A prospective study of the utility of pre-induction tests as predictors of attrition in infantry recruits

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Abstract

Background

Soldiers in modern armies perform tasks that are increasingly technologically dependent. Training them to obtain necessary technological skills is both complex and expensive. Personnel attrition is costly and can affect military readiness. The purpose of this study was to examine the utility of pre-induction tests as a predictor of attrition in the first year of infantry training.

Methods

303 infantry recruits participated in the study. Before beginning military service their health profile was determined and they were given a Quality Group score, which is determined by psycho-technical tests, a personal interview and the quality of their education. Recruits were screened shortly following induction using a battery of tests including questionnaires, anthropometrics, functional movement screening (FMS), upper and lower quarter Y balance tests, dynamic tests, and followed by orthopaedists and their unit doctors for orthopaedic injuries and problems during the first year of training.

Results

165/303 (54.5%) recruits were diagnosed with injury or pain during the course of their first year of training. 46 recruits (15.1%) did not complete their first year of service as combatants and 18 (5.9%) were discharged from service. On multivariable analysis for attrition, protective factors were higher Quality Group scores (OR 0.78, CI 0.69-0.89) and recruits diagnosed with orthopaedic injuries or musculoskeletal pain (OR 0.21 CI 0.09-0.50). Pain in the balance test performed at the beginning of training was a risk factor (OR 3.39, CI 1.47-7.79). These factors together are only responsible for 15.4% of infantry attrition according to partial eta squared analysis.

Conclusions

The three variables found by multivariable analysis to be associated with infantry attrition in this study together are responsible for 15.4% of the attrition. Measuring these variables would seem to be most valuable in armies in which the number of candidates for a specific infantry unit greatly exceeds the number of positions. The IDF approach of trying to keep attriters within the Army in non-combatant roles and not discharging them from service is a way to manage the problem of infantry attrition.

Trial Registration

Prospectively registered on clinicaltrials.gov, registration number NCT02091713

Background

Modern armies require highly trained manpower to perform the increasingly technological dependent tasks of both combatant and non-combatant soldiers. Training soldiers to obtain these skills is both complex and expensive. Personnel attrition in the military is therefore costly and can affect readiness [1]. The word attrition can be used to mean those dropping-out of military service. In this context, the three-month attrition rate in the U.S. Armed Forces is in the range of 5.1–6.3 percent for all of the branches of service. By 36 months, the attrition rate is 29.7 percent in the Army and 18.5 percent in the Marine Corps [2]. Another use of the word attrition is to indicate soldiers who did not continue to serve in the role for which they were initially trained. Gottlieb et al reported that 31.7% of female recruits an Israeli light infantry unit had dropped out of combat service by 18 months after recruitment [3].

Comparing studies of military attrition between armies is complicated by the fact that some countries have no military conscription while others have military conscription, but service in them is for different periods of time [4–7]. In some countries with military conscription, the conscription is limited to males. In others the conscription law is not enforced.

Because of the magnitude of the problem [8], the United States Office of the Secretary of Defense commissioned a study of military attrition from the Rand Corporation.[2] The goal of the study was to identify factors related to attrition and to develop policies to mitigate it. The Rand Report developed a predictive algorithm for the US Armed Forces but concluded that it screened out too many non-attriters. The algorithm they developed can predict a attriter or non-attriter in the US Armed Forces 60% of the time, but this is only marginally better than a flip of a coin. Their algorithm does not relate to the reason for attrition. Reasons for attrition can be medical or non-medical, with many of the medical reasons being orthopaedic.

We undertook a prospective study of predictors of attrition and injury in a infantry unit in the Israel Defense Forces (IDF). A battery of physical, medical, psychological and psychometric tests were evaluated a predictors of attrition and injury in the study.

Materials And Methods

Study population

The study protocol was approved by the ethics committees of the Israeli Defense Forces (1294-13-IDF) and the Sheba Medical Center (0529-13-SMC) and registered in the NIH research database (clinicaltrials.gov registration number NCT02091713).

