

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

Authors:

SSG Amit Assor [1]

Maj Yitzhak Elefant BPT MSc [1]

Uri Levor [1]

CPT Anat Lazikin BSc [1]

David Erez [1]

LTC Daniel S Moran PhD [1] [2]

LTC Itay Ketko MSc [1] [3]

[1] Institute of Military Physiology, Trauma and Operational Medicine Division, Surgeon General Headquarters, Israel Defense Forces Medical Corps, Tel Hashomer, Ramat Gan, Israel.

[2] School of Health Sciences, Ariel University, Ariel, Israel.

[3] Department of Military Medicine, Faculty of Medicine, Hebrew University, Jerusalem, Israel.

Corresponding Author:

LTC Itay Ketko

iketko@gmail.com

To cite this article:

Assor A, Elefant Y, Levor U, Lazikin A, Erez D, Moran DS, Ketko I. Integrating female soldiers into an infantry combat role in the IDF – preliminary insights. J Isr Mil Med June 2024; 21(62): [35-27].

Submitted for publication: November 15, 2023

Approved for publication: February 12, 2024

Disclaimer: The views expressed in the submitted article are the authors' own and not the official position of any institution.

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

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 \pm 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%

	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.

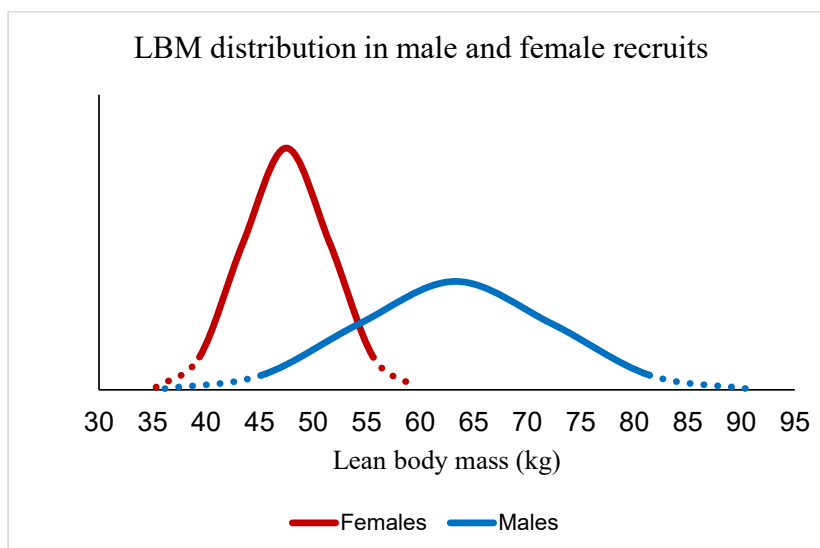
Despite measurable improvements among female recruits, male recruits consistently outperformed female recruits across all assessments ($p < 0.001$).

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.



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=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).

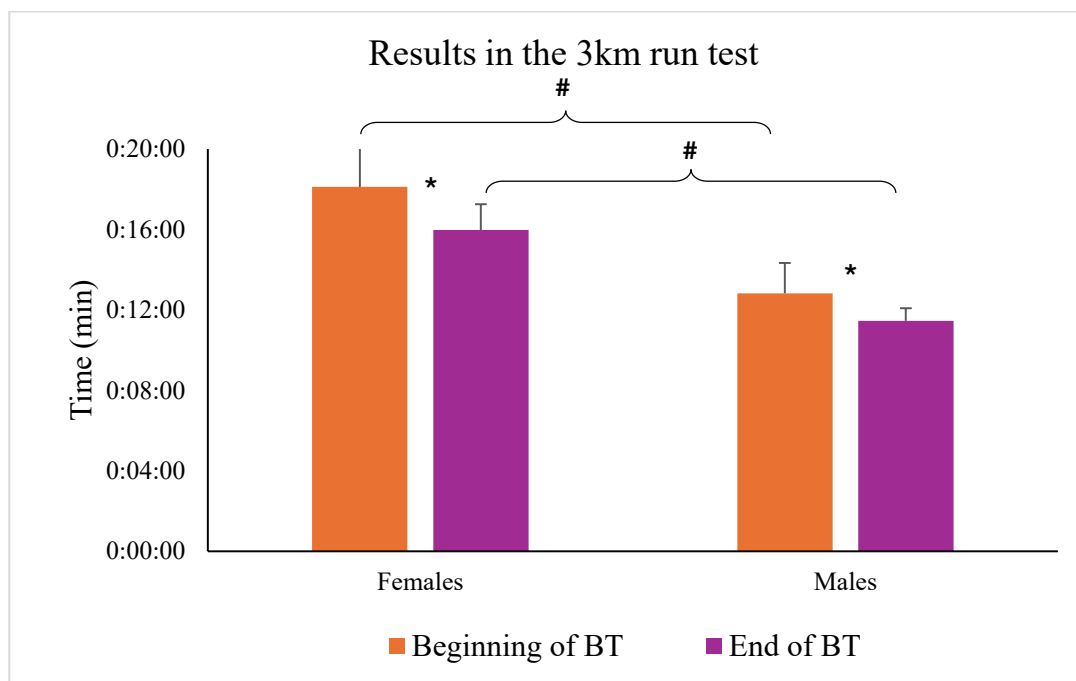
Nutritional practices improved in both groups, although baseline differences were evident. Prior work indicates that female soldiers often experience greater difficulty meeting energy and micronutrient requirements during

