⁴; all VIF were < 3 , indicating no concern about multicollinearity. To ensure that results were robust to possible violations of regression assumptions, permutation tests for the regression parameters were done for the final main effects and moderation models, using the `lmpperm` function from the `permuco` package in R⁴⁵.

Results

Sample descriptives (Table 1)

Of the sample, about half were women, lived in the Tel Aviv/Central region; and about 40% were aged 18–34, secular, finished high school. High PTSD symptom scores, indicating possible PTSD, was found in 25% of the sample, and 39% reported at least weekly exposure to hate speech on social media networks. Of the sample, prevalence of problematic technology use was 8% for social media and internet and 28% for smartphone; 39% reported at least one self-exposure to the October 7th attacks; and at least weekly war exposure was 62% for direct and 46% for indirect. Self-report of perceived mental health problems was 51% for mood, anxiety, or stress disorders; 20% for substances; and 53% for addictive behaviors.

Objective 1: association of hate speech and PTSD

Higher frequency of hate speech on social media networks was associated with increased average PTSD scores (Table 2). To distill out the unique association of hate speech with PTSD symptomology, after accounting for other variables (e.g., confounders or potential mediators), additional predictors were added sequentially. The magnitude of association was reduced but remained significant ($p < 0.0001$). For example, the unadjusted regression coefficient was 6.8, and decreased to 5.3 after including DERS-18 in the model; 3.5 after including problematic technology use; and 2.3 after including terror/war exposure. In the final model, a one standard deviation increase in hate speech exposure was associated with a 2.2 ($p < 0.0001$) point increase in average PTSD score, adjusting for sociodemographic variables, difficulties in emotional regulation, terror and war exposures, problematic technological behaviors, and perceived mental health problems prior to October 7th.

Objective 2: moderation by difficulties in emotion regulation

In all models, the association of hate speech and PTSD score differed by difficulties in emotion regulation (Table 2; p -values for interaction term all < 0.05); as DERS-18 increased, the magnitude of association increased (Table 3).

Objective 3: association of other factors with PTSD

Additionally, most of the predictors were associated with increased PTSD scores (Table 4). In the fully adjusted main effects model, women, on average, showed higher PTSD scores than men (6.5, $p < 0.0001$). Increased PTSD scores were associated with a one standard deviation increase in problematic technological behaviors scores (social media [2.4, $p < 0.0001$]; smartphone [1.8, $p < 0.0001$]; and internet [1.1, $p = 0.0007$]), terror/war exposure (October 7th attacks [1.6, $p < 0.0001$]; direct exposure [2.0, $p < 0.0001$]; and indirect exposure [1.3, $p < 0.0001$]), and difficulties in emotion regulation (4.0, $p < 0.0001$). Higher average PTSD scores were also observed among those with self-reported perceived problems with mood, anxiety, or stress (4.0, $p < 0.0001$) and substances (3.5, $p < 0.0001$). The permutation tests showed that all significant effects remained, confirming that results were robust to assumption violations.

Discussion

Data from a large, quasi-representative cross-sectional sample of adult Jews in Israel provide a unique opportunity to examine the role of hate speech over social media networks in PTSD symptomology, in the context of a mass casualty terror attack and ongoing war. Higher frequency of exposure to online hate speech was associated with increased PTSD symptomology, independent of other key correlates of PTSD: gender; difficulties in emotional regulation; problematic technological behaviors; terror and war exposure; and pre-existing problems with mental health. Additionally, those with higher levels of difficulties in emotional regulation showed stronger association between online hate speech and PTSD symptoms.

As predicted in Objective 1, higher frequency of online hate speech exposure was associated with greater PTSD severity. While no previous study assessed the association of online hate speech specifically with PTSD, these results provide additional evidence for the role of hate speech in psychological distress, similar to previous studies^{8,9,11–13}. Online hate speech can exacerbate effects of traumatic events, or may itself be considered a form of trauma¹⁰. While studies have considered the digital spread of graphic media as a form of terror^{4,23} in this study, online hate speech showed an effect above and beyond exposure to uncensored media (likely to have occurred online). These results suggest that hate speech could also be considered an important aspect of digital terror.

	Regression coefficient	95% confidence interval
Low DERS-18 (16th percentile)	1.74	1.12, 2.36
Mid DERS-18 (50th percentile)	2.09	1.59, 2.60
High DERS-18 (84th percentile)	2.68	2.05, 3.32

Table 3. Association of hate speech and PTSD symptomology by difficulties in emotion regulation (DERS-18) levels. DERS-18 = Difficulties in emotional regulation scales, 18 items. Model adjusted for sociodemographics, problematic use of technology, exposure to terror and war, and prior self-perceived mental health problems.