Participants were new male recruits from five basic training companies of the Nahal infantry brigade, age 18 to 21 years-old. Before their induction each recruit had undergone two evaluations to determine in which IDF units they were suitable and qualified to serve:

1) Quality Group Score (Hebrew acronym KABA [9]): The score is calculated based on three components. Fifty percent is based on the results of psycho-technical computerized tests (Hebrew acronym DAPAR)

which evaluate language, mathematical and logic skills. Thirty-three percent is based on a personal interview which evaluates suitability for military service. Seventeen percent is based on a score that represents the number of years and quality of the subject's formal education. Scores range from 41 to 56 with a score ≤ 43 considered unsuitable for regular military service [10]. The average score for Israelis is 49. A minimum KABA score of 48 is necessary to serve in the Nahal Brigade.

2) Medical Profile: All citizens in Israel are members of one of four health maintenance organizations (HMO). Assessment of the subject's general health is based on records from their HMO, hospitals and individual treating physicians and medical interviews and physical examinations done in the framework of the pre-induction process in IDF centers. According to this evaluation the subject receives a numerical health profile [11]. There is a minimum health profile requirement for service as an infantry soldiers in the Nahal Brigade.

All the study recruits had health profiles and KABA scores that allowed them to serve as infantry soldiers. Although they were assigned by the IDF to service in the Nahal Brigade, many had requested specifically to serve in the Brigade.

Following arrival at the basic training base, recruits in each induction group with appropriate KABA scores were offered to volunteer for service in the Nahal assault battalion (rather than service as regular infantry combatants in the regular Nahal battalions). In order to be accepted into the assault battalion they had to participate in an arduous 3-day physical and mental trial done under strict surveillance. Many candidates quit before the end of the trial. Those completing the trial and who had better scores were selected to serve in the assault battalion. The remaining recruits were assigned to the regular infantry battalions within the Nahal brigade. During the trial, observers looked for different traits such as perseverance, ability to perform individual and group physical and mental tasks as well as social interactions. Details of the trial are classified and not were not available to the research team. Recruits in the assault battalion have a different and more physically demanding training program than those who serve in the regular battalions.

Nahal recruits inducted in November 2014 (1 assault company & 1 infantry company) and March 2015 (1 assault company & 2 infantry companies) were recruited into the study just after their company assignment.

Study design

Baseline evaluation

Following recruitment into the study, baseline data collection was done on two consecutive days.

Day 1: Data collected included questionnaires regarding demographics, life style, dietary and physical fitness habits as well as self-reporting of past or present orthopaedic injury or pain.

Day 2: A battery of physical tests, was performed in random order (apart from the final test, a shuttle run, to minimize the effects of physical exhaustion on the results of the other tests). To ensure measurement consistency, each physical test was performed on all recruits by the same trained member of the study team.

Physical testing: Measurements were made of height, weight, waist & hip circumferences, upper extremity length (most superior lateral point of acromion process to the lower and lateral border of styloid process of radius, palm facing forward), lower extremity length (anterior superior iliac spine to medial malleolus) and skinfold thickness at four sites: subscapular, biceps, triceps, iliac crest, three times each, (Mayer DC, Ontario, Canada). Body density was calculated according to Durnin & Rahaman [12] and Durnim & Womersly [13]. Body fat percentage was calculated according to Siri [14]. Total foot & heel to ball length were assessed with a Brannock device (Brannock Device Company, Liverpool, NY, USA). Navicular height was assessed with a standard caliper with the recruit standing in relaxed bipedal stance, as the vertical distance from the most medial prominence of the navicular to the supporting surface [15]. Ankle Dorsiflexion (DF) was measured (mean of 3 repetitions, each side) with a digital inclinometer (1° increments, S-Digit mini, Geo-Fennel, Hesse, Germany).

