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- המאמרים המתפרסמים בכתב העת המדעי "הרפואה הצבאית" הם שפיטים. מאמרים אלה רואים אור בתום תהליך סקירת עמיתים (peer review).
- "הרפואה הצבאית" הוא כתב עת רבעוני. בכל שנה מתפרסמים בקביעות ארבעה גליונות של העיתון.
- הקוראים מוזמנים לכתוב למערכת ולהגיב בנוגע לפרסומים. מערכת העיתון תשקול לפרסם את המכתבים בגיליונות הבאים. כתב העת "הרפואה הצבאית" יוצא לאור בחסות מדעית משותפת של ההסתדרות הרפואית בישראל (הר"י) וחיל הרפואה. עם זאת, מחברי המאמרים המתפרסמים בכתב העת הם הנושאים באחריות לתוכן מאמריהם.

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These outcomes illustrate how structured preventive measures directly contribute to operational readiness. Notably, combat-designated soldiers who underwent this intervention experienced substantially fewer dental emergencies than their untreated counterparts, validating the importance of early dental risk identification and treatment.

This study reinforces that preemptive care is not only medically sound but strategically essential. Future military planning should institutionalize such care for all deployable units, integrating it as a fundamental component of personnel readiness programs.

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These results illustrate a nearly twofold reduction in emergency dental care needs among enlisted and career soldiers compared to reservists. Notably, even within combat-designated personnel, those who underwent preemptive care experienced significantly fewer emergencies. The internal consistency of lower emergency appointment rates within the low-risk group vs. the high-risk one further validates the predictive strength of the IDFMC's dental classification and intervention model.

This stratification and comparative analysis highlight the benefits of proactive dental care for force readiness, with emergency dental interventions halved in populations that received structured preventive dental care.

Discussion

This study confirms the protective effect of systematic, early dental interventions. Emergency dental needs were significantly lower in the population that received early care. Even within high-risk individuals, proactive treatment resulted in lower emergency rates compared to the untreated reservist group.

Reservists utilized a disproportionately high share of emergency dental services. Their lack of pre-deployment care illustrates the critical role that preventive health infrastructure plays in force readiness. Delays or gaps in oral care can translate into preventable logistical burdens and compromised operations.

A key feature of the IDFMC model is its automation. Once classified, soldiers' dental data follow them across clinics, ensuring continuity without the need for re-evaluation by each practitioner. This system-wide standardization not only streamlines operations but also supports research and policy making.

Several limitations should be acknowledged. First, the reservist population is inherently heterogeneous, and data on time since discharge from regular service were unavailable. Consequently, some reservists may have completed their compulsory service recently, while others may have had prolonged intervals without structured military dental care. This heterogeneity may partially contribute to the observed differences in emergency dental utilization. Future studies incorporating time since discharge and age stratification would further refine the assessment of this effect.

Another consideration is the potential influence of healthcare utilization behavior. Upon mobilization, reservists gain renewed access to military dental services, which may lower barriers to seeking care and increase presentation rates to emergency dental clinics, including for conditions that might not strictly constitute acute emergencies. This utilization effect may partially contribute to the higher emergency appointment rates observed among reservists.

The current analysis lacks detailed categorization regarding the specific clinical reasons for emergency dental visits. While appointments were classified as emergency encounters, the dataset did not uniformly distinguish between acute conditions such as severe pain, infection, or trauma and less urgent presentations. Future studies incorporating standardized diagnostic categorization of emergency encounters would allow for a more nuanced assessment of emergency dental care utilization.

An additional consideration is the ability to distinguish between the effects of preemptive dental intervention and individual characteristics related to dental health. Individuals classified as low-risk may reflect behavioral or lifestyle factors associated with better oral health and lower use of emergency dental care, independent of the preemptive treatment itself. The influence of such individual factors cannot be entirely excluded, and part of the observed reduction in emergency visits may therefore be unrelated to the intervention's direct effect. Future studies comparing dental morbidity before and after preemptive care would allow a clearer assessment of the contribution of preemptive dental treatment.

Conclusion

The Israeli military's proactive dental care system offers a replicable model for armed forces worldwide. The nearly 50% reduction in emergency dental visits among those treated in advance underscores the effectiveness of preventive health strategies in mission-critical environments.

At its core, the intervention aligns three critical objectives: providing systematic proactive dental care, achieving improved combat readiness, and securing a 50% reduction in emergency dental needs.

- **Reservists**: 10.6% required emergency dental care.
- **Enlisted and Career Soldiers**: 5.4% ($p < 0.05$).

Among combat-designated personnel:

- **Combat-Designated Reservists**: 7.1%
- **Combat-Designated Enlisted Soldiers**: 4.8% ($p < 0.05$).

Additionally, when stratified by preemptive care risk assessment:

- **Low-Risk Individuals (Preemptive Care)**: 4.7% required emergency appointments.
- **High-Risk Individuals (Preemptive Care)**: 5.6% ($p < 0.05$).

Figure 1 - Emergency Dental Care Rates by Group - Flowchart showing emergency dental appointment rates among 80,991 IDF soldiers. Reservists without preemptive care had higher rates than enlisted soldiers with preventive treatment, both overall and within combat-designated subgroups.

nearly 24% of all non-battle injury medical evacuations. Affected soldiers were absent from their units for an average of 10.5 days, highlighting the operational cost of untreated dental issues. Chaffin et al. (2024) found that dental emergencies still accounted for a large proportion of non-battle injuries requiring medical care at field facilities. Simecek (2008) emphasized that many of these emergencies stem from preexisting, untreated dental conditions that could have been addressed earlier. In total, these findings underscore that despite improvements in care, untreated dental disease remains a persistent vulnerability in military health systems.

A compelling body of work now supports the efficacy of prevention-focused care during recruit training. Simecek et al. (2021) demonstrated that providing comprehensive dental treatment during basic training significantly reduced the incidence of emergency visits later in service. Recruits who received full dental treatment experienced fewer urgent care visits than those with deferred or incomplete care. This aligns with earlier studies (Simecek & Colthirst, 2020; 2025), which identified specific risk indicators, such as caries burden and untreated pulp involvement, that predicted future emergencies. These insights have informed the development of risk-based classification and targeted prevention models in military dental services.

In contrast to civilian health organizations, the Israel Defense Forces Medical Corps (IDFMC) provides free, comprehensive dental care with a proactive approach. Military service is mandatory for all Israeli citizens (unless exempted for medical or other reasons), and those designated for combat roles receive dental screening and treatment shortly after enlistment. The IDFMC employs a dental classification system to triage care based on risk and ensure dental fitness before deployment.

The 2023 Iron Swords War provided an unplanned, natural experimental setting. Following the October 7 attack, over 300,000 reservists were mobilized, many of whom had not received preemptive dental intervention. Their emergency dental care rates could thus be compared with those of a control group of enlisted and career soldiers.

Methods

This retrospective observational study uses electronic health records from the IDFMC to compare emergency dental treatment rates between a study group and a control group from January 1 to November 11, 2024. The study group included reservists mobilized during the 2023 Iron Swords War who had not received preemptive dental care. The control group consisted of enlisted and career soldiers who had received systematic, risk-based preventive care under the IDFMC program. This natural division, arising from the unplanned mass mobilization of reservists, enabled a direct comparison of emergency dental outcomes between those with and without access to pre-deployment care.

Soldiers were categorized into the IDFMC's four risk categories, which are similar to those of other military systems, such as NATO (see Groves, 2008). The IDFMC classifies soldiers using the following categories:

- **Category 1**: No caries, minimal oral hygiene needs.
- Category 2: Up to 5 caries lesions, none deeper than 50% of dentin.
- **Category 3**: 6-10 caries, any lesion affecting more than 50% of dentin, teeth undergoing root canal treatments up to coronal build-up, severe periodontal disease.
- **Category 4**: >10 caries, any lesion impinging on the dental pulp, teeth in need of root canal treatment, hopeless teeth to be extracted, third molars to be extracted.

Categories 1-2 were designated low risk; 3-4, high risk.

Data were drawn from the IDFMC centralized electronic dental record system. Automated classification of risk categories based on treatment plans ensured consistency. A total of 80,991 individual records and 420,109 treatments were examined.

Emergency dental appointment frequencies were analyzed using descriptive statistics. T-tests and Fisher's exact test were used to determine statistical significance ($p < 0.05$).

3. Results

The findings showed a statistically significant difference in emergency dental care utilization across different service populations (see Figure 1):

The Impact of Preemptive Dental Care on Emergency Dental Needs During Military Deployment: Evidence from the 2023 Iron Swords War

Abstract

Background: Dental emergencies present significant operational challenges in military settings, where access to care is limited, and disruptions compromise combat readiness. The Israel Defense Forces Medical Corps (IDFMC) offers a unique model of preemptive dental care for combat-designated soldiers. This study examines the efficacy of this model during the 2023 Iron Swords War, a conflict characterized by the rapid mobilization of reservists without prior dental screening.

Methods: We conducted a retrospective comparative study analyzing 80,991 dental records and 420,109 treatments performed between January 1 and November 11, 2024. Emergency dental appointment rates among mobilized reservists (without preemptive care) were compared to those of enlisted and career soldiers, with access to IDFMC's proactive dental intervention. Risk-based stratification and emergency rates within each category were also analyzed.

Results: Emergency dental appointments were required in 10.6% of reservists versus 5.4% of enlisted and career soldiers ($p < 0.05$). Among combat-designated soldiers, 7.1% of reservists required emergency dental care compared to 4.8% of enlisted soldiers ($p < 0.05$). Within the proactive care group, 4.7% of low-risk and 5.6% of high-risk individuals required emergency appointments ($p < 0.05$).

Conclusion: The preemptive dental care model significantly reduced emergency dental needs, improved combat readiness, and validated the value of systematic, risk-based interventions in military health systems.

Keywords: Preemptive, Military, Readiness, Dental, Prevention.

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Introduction

Dental readiness is essential to overall military preparedness. Studies across multiple nations have documented that dental emergencies are common among deployed troops and can have significant operational consequences. A landmark analysis by Mahoney and Coombs (2000) reported emergency rates of 150–200 per 1,000 soldiers annually, and similar findings have been echoed in later U.S. Army reviews (Chaffin & Moss, 2008). Such emergencies often result in lost duty time, evacuation from the theater, and interruptions in unit effectiveness.

More recent evaluations have continued to show elevated rates of dental emergencies in military settings. Gunepin et al. (2015) reported that 15.7% of medical evacuations during French military operations were due to dental emergencies, accounting for

These individuals may differ systematically from those discharged earlier, particularly in resilience, health-seeking behavior, and medical follow-up, which could introduce selection and detection biases. Notably, the proportion of volunteers was higher following the October 7, 2023, events, raising the possibility that the observed increase in diagnoses during the post-war period may partly reflect enhanced motivation to serve, increased medical oversight, or longer follow-up time, rather than a true rise in new IBD cases. Although wartime exposure remained significantly associated with IBD diagnosis in multivariable models, these findings should be interpreted with caution. Further research involving broader military and civilian populations, including individuals who did not remain in service, is warranted in order to clarify the extent to which the association reflects underlying biological effects versus systemic or behavioral factors.

Additionally, we lacked detailed service data, including combat versus support roles, unit type, deployment duration, and specific exposure characteristics, preventing subgroup analyses that could help identify high-risk populations or specific stressors. We also cannot assess IBD incidence or prevalence in the general IDF population, as our data are limited to this volunteer cohort. This is a signal-generating study that requires validation in broader military and civilian populations before drawing general conclusions about wartime stress and IBD risk.

Conclusions

In this retrospective study of a cohort of volunteer personnel who developed chronic illness during service and volunteered to continue, exposure to the October 7, 2023, war was significantly associated with an increased likelihood of volunteering with Inflammatory Bowel Disease. This association persisted after adjustment for key demographic and service-related factors. However, the interpretation of these findings must account for the selective nature of the volunteer cohort, particularly given the higher proportion of volunteers in the post-war period, which may have contributed to both increased detection and follow-up. While these results raise important questions about the potential impact of acute wartime stress on IBD onset, they also highlight the need for further studies in more representative populations, in order to disentangle biological effects from systemic and behavioral influences.

