Increasing the Physical Fitness of Low-Fit Recruits before Basic Combat Training: An Evaluation of Fitness, Injuries, and Training Outcomes

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Recruits arriving for basic combat training (BCT) between October 1999 and May 2004 were administered an entry-level physical fitness test at the reception station. If they failed the test, then they entered the Fitness Assessment Program (FAP), where they physically trained until they passed the test and subsequently entered BCT. The effectiveness of the FAP was evaluated by examining fitness, injury, and training outcomes. Recruits who failed the test, trained in the FAP, and entered BCT after passing the test were designated the preconditioning (PC) group (64 men and 94 women). Recruits who failed the test but were allowed to enter BCT without going into the FAP were called the no preconditioning (NPC) group (32 men and 73 women). Recruits who passed the test and directly entered BCT were designated the no need of preconditioning (NNPC) group (1,078 men and 731 women). Army Physical Fitness Test (APFT) scores and training outcomes were obtained from a company-level database, and injured recruits were identified from cases documented in medical records. The proportions of NPC, PC, and NNPC recruits who completed the 9-week BCT cycle were 59%, 83%, and 87% for men ($p < 0.01$) and 52%, 69%, and 78% for women ($p < 0.01$), respectively. Because of attrition, only 63% of the NPC group took the week 7 APFT, compared with 84% and 86% of the PC and NNPC groups, respectively. The proportions of NPC, PC, and NNPC recruits who passed the final APFT after all retakes were 88%, 92%, and 98% for men ($p < 0.01$) and 89%, 92%, and 97% for women ($p < 0.01$), respectively. Compared with NNPC men, injury risk was 1.5 (95% confidence interval, 1.0–2.2) and 1.7 (95% confidence interval, 1.0–3.1) times higher for PC and NPC men, respectively. Compared with NNPC women, injury risk was 1.2 (95% confidence interval, 0.9–1.6) and 1.5 (95% confidence interval, 1.1–2.1) times higher for PC and NPC women, respectively. This program evaluation showed that low-fit recruits who preconditioned before BCT had reduced attrition and tended to have lower injury risk, compared with recruits of similar low fitness who did not precondition.

Introduction

Physical fitness has been shown to be a critical element in the success of new recruits who enter basic combat training (BCT). Individuals who have a low level of physical fitness on arrival at BCT have been shown to be more susceptible to injury[1,2] and more likely to be discharged[3] than their more-fit counterparts. Multivariate analysis of discharge risk factors suggested that physical fitness might be even more important than the classic indicator of discharge risk, educational level.[3,4]

In 1998, Fort Jackson, South Carolina, recognized the importance of initial physical fitness in BCT and established a minimal physical fitness requirement for entrance to BCT.[5] A fitness test program had existed since 1987, but the only passing requirement for entry to BCT in that early program was 1 push-up (PU) for women and 13 PUs for men.[6] In October 1998, the test was changed to a three-event evaluation that included PUs, sit-ups (SUs), and a 1-mile run. In October 1999, fitness standards for entry to BCT were mandated by the Army Training and Doctrine Command for all five locations where Army BCT was conducted.[7] Between October 1999 and May 2004, new recruits arriving for BCT were given the entry-level physical fitness test at the BCT reception station and could not enter BCT until they met the standards shown in Table I. After May 2004, the entry-level fitness test was no longer conducted at the reception station. It became the responsibility of Army recruiters to administer the test to new recruits, and recruits did not ship to their BCT training site until they passed the test.

For the entry-level physical fitness test at the reception station, recruits were tested in large groups, with drill sergeants administering the tests. A drill sergeant read detailed instructions on how to perform each test event, from Army Field Manual 21-20.[8] When testing began, drill sergeants conducted one-on-one monitoring of the performance of each trainee in PUs and SUs. The recruit had only to meet, not to exceed, the standards in Table I (i.e., if the trainee met the standard, then the test was successfully terminated). If a recruit failed the PU event on the first attempt, then he or she was sent to another drill sergeant and given specific individualized instruction on how to perform correct PUs; a second attempt was allowed. Only one attempt was allowed for the SU test and the 1-mile run. For the 1-mile run, recruits were provided a "pacer," who ran at the exact pace required to pass the test. In addition, "chasers" attempted to motivate recruits who fell behind the pacer and reminded recruits where the pacer was located.