Assessment of major movement limitations and asymmetry were assessed using the Functional Movement Screen (FMS) including seven tests (deep squat, hurdle step, in-line lunge, active straight leg raise, shoulder mobility, trunk stability push-up, and quadruped rotary stability [16, 17]. Rating are from 0 to 3 (0: pain present, 1: unable to complete test, 2: compromised/compensated performance, 3: correct movement without compensation).

Upper and lower quarter balance was assessed by the upper and lower quarter Y balance test (Functional Movement Systems, Inc., Virginia, USA [18, 19]. All examiners performing the FMS tests had formal training to administer the tests.

Dynamic tests: The timed 6-meter hop test [20], the crossover hop test (maximum distance of 3 hops alternating sides of a 15 cm wide tape [20] and a modified 240-meter shuttle run (6 times 40 meters, not paced) without load, followed, after a 10 minute recovery period by a loaded 240-meter shuttle run [21] were performed. Recruits ran wearing a weighted military vest fitted to their torso. The vest weight was set according to the body weight: 9Kg for BW < 60Kg, 11Kg for 60Kg < BW < 80Kg or 13Kg for BW > 80Kg [21, 22]. The time to complete the 240 meters with & without the weighted vest was recorded.

Jump tests: The single leg maximum vertical jump (SLVJ) displacement was performed. After two warm-up trials on each leg, three tests, with at least 20 seconds rest between each jump were performed for each leg. The jump height was assessed by the Optogait System (Microgate Corporation, New York, USA) based on the time in the air [23].

The socio-economic status (SES) of each recruit was defined as being level 1 to 10 based on their place of residence according to tables published by the Israel Central Bureau of Statistics [24]. One represents the weakest and ten the strongest SES.

Recruits were then followed for one year for injuries and attrition. For the first 30 weeks of training a dedicated team of orthopaedists examined each soldier for signs and symptoms of overuse injuries, acute orthopaedic injuries and pain of musculoskeletal origin. All data was incorporated into a custom designed application on a relational database (MS Access®, Microsoft, Redmond, WA) detailing recruits' presence (if absent, reason was determined and attrition documented as necessary) diagnoses, side involved, dates, etc. After the first 30 weeks, follow-up to 52 weeks was conducted by checking the computerized patient record (CPR) of the IDF Medical Corps and documenting all overuse and acute injury related information. This data as well as data from the IDF central manpower database was manually entered into the MS Access® database. Any diagnosed injury was treated according to the IDF Medical Corps guidelines.

Data collection and analysis:

Data collected from the initial phase (questionnaires, results of physical testing) were documented on a paper case report form, verified and assembled into a spreadsheet (MS Excel®, Microsoft, Redmond, WA). Data was imported from the excel and access files and analyzed with SPSS (version 20, IBM Corp., Chicago, IL) and SAS (version 9.4, SAS Institute Inc., Cary, NC, USA).

Injury data (possibly more than 1 per recruit) were flattened with the first incident giving the date. Recruits were divided into those with and those without each injury or injury group. Injuries were grouped into two types: objective injuries including stress fractures, ankle sprains, knee ligament and meniscus injuries, shoulder dislocations, etc., and pain-type injuries where the main manifestation of the injury is pain (back pain, anterior knee pain, shoulder pain, etc.). Attrition was defined as any case where there was positive evidence that the recruit was not serving as a combat soldier at one year following induction. Absolute attrition was defined as a case when the recruit was not serving in the IDF at one year following induction.

Statistical analysis:

Descriptive parameters were analyzed for the entire study population and separately for the subgroups regular battalions and assault battalions. Normality of distributions was assessed visually. Statistical analyses performed included Spearman's and Pearson's correlations between various baseline interval variables followed by parametric tests for normally distributing results (Student's t-test, to compare injured vs. non-injured). Mann-Whitney analysis was performed on non-normally distributing results. chi square or Fischer's exact tests were used for nominal variables. Independent variables associated with outcome measures by univariate analysis were assessed by logistic regression. Differences were considered statistically significant if the p value was less than 0.05. Survival analysis was performed with SAS PROC LIFETEST.