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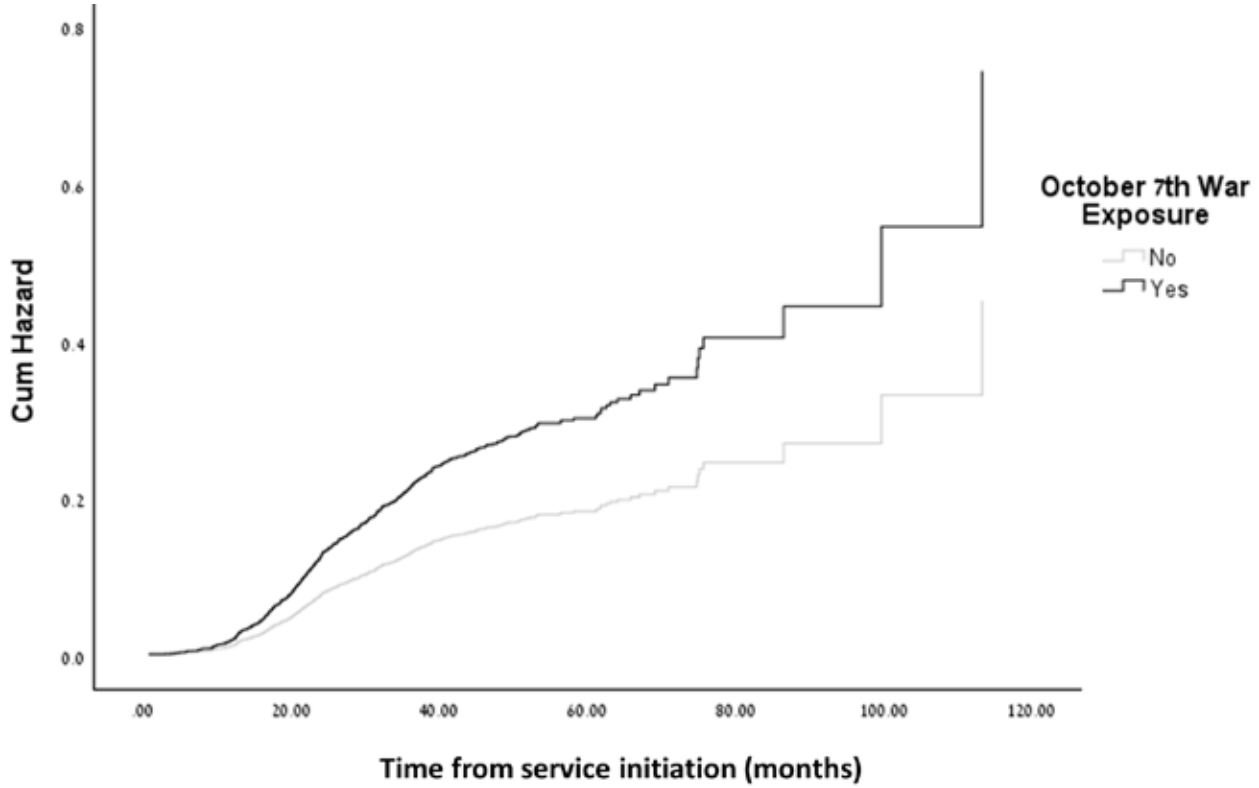

Figure 1 - Hazard Function to volunteer with IBD Over Time Among IDF volunteers.

trauma, affecting the entire Israeli population, created unprecedented psychological stress, which likely contributed to both accelerated IBD development in genetically predisposed individuals and increased volunteering rates due to increased motivation and national needs.

Our findings reveal important demographic patterns. Female volunteers demonstrated increased IBD incidence, consistent with epidemiological data showing higher IBD prevalence among women in certain populations. Additionally, volunteers diagnosed with IBD had notably higher educational attainment, which may reflect greater health awareness and more proactive healthcare-seeking behavior.

The study period witnessed increased volunteerism among IBD patients following the October 7 events. This phenomenon likely reflects heightened national solidarity and motivation to serve during wartime, potentially encouraging individuals with chronic conditions to volunteer despite their health status. Additionally, over the years, the military has improved its ability to identify which volunteers with chronic conditions are suitable for service and likely to remain medically stable.

From a healthcare policy perspective, these results underscore the critical importance of maintaining routine medical services during emergencies. The understanding that emergency situations significantly impact routine healthcare utilization and disease patterns cannot be ignored in healthcare planning. Military and civilian healthcare systems must recognize that the indirect health effects of crisis situations may be as significant as the direct effects, requiring sustained investment in routine diagnostic and therapeutic services even when resources are stretched.

Limitations

This study has several important limitations. The cohort included only individuals diagnosed with a chronic illness who subsequently volunteered to continue military service, representing a select subgroup that may not reflect the broader population of IBD cases.

diagnosed compared to those with less than 12 years (17.2% vs. 4.9%; $\chi^2 = 6.38$, $p = .012$).

Cognitive ability, as measured by pre-service IQ scores, was strongly and significantly associated with IBD diagnosis. Participants in the high IQ category had a notably higher prevalence of IBD compared to those in the low category (21.1% vs. 6.9%; $\chi^2 = 43.70$, $p < .001$). Socioeconomic status showed a non-significant trend, with no statistically significant differences across SES levels ($\chi^2 = 4.41$, $p = .110$).

Exposure to wartime conditions (the primary independent variable of the study) was significantly associated with IBD incidence among IDF volunteers: 23.8% of those who served during the war and chose to volunteer to military service were diagnosed with IBD, compared to 15.3% among those who did not serve during that time ($\chi^2 = 26.89$, $p < .001$). In contrast, no significant group differences were found with respect to religion (Jewish vs. other; $\chi^2 = 2.16$, $p = .142$) or combatant status ($\chi^2 = 0.91$, $p = .339$).

A multivariable logistic regression analysis was conducted to identify independent predictors of IBD incidence among volunteers during military service (see Table 2). The model revealed that exposure to wartime conditions was significantly associated with an increased likelihood of volunteers' diagnosis with IBD during service, even after adjusting for relevant sociodemographic variables. Specifically, participants who were exposed to wartime conditions had 1.71 times greater odds of IBD onset compared to their unexposed counterparts (OR = 1.71, 95 % CI [1.39, 2.10], $p < .001$).

In addition to wartime exposure, two other variables emerged as significant independent predictors. Female volunteers had higher odds of volunteering for service after a new IBD diagnosis than males (OR = 1.28, 95% CI [1.07, 1.54], $p = .009$). Moreover, individuals with more years of formal education were also at elevated risk, with each additional year of education associated with a more than threefold increase in the incidence of IBD diagnosis (OR = 3.44, 95 % CI [1.07, 11.04], $p = .038$).

Figure 1 illustrates the hazard function for time to IBD diagnosis, stratified by wartime exposure. As shown, the cumulative hazard curve for participants exposed to the October 7 war was markedly steeper, indicating both earlier and more frequent IBD diagnoses in this subgroup. To formally assess this correlation, a Cox proportional hazards regression analysis was performed. Results indicated that wartime exposure was a significant predictor of time to IBD diagnosis (in volunteer subgroup), with exposed individuals exhibiting a 65% increased hazard compared to unexposed individuals (HR = 1.65, 95% CI [1.37, 1.98], $p < .001$).

DISCUSSION

This study is among the first to examine the association between service during wartime and IBD diagnosis among volunteers to military service, suggesting a potential role of acute psychological trauma in triggering diseases such as IBD. The observed association aligns with established research showing that psychological stress increases disease activity in IBD patients, with adverse life events significantly increasing relapse likelihood (4). The collective nature of the October 7

Predictor	B	OR	95% CI	p-value
Gender (Female)	0.247	1.280**	1.065-1.538	0.009
Education	1.236	3.442*	1.073-11,044	.038
Wartime Exposure	0.534	1.707***	1.387-2.100	<.001

Note: *p<.05, **p<.01, ***p<.001.

Table 2 - Multivariate logistic regression predicting onset of IBD during military service in volunteers.

relationship between wartime exposure and the onset of IBD, a Cox proportional hazards regression was performed. The event was defined as a physician-confirmed IBD diagnosis, and the time variable represented the number of months from enlistment until diagnosis or discharge (end of follow-up). Wartime exposure was the primary predictor. Hazard ratios (HRs) and 95% confidence intervals (CIs) were calculated to estimate the relative risk of IBD incidence associated with exposure to wartime conditions.

RESULTS

This retrospective cohort includes 3,477 individuals who, despite being deemed unfit for continued military service due to medical conditions identified during their service, voluntarily continued serving. Out of the 3,477 participants, 589 (16.9 %) were diagnosed with IBD during service and subsequently volunteered to continue. Of these, 433 (73.5 %) were diagnosed before October 7, 2023 (pre war period), and 156 (26.5 %) during or after that date.

As presented in Table 1, several significant differences emerged between participants diagnosed with IBD during military service and those without such a diagnosis. Gender was significantly associated with IBD status, with a higher proportion of female participants among IBD cases compared to non-cases (19.3% vs. 15.7%; $\chi^2 = 6.94$, $p = .008$). Educational attainment was also associated with IBD, in that individuals with 12 or more years of education were more likely to be

	Non IBD $n = 2,888$(%)	IBD $n = 589$(%)	χ^2	p-value
Gender				
Male	1,933 (84.3)	361 (15.7)	6.937**	0.008
Female	955 (80.7)	228 (19.3)		
Religion				
Jewish	2,840 (82.9)	584 (17.1)	2.155	.142
Other	48 (90.6)	5 (9.4)		
Years of Education				
≤12	58 (95.1)	3 (4.9)	6.378*	.012
12 or more	2,830 (82.8)	586 (17.2)		
IQ				
Low	309 (93.1)	23 (6.9)		
Medium	1,433 (84.5)	262 (15.5)	43.699***	<.001
High	1,139 (78.9)	304 (21.1)		
Socioeconomic Status				
Low	170 (78.3)	47 (21.7)		
Medium	623 (84.4)	115 (15.6)	4.411	.110
High	2,014 (83.1)	409 (16.9)		
Service During War				
Yes	500 (76.2)	156 (23.8)	26.890***	<.001
No	2,388 (84.7)	433 (15.3)		
Combatant				
Yes	235 (80.8)	56 (19.2)	0.914	0.339
No	2,396 (83.0)	486 (17.0)		

Note: *p<.05, **p<.01, ***p<.001.

Table 1 - Background and service-related variables by IBD in volunteers (N = 3,477).

capacity (7), and under protected administrative and medical arrangements. Of the 3,477 volunteers, 589 (2.96%) were diagnosed with IBD. The data were obtained from the IDF's computerized database, which includes volunteers' demographic characteristics, military service data, intellectual functioning, and medical diagnoses. The medical records are from January 1, 2000, through December 31, 2024. This cohort included those who were diagnosed with IBD during their service and volunteered to continue it. No exclusion criteria were applied.

This study specifically examined the volunteer population – those who chose to continue service after developing disqualifying conditions – and does not include data on personnel who were diagnosed and discharged without volunteering to continue.

Ethics

The institutional review board of the IDF Medical Corps approved the study and waived informed consent, citing the need to preserve participants' anonymity [approval number 2495-2025].

Measures

Demographic and service-related characteristics included gender, place of birth (Israel or abroad), religious affiliation (Jewish vs. non-Jewish), and educational attainment (less than 12 years vs. 12 years or more). Socioeconomic status (SES) was determined using residential address data sourced from the Israeli Ministry of Interior. These were classified using a national 10-point SES scale developed by the Israel Central Bureau of Statistics (2006), which ranks municipalities based on socioeconomic indicators. For this study, SES was grouped into three categories: low (scores 1–3), medium (4–6), and high (7–10).

Military service variables included whether the individual served in a combat position (yes/no) and their intellectual ability, measured by an intelligence test equivalent to an IQ score. This test comprises four subtests assessing cognitive functioning and yields a score on a 9-point scale ranging from 10 (lowest ability) to 90 (highest), in 10-point increments (Goldberg et al., 2011). For analysis, cognitive scores were classified into three levels: low (10–30), average (40–60), and high (70–90).

Independent variables

Wartime Exposure. Exposure to wartime conditions was defined by military service status during the Israel-Hamas war, which began on October 7, 2023. Participants were classified as unexposed if they had completed their military service by October 6, 2023, thus having no overlap with the wartime period. In contrast, participants were classified as exposed to wartime conditions if they were actively serving in the military at any point on or after October 7, 2023. This definition included both individuals who began their service on or after the outbreak of the war and those who enlisted before the war's outbreak but remained on active duty during the conflict. Accordingly, wartime exposure status reflected actual presence in the military during the wartime period, irrespective of the enlistment date.

Dependent Variables

IBD. The IDF requires mandatory military service for all 18-year-olds, and conducts comprehensive pre-enlistment medical and psychometric screenings. Family physicians must report any childhood health conditions to military physicians prior to recruitment. This unique system provides an opportunity to examine how pre-existing health conditions interact with military service stressors. Individuals diagnosed with IBD are generally exempt from mandatory military service; however, those who are medically eligible and choose to do so may volunteer for service.

Statistical analysis

All statistical analyses were conducted using IBM SPSS Statistics for Windows, Version 29.0. A two-tailed p-value of ≤ .05 was considered statistically significant. Descriptive statistics were calculated to examine the distribution of demographic and service-related variables across the entire cohort. Means and standard deviations were reported for continuous variables, while frequencies and percentages were used for categorical variables. Next, chi-square tests were conducted to explore the degree to which background characteristics and wartime exposure are associated with IBD diagnosis during military service. Logistic regression analysis was used to assess the contribution of wartime exposure and other demographic variables to the likelihood of being diagnosed with IBD. To evaluate the temporal

INTRODUCTION

Inflammatory bowel diseases (IBD), encompassing Crohn's disease (CD) and ulcerative colitis (UC), are chronic inflammatory conditions of the gastrointestinal tract with significant global health implications. Global prevalence in 2019 was approximately 4.9 million cases, with annual prevalence rates varying significantly by region: 10.5-46.14 per 100,000 in Europe, 7.3-30.2 per 100,000 in North America, and 1.37-1.5 per 100,000 in Asia (1). In Israel, IBD prevalence in 2019 was 519 per 100,000 population (0.52%), affecting 46,074 patients nationwide (2).

Military medical classification systems worldwide typically consider IBD patients unfit for standard military service due to deployment limitations, medication requirements, and potential complications during service. However, emerging evidence suggests that individuals with controlled IBD may perform military duties successfully, as demonstrated by a prospective study of 16 Israeli Air Force aviators with IBD who maintained operational flying status over 23 years without adverse safety events (3).

The Israel Defense Forces (IDF) implemented a medical volunteer program allowing individuals with chronic medical conditions, including IBD, to serve if their condition is stable and manageable. This volunteer population consists of two distinct groups: those who enlisted as volunteers due to pre-existing disqualifying medical conditions (such as IBD), and those who were diagnosed with disqualifying conditions (such as IBD) during active military service and subsequently chose to continue serving in a volunteer capacity. The latter group, representing volunteers "from within service", provides a unique opportunity to study disease progression and diagnostic patterns within the military healthcare system.