If a recruit failed to meet the criterion for any single test event, then the recruit was considered a test failure and entered the Fitness Assessment Program (FAP). In the FAP, recruits performed a specific physical training program that included running, weight training, PU and SU improvement, road marching, and stretching. They also participated in military training, e.g., customs and courtesies, drill and ceremony, wearing of the uniform, Uniform Code of Military Justice, and Army values. Entry-level fitness tests were administered twice per week; once

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TABLE I

ENTRY-LEVEL PHYSICAL FITNESS TEST CRITERIA TO ENTER BCT

Event	Men	Women
PUs (repetitions)	13	3
SUs (repetitions)	17	17
1-mile run (minutes)	8.5	10.5

the trainee passed the test, he or she could begin BCT. Those who could not meet the standards within 3 to 4 weeks were discharged from service.

The purpose of this study was to examine the effectiveness of the FAP in preparing recruits for BCT. BCT outcome measures that determined FAP effectiveness included physical fitness, injuries, and training outcomes (attrition or graduation).

Methods

Groups

Three groups of recruits who trained in 10 BCT companies (two battalions) at Fort Jackson, South Carolina, between late March and June 2003 were examined. One group of recruits failed the entry-level physical fitness test and entered the FAP in the normal manner. They trained in the FAP until they could pass the test and subsequently entered BCT (64 men and 94 women). This group was designated the preconditioning (PC) group. Another group of recruits failed the entry-level physical fitness test but were allowed to enter BCT without preconditioning in the FAP (32 men and 73 women). This cohort was designated the no preconditioning (NPC) group. The third group of recruits included those who passed the entry-level fitness test and went directly to BCT in the normal manner (1,078 men and 731 women). This group was designated the no need of preconditioning (NNPC) group.

Physical Fitness Outcomes

Once the recruit entered BCT, two types of physical fitness tests were conducted. The first type was the initial fitness assessment. This test consisted of a 1-minute, maximal-effort, PU event, a 1-minute, maximal-effort, SU event, and a 1-mile run for time. This test was given within 1 to 3 days after arrival at the BCT company. The second type of fitness test was the Army Physical Fitness Test (APFT). This consisted of a 2-minute, maximal-effort, PU event, a 2-minute, maximal-effort, SU event, and a 2-mile run for time.[8–10] APFTs were administered at weeks 5 and 7 of the 9-week BCT cycle. All fitness tests were administered by the drill sergeants, who were very familiar with the well-standardized test procedures. Test scores for all fitness tests were downloaded from a company-level database called Warrior Training Room.

Administration of the three events in the initial fitness assessment and the APFT were identical except for the time allotted to the PU and SU events and the distance of the run. For PUs, trainees were required to lower their bodies in a generally straight line to a point where their upper arms were parallel to the ground and then to return to the starting point, with their elbows fully extended. For SUs, trainees' knees were bent at a 90° angle, fingers were interlocked behind the head, and a second person held the participant's ankles, keeping the participant's heels firmly on the ground. The trainees raised their upper bodies to a vertical position, so that the base of the neck was anterior to the base of the spine, and then returned to the starting position. The numbers of PUs and SUs successfully completed in the allotted time were recorded. For the run, the time to complete the distance was the performance measure.

To meet a mandated BCT graduation requirement, recruits were required to achieve certain age- and gender-adjusted standards[8] at week 7 of BCT. Trainees who did not meet the standards by week 7 were allowed to retake the test, and there were no limits on the number of retakes, at the discretion of the company drill sergeants.

Injury Outcomes

Injury data were obtained from the Standard Ambulatory Data Record (SADR), which contains automated accounts of outpatient medical visits. Each time a trainee saw a medical care provider at the troop medical clinic or the hospital, that provider completed a SADR form as part of the medical visit. The SADR form included the date of the visit and the diagnosis (as an International Classification of Diseases Code, 9th Revision). The Army Medical Surveillance Activity downloaded the SADR data for all recruits in the 10 companies involved in this project. Specific, preselected, International Classification of Diseases Code, 9th Revision, indicative of injury[11] were used to determine whether the trainees in the study were injured.

Training Outcomes

Training outcomes for recruits included graduation, discharge, newstarting, or being sent to the APFT Enhancement Program (APFTEP). Graduates were recruits who began training on the first day of the company training cycle and graduated with the same company after 9 weeks of BCT. The largest proportion of trainees typically had this outcome.

Discharged trainees were those who were deemed unsuitable for service in the Army and were formally released from their service commitment. There were numerous reasons for discharge, but most reasons fell into two major categories, i.e., medical conditions that existed before service or poor entry-level performance. Entry-level performance discharges were most often the result of the trainee's inability to adapt to the military environment because of lack of ability (could not adequately perform critical military tasks) or psychosocial reasons (e.g., lack of motivation, inability to follow orders, or personality problems).