Sample size calculation:

Based on an expected 1 year overall injury rate of 50%, and a 10% rate of FMS ≤ 14 (O'Connor et al.[25]), it would be reasonable to expect that if low FMS scores predicted injury well (20% more than the norm),

there would be 70% injured in the low FMS score group (47.7% in the high FMS score group). With $\alpha = 0.05$ and $\beta = 0.2$, unequal groups (1:9 ratio) the total needed is 300 subjects (actual power = 0.923, PROC POWER, SAS).

Results

303 recruits, average age 19.1 ± 1.1 years were enrolled into the study. 126 were in the first induction and 177 in the second induction group. Overall, 186 recruits were in regular infantry battalions and 117 were in assault battalions. The characteristics of recruits in the regular infantry battalion compared with those in the assault battalion are presented in Table 1. Recruits in the assault battalion were slightly older and had statistically significant higher mean KABA scores as well as higher mean scores for each of the three subcomponents of their KABA scores, than those in regular infantry battalion. The recruits in the assault battalion were also more physically fit as judged by their running shuttle times. This was also reflected in their having participated in more physical training and lower smoking rates.

Table 1 – Baseline characteristics of regular and assault infantry recruits

	N	All Average ± SD	Regular infantry Average ± SD	Assault infantry Average ± SD	
Parameter		303, 100%	186, 61.4%	117, 38.6%	p value (t-test)
Age (years)	303	19.1±0.9	19.0±0.9	19.2±0.8	0.0586
Height (cm)	299	177.1±6.5	177.0±6.5	177.2±6.5	NS
Weight (Kg)		72.1±10.9	72.3±12.0	71.8±8.9	NS
BMI		23.0±3.2	23.0±3.5	22.9±2.6	NS
Fat percentage		16.0±4.2	16.8±4.4	14.8±3.5	<.0001
Waist hip ratio		0.85±0.37	0.89±0.60	0.82±0.04	NS
Navicular height (mm)_right	296	45.0±7.6	44.6±7.9	45.4±7.0	NS
Shoe size	297	43.4±2.6	43.2±3.1	43.6±1.5	NS
Foot length right (mm)		270±13	270±14	270±11	NS
Heel to bunion length right (mm)		194±9	194±10	194±9	NS
Upper extremity length right (cm)	298	57.2±3.5	57.0±3.8	57.6±2.8	0.0865
Lower extremity length right (cm)	297	92.1±5.9	91.9±6.2	92.3±5.5	NS
Shuttle run time with no weights (sec)	286	63.9±6.4	64.8±7.8	62.5±3.2	0.0006
Shuttle run time with weights (sec)	278	68.5±7.3	69.7±8.7	66.6 ± 3.8	0.0006
Delta shuttle run time (sec)	278	4.5±6.0	4.8±7.5	4.2±2.1	NS
Years of physical training	292	2.9±1.6	2.7±1.6	3.4±1.6	0.0003 ^a
Weekly training sessions (>30m)	295	2.7±1.0%	2.5%±1.0	3.1%±1.1	<0.0001 ^a

Smoking ^b	258	38.4%	47.2%	24.2%	0.0002 ^c
Smoking $\geq$ 3 years ^b	249	18.8%	23.7%	11.1%	0.0065 ^c
Psychotechnical Grading	303	56.3 $\pm$ 17.1	54.3 $\pm$ 17.2	59.4 $\pm$ 16.6	0.01
General Interview Score	286	26.8 $\pm$ 4.9	25.8 $\pm$ 4.9	28.4 $\pm$ 4.4	<0.0001
KABA	303	52.2 $\pm$ 3.0	51.7 $\pm$ 3.1	53.0 $\pm$ 2.7	0.0003
Socio-Economic Status	300	6.1 $\pm$ 1.6	6.2 $\pm$ 1.5	5.9 $\pm$ 1.7	NS

Statistical significance by Student's t test unless stated otherwise. ^aCochran-Armitage Trend Test.