The relationship between psychological stress and IBD development has been recognized in medical literature. Psychological stress increases disease activity in IBD patients, with adverse life events, chronic stress, and depression significantly increasing relapse likelihood in patients with quiescent disease (4). Studies demonstrate that patients with severe IBD activity experienced significantly more interpersonal trauma and victimization than those with quiescent IBD (5). Approximately one-quarter to one-third of patients with IBD report significant post-traumatic stress symptoms from their disease experiences, and these symptoms are associated with several adverse IBD outcomes (6).

The October 7, 2023, terrorist attacks in Israel and the subsequent war created an unprecedented national trauma with documented widespread psychological impact on the Israeli population. Such massive psychological stressors have been shown in other contexts to accelerate the development and progression of chronic inflammatory conditions, including IBD.

Conventionally, during periods of active military conflict, military medical priorities shift toward acute combat-related injuries and emergency care, with routine medical evaluations and non-urgent diagnostic workups often deferred or deprioritized. However, chronic medical concerns don't become any less pressing during wartime; on the contrary, the significant psychological stress associated with traumatic events may accelerate disease manifestation and exacerbation, potentially leading to more severe symptom presentation that necessitates urgent medical attention and more rapid diagnostic processes.

This study examines the time period from military enlistment to IBD diagnosis among volunteer military personnel serving before and during the October 7 events and subsequent conflict. We hypothesized that despite potential shifts in military medical priorities during wartime, significant psychological stress associated with these traumatic events could accelerate disease development and increase volunteering motivation, resulting in a higher volunteerism rate among IBD patients in the exposed group compared to historical controls.

METHOD

Study Design and Population

This retrospective cohort study includes 3,477 Israeli soldiers in sufficient physical and mental health who served in the military and were diagnosed, during their service, with a serious medical condition that necessitated a downgrade of their medical profile to a level deemed unfit for continued military service. However, they all remained in service in a volunteer

Service at Wartime and Risk of Inflammatory Bowel Disease Among Military Volunteers

ABSTRACT

Objective: To investigate trends in new onset of inflammatory bowel disease (IBD) among Israel Defense Forces (IDF) volunteers exposed to service during the October 7 conflict.

Methods: This retrospective cohort study included 3,477 Israel Defense Forces soldiers who enlisted between 2000 and 2024, had standard medical profiles, developed disqualifying chronic conditions during service, and elected to continue volunteering. Physician-assigned IBD diagnoses were tracked from enlistment through discharge. Hierarchical logistic regression and Cox proportional hazards models assessed the correlation between service during wartime and incident IBD.

Results: Out of 3,477 soldiers, 589 (16.9%) were diagnosed with IBD during service. Multivariable logistic regression revealed that service at wartime (OR = 1.71, 95% CI [1.39–2.10], p < .001), female gender (OR = 1.28, 95% CI [1.07–1.54], p = .009), and higher educational attainment (OR = 3.44, 95% CI [1.07–11.04], p = .038) were independently associated with increased odds of incident IBD. Similarly, in the Cox proportional hazards analysis, wartime service was associated with an earlier IBD diagnosis (HR = 1.65, 95% CI [1.37–1.98], p < .001), indicating a higher rate of onset among those serving during these periods.

Conclusion: Within this selected cohort of IDF volunteers, service during October 7 was associated with higher odds of incident IBD and earlier diagnosis; however, these preliminary results are hypothesis-generating and do not estimate IBD incidence or prevalence among all soldiers. They may relate to the potential role of acute stress and psychosocial factors during military service.

Keywords: Inflammatory bowel disease (IBD), wartime, military service.

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that training in the unit, along with close supervision, contributes to the therapists' sense of confidence in using a specific treatment method.

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for using one method or another, therapists noted that FTTs pose challenges in establishing a close and empathetic relationship, managing tensions during sessions, helping patients connect with deep emotions, and encouraging exposure and sharing. However, the confidence level in treating soldiers with military trauma from the October 7 war is high, as is the confidence level in the FTT tools available to the therapists.

Among FTTs, the majority reported certifications in EMDR (75.8%) and WET (51.5%). They expressed high confidence in the use of WET (61.6%) and the highest confidence in dynamic therapy (81.3%), despite dynamic therapy not being a first-line treatment for combat casualties. Research indicates a significant gap between the proven effectiveness of gold standard focused trauma therapies, such as PE and CPT, and therapists' confidence in using them. This finding is consistent with professional literature [28], which suggests that therapists often do not utilize evidence-based treatments, even though they are effective. The disparity between certification rates and confidence levels in this study — especially notable in EMDR — raises questions about the effectiveness of the training programs. One possible explanation is professional experience: 46.4% of therapists had considerable experience (11 to 34 years), which may foster openness to adopting methods such as EMDR and WET. Furthermore, the study found that the EMDR and WET training provided by the CSRU, combined with weekly supervision, significantly boosts confidence and implementation rates (91.3%). This underscores the importance of targeted professional development in enhancing therapists' skills and confidence. Supervision emphasizes the importance of professional support systems for trauma therapists. In the current study, therapists reported individual supervision as the most significant support resource (88%), followed by team meetings and group supervision (80%). These systems are critical for combining individual guidance, group support, and continuous professional development, particularly in acquiring trauma-focused and evidence-based methods. In emergency contexts, such systems are essential not only for treatment quality but also for preventing secondary traumatization among therapists [29]. Research supports this finding: Baird and Kracen et al. [4] highlight the role of professional supervision in reducing traumatic effects, Greinacher et al. [7] emphasize the need for support systems for emergency teams, and Baum et al. [8] found that trained therapists reported fewer shock, flooding, avoidance, and detachment symptoms while experiencing greater meaning and satisfaction in their work.

Summary

The research findings emphasize the complexity of the CSRU therapists' work during the war. The extensive exposure to traumatic content, the gap between recommended treatment methods and field practice, as well as that between the confidence in these tools and their actual use, and the need for professional support systems attest to the unique challenges in this field.

The surveyed therapists show a clear preference for EMDR, WET, and dynamic therapy methods, both in training and in confidence. These may be perceived as more effective or easier to implement in the specific context of treating military trauma. Additionally, this may be attributed to the training and close supervision provided in CSRU for both methods.

Study Limitations and Recommendations

This study has several limitations. First, the sample size (33) limits the ability to draw statistically significant conclusions. Second, the data are based on self-report, which may introduce bias. Third, the study was conducted at a specific time point, without comparison to the pre-war situation or longitudinal follow-up. Fourth, we used PCL-5 as a dichotomous variable; we did not use the tool's standard 0-4 scale because we initially intended to survey for professional support purposes and not for research on secondary traumatization.

In addition to the findings discussed in this article, the relatively small sample size (for a quantitative study) suggests the need for further research. A follow-up qualitative study involving in-depth interviews with the therapists who treated soldiers with military trauma during the war could provide valuable insights.

Finally, it would be beneficial to expand the existing range of FTTs available to CSRU therapists to include CPT and PE training, and to provide close accompaniment and supervision in these as well, since we observed

experienced by the reservists they were treating for military trauma typically led to PTSS. We also sought to examine whether they feel confident treating soldiers who participated in the October 7 war and confident in the professional FTT tools available to them. We hypothesized that the more exposure events a therapist has experienced, the higher the number of post-traumatic stress symptoms would be. Additionally, we expected that the stronger therapists' confidence in their professional capabilities, the higher their confidence in using FTTs.

Overall, our study did not reveal a statistically significant association between the therapists' exposure to the soldiers' traumatic event/s and PTSS. However, the likelihood of PTSS increased dramatically (71-fold) among therapists who were the parents of a soldier who participated in the war while they were working in the CSRU, although only four (12%) were in this category. While this is a small absolute number and therefore generalizability may be limited, we have no point of reference, as this phenomenon has not been studied. This may merit a future study with a larger sample size of therapists who have treated military trauma while being the parent of a soldier in wartime, to examine the correlation between this situation and post-traumatic stress symptoms — particularly in Israel, where this is a relatively likely set of circumstances compared to other settings.

Among the general population of parents of soldiers (and prior to the war), a study examining 202 Israeli parents between January and September 2023 found that nearly one quarter (22.8%) of parents experienced distress, defined as having high depression, anxiety, or stress scores. The nature of the children's military service affected the parents' attitudes. Specifically, combat service (vs. non-combat) was significantly associated with distress: parents of combat soldiers were four times more likely to report distress than parents of non-combat soldiers. In addition, highly classified positions preventing the child from sharing information with the parents was significantly associated with parents' distress [25].

As noted, this study did not find a significant relationship between therapists' exposure to soldiers' trauma event/s and PTSS. In this context, however, the study found that higher therapists' resilience was a protective factor against developing such symptoms. Still, post-traumatic stress symptoms are clearly evident in the therapists' responses to the PCL-5 questionnaire, especially in the re-experiencing and arousal and reactivity clusters (mainly hypervigilance, concentration difficulties, exaggerated startle response, and sleep disturbances). These symptoms align with the definition of secondary traumatization [4] and indicate that even without direct exposure to the traumatic event, therapists experience physical and emotional reactions similar to those of their patients. Interestingly, the negative cognitions and mood cluster remained essentially unchanged. These findings are compatible with research conducted among complementary medicine therapists (N = 118) working in hospitals, which found that 12.7% had symptoms of secondary traumatization, with clinical levels of re-experiencing, arousal, and reactivity, and avoidance symptom clusters [26].

Finally, compared to the soldiers' rates of exposure to traumatic events during the war as reported upon intake to the CSRU, the mean exposure of therapists was almost twice as high as that of soldiers treated in the unit at the same time. The mean number of exposures among 806 reservists who sought help from the CSRU was 6.514 [27]. Further research and comparative analysis of the exposure rates of CSRU patients and therapists may shed light on the phenomenon of secondary traumatization among therapists treating military trauma in the unit.

Regarding hypothesis 2, which suggested that the stronger therapists' confidence in their professional capabilities, the higher their confidence in using FTTs would be, the study found that therapists reported the highest confidence in dynamic therapy rather than in FTTs. On the one hand, 81.3% of therapists reported high or very high confidence in dynamic treatment (which most are trained in within general practice). On the other hand, although most therapists (75.8%) were certified in EMDR, only about 22.2% reported high or very high confidence in implementing the method, and only half of therapists (51.9%) reported moderate confidence in its use. These findings indicate that therapists have difficulty using FTTs. When asked about considerations

		B	Wald	Likelihood ratio test (LRT)	*df*	Exp(β)	95% Confidence Interval		*p*	*p* (LRT)
							Low	High		
Intercept		7.740	10.923	1.560	1	2298.207	7.216	731997.236	<.001	.212
Gender	Male	-.644	1.279	1.249	1	.525	.172	1.604	.258	.264
	Female		0[a]			1				
Country of birth	Israel	5.814	8.216	7.173	1	335.073	6.288	17855.865	.004	.007
	Other		0[a]			1				
religion	Secular	1.626	3.429	3.228	1	5.084	.909	28.428	.064	.072
	Religious		0[a]							
One of the children's participations in the war	Yes	4.296	5.335	4.868	1	71.428	.522	.000	.021	.027
	No		0[a]							
Professional seniority		-.157	3.504	3.295	1	.855	.726	1.007	.061	.069
Seniority in the CSRU		.111	1.163	1.139	1	1.118	.913	1.368	.281	.286
Resilience		-1.312	3.858	3.606	1	.269	.073	.997	.049	.058
Self- self-efficacy		-.549	.330	0.328	1	.578	.089	3.756	.566	.567
Exposure to Soldiers' Combat Traumas		.006	.007	0.007	1	1.006	.881	1.149	.931	.931

Note: Generalized Linear Models

Table 2 - Predicting post traumatic symptoms

meaning that the stronger their confidence in their professional capabilities, the more confident they will be in using FTTs. This hypothesis was partially confirmed. First, dynamic therapy showed the highest confidence level compared to FTTs (which they are trained in). Second, 81.3% of therapists reported high or very high confidence in using various FTTs, despite only 60.6% reporting formal certification in these tools. Third, among all FTTs, therapists reported the highest confidence in using WET, with 61.6% reporting high or very high confidence, although only 51.5% were certified in the method. Conversely, although most therapists (75.8%) were certified in EMDR, only about 22.2% reported high or very high confidence in its implementation. Half of the therapists (51.9%) reported moderate confidence in using it.

Finally, the number of years of professional experience was found to have a positive correlation with confidence in EMDR treatment ($r = .542$, $p = .006$), CBT ($r = .452$, $p = .039$), as well as with confidence in treating soldiers with military trauma from the October 7 war ($r = .596$, $p < .001$).

Professional Support Systems

Among the training and support provided by the CSRU to therapists' work and well-being, therapists reported high satisfaction with team meetings, individual and group supervision, and specialized training in EMDR and/or WET. Individual supervision is perceived as the most significant support resource (88% reported that it contributes greatly), alongside team meetings and group supervision (80% reported that these contribute greatly).

Finally, we should mention that the overall self-efficacy among the sample group is high, with a mean score of 3.36 (SD = 0.391; median = 3.5; range 2.5-4.0). Additionally, the mean level of resilience is also high, at 3.62 (SD = 0.471; median = 3.66; range 2.83-4.67).

4. Discussion

In the current study, we sought to examine whether CSRU therapists' exposure to the traumatic events

exposure to traumatic events a therapist experiences, the higher the number of symptoms will be. This hypothesis was not confirmed. Although the mean number of therapists' exposures to soldiers' traumatic events was high, with 13.73 items (SD = 4.38; range 0-19), the number of PTSS as measured by PCL-5 was relatively low, with each therapist experiencing at least two symptoms (SD = 2.48; median = 1.0; range 0-11). Specifically, p = .105, which indicates a weak significance of a direct relationship; however, this relationship is not considered significant. Therapists were exposed to a wide range of traumatic events through their patients. An exceptionally high proportion (90% or more) were exposed to events of soldiers coming under artillery, rockets, or mortar fire, exposure to bodies or human remains, knowing someone seriously injured or killed (93.9%, respectively), and exposure to dead or seriously injured IDF soldiers (90.9%). In addition, 75.8% were exposed to a soldier's experience of being involved in the death of an enemy combatant, and 45.5% to soldiers involved in the death of a noncombatant.