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



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

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.

REFERENCES

1. Yanovich R, Evans R, Israeli E et al. Differences in Physical Fitness of Male and Female Recruits in Gender-Integrated Army Basic Training. *Med Sci Sports Exerc* 2008; 40(11):654-659.
2. Finestone AS, Milgrom C, Yanovich R et al. Evaluation of the Performance of Females as Light Infantry Soldiers. *BioMed Res Int* 2014; 2014:572953.
3. Sultani S, Gross M, Babushkin V et al. Anatomy and physiology-related gender differences which affect one's ability to carry weight – a literature review. *J Isr Mil Med* December 2022; 19(56):11-18.
4. Epstein Y, Yanovich R, Moran DS, Heled Y. Physiological employment standards IV: integration of women in combat units physiological and medical considerations. *Eur J Appl Physiol* 2012; 113:2673–2690.
5. Carter A. No Exceptions: The Decision to Open All Military Positions to Women. Belfer Center for Science and International Affairs, Harvard Kennedy School 2018.
6. Fieldhouse A, O'Leary TJ. Integrating women into combat roles: comparing the UK Armed Forces and Israeli Defense Forces to understand where lessons can be learned. *BMJ Mil Health* 2023; 169(1):78-80.
7. Durnin JVGA, Womersley J. Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 Years. *Br J Nutr* 1974; 32(1):77-97.
8. Nindl BC. Physical Training Strategies for Military Women's Performance Optimization in Combat-Centric Occupations. *J Strength Cond Res* 2015; 29():101-106.
9. Wood PS, Grant CC, Du Toit PJ, Fletcher L. Effect of Mixed Basic Military Training on the Physical Fitness of Male and Female Soldiers. *Mil Med* 2017; 182(7):1771-1779.
10. Flanagan SP, Vanderburgh PM, Borchers SG, Kohstall CD. Training College-Age Women to Perform the Pull-Up Exercise. *Res Q Exerc Sport* 2003, 74(1), 52–59.
11. Chapman S, Roberts J, Smith L et al. Sex differences in dietary intake in British Army recruits undergoing phase one training. *J Int Soc Sports Nutr* 2019; 16(1).
12. Levor U, Shulman I, Faran S et al. "Junction Nutrition" model – nutritional support management in management training. *J Isr Mil Med* 2022; 19(56):19-26.
13. Hadid A, Evans RK, Yanovich R et al. Motivation, cohesion, satisfaction, and their relation to stress fracture among female military recruits. *Eur J Appl Physiol* 2008; 104: 329–335.
14. Tarrasch R, Lurie O, Yanovich R, Moran DS. Psychological aspects of the integration of women into combat roles. *Pers Individ Differ* 2011;50(2):305-309.
15. Brutsche KILOGRAMS. Closing the gender gap: An analysis of female retention in combat arms branches (Master's thesis, U.S. Army Command and General Staff College). Defense Technical Information Center 2022.