^bPresented as % of recruits. ^cChi square.

During their first year of military service, 30 recruits (9.9%) had stress fractures, 88 (29.0%) had back pain, 71 (23.4%) had anterior knee pain and 25 (8.3%) had ankle sprains. Overall, 165 (54.5%) recruits were diagnosed with orthopaedic injury or pain. Details of injuries and groupings are presented in Table 2. Total orthopaedic diagnoses are divided according to those of a more objective nature, e.g. ankle sprain & stress fracture and those of a more subjective nature e.g. back pain & anterior knee pain. There was a statistically higher incidence of recruits suffering from more subjective diagnoses than those suffering from more objective diagnoses ($p = 0.0001$). Recruits in the assault battalion sustained more ankle sprains and more upper extremity injuries than recruits in the regular battalion, but they had lower rates of back pain. Overall, of the 303 recruits inducted, 46 (15.2%) did not manage to complete the year as combatants. The attrition rate was 37/186 (19.9%) for the regular infantry recruits and 9/117 (7.7%) for assault infantry recruits ($p = 0.004$). Eighteen of the 46 recruits (39%) who did not complete the year as combatants were discharged from military service (during the year). The rest continued to serve in non-combatant capacities.

Table 2 - Outcome injuries and attrition during the first year of service by battalion

	All N=303 (%)	Regular Infantry N =186 (%)	Assault Infantry N-117 (%)	p value
Femoral stress fracture	6 (2.0%)	3 (1.6%)	3 (2.6%)	NS
Tibia stress fracture	22(7.3%)	16 (8.6%)	6 (5.3%)	NS
Metatarsal stress fracture	3(1.0%)	2 (1.1%)	1 (0.8%)	NS
Other stress fracture	1(0.3%)	0	1 (0.8%)	NS
All stress fracture	30 (9.9%)	20 (10.7%)	10 (8.6)	NS
Lateral ankle sprain grades 1-3	25 (8.2%)	11 (5.9%)	14 (12.0%)	0.062
Achilles tendinitis	3 (1.0%)	1 (0.5%)	2 (1.7%)	NS
Anterior knee pain	71 (23.4%)	45 (24.2%)	26 (22.2%)	NS
Low back pain	35 (11.6%)	29 (15.6%)	6 (5.1%)	0.005
All back pain	88 (29.0%)	63 (33.9%)	25 (21.4%)	0.020
All upper extremity injuries	33 (10.9%)	15 (8.1%)	18 (15.4%)	0.047
All foot injuries	37 (12.2%)	22 (11.8%)	15 (12.8%)	NS
Injury (objective type injury)	56 (18.5%)	31 (16.7%)	25 (21.4%)	NS
Pain (pain type injury)	131 (43.2%)	87 (46.8%)	44 (37.6%)	NS
Injury or pain (either type)	165 (54.5%)	104 (55.9%)	61 (52.1%)	NS
Attrition	46 (15.2%)	37(19.9.0%)	9 (7.7%)	0.004

None of the anthropometric or physical parameters measured or responses received from the questionnaires at baseline (including satisfaction questions) were related to the outcome measures of injury, pain, and attrition). Reporting pain during the screening tests was associated with more total injuries and "pain" type injuries but not the injuries classified as objective. Full data is presented in Additional file 1.

Factors associated with attrition on univariate analysis are presented in Table 3. Relative risks are presented only for significant factors of discrete variables. Note that the first three factors presented in the table are diagnoses made during training.

Table 3 - Factors associated with attrition on univariate analysis. Relative risks presented only for significant factors of discrete variables.