Distribution of Post-Traumatic Cluster

Overall, although the results showed that arousal and reactivity, as well as re-experiencing symptoms, were prominent, few therapists reported negative alterations in cognition and mood, or in the avoidance cluster. Nearly one third (30.0%) reported arousal and reactivity — specifically hypervigilance; 24.2% reported concentration difficulties, 21.2% reported exaggerated startle response, and sleep disturbances. Regarding intrusive thoughts, 24.2% reported experiencing distressing, recurring, involuntary, and intrusive memories of the event described to them, and 12.1% reported intense psychological distress when exposed to stimuli symbolizing the event. Of note, 30.3% (n = 10) reported not experiencing any of the post-traumatic stress symptoms.

Relationship Between Research Variables

Among all the variables — exposure, post-traumatic stress symptoms, self-efficacy, resilience, age, years of professional experience, and years with the CSRU — Spearman correlations revealed a positive correlation only in self-efficacy. Self-efficacy was positively correlated with resilience (r = .353, p = .044), age (r = .414, p = .021), and professional experience (r = .377, p = .040), indicating that higher resilience is associated with greater self-efficacy. Similarly, self-efficacy has been shown to increase with age and with years of professional experience.

Predicting Post-Traumatic Stress Symptoms (PTSS)

The study identified several variables that predict PTSS in the sample (Table 2). These include being born in Israel (OR = 335.073; 95% CI: 6.228–17855.865, p = .004) and being a parent of a soldier participating in the war (OR = 71.428; 95% CI: .522–.000, p = .021). Additionally, higher resilience levels were protective, as indicated by a regression coefficient of -1.312 (OR = .269, 95% CI: .073–.997, p = .049). In absolute numbers, only one of the therapists was not born in Israel; four were parents of soldiers serving in the war.

Confidence in Treating Soldiers With Military Trauma From the October 7 War, and Confidence in Use of FTTs

Confidence in treating soldiers with military trauma from the October 7 war. Overall, the average for the entire sample indicates a high level of confidence in treating soldiers with military trauma from the October 7 war (average 7.33 on a scale of 1-10).

Training and Certification in FTTs. Most therapists (75.8%) were certified in EMDR, approximately half (51.5%) in WET, and approximately one-third (33.3%) in CBT. Less than 10% of therapists were certified in PE (9.1%) and CPT (0.3%), despite these being regarded as leading evidence-based FTTs in trauma treatment effectiveness. Additionally, a high percentage (60.6%) were certified in dynamic therapy within their general practice outside the CSRU.

Confidence using FTTs in treating soldiers with military trauma from the October 7 war. Hypothesis 2 suggested that a positive association will be found between the therapists' professional experience and their level of confidence in using FTT tools in treating soldiers for military trauma from the October 7 war,

survey, participants were instructed as follows: "Below is a list of problems that people sometimes have in response to a very stressful experience. Keeping the worst event you have been exposed to in mind, please read each problem carefully and then select one of the numbers on the right to indicate how much you have been bothered by that problem in the past month." Additionally, we did not use the tool's standard 0-4 scale because we initially intended the survey to be used for professional support purposes.

The DSM-5 PTSD definition comprises a variety of symptoms that fall into four clusters: re-experiencing (e.g., repeated, disturbing dreams of the event), avoidance (e.g., avoiding memories, thoughts, or feelings related to the event), negative alterations in cognition and mood (e.g., blaming oneself or someone else for things that relate to the stressful experience), and alterations in arousal and reactivity (e.g., difficulty concentrating) [24]. Our goal was to understand which PTSD clusters were common and how they were distributed. Thus, the items were rated on a dichotomous scale (yes/no). The data of the current study revealed high internal consistency over the entire scale (Cronbach's $\alpha = .77$).

2.4. Statistical Analysis

Data analysis was performed with SPSS (version 30.0; Armonk, NY: IBM Corp) . Statistical significance was set at $p < .05$. We used descriptive statistics to present the study participants and the main study variables (means and standard deviations for continuous variables and distributions for categorical variables [%, N]). To evaluate the differences between background variables in PTSS we used the Kruskal-Wallis and Mann–Whitney (Wilcoxon W) tests. Spearman's rank correlation was used to examine the association between the research variables. Finally, we performed a Generalized Linear Models-GLM to examine relationships and predictors of PTSS.

3. Results

Of 33 therapists, 51.5% were male and 48.5% female, with a mean age of 40.52 years (SD = 6.20; median = 39.00; age range 31-60). Their professional experience ranged between one and 34 years (average 11.77 years), with 70.0% having one to two years of experience in the CSRU. About half of the therapists (46.4%) had 11-34 years of professional experience. Finally, four therapists, representing 12.1% of the study population, had at least one child who served in the war while they were employed as therapists with the CSRU. Table 1 presents the categorical descriptive statistics.

Hypothesis 1 suggested that a positive association would be found between the number of exposures to the soldiers' traumatic events and the therapists' post-traumatic stress symptoms, meaning the more

		N	%
Gender	Male	17	51.5
	Female	16	48.5
Country of birth	Israel	27	96.4
	Other	1	3.6
religion	Secular	25	80.6
	Religious	4	12.9
	Traditional	2	6.5
One of the children's participations in the war	Yes	4	12.1
	No	29	87.9
Professional training	Psychotherapist	10	30.3
	Masters in Social Work	14	42.4
	Psychologist Intern	5	15.2
	Specialist Psychologist	4	12.1

Table 1 - Descriptive Statistics

(yes/no) during the period of the therapists' military work, professional training (psychotherapist/ MSW/ psychologist intern/ specialist psychologist), number of years of professional experience as practitioners, and years of experience in the CSRU.

2.3.1. Independent variables

Exposure to Combat Scale [21]: The therapists' exposure to the soldiers' military trauma was measured through the Exposure to Combat Scale questionnaire that includes 18 statements (items) related to war experiences, based on combat experiences reported by U.S. Army and Marine Corps soldiers deployed in Iraq or Afghanistan. The answers to all are dichotomous (yes/ no). In the current study, we asked therapists the same 18 questions we routinely ask soldiers to assess the number and nature of the events they experienced. The responses to the 18 statements were scored by summing up the number of exposures per participant, and in addition, the mean exposure and standard deviation (SD) were calculated for the entire sample. The data of the current study revealed high internal consistency for the entire scale (Cronbach's $\alpha = .90$).

FTT – The CSRU employs various therapeutic tools that are considered the gold standard in trauma treatment [17-20], including prolonged exposure therapy (PE), cognitive processing therapy (CPT), cognitive behavioral therapy (CBT), eye movement desensitization and reprocessing (EMDR), and written exposure therapy (WET). Additionally, and bearing in mind that the surveyed therapists were serving as called-up reservists, we note that most therapists in general practice are trained in dynamic treatment, with those specializing in trauma (in civilian or military settings) receiving additional specialized training. Additionally, for the past three years, the CSRU has been providing supervision in FTT, specifically in EMDR and WET. In this study, we asked therapists a single question about their confidence in using FTTs with the soldiers they were treating. The questionnaire uses a ten-point Likert scale, ranging from 1 ("not at all confident") to 10 ("very confident").

Generalized Self-Efficacy Scale – The self-efficacy variable was measured using the Generalized Self-Efficacy Scale (GSES), which assesses the strength of individuals' belief in their ability to respond to and manage challenging events or obstacles affecting their environment and lives [22]. The questionnaire consists of 10 items, each using a four-point Likert scale. The current study's data revealed high internal consistency throughout the scale (Cronbach's $\alpha = .81$).

The Brief Resilience Scale – The resilience variable was measured using the Brief Resilience Scale, a questionnaire designed to assess the ability to bounce back from an adverse or stressful event [23]. The questionnaire consists of six items (e.g., "I tend to bounce back quickly after hard times"; "I have a hard time making it through stressful events"; "It does not take me long to recover from a stressful event"), using a five-point Likert scale, with answers ranging from "strongly disagree" to "strongly agree". The current study's data revealed high internal consistency throughout the scale (Cronbach's $\alpha = .62$).

Professional Support Systems – We asked one question to assess satisfaction with the maintenance of the care team's well-being: "Please rate your level of satisfaction with the professional maintenance of the care team's well-being concerning the various trainings". The 'various trainings' referenced were those provided by the CSRU, specifically, training for FTTs, individual and group supervision, and team meetings (i.e., professional support). The questionnaire uses a ten-point Likert scale, with 1 indicating "not at all satisfied" and 10 "very satisfied."

2.3.2. Dependent variable

Post-traumatic Stress Symptoms (PTSS) were examined using the PTSD Checklist – PCL-5 [24]. This twenty-item questionnaire relates to four symptom clusters congruent with those of the DSM-V: re-experiencing, avoidance, negative alterations in cognition and mood symptoms, and alterations in arousal and reactivity. The PCL-5 is designed to be administered using the standard instructions that explicitly guide participants to anchor their responses to the "worst event" they have experienced. In this

such as the October 7 events and the war.

In the current study, we sought to examine whether there is an association between therapists' exposure to soldiers' military traumas and post-traumatic stress symptoms (PTSS), specifically among therapists treating these soldiers within active reserve duty in the IDF Combat Stress Reaction Unit (CSRU). A study conducted after the October 7 attack highlighted that Israeli mental health professionals view their work as a civic duty, referring to it as their personal "Tzav 8", a term borrowed from the military emergency call-up notice. This perspective is rooted in cultural values of solidarity and national responsibility [15]. Additionally, we also sought to determine whether the CSRU therapists feel confident treating soldiers who participated in the October 7 war, as well as their confidence in the focused trauma therapy (FTT) tools available to them. Research among Israeli military mental health professionals shows that faith in their professional capabilities and tools, as well as social support, are protective factors against post-traumatic symptoms and contribute to resilience [16].

Studies of evidence-based FTT tools indicate that they are safe and effective for PTSD, even with comorbidity with conditions such as depression or anxiety [17]. The FTTs found effective are cognitive processing therapy (CPT) [18], eye movement desensitization and reprocessing (EMDR) [19], prolonged exposure (PE) [18], and written exposure therapy (WET) [18]. In the U.S., these are first-line treatments as per Veterans Affairs VA)/Department of Defense (DoD) guidelines, since they demonstrate the strongest evidence for PTSD treatment in soldiers [20]. Nevertheless, there is a gap between the documented effectiveness of evidence-based FTTs and their comparatively low use among therapists trained in these tools [18], suggesting a lack of confidence.

Note: For clarity, the therapists surveyed were active reservists, i.e., called up for reserve duty as therapists in the CSRU. Similarly, the soldiers they treated within the unit were also reservists at the time of treatment, regardless of whether they had participated in the October 7 war as mandatory-service soldiers or emergency reservists.

Following the above, the research hypotheses are as follows: (1) An association will be found between the number of exposures to soldiers' traumatic events and the therapists' post-traumatic stress symptoms (PTSS). The association will be positive, i.e., the more exposure events a therapist experiences, the higher the number of symptoms they will experience; (2) An association will be found between the therapists' professional experience and their level of confidence in using FTT tools in treating soldiers for military trauma from the October 7 war. The association will be positive: the stronger their confidence in their professional capabilities, the more confident they will be in using FTTs.

2. Method

2.1. Study participants

This cross-sectional study involved 33 military mental health professionals working as therapists in the CSRU (as reservists within "Tzav 8" emergency call-up), treating reserve soldiers who are suffering from military trauma after participating in the October 7, 2023, war (whether as reservists or mandatory-service soldiers). The demographic and background characteristics of the participants are shown in Table 1.

2.2. Design, procedure, and materials

We based our cross-sectional retrospective survey on 33 therapists who served as emergency-call-up ("Tzav 8") reservists in the CSRU between October 7 and the end of April 2025. The online survey, including four self-report questionnaires and background information, was sent to the therapists' mobile phones; responses were anonymous. The survey was created in advance for staff use to assess whether the mental health team needed support during their work. Participation in the survey that formed the basis for this study was voluntary and anonymous. Because the survey was not originally intended for research, it was not submitted to the Institutional Review Board Committee; however, the study received IDF approval for publication.

2.3. Measures

Background variables

The demographic details collected included gender, age, country of birth (Israel/other), religion (secular/religious), children's participation in the war as soldiers

traumatic stress disorder (PTSD) as a result of exposure to trauma experienced by others, even though they were not directly exposed to a life-threatening situation themselves. Working with traumatized individuals requires therapists' emotional involvement, which increases their risk of secondary traumatization and suffering from secondary traumatic stress [1,4]. These symptoms include hypervigilance, avoidance, and emotional numbing [4]. While secondary traumatization manifests in symptomatic responses similar to PTSD, vicarious traumatization involves deep and lasting changes in the therapist's world perception, beliefs, and coping methods [1]. This study focuses on secondary posttraumatic stress symptoms (PTSS).

Key risk factors for PTSS in therapists treating individuals with PTSD include cumulative exposure to traumatic content, low tolerance for ambiguity, and a high workload with trauma cases, as identified in studies of social workers [3,5] and other therapeutic helping professionals [6]. A systematic review by Greinacher et al. [7] reinforces the finding that cumulative exposure to traumatic events constitutes a significant risk factor for PTSS, especially when exposure includes a wide range of traumatic content in a short period, as may occur in emergency and war situations. However, protective factors, such as social support and resilience, can prevent the onset of PTSS among mental health professionals [3,7]. Resilience, a sometimes amorphous concept, is often defined as the ability to recover or "bounce back" from challenging circumstances. Resilience is a common response to adversity [8], drawing on psychological constructs, cognitive traits, behaviors, and circumstances, among others, and is a measurable phenomenon. Factors contributing to resilience among mental health professionals, first responders, and various emergency personnel include dedicated professional training, regular supervision, and social and professional support systems. These serve as protective factors, reducing the risk of developing PTSS [2,7,9].