	Regression coefficient	95% confidence interval	p-value
Hate speech	2.19	1.69, 2.69	< 0.0001
Sociodemographics			
Age	0.04	0.01, 0.07	0.006
Gender	6.48	5.68, 7.28	< 0.0001
Area of residence	-0.12	-0.37, 0.14	0.377
Religiosity	-0.32	-0.73, 0.09	0.121
Problematic technological behaviors			
Social media use ^a	2.36	1.71, 3.01	< 0.0001
Smartphone use ^b	1.81	1.18, 2.45	< 0.0001
Internet use ^c	1.09	0.46, 1.72	7E-04
Exposure to terror/war			
Exposure to October 7th attacks	1.59	1.17, 2.01	< 0.0001
Ongoing direct war exposure	1.95	1.53, 2.38	< 0.0001
Ongoing indirect war exposure	1.34	0.83, 1.84	< 0.0001
Difficulties in emotion regulation ^d	3.95	3.48, 4.42	
Self-perceived mental health problems			
Mood, anxiety, stress problems ^e	3.96	3.11, 4.81	< 0.0001
Substance use problems ^f	3.54	2.47, 4.61	< 0.0001
Addictive behavior problems ^g	0.74	-0.16, 1.64	0.107

Table 4. Predictors of post-traumatic stress disorder symptomology, final main effects model. Continuous predictors (except age) were standardized before analysis. Associations are considered significant at the $p < 0.0033$ level, due to correction for multiple testing. a Bergen social media addiction scale³⁷. b Smartphone Addiction scale, short version³⁹. c Internet Addiction Test⁴¹. d Difficulties in Emotional Regulation-18³⁶. e prior to October 7th, self-perceived problems with: anxiety, depression, PTSD, other mood disorder. f prior to October 7th, self-perceived problems with: alcohol, cannabis, prescription sedatives, stimulants, opioid painkillers, other illicit drugs. g prior to October 7th, self-perceived problems with: pornography, compulsive sexual behavior, electronic gaming, gambling, social media, smartphone, internet.

As predicted in Objective 2, the association of hate speech and PTSD was stronger for those with difficulties in emotion regulation. Difficulties in emotion regulation was associated with PTSD symptomology, as found in many previous studies^{14,15,18} with emotion dysregulation related to the development, maintenance, and severity of PTSD, possibly because of difficulties in dealing with the strong emotions raised by the trauma and distress^{14,46}. The emotional effects of hate speech could be exacerbated among those with difficulties in regulation, increasing risk of PTSD symptoms, similar to previous studies showing similar effects among those exposed to other forms of trauma or stress¹⁴. Furthermore, those with maladaptive emotion regulation strategies, who use addictive behaviors such as problematic social media to cope with stress and manage negative emotions^{47,48} may be at increased risk for PTSD. The social media use could increase distress, through exposure to graphic media and online hate speech, which could be related to increased risk for PTSD.

While it makes sense to consider that exposure to hate speech, especially for someone with a harder time regulating emotions, could bring up bad feelings and memories, and be associated with greater PTSD severity, this cross-sectional study cannot determine directionality. Alternatively, those with PTSD, especially with emotion dysregulation, might be at increased risk for hate speech exposure due to increased risk for problematic social media use^{14,16,42} might be more likely to consider online material as hateful, or might react more negatively to this kind of material. Furthermore, there may also be positive ways to cope with stress via social media, which can provide connection and support. Lastly, results showing that the magnitude of association between hate speech and PTSD severity got weaker with inclusion of additional predictors, e.g., problematic technology use, and terror/war exposure, suggest that these could be mediating the effect of hate speech. Longitudinal studies should further explore the potentially complex interactions between social media use, online hate speech, trauma exposure, emotion regulation, and PTSD.

In line with Objective 3, other factors were uniquely associated with PTSD as well. Similar to many previous studies worldwide and in Israel, for example, women showed higher PTSD scores^{49,50}; problematic technology use and exposure to uncensored media (mostly via social media) were also associated with more severe PTSD symptomology^{3,4,27,51–58}. Problematic technology use may lead to re-exposure to the traumatic event and increase exposure to ongoing stress, worsening mental health^{28,59}. Further studies should identify how these and additional aspects of technology use work together with online hate speech exposure to negatively impact well-being, so individuals can make informed choices about their behaviors. As expected, terror and war exposures were associated with increased PTSD symptomology. The association of indirect exposure (uncensored war media) suggests re-assessment of the criterion that excludes exposure through media as a traumatic event which may be able to lead to PTSD, similar to previous studies^{58,60}. Furthermore, ongoing stressors should be accounted for in PTSD risk, as suggested previously^{61,62}. Last, previous problems with mental health issues, such as mood and stress-related disorders, are known to increase risk for current PTSD^{4,27} and PTSD and

substance use problems are known to be associated^{63,64}. Using substances to cope with trauma and stress may lead to negative, self-reinforcing spirals, culminating in increased mental health disorders^{28,65–67}. Future studies should take these and other factors into account, using machine learning to more fully understand the complex relationships underlying vulnerability to PTSD.