Variable	Succeeded	Failed (attrition)	RR (CI) Comment	P
Injury during training	54 (96.4%)	2 (3.6%)	0.20 (0.05 to 0.80%)	0.007
No injury during training	203 (82.2%)	44 (17.8%)	Injury protective factor	
Pain during training	119 (90.8%)	12 (9.2%)	0.46 (0.25 to 0.86%)	0.011
No Pain during training	138 (80.2%)	34 (19.8%)	Pain protective factor	
Injury or pain (Total injury)	151 (91.5%)	14 (8.5%)	0.37 (0.20 to 0.66)	0.0004
No Injury nor pain	106 (76.8%)	32 (23.2%)	Injury protective factor	
Pain in Y-balance test	62 (72.8%)	22 (26.2%)	2.4 (1.4 to 4.1)	0.001
No pain Y-balance test	188 (89.1%)	23 (10.9%)	Balance pain risk factor	
Pain FMS	189 (85.5%)	32 (14.5%)		NS
No pain FMS	64 (83.1%)	13 (16.9%)		
Pain Y-balance leg	38 (74.5%)	13 (25.5%)	1.91 (1.08 to 3.38)	0.03
No pain Y-balance leg	208 (86.7%)	32 (13.3%)		
Pain Y-balance arm	35 (74.5%)	12 (25.5%)	1.87 (1.04 to 3.36)	0.04
No pain Y-balance arm	196 (86.3%)	31 (13.7%)		
Pain FMS clearing 2	56 (78.9%)	15 (21.1%)	1.72 (0.96 to 3.08)	0.07
No pain FMS clearing 2	171 (87.7%)	24 (12.3%)		
Satisfaction with army assignment	86.7±18.6	78.7±27.0		0.058
Regular Infantry	149 (80.1%)	37 (19.9%)	2.59 (1.30 to 5.16)	0.004
Assault Infantry	108 (92.3%)	9 (7.7%)		
Psychotechnical Grading	58.0±16.8	47.3±15.5		<0.0001
General Interview Score	27.3±4.7	24.5±5.4		0.0006

KABA	52.5±2.8	50.4±3.2	<0.0001
Socio-Economic Status	6.0±1.6	6.3±1.6	NS

Figure 1 presents the reasons for attrition and the survival without attrition of soldiers in the regular and assault battalions. Attrition refers to transfer from the status of a combat infantry soldier to a non-combat soldier. The attrition was significantly greater in the regular infantry battalion ($P=0.0034$, PROC LIFETEST, Chi-Square, Wilcoxon). The major reason for attrition among both regular and assault infantry soldiers was there not being able to perform the tasks required by their unit or not being able to fit in with their unit. The reason for attrition was medical for 19% of the regular infantry recruits and 11% for the assault infantry recruits ($p = 0.3$).

Table 4 presents the multivariate analysis of factors associated with attrition defined as not serving as an infantry soldier at one year. Higher KABA and pain or injury during training were protective factors and pain. Recruits with pain in Y-balance test had 3.4 times more attrition. These variables together are responsible for 15.4% of attrition by partial eta squared.

Table 4 - Factors significant in for attrition multivariate analysis

Outcome	Variable	P	Odds ratio (95% Confidence Limits)	Partial Eta Squared
Attrition (52w)	Intercept	0.0008		
	KABA	0.0001	0.78 (0.69 to 0.89)	0.070
	Injury or pain (during training)	0.0004	0.21 (0.09 to 0.50)	0.053
	Pain in Y-balance test	0.004	3.39 (1.47 to 7.79)	0.031

Discussion

Because modern warfare is increasingly technologically based, soldiers require longer training periods. The length of duty of soldiers is also a function of the characteristics of the armies in which they serve and may be relatively short. At the time of this study the time of compulsory service for males in the IDF was 36 months. The supply of quality new recruits may also be limited. All of these factors together make attrition a problem. The attrition rate found in this study was 15.2%. at one year. This number compares to the 15% attrition in the US. Army reported in the Rand study for the same time period [2]. These number however represent very different things. The US. Army numbers represent those soldiers who leave service. The IDF number represents those recruits who left their combat unit. Only 6% were actually discharged from military service. The rest of the attriters remained in military service, but were transferred to non-combatant roles in the IDF. By employing this system, the IDF is able to gain some utility even from recruits who did succeed as infantry soldiers.