A study among 223 Israeli therapists treating October 7 survivors and their families examined their professional well-being, which included satisfaction, compassion fatigue, burnout, and secondary traumatic stress. The study found that 83.6% of therapists exhibited moderate levels of PTSD symptoms, 44.7% exhibited moderate levels of burnout, and 64.8% exhibited moderate-to-high levels of satisfaction [10]. Those treating bereaved families and families of hostages reported higher anxiety and PTSS [10]. Several studies were conducted during the October 7 war among Israeli therapists who had been exposed to traumatic events experienced by their patients. One study of 73 therapists found that 18% scored above the threshold on a questionnaire assessing post-traumatic symptoms, suggesting a high probability of PTSD. The researchers discovered that empathic concern and fantasy moderated the relationship between the therapists' exposure to difficult content during treatment and the severity of their PTSD symptoms [11]. A qualitative study conducted between December 2023 and March 2024 among 25 experienced (average 10.8 years) psychologists and social workers in mental health practice found that participants experienced secondary trauma that manifested in emotional detachment, physical symptoms, and arousal and reactivity. However, they also derived deep meaning and satisfaction from their work, contributing to their personal and professional growth [12]. In a study of 60 mental health therapists (75% women) from the Sderot Resilience Center, one year after October 7, PTSS was associated with increased stress. Finding meaning in work was associated with lower stress when secondary trauma symptoms were low or moderate, but not when they were high [13].

Secondary traumatization, or the development of PTSS among mental health professionals, is a phenomenon that is much less widely researched than direct traumatization. This is particularly true among military mental health professionals who are exposed to soldiers' military traumas.

Among the latter, symptoms can be more complex when the therapists themselves have been directly exposed to the same traumatic events, a phenomenon called shared traumatic reality [2]. In one study, therapists' direct exposure to the same traumatic event (or a different one within the same context) was associated with higher levels of PTSD, whereas indirect exposure (through their patients) was associated with distress and emotional exhaustion [14]. Such double exposure is likely in the case of large-scale or nationwide events,

The Association Between Exposure to Soldiers' Combat Trauma and Posttraumatic Stress Symptoms in Military Health Professionals: A Survey of IDF Combat Stress Reaction Unit Therapists

Abstract

Background: The October 7, 2023, war significantly impacted Israeli mental health therapists, particularly those exposed to soldiers' military trauma. Identifying risk and resilience factors is critical for preventing the development of post-traumatic stress symptoms among therapists treating soldiers with military trauma.

Methods: An anonymous online survey was conducted among 33 therapists serving as reservists in the IDF Combat Stress Reaction Unit and treating soldiers (including reservists) who participated in the war. The survey included four self-report questionnaires, measuring the therapists' exposure to soldiers' description of their military trauma (Exposure to Combat Scale), post-traumatic stress symptoms (PTSD Checklist – PCL 5), self-efficacy (Generalized Self-Efficacy Scale), and resilience (Brief Resilience Scale). Statistical analyses included descriptive statistics, correlation analysis, and generalized linear models.

Results: Thirty-three therapists participated in the study (51.5% male and 48.5% female), 46.4% with 11-34 years of professional experience. Over 90% were exposed to soldiers' description of their military trauma (e.g., events of hand-to-hand combat, exposure to bodies or human remains, acquaintance with someone killed or seriously injured), and 30.3% reported post-traumatic symptoms (PTSS) — primarily arousal and reactivity, and intrusive thoughts. No significant association was found between the degree of exposure to the soldiers' trauma and therapists' PTSS. However, the risk of PTSS increased 71-fold in therapists who are parents to soldiers who participated in the war (12% of the sample). High resilience levels were a significant protective factor.

Conclusions: Therapists exposed to soldiers' traumatic combat experiences need professional support, particularly those with children who were soldiers in the October 7 war.

Keywords: post-traumatic stress symptoms, war events; therapists' exposure to soldiers' combat events, military trauma, combatants.

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1. Introduction

Treating trauma victims exposes therapists to traumatic content, which may impact their mental well-being and professional effectiveness [1-3]. The research literature distinguishes between two main phenomena: secondary traumatic stress and vicarious traumatization. While these terms are occasionally used synonymously, they signify distinct processes and outcomes [4]. Secondary traumatic stress describes a phenomenon in which therapists develop symptoms similar to post-

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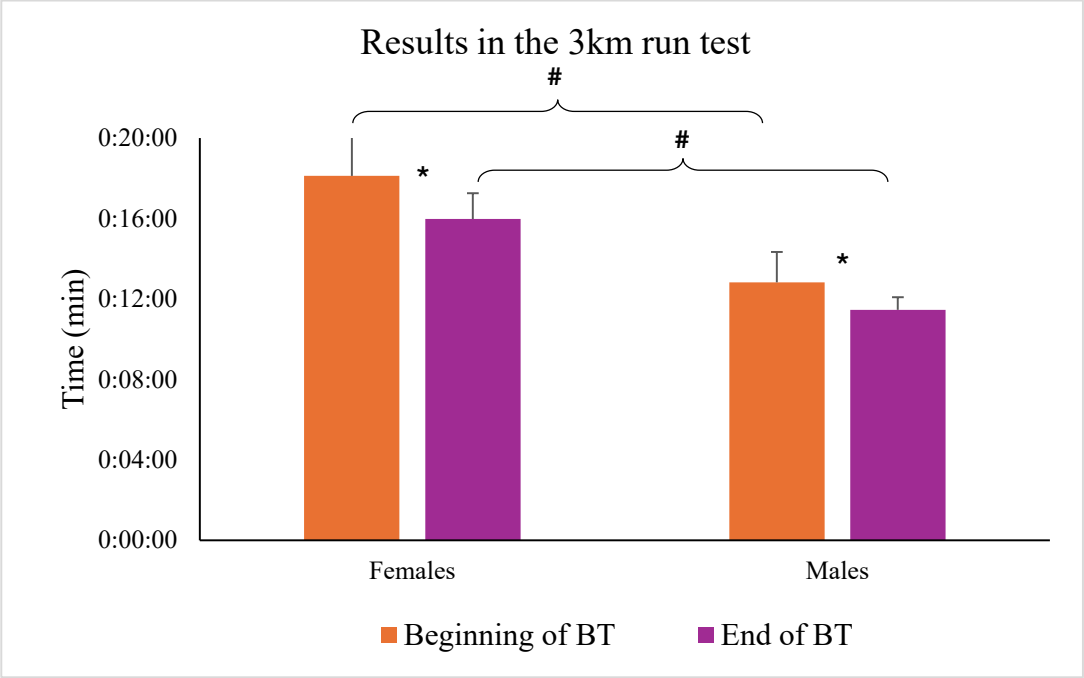
gates, and are embedded within training command structures.

Limitations

The absence of pre-recruitment screening among female recruits produced a heterogeneous cohort and limited comparability with male recruits. Training modifications implemented to mitigate injury further reduced experimental symmetry. Field conditions constrained data collection, and attrition limited statistical power.

Summary

Female recruits entered infantry training with substantially lower physical preparedness than male recruits, reflecting both biological differences and divergent pre-enlistment preparation pathways. Although significant improvements occurred, participants were unable to meet infantry standards, and integration was not achieved. These findings underscore the need for pre-recruitment conditioning programs, objective entry screening, and extended preparatory phases if future infantry integration initiatives are pursued.



Results of the 3-km run tests throughout training for female and male recruits, and the trend of change

* Statistically significant ($p<0.05$) difference between the running times of the tests performed at the beginning and end of BT.

Statistically significant ($p<0.05$) difference between male and female recruits at each running test.

Figure 2: Trend of change in the 3-km run test recruits performed throughout BT.

and training outcomes. Infantry training cannot serve as both a general conditioning framework and a primary selection filter without increasing the risk of attrition and injury. Future integration efforts would therefore benefit from establishing role-specific pre-enlistment screening benchmarks aligned with the demands of infantry tasks.

Second, the magnitude of baseline disparities indicates that preparatory conditioning must precede formal infantry basic training. Extended pre-basic training programs focused on progressive resistance training, trunk stabilization, upper-body strength development, and load carriage acclimatization may be required to establish a physiological substrate compatible with infantry task loads.

Third, training architecture warrants critical review. While adjusted effort scales may mitigate injury risk, they also alter exposure to the defining stressors of infantry service. This tension necessitates explicit policy decisions regarding whether integration aims to achieve absolute task equivalence or role-specific capability differentiation.

Finally, the results reinforce the central role of military medical services as operational partners. Continuous physiological monitoring, injury surveillance, and adaptive load management are enabling functions that determine whether integration models succeed. Integration initiatives should therefore incorporate formal medical governance frameworks that define injury thresholds, attrition criteria, and progression

		Females (N=21)	Males (N=21)
Weight (kg)	Beginning	65.0	70.4
	Middle	65.5	72.6
	End	65.2	-
	Change (%)	**+0.2**	-
BMI (kg/m^2)	Beginning	24.0	22.0
	Middle	24.2	22.7
	End	24.1	-
	Change (%)	**+0.2**	-
Fat (%)	Beginning	22.9	11.8
	Middle	22.5	13.5
	End	21.9	-
	Change (%)	**-4.0**	-
LBM (kg)	Beginning	49.8	61.7
	Middle	50.6	62.5
	End	50.8	-
	Change (%)	**+2.0**	-

- Comparison between anthropometric measurements throughout the training program, and the percentage of change from start to end for the female recruits.

Table 2: Anthropometric measurements over the course of 4 months training.

inability of female recruits to complete unassisted weighted pull-ups illustrates this biomechanical bottleneck.

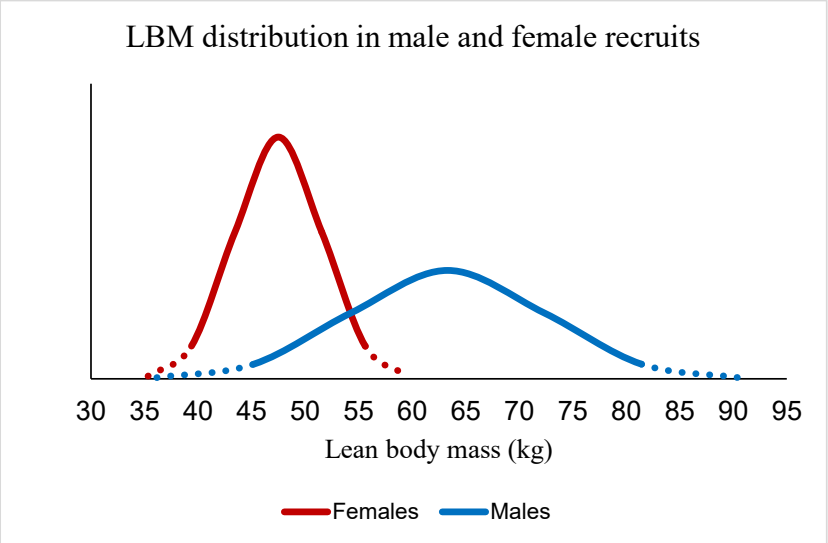
Although targeted conditioning can substantially improve female physical readiness (8), the present study demonstrates that four months of basic training, even with adjusted effort scaling, was insufficient to close performance gaps to infantry qualification standards. Pre-enlistment preparation disparities and the absence of female screening likely contributed to this limitation (10).

Nutritional practices improved in both groups, although baseline differences were evident. Prior work indicates that female soldiers often experience greater difficulty meeting energy and micronutrient requirements during intense training (11,12). Larger studies are warranted to clarify the contribution of nutritional optimization to integration success.

Psychological factors remain operationally relevant. Motivation and satisfaction were high in this cohort. Lower motivation among early withdrawals suggests that psychosocial screening may complement physiological preparation (13–15).

Operational Considerations

The findings of this pilot program have direct implications for force design, training doctrine, and military medical governance. First, the absence of pre-recruitment physical screening among female participants fundamentally shaped cohort composition



The top 10% of the female group (LBM range: 53.8–57.3 kg) was comparable to the lower 30% of the male group (≥ 57.0 kg)

Figure 1: Overlap in the LBM of the male and female recruits at the baseline measurement.

Motivation

Questionnaires indicated high motivation and unit satisfaction in both groups, with moderate perceived stress. The two female recruits who withdrew early reported lower motivation relative to their peers.

Discussion

This investigation evaluated a pilot attempt to integrate female recruits into IDF infantry basic training and provides preliminary physiological and operational insights relevant to future integration initiatives.

Consistent with prior military and civilian literature, marked sex-based differences in body composition, musculoskeletal characteristics, and aerobic fitness were evident at baseline (1–4). These variables are directly relevant to infantry task demands, including load carriage, obstacle negotiation, and sustained high-intensity effort.

Beyond gross performance disparities, the observed anthropometric and strength differences have direct mechanistic implications for injury risk and task sustainability. Lower lean body mass, reduced upper-body strength, and higher relative load carriage ratios increase mechanical strain on the lumbar spine, pelvis, and lower extremities. When external loads exceed approximately 30% of body mass, women experience disproportionately higher joint reaction forces, altered gait mechanics, and earlier neuromuscular fatigue compared with men (1,3,9). These mechanical patterns are associated with increased risk of tibial stress fractures, patellofemoral pain, lumbar overuse syndromes, and shoulder traction injuries.