Several possible implications of this study are discussed. Due to its ubiquitous and potentially damaging nature, online hate speech may be an important societal and public health issue^{5,6} akin to more general hate crimes and cyberbullying. Thus, hate speech may benefit from population wide interventions¹¹ similar to overall problematic internet or social media use⁶⁸.

Public health approaches take into account three aspects of risk: the agent (online hate speech), the environment (society), and the host (individual)⁶⁸. Many studies have used machine learning to identify online hate speech⁵ and other studies explored the dynamics of perpetration, i.e., who, when, and why⁶ both of which are important for development of artificial intelligence and education methods to monitor and prevent hate speech¹¹. On the societal level, due to the global reach of digital information, public health policies could be similar to the World Health Organization's global monitoring system on alcohol, which recommends a standardized list of evidence-based policies worldwide¹¹. Policies could be developed for regulating hate speech exposure, especially to protect vulnerable populations (children, minority groups); providing warnings; and education about possible negative effects of such exposure and how to reduce the impact²³. On the individual level, those with difficulties in emotion regulation may be at increased risk for harms related to hate speech exposure. Clinicians who are aware of these risks could discuss this vulnerability with patients. Most importantly, informing people of potential harms could help them become more responsible consumers. People may choose to be exposed to hate speech online while engaged in activities that are important to them, such as ensuring that others are aware of what they are going through. Yet, people could be made aware that reducing exposure to all forms of digital terror may be protective for their health⁴.

Study limitations are noted. First, although the direction modeled is logical, regression analysis of cross-sectional data cannot determine the directionality of the associations, which may be reciprocal. Longitudinal studies are needed to better understand the possibly complex temporal and causal relationship of online hate speech with PTSD. Second, these data were collected during ongoing war trauma, quite close to the mass terror event; associations may differ over time or in other populations with less trauma exposure. Third, a range of risk factors for PTSD were included in the model, but there may be other important measures that should be included for a more complete picture. Fourth, there may have been selection bias, as only those able to participate in the online survey could participate, but quotas were used to collect a quasi-representative sample of the adult, Jewish, Hebrew-speaking population of Israel. The sample was not representative of population sectors that would need methodological adaptations, e.g., those with cultural differences or less likely to complete online surveys. Additional studies in more diverse samples should confirm and build on these results. Fifth, while validated screening tools were used for PTSD symptomology and technology addiction, in-house measures were used for trauma exposures and perception of prior mental health issues. Specifically, a single item was used to assess frequency of hate speech (via social media), which is useful for initial assessment, but limited. Future studies should investigate more details, e.g., what is being targeted (respondent, community, country), why they are being targeted, the context of the hate speech, and which platforms they are on, to better define and validate a hate speech construct. Last, the distribution of most of the study variables differed by gender or age (Supplementary Tables 1 and 2); further studies should explore if the relationship between online hate speech exposure and PTSD differs by age or gender.

In conclusion, this study adds novel information about the potential role of online hate speech in PTSD vulnerability, in the context of other key PTSD risk factors. Results may have implications for public health, suggesting that policies could be developed to reduce the exposure to and impact of online hate speech on the societal and individual levels. It could be helpful for individuals exposed to traumatic events to be aware of the potential for hate speech to exacerbate their distress, especially if they have difficulties in emotion regulation. Clinicians seeing patients with vulnerability to psychopathology could discuss their social media use, specifically their reactions to online hate speech, and assist development of adaptive emotion regulation strategies. Ultimately, further understanding of the complex risks for PTSD can help the development of more precise prevention and intervention strategies.

Data availability

The datasets analysed during the current study are available from the corresponding author on reasonable request.

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Author contributions

D.S. came up with the idea for the study, was responsible for the statistical analysis and wrote the manuscript text, and prepared the tables and figure. M.D.L helped with the methodology and interpretation of results. V.S. and M.V. were responsible for data curation. M.M. helped with interpretation of results. All authors reviewed the manuscript.

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Declarations

Competing interests

The authors declare no competing interests.

Additional information

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