Fifty-four percent of recruits in this study suffered from orthopaedic injuries or pain during their first year of military service, but FMS, upper and lower quarter Y balance tests, and dynamic tests were not predictive for their injuries. Orthopaedic problems were the reason for attrition in most of the cases. While 17% of the attrition in this study was for non-psychiatric medical reasons, but only 37.5% of the medical reasons were orthopaedic problems. This corresponds to the previously report of orthopaedic problems being 43% of the medical reasons for attrition in a retrospective IDF cohort of infantry and non-infantry combat soldiers [11].

Because of a high incidence of musculoskeletal problems in the U.S. military, FMS and Y-balance tests were evaluated as a possible predictor of risk for musculoskeletal problems during the first 180 days of military training [26]. Similar to the present study, they did not find these tests to have predictive value for musculoskeletal injuries. This finding was true for both males and females as well for service in the army, air force and marines. There is evidence that the ability to predict musculoskeletal injuries in non-military populations is also limited [27–31].

By multivariable analysis higher Quality Group (KABA) scores and pain or injury during basic training were found to be protective factors for attrition in the present study. Pain during the Y-balance test predicted increased risk for attrition. FMS and other functional tests scores were not found to be related to attrition by multivariable analysis. The IDF Manpower Corps has used KABA scores to designate the suitability of a recruit for service in different tracks within the IDF for over two decades. The present study shows that KABA scores can be used to predict attrition in infantry soldiers. There is some evidence that KABA scores may be less predictive of recruit performance for ultra-orthodox and Ethiopian recruits in the IDF. Infantry assault recruits in this study had higher mean KABA scores than infantry recruits. Recruits that did not pass the strenuous three-day physical sorting process for entrance into the assault battalion were 2.6 times more likely to not be combat soldiers at one year than those who passed the sorting process. This is in spite of the fact that the training in the assault battalions is significantly harder than in the regular infantry battalions.

One would expect recruits with injury or pain during their training would have a higher attrition rate. On multivariable analysis the opposite was true in this study. It may be that those recruits with injury or pain had less attrition because they refrained from pushing themselves to their physical maximum. They may have done this because they received reduced duty from their commanders or simply reduced their own personal effort. The second possibility is that these recruits, acknowledged their pain and learned to accept that experiencing pain is part of infantry training and not necessarily representative of pathology. This is in line with the concepts behind Acceptance Commitment Therapy (a form of relational frame theory related to cognitive behavioral therapy). Confronting pain rather than trying to avoid it is known as "cognitive defusion" [32, 33]. In this manner, receiving an orthopaedic diagnosis and discussing it with clinicians, officers and/or peers could have had a positive effect.

That experiencing pain during the Y-balance test was found to be a risk factor for attrition may indicate that such soldiers had lower thresholds of pain. This might make them less likely to be able to tolerate

the pain that normally accompanies infantry training.

Abbreviations

IDF

Israel Defense Forces

KABA

Quality group score (Hebrew acronym)

HMO

Health maintenance organization

FMS

Functional movement score

CPR

Computerized patient record

Declarations

Ethics approval and consent to participate

The study protocol was approved by the ethics committees of the Israeli Defense Forces (1294-13-IDF) and the Sheba Medical Center (0529-13-SMC) and registered in the NIH research database (clinicaltrials.gov, registration number NCT02091713). All subjects signed informed consent.

Consent for publication

Not applicable

Availability of data and materials

Except for the supplementary files, the datasets generated and/or analyzed during the current study are not publicly available due to the potential sensitive nature of military healthcare data.

Competing interests

The authors declare that they have no competing interests.

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Authors contributions

CF designed, organized and supervised the project. RN participated in study design and was responsible for manpower allocation and the budget. UE and HG organized and participated in the recruit screening.

YH participated in study design and data analysis. CM and ASF performed the orthopaedic follow-up and performed data analysis and wrote the manuscript.

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Figures

Figure 1

The time and reasons for recruit attrition

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The time and reasons for recruit attrition

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