Bone health represents an additional constraint. Lower baseline bone mineral density combined with delayed osteogenic adaptation may explain the higher prevalence of stress fractures reported in this cohort and in previous military populations (2,4). Infantry training concentrates high-impact loading within compressed timeframes, and when skeletal adaptation lags behind microdamage accumulation, bone stress injury becomes a predictable outcome.

Upper-body strength limitations further constrain task feasibility. Tasks such as casualty extraction, wall scaling, and prolonged weapon handling require both maximal and sustained submaximal force production. Even when aerobic fitness improves, insufficient upper-body strength restricts the translation of cardiovascular adaptation into operational performance. The persistent

	Females (N=29)	Males (N=28)	p-value
Height (cm)	163.1 ± 5.8	179.0 ± 7.6	<0.001
Weight (kg)	65.0 ± 8.8	72.5 ± 12.1	0.01
BMI (kg/m^2)	24.6 ± 4.1	22.5 ± 2.8	0.04
Fat (%)	23.9 ± 5.9	12.3 ± 3.8	<0.001
LBM (kg)	49.1 ± 5.3	63.3 ± 9.1	<0.001

- Baseline anthropometric measurement (height, weight, BMI, body fat percentage, LBM) of the female and male recruits, including statistically significant differences between the two groups (t-test).

Table 1: Anthropometric measurements at the beginning of basic training.

of males. Forty-five percent of females exceeded age- and sex-specific body fat recommendations (>23.5%), compared with 4% of males (>19.5%). Mean LBM was significantly higher in males (63.3 ± 9.1 kg) than in females (49.1 ± 5.3 kg), although partial overlap was observed (Figure 1).

Over four months, female recruits demonstrated reductions in body fat percentage and increases in LBM (Table 2). These changes did not reach statistical significance. Male recruits showed nonsignificant increases in body mass, body fat percentage, and LBM from baseline to midpoint.

Physical Fitness

At the initial PFT, male recruits significantly outperformed female recruits in all components ($p < 0.001$). Median performance was 12 pull-ups, 21 dips, and a 3-km run time of 12:45 minutes among males, compared with zero pull-ups, 7 dips, and 19:29 minutes among females.

To pass the pull-up test, recruits were required to complete at least five repetitions while wearing a 7-kg vest. During the first two tests, female recruits performed assisted pull-ups without load. Median performance increased to three repetitions, with 44% completing at least five assisted repetitions. At the final assessment, conducted without assistance and with load, only 38% completed at least one pull-up.

For the dips test, the passing criterion was five repetitions. Female recruits performed assisted dips in the first two tests. Median performance increased from 7 to 14 repetitions but declined to 7 when assistance was removed.

Both groups demonstrated significant improvement in the 3-km run ($p < 0.001$), with a mean improvement of approximately 12% in females and 11% in males (Figure 2).

Grip strength increased from a median of 27.8 to 29.8 kg in females and decreased from 42 to 41 kg in males. Neither change reached statistical significance.

Despite measurable improvements among female recruits, male recruits consistently outperformed female recruits across all assessments ($p < 0.001$).

Nutrition and Health

At baseline, 31% of female and 39% of male recruits reported smoking. Three female recruits reported vegetarian diets, and six reported avoidance of specific food groups. Three male recruits reported food restrictions.

Both groups reported improved dietary behaviors during training, including increased caloric intake and improved meal regularity. Dietary supplement use was reported by 41% of females and 11% of males.

Prior to enlistment, 21% of female recruits and 7% of males reported mild overuse injuries. Fourteen percent of females and 7% of males reported prior stress fractures, primarily involving the tibia or fibula.

training loads, and to determine whether adaptation converges sufficiently to permit qualification under existing infantry standards.

Methods

Participants

Twenty-nine female recruits and twenty-eight male recruits, aged 18 to 19 years, who commenced basic training concurrently, were enrolled. The study protocol was approved by the IDF Human Use Committee (IRB No. 1998-2019). Written informed consent was obtained from all participants prior to enrollment.

Study Protocol

Participants were followed prospectively over the 16-week basic training period. Data collection occurred at three time points: at the start of basic training (baseline), at the midpoint (approximately 8 weeks), and at the conclusion of training. Due to operational constraints, end-of-training measurements were not obtained in the male group.

Data Collection

At each assessment, the following measures were obtained:

- Anthropometry, including height, body mass, body mass index (BMI), body fat percentage assessed by skinfold caliper using the four-site method (7), lean body mass (LBM), and handgrip strength assessed using a mechanical dynamometer.
- Self-administered questionnaires assessing pre-enlistment exercise habits, nutritional practices, general health behaviors, prior overuse injuries, and motivation.

Physical performance was monitored continuously throughout training. All recruits completed three standardized physical fitness tests (PFTs), which served as formal benchmarks within the training program. The PFT comprised a 3-km timed run, pull-ups with an additional 7-kg load (maximum repetitions), and parallel-bar dips (maximum repetitions). Only recruits who completed all three PFTs were included in the performance analyses (16 female recruits and 24 male recruits).

Although identical performance standards were applied to both groups, the timing of the tests differed between male and female platoons due to training schedules.

Data Analysis

Analyses were conducted at two levels:

1. Within-group comparisons to evaluate longitudinal changes.
2. Between-group comparisons at each time point.

Paired and independent-samples t-tests were applied for continuous variables, and chi-square tests were applied for categorical variables. Statistical significance was set at $p < 0.05$. Results are presented as means ± standard deviations. Only participants completing all designated assessment points were included. Analyses were performed using Microsoft Excel.

Results

Cohort Characteristics and Attrition

The initial cohort comprised 29 female and 28 male recruits. Between baseline and midpoint, one male recruit withdrew from study participation but continued training. Four female recruits were dismissed from training due to injury, reduced motivation, or unsuitability for the program. Two additional female recruits were dismissed prior to the final assessment. The pilot program was terminated shortly after completion of basic training.

Pre-Recruitment Preparation

Self-reported questionnaires demonstrated marked sex differences in pre-enlistment physical preparation ($p < 0.001$). Only 38% of female recruits reported engaging in regular training for more than three months prior to enlistment, compared with 86% of male recruits. Male recruits also reported higher weekly training frequency and longer training sessions.

Anthropometric Measures

At baseline, significant sex differences were observed in height, BMI, body fat percentage, and LBM ($p < 0.01$; Table 1).

Twenty-four percent of female recruits were classified as overweight (BMI > 26.9 kg/m²), compared with 4%

benefit from rigorous pre-recruitment preparation, careful medical and physiological monitoring, modified training progressions, and critical re-evaluation of physical entry standards.

Keywords: Female combatants, gender, sex, integration, combat roles.

Introduction

The integration of female recruits into combat roles in the Israel Defense Forces (IDF) has been an evolving process over several decades. Considerable progress has been made: approximately 90% of IDF positions are open to women, who now constitute approximately 20% of combat personnel. Female soldiers presently serve in a broad range of combat roles, including border patrol units, naval combat positions, aviation, air defense, artillery, and the Oketz canine unit, among others.

The process of expanding combat roles to female recruits has proceeded gradually and under close medical and physiological oversight. This cautious approach reflects well-established anatomical and physiological differences between males and females. Numerous studies consistently demonstrate that, on average, females are shorter, have lower body mass, exhibit higher body fat percentage, have reduced lean body mass and bone mineral density, have lower iron stores, and experience higher rates of overuse injuries than males (1–4). These biological characteristics influence tolerance to extreme physical exertion, maximal strength development, and aerobic capacity. Such factors have direct operational relevance, particularly in infantry roles characterized by sustained load carriage and repeated high-intensity physical demands (1,3).

From an operational perspective, infantry service represents the most physically demanding occupational category within the IDF. Infantry soldiers are routinely exposed to prolonged load carriage, repetitive high-impact locomotion, obstacle negotiation, close-quarters maneuvering, and sustained operations under thermal, sleep-restricted, and nutritionally constrained conditions. These operational demands are cumulative rather than episodic and require not only peak physical performance but also resilience to repeated mechanical loading and incomplete recovery. Infantry training, therefore, functions as both a selection mechanism and a physiological conditioning process, intended to identify recruits capable of sustaining combat readiness while minimizing attrition and injury burden.

Within this context, the integration of female soldiers into infantry roles constitutes not merely a personnel policy initiative but a systems-level operational challenge. Decisions regarding eligibility, training architecture, medical oversight, and performance standards directly affect force readiness, injury incidence, training efficiency, and long-term operational sustainability. Military organizations that have expanded female participation in combat roles consistently emphasize the necessity of empirically grounded integration models rather than policy-driven implementation alone (5,6). Accordingly, pilot programs serve as operational experiments that enable commanders and medical leadership to evaluate feasibility, health impacts, and training outcomes before institutional adoption.

In 2023, a milestone was achieved with the initiation of a pilot program integrating female soldiers into a combat engineering unit by establishing an elite, all-female platoon. Although physical entry requirements were high, the training program was not identical to that of male soldiers. The initiative proved operationally successful, and female graduates were subsequently approved for routine assignment.

Consistent with broader trends across Western militaries (5,6) and in response to growing institutional and societal demand, the IDF subsequently initiated a second pilot program within an infantry unit. The physical demands of this unit exceeded those of the combat engineering program. Female recruits were expected to meet identical operational standards, although training progression was implemented using an adjusted effort scale.

The Military Physiology Branch of the IDF Medical Corps conducted continuous monitoring of participating recruits. The present study was designed as an operational physiology assessment embedded within an authentic infantry training environment. The primary objective was to characterize how female recruits physiologically adapt to infantry basic training, to describe performance trajectories under authentic

Integrating Female Soldiers into an Infantry Combat Role in the IDF – Preliminary Insights

Abstract

Introduction: In recent years, the Israel Defense Forces (IDF) has expanded combat opportunities for female recruits. This process has proceeded cautiously, given established physiological differences between males and females that may influence performance in physically demanding roles. A pilot program integrating female soldiers into an infantry unit was therefore closely monitored. The objective of the present study was to evaluate the effects of infantry basic training on health indices and physical performance in female recruits, in comparison with their male counterparts.

Methods: Twenty-nine female and twenty-eight male recruits undergoing the same basic training program were followed prospectively. Anthropometric indices, aerobic fitness, muscular strength, and self-reported questionnaires addressing nutritional habits and motivation were collected at the beginning, midpoint, and conclusion of basic training. Changes over time and sex-based differences were analyzed.

Results: At entry into basic training, significant sex-based differences were observed in anthropometric variables and physical performance. Over the training period, female recruits increased lean body mass by approximately 2%, reduced body fat by approximately 4%, and improved indices of muscular strength and aerobic performance by approximately 12%. Despite these improvements, female recruits did not meet the physical performance standards required to complete the infantry training program.

Conclusions: The present findings demonstrate that persistent physiological and performance gaps between male and female recruits pose substantial challenges to full integration into infantry combat roles. In this pilot program, female participants were not successfully integrated into an infantry unit. These results indicate that future integration efforts may

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noise patterns such as gunfire tends to cause focused damage at the base structures in the cochlea and adjacent neural structures, resulting in significantly greater impairment at higher frequencies (as reflected by the hPTA). (36) The complex mechanisms resulting in long-term SNHL are believed to be an intricate synergy of neuroinflammatory mechanisms of damage (37). This notion is supported, amongst other evidence, by the improved therapeutic response to the combination of HBOT and systemic anti-inflammation compared to HBOT alone. (12,38,39)

For military health organizations such as the IDF Medical Corps, these findings hold immediate policy relevance. As modern conflicts increasingly involve high-explosive weaponry, distinguishing blast injury from standard acoustic trauma is critical for medical triage and force preservation. Our data confirm that while the combined HBOT and steroid protocol is effective for the lower frequencies often affected by blast, the high-frequency hearing loss in these patients is significantly more resistant to treatment compared to gunfire exposure. Operationally, this suggests that while the current aggressive treatment protocol should be maintained for all acute acoustic trauma, clinicians must adjust prognostic expectations for blast victims. These service members may experience lower rates of full auditory recovery and may require earlier referral to auditory rehabilitation to facilitate an effective return to duty.

Conclusion

Combined HBOT and systemic steroids appear effective in the treatment of acute acoustic trauma. Current evidence suggests that neurotologic blast injuries exhibit distinct patterns of damage and response to HBOT compared to gunfire-induced acute acoustic trauma, including more pronounced lower-frequency involvement and a more limited response at higher frequencies. Larger, prospective, and preferably long-term investigations directed specifically at blast-injured patients are imperative to improve our understanding and clinical outcomes for this injury mechanism, which is ever-increasing in prevalence. Such well-designed studies could also help isolate the relative contribution of HBO therapy compared with systemic steroids.

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None to declare

Contributorship

IG and GW conceptualized this study. IG and IMG conducted the search, independently assessed articles for eligibility, and completed the initial draft for this manuscript. IG performed the statistical analysis. All authors reviewed and approved the final version of this article.