Newstarted trainees were those who left any of the companies involved in this project and entered another BCT unit before the end of the 9-week BCT cycle. Trainees were newstarted (recycled) because they did not complete mandatory requirements for reasons such as lack of motivation, serious injury, emergency leave, or inability to meet specific training standards with their peers (i.e., difficulty developing specific skills such as basic rifle marksmanship).

APFTEP trainees were a special class of newstarts who were tracked separately for this project. APFTEP trainees were those who could not pass their final APFT before their scheduled graduation date. Rather than graduate, they were sent to the APFTEP, where they physically trained for up to ~3 weeks. Once

they passed the test, they graduated; if they could not pass the test within the allotted time, they were discharged from service. Discharges or graduations from the APFTEP were not tracked in this study; the endpoint for this analysis was entry into the APFTEP.[12]

Training outcomes were downloaded from the Warrior Training Room database. The dates of individual training outcomes were not included as part of Warrior Training Room and needed to be obtained from other sources. Discharge dates were obtained from discharge summaries provided by the battalion S-1 (Personnel Section). Newstart dates were obtained from summaries provided by the battalion S-3 (Plans, Training, and Operations Section). Dates of arrival at the APFTEP were obtained from rosters in the APFTEP unit.

Physical Characteristics

Age and gender data were obtained from the Warrior Training Room database. Height and weight data were obtained from the Reception Battalion Automated Support System. Body mass index (BMI) was calculated as weight/height^2.[13]

Data Analysis

SPSS software, version 10.0.5 or 12.0.1 (SPSS, Chicago, Illinois), was used for all analyses. Differences among groups in physical characteristics (age, height, weight, and BMI) were analyzed by using one-way analysis of variance (ANOVA) followed by Tukey's test. Group differences in the proportions of graduated, discharged, newstarted, and APFTEP trainees were analyzed by using the χ^2 test of proportions.

Comparison of group differences in the initial fitness assessment results was made by using one-way ANOVA followed by Tukey's test. Comparison of group differences on the APFT at weeks 5 and 7 was performed by using ANOVA and, where necessary, analysis of covariance (ANCOVA). If there were no significant differences for the initial fitness assessment, then a 3×2 (groups by weeks) mixed-model ANOVA was performed. The model compared the groups as independent measures and the test periods as repeated measures. If there were significant differences for the initial fitness assessment, then an ANCOVA was performed. For the ANCOVA, a 3×2 mixed-model analysis was performed after adjustment for the initial fitness assessment scores. These analyses were performed separately with the raw scores for each test event (PU, SU, and run events). Group differences in both the ANOVA and ANCOVA were analyzed with Tukey's test. Group differences in the proportions of trainees passing the APFT at week 5, week 7, and after all retakes were analyzed with the χ^2 test of proportions.

Cox regression (survival analysis) was used to examine group differences in time to first injury. Univariate analysis considered each covariate separately (groups, age, height, weight, BMI, and initial fitness assessment events). Covariates were included in a multivariate model if they achieved a p value of <0.25 in the univariate analysis.[14] However, initial fitness assessment events were not included in the multivariate model, because these covariates already distinguished between the three groups (i.e., physical fitness determined group differences). For each Cox regression, once a trainee had an injury, his or her contribution to time in BCT was terminated for injury analysis purposes. Those not completing BCT (discharged, newstarted, and APFTEP personnel) had their times terminated (censored) on the day they left the unit. All covariates were entered into the regression models as categorical variables. Continuous variables were converted into categorical variables with four approximately equally sized risk groups (quartiles) based on the gender-specific distribution of scores for each event. Age was partitioned into three categories (17–19, 20–24, or >24 years). For all variables, simple contrasts with a baseline variable were used (baseline defined with a risk ratio of 1.00).

Results

Entry-Level Physical Fitness Test

Table II shows the entry-level physical fitness test results for the three groups. No statistical analyses involving the NNPC group were performed because there was no variance in PU and SU test scores (the test was terminated after trainees reached a particular number of repetitions). Examination of the scores in Table II shows that performance on all test events was higher for the NNPC group, compared with the NPC and PC groups. Performance differences between the NPC and PC groups were small. The average ± SD time in the FAP for the PC group was 19 ± 9 days for men, 17 ± 9 days for women, and 18 ± 9 days for men and women combined.