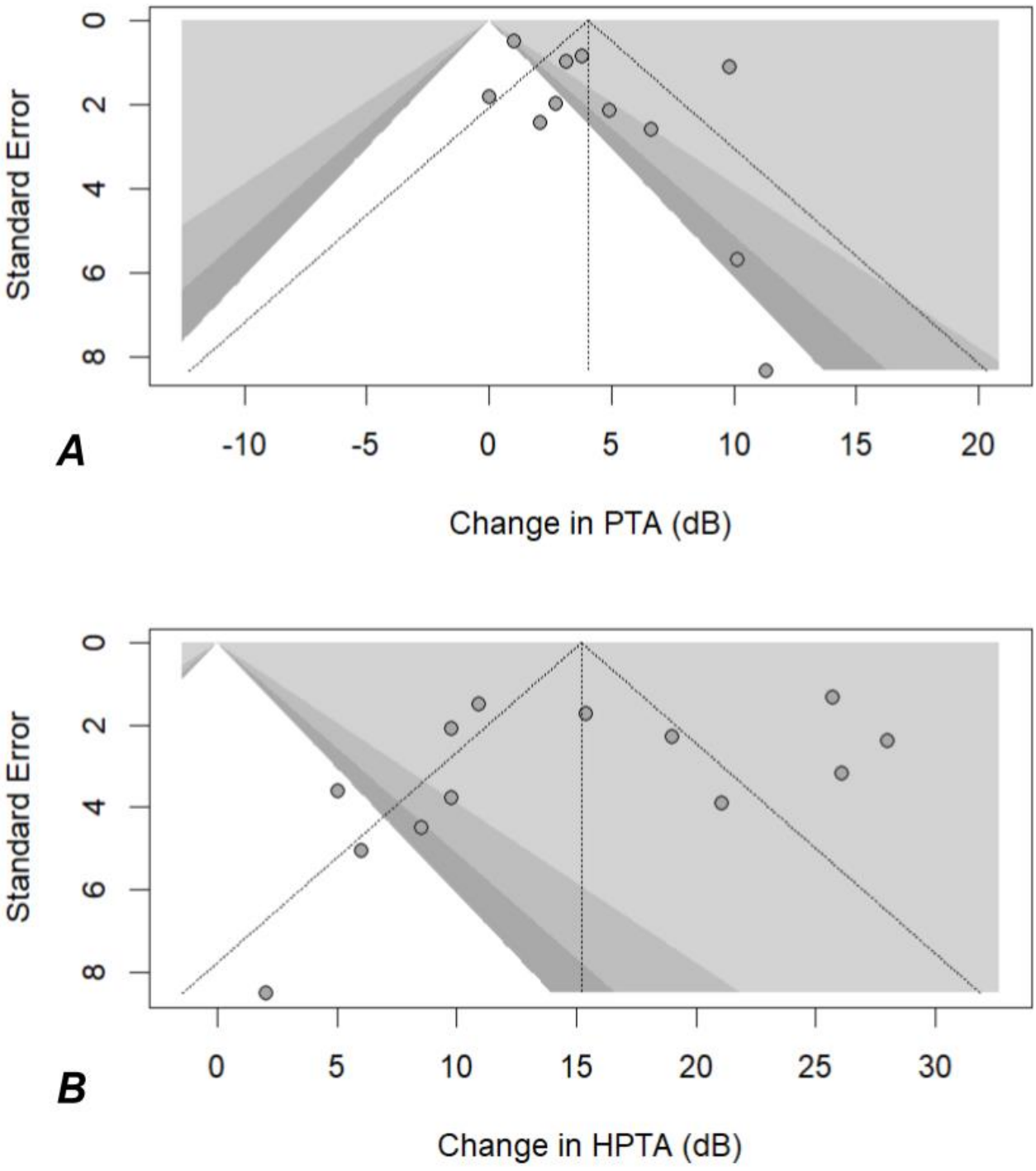

Figure 4 - Funnel plots assessing the risk of publication bias by plotting the effect size (Change in dB) against the standard error. (A) Pure Tone Average (PTA): Shows the distribution of studies for low-to-mid frequency outcomes. (B) High-Frequency Pure Tone Average (hPTA): Shows the distribution for high-frequency outcomes. The vertical dotted line represents the pooled effect estimate, and the diagonal dotted lines represent the pseudo-95% confidence limits. Asymmetry in the plot would suggest potential publication bias; Egger's regression tests indicated low evidence of bias for hPTA ($p=0.47$) and a slightly higher risk for PTA ($p=0.16$).

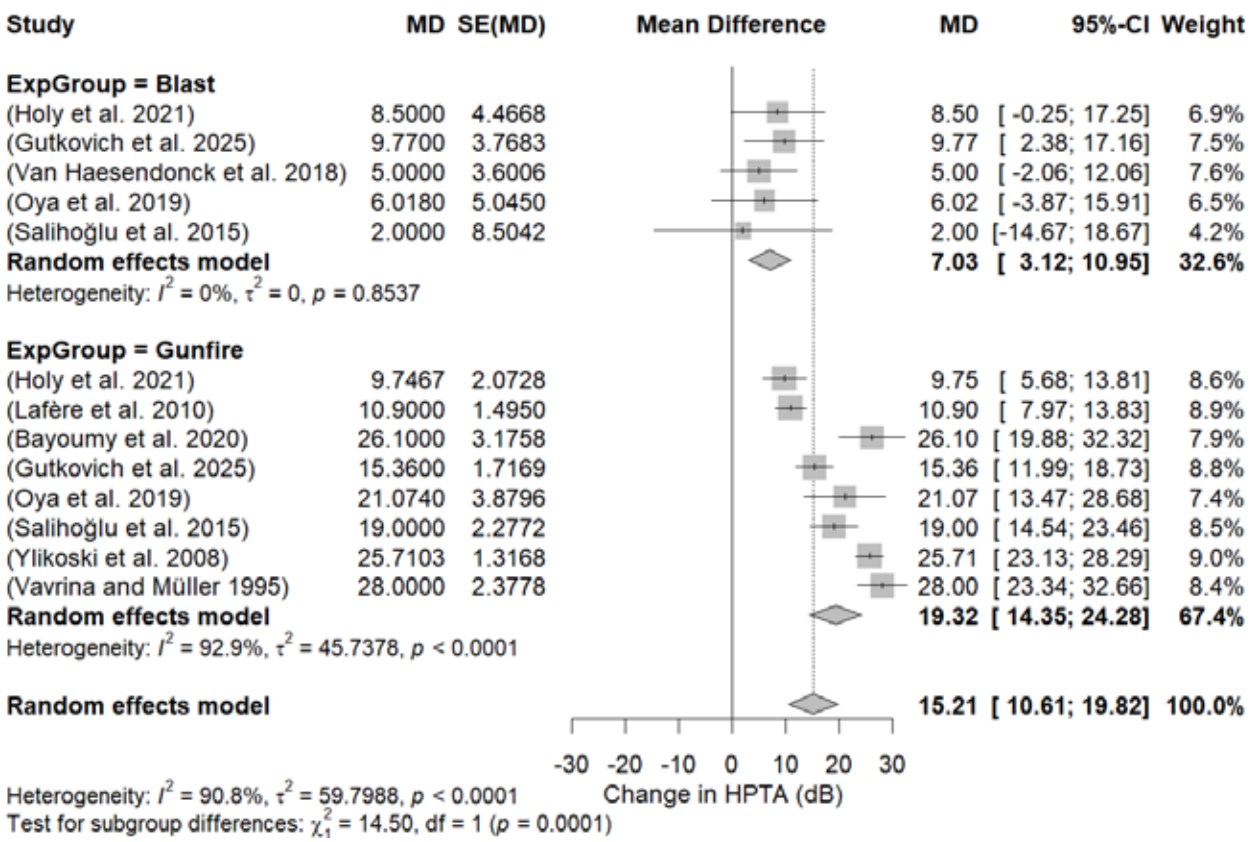

Figure 3 – High Pure Tone Averages - The mean effect of HBOT with corticosteroids on high-frequency thresholds is presented. hPTA is calculated as the average threshold at 3, 4, 6, and 8 kHz. The data is stratified by Blast and Gunfire subgroups. Black squares indicate individual study mean differences (MD) with 95% confidence intervals (CI), and blue diamonds represent the pooled estimate from a random-effects model. Note the significantly larger improvement in the Gunfire cohort (Pooled MD 19.32 dB) compared to the Blast cohort (Pooled MD 7.03 dB).

military protocols often strive for standardization, local logistical constraints and evolving clinical guidelines over three decades inevitably introduced variability in treatment intensity and timing.

Notwithstanding these concerns, overwhelming evidence in animal studies (20–24) and the published evidence included in this review underline the distinct clinical and pathophysiological attributes of blast injury. Recent conflicts have resulted in a 3 to 20-fold increase in the prevalence of reported blast injuries (5,25–28), justifying the further inquiry into this neurotologically distinct entity. Our analysis shows lower frequency impairment (as reflected by the PTA) to be more common, and shows a slightly better response to HBOT with steroids, in blast injury compared with gunfire. This could be the result of the multifactorial nature of auditory damage resulting from blast injuries, distinguishing them from more localized and mechanistically straightforward acute acoustic trauma (AAT). (29) Both blast injuries and AAT can cause sensorineural hearing loss primarily through damage to the cochlear hair cells. (30) However, blast injuries exert a broader impact that includes damage to all other structures in the auditory system, (31) including synaptopathy, (32) spiral ganglion neuron loss, (33) cortical dysfunction, (7) altered neurotransmitter signaling, (34) and neuroinflammation. (35)

Conversely, pure AAT resulting from short impulse

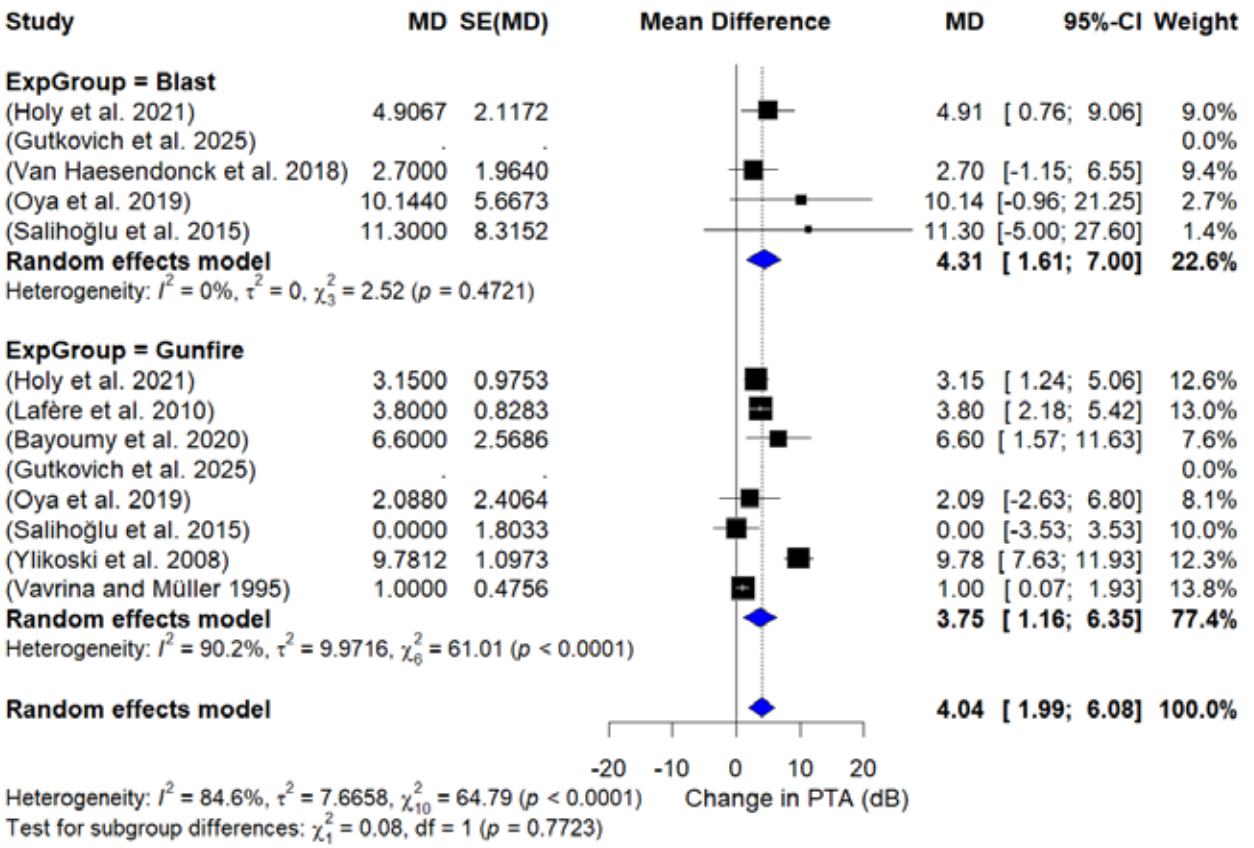

Figure 2 – Pure Tone Averages - This forest plot displays the mean difference (MD) in hearing thresholds following hyperbaric oxygen therapy (HBOT) combined with corticosteroids. PTA is defined as the average threshold at 0.5, 1, and 2 kHz. The analysis is stratified by injury mechanism: Blast (top) vs. Gunfire (bottom). Black squares represent the mean difference for each study, with horizontal lines indicating the 95% confidence intervals (CIs). The size of the square corresponds to the study's weight in the analysis. The blue diamonds represent the pooled effect sizes for each subgroup, calculated using a random-effects model. The vertical line at 0 dB indicates no effect; values to the right indicate hearing improvement.

Discussion

In this systematic review, we identified 9 human studies reporting pure-tone threshold averages following acute acoustic trauma. Only in five of these were any data reported concerning the auditory outcomes of blast injury.(2,3,13–15) This relative paucity of evidence could be the confluence of two factors. First, blast exposure used to be a relatively rare occurrence, restricted to active war zones and terror attacks, where HBO therapy with steroid availability is limited, and hearing restoration is not always the most pressing issue at hand. (16) Second, the complex nature of blast exposure, compared with impulse and impact noises, makes the quantification of the hazardous acoustic energy in each individual exposure scenario extraordinarily complex. (17) For these reasons, several authors deemed the exposure history or even the initial audiogram insufficiently reliable to differentiate blast injury from other forms of AAT. (18,19)

A significant source of heterogeneity in this meta-analysis, particularly within the gunfire cohort (I2 > 90%), likely stems from the temporal and geographic variability across the included studies 444. The data span 30 years (1990–2022) and covers diverse medical settings across Europe, the Middle East, and South America (5). This diversity is reflected in the hyperbaric protocols employed, which ranged from 5 to 20 sessions and used pressures between 2.0 and 2.5ATA. While

Authors	Study Period	Country of Origin	Population	Exposure Type	Time from exposure to Tx	Treatment offered	N	Female	NOS
Holy et al. (2)	2014-2019	Czech Republic	military and civilian	Gunfire and Blast	< 7 days	HBOT + Systemic Steroids	68	2	5/9
Gutkovich et al. (3)	2016-2022	Israel	military	Gunfire and Blast	< 7 days	HBOT + Systemic Steroids	86	6	6/9
Van Haesendonck et al. (13)	2018	Belgium	civilian	Blast	Not Reported	HBOT + Systemic Steroids	21	10	7/9
Oya et al. (14)	1997-2017	Brazil	military	Gunfire and Blast	Mean 24.5 days	HBOT + Systemic Steroids	37	3	5/9
Salihoğlu et al. (15)	2011-2013	Turkey	military	Gunfire and Blast	< 10 days (Group A)	HBOT + Systemic Steroids	73	0	5/9
Lafère et al. (12)	2006-2008	Belgium	military	Gunfire	Not Reported	HBOT + Systemic Steroids	98	0	7/9
Bayoumy et al. (40)	2012-2017	Netherlands	military	Gunfire	2 days	HBOT + Systemic Steroids	53	0	5/9
Ylikoski et al. (11)	1993-1996	Finland	military	Gunfire	Not Reported	HBOT + Systemic Steroids	60	0	5/9
Vavrina and Müller (10)	1990-1992	Switzerland	military	Gunfire	Not Reported	HBOT Only	78	0	4/9

Table 1 – Studies included in this meta-analysis are presented below, including the critical appraisal (by way of Newcastle-Ottawa Scale (NOS)).

in blast-injured cohorts, with a modestly more pronounced improvement in PTA (pooled Md 4.3 dB (95% CI 1.6 to 7.0, p = 0.019) with low heterogeneity (I^2 = 0.4%)). The improvement in hPTA was significantly less pronounced, with pooled Md of 7.03 dB (95% CI 3.1 to 10.9, p < 0.001, I^2 = 0.3%). These results are presented in Figure 2 and Figure 3.

The test for subgroup differences confirmed that the therapeutic effect of HBOT with steroids differed significantly between the two mechanisms of injury. Improvements in hPTA were significantly greater in gunfire-related trauma compared with blast-related injury (p = 0.004). Improvement in PTA was slightly more pronounced in the blast-injured group (p=0.019), although this difference was not clinically significant (Md 0.56 dB, 95% CI 0.04 to 0.83). Estimating publication bias by a funnel plot (Figure 4) revealed relatively low evidence of publication bias (Egger's regression p=0.47) for hPTA, with a slightly higher risk of publication bias for PTA (p=0.16).

pre- and post-treatment SDs, assuming a conservative correlation coefficient (r) of 0.5. A random-effects model (DerSimonian and Laird) was employed to account for between-study heterogeneity. Heterogeneity was assessed using the I^2 statistic, with I^2 values >50% considered substantial. Publication bias was evaluated using funnel plots and Egger's regression test. However, given the limited number of studies included ($n=9$), these results were interpreted with caution due to potential small-study effects.

Results

A total of 853 articles were identified through initial database searching. After removal of duplicates (n=692) and screening of abstracts, 189 full-text articles were assessed for eligibility. Ultimately, 35 studies met the inclusion criteria for qualitative synthesis, and 9 studies remained after excluding those with poorly defined exposure (14), purely animal models (2), and a lack of quantitative outcome (10). This selection process is presented in Figure 1.

The mean age across studies ranged from 18 to 34 (range 4-80) years, and the populations were predominantly male (54–100%), reflecting the overwhelmingly military cohorts studied. Hyperbaric oxygen therapy protocols ranged from 5 to 20 sessions, at maximal pressures of 2.0–2.5 ATA administered over 60-120 minutes, in addition to standard medical therapy that included systemic or intratympanic corticosteroids in all but one study.(10) Reported pure tone averages allowed for a relatively simple calculation of the changes in pure-tone average (ΔPTA) and high-frequency pure-tone average (ΔhPTA) in the minority of cases where these figures were not directly reported (10–12). These studies are outlined in Table 1.

For gunfire-related acute acoustic trauma, HBOT with steroids was associated with a statistically significant improvement in hearing thresholds. The pooled mean difference in PTA was 3.75 dB (95% CI 1.2 to 6.3, $p < 0.001$) with relatively high heterogeneity ($I^2 = 90\%$). The pooled mean difference in hPTA was considerably more pronounced at 19.3 dB (95% CI 14.3 to 24.3, $p < 0.001$, $I^2 = 92\%$). Conversely, overall improvement was considerably less clinically or statistically significant

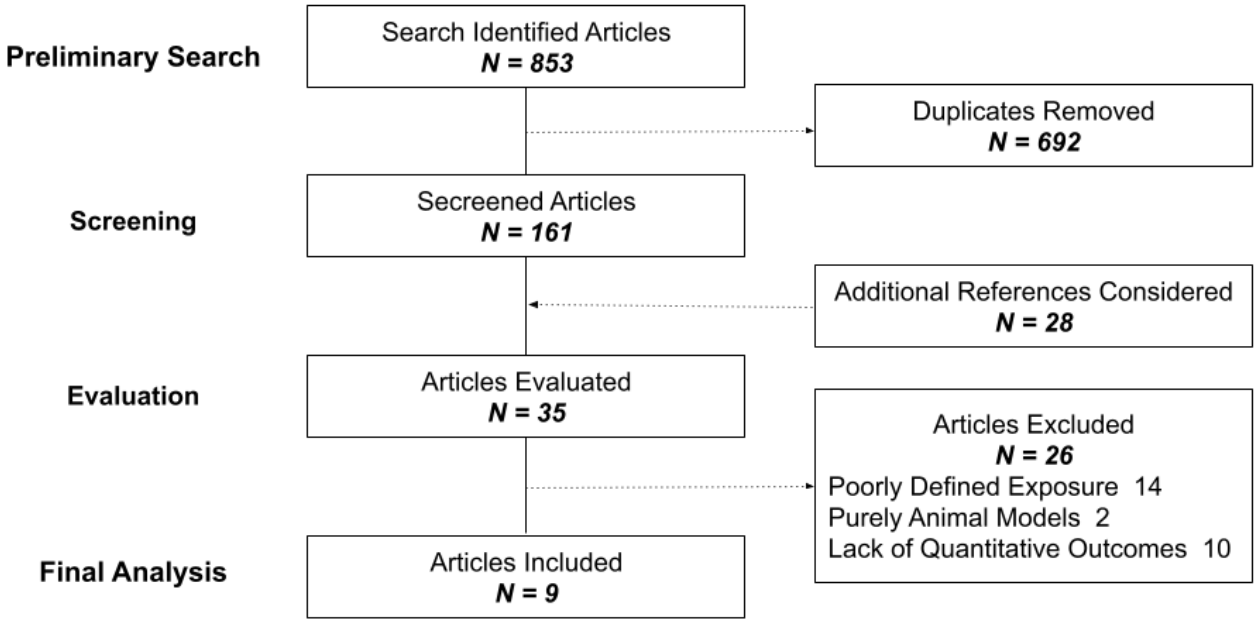

Figure 1 – The selection process is depicted in accordance with CONSORT guidelines. The search strategy yielded 853 initial articles; after removing duplicates and screening for eligibility criteria (human participants, quantitative auditory outcomes), 9 studies were included in the final meta-analysis. Reasons for exclusion, such as lack of quantitative data or insufficient exposure history, are detailed in the exclusion box.

impairments in 2020, representing a prevalence of 4.0 per 1,000 people. The rate was significantly higher in men (7.0 per 1,000) than in women (1.1 per 1,000). (3)

While etiology varies (e.g., presbycusis, genetic and congenital factors, toxins, autoimmune or idiopathic processes, and infections), the vast majority of new cases in young adults are due to noise exposure. (4) While occupational and recreational noise exposures are important etiologies worldwide, over two-thirds of the disease burden in service personnel results from acute, short, and intense noise exposure. Firearm exposure remains the leading offending agent; however, escalating conflicts and particularly large-scale land-based operations increase the relative proportion of another mechanism – high explosives resulting in blast injury. (5)

Blast injury is distinct from other mechanisms of acute acoustic trauma (AAT) in a few crucially important ways. (6) First, while other forms of harmful noise can be reliably quantified in terms of peak sound wave pressure, blast-generating explosions are characterised by complex and multiple sound pressure waves. In other words, the same peak pressure can be delivered over prolonged periods and over multiple positive and negative pressure waves. (7) Second, explosions generate multiple mechanisms of injury beyond the initial pressure wave. These include shrapnel (secondary blast injury), patient displacement or the rush of air returning to fill the low-pressure area created by the explosion ("blast wind", all included under the general category of tertiary blast injury), and any ensuing thermal and kinetic injury (e.g., the collapse of the building, or quaternary blast injury). (6)

These important mechanistic differences are very likely to result in distinct natural histories, therapeutic options, and prognoses. (8) Currently, the administration of a combination of glucocorticoids and hyperbaric oxygen therapy (HBOT), consisting of pressurizing the patient in a hyperbaric chamber and breathing oxygen at partial pressures of 1.5-3.0 atmospheres absolute (ATA), is emerging as the accepted therapy for AAT. (9) We aimed to systematically review the available evidence concerning the response to combination therapy (i.e., HBOT with steroids) and auditory prognosis of blast-injured versus gunfire-exposed patients.

Methods

Search Strategy

A comprehensive and systematic literature search was conducted across the following databases: PubMed, Embase, Web of Science, Scopus, and the Cochrane Library. The search included articles published from January 1990 through March 2025. Keywords and MeSH terms included combinations of: "blast injury," "acoustic trauma," "explosion," "sensorineural hearing loss," "SNHL," "cochlear damage," "central auditory processing," "cochlear synaptopathy," "tinnitus," "temporal bone injury," "auditory dysfunction," "hyperbaric oxygen," "HBO" and "HBOT".

Study Selection

Original, peer-reviewed studies reporting blast injuries in humans were included in this study, provided they reported quantitative data on auditory outcomes, including pure tone averages (PTA) and high-frequency pure tone averages (hPTA) before and after the therapeutic course, with pooled mechanism cohorts analyzed separately. Qualitative studies, animal models, and studies in which exposure history was not sufficiently described were excluded from this analysis.

Data Extraction

Two independent reviewers (IG and IMG) reviewed candidate studies and extracted data. Extracted data included study design, population characteristics, the mechanism of exposure, evaluation and treatment latency, type of treatment administered, and the hearing assessment methods (e.g., pure-tone audiometry, subjective symptoms, etc.). Risk of bias for human studies was assessed using the Newcastle-Ottawa Scale (NOS) for cohort and case-control studies. Disagreements between reviewers were discussed and resolved by consensus.

Statistical Analysis

Meta-analyses were performed using R (metafor package (41)). For continuous outcomes, mean differences (MD) in hearing thresholds (change scores) were calculated. When the standard deviation (SD) of the change score was not directly reported, it was calculated using the

Hyperbaric Oxygen Therapy in Neurotologic Blast Injury - a Systematic Review and Meta-Analysis

Abstract

Background

Blast injury is a clinically and mechanistically distinct form of acute acoustic trauma. We aimed to compare the auditory effects of hyperbaric oxygen therapy (HBOT) with systemic glucocorticoids in blast-injured patients versus those exposed to gunfire.

Methods

Original, peer-reviewed studies published between January 1990 and March 2025 reporting gunshot or blast injuries in humans were included if they provided quantitative auditory outcomes, including pure-tone averages (PTA) and high-frequency pure-tone averages (hPTA), before and after therapy. Exposure definitions were harmonized: gunfire was defined as acute acoustic trauma from small arms fire (impulse noise), and blast injury as exposure to high-explosive detonations (e.g., IEDs, mortar, artillery) characterized by complex pressure waves. Qualitative studies, animal models, and studies lacking a sufficiently described exposure history were excluded. Studies reporting generic "acoustic trauma" or pooling blast and gunfire cohorts without extractable subgroup data were also excluded to prevent mechanism misclassification.

Results

Nine studies were included, five of which described blast-injured patients. Following completion of HBOT with steroids, PTA improvement was slightly greater in blast-injured patients (pooled Md 4.3 dB, 95% CI [1.6–7.0]) compared with gunfire-injured patients (pooled Md 3.75 dB, 95% CI [1.2–6.3]; p = 0.019). Improvement in hPTA was significantly greater in the gunfire group (19.3 dB, 95% CI [14.3–24.3]) than in the blast group (pooled Md 7.03 dB, 95% CI [3.1–10.9]; p = 0.004).

Conclusions

Neurotologic blast injuries demonstrate distinct patterns of damage and response to HBOT compared with gunfire-induced acute acoustic trauma, including greater low-frequency involvement and a more limited response at higher frequencies.

Keywords: Hyperbaric Oxygen, Acute Acoustic Trauma, Blast Injury.

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Background

Sensorineural hearing loss (SNHL) is a type of hearing loss that results from damage to the inner ear or the auditory nerve. It is the most prevalent type of chronic hearing loss, accounting for approximately 90% of all reported cases, and is a major public health concern. (1) Globally, over 1.5 billion people (nearly 20% of the population) live with hearing loss, 430 million of whom have disabling hearing loss. (2) In Israel, approximately 24,500 adults aged 18 and older were registered with hearing

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