Table III shows the proportions of NPC and PC trainees who failed events in the entry-level physical fitness test. NNPC trainees are not included because they all passed the test. A trainee could have failed more than one event. There were no significant differences between the NPC and PC groups in the proportions of trainees who failed test events. The largest proportion of test failures was attributable to slow run times.

Physical Characteristics

Table IV shows a comparison of the physical characteristics of the three groups. Physical characteristics differed little between NPC and PC trainees, although PC women were slightly taller than NPC women. NPC and PC men and women were heavier and had higher BMI values than did NNPC men and women.

TABLE II

COMPARISON OF ENTRY-LEVEL FITNESS TEST SCORES (MEANS ± SD)

Group	PUs (repetitions)	SUs (repetitions)	1-Mile Run (minutes)
Men			
NPC	12 ± 3	16 ± 4	9.2 ± 1.1
PC	11 ± 4	15 ± 4	9.1 ± 1.0
NNPC	13 ± 0	17 ± 0	7.3 ± 0.8
p^a	0.48	0.36	0.59
Women			
NPC	2 ± 1	14 ± 6	11.0 ± 1.6
PC	2 ± 1	12 ± 6	11.0 ± 1.1
NNPC	3 ± 0	17 ± 0	9.3 ± 1.0
p^a	0.70	0.10	0.93

[a] From t test comparing NPC and PC. No test was performed for NNPC because of the lack of variance in the PU and SU scores.

TABLE III

COMPARISON OF PROPORTION OF TRAINEES FAILING EACH ENTRY-LEVEL PHYSICAL FITNESS TEST EVENT

Gender	Group	PUs	SUs	1-Mile Run
Men	NPC (% failed)	15.6	21.9	75.0
	PC (% failed)	27.1	28.8	72.4
	p^a	0.21	0.47	0.79
Women	NPC (% failed)	41.1	35.6	67.1
	PC (% failed)	36.4	45.5	57.0
	p^a	0.54	0.21	0.19

[a] From χ^2 test of proportions.

Physical Fitness Outcomes

Only trainees who completed the fitness tests could be included in the analysis of the physical fitness outcomes, because ANOVA and ANCOVA require full data. Table V shows the proportion of trainees who took the initial fitness assessment and the week 7 APFT. There was a tendency for fewer trainees in the NPC group to take the initial fitness assessment, compared with the PC and NNPC groups. Because of attrition, substantially fewer trainees in the NPC group took the final APFT (week 7), compared with the PC and NNPC groups. There were no significant differences in the proportions of PC and NNPC trainees who took the initial fitness assessment or the final APFT.

Table VI shows the initial fitness assessment scores for the three groups. At the start of training, there were substantial differences between the three groups. For all three test events, the NNPC group demonstrated higher performance levels than did the NPC and PC groups, among both men and women. In the PU event, the performance of the PC group was similar to the performance of the NPC group for both men and women. For both the SU and 1-mile run events, the performance of the PC trainees exceeded that of the NPC trainees. Overall, the NNPC group was the most fit at the start of BCT, followed by the PC group and finally the NPC group.

Table VII shows the APFT raw scores for men and women in the three groups. For all three events among both men and women, there were significant main effects of weeks ($p < 0.01$) and groups ($p < 0.01$). Most interactions were not significant ($p > 0.30$), except for the female SU data ($p < 0.01$). For the female SU data, the group by week interaction suggested that the PC and NPC groups improved more than the NNPC group from week 5 to week 7. The post hoc Tukey's test of the group main effects indicated that, for all three events among both men and women, the NNPC group demonstrated higher performance than the NPC and PC groups ($p < 0.01$). There were no differences between the NPC and PC groups ($p > 0.58$).

Table VIII shows the proportions of men and women passing the APFT. At week 5, at week 7, and after all retakes, the proportion of passing recruits in the NNPC group was greater than those in the NPC and PC groups. Although the proportion of PC recruits passing the test was consistently higher than the proportion in the NPC group, these differences were not significant at any of the three time points for either men or women.

Injury Outcomes

Table IX shows the univariate Cox regression results for groups, age, height, weight, BMI, and the three fitness variables. Compared with the NNPC group, the NPC group had the highest injury risk, followed by the PC group, for both men and women. Older men and women were at elevated injury risk, compared with the youngest group. Height, weight, and BMI had little consistent association with injury risk. Lower performance on any initial fitness assessment event (PU, SU or 1-mile run event) was associated with progressively higher injury risk.

Table X shows the multivariate Cox regression with groups, age, height, and weight in the model. Injury risk among the three groups remained similar to that in the univariate analyses. Injury risk was highest in the NPC group, lower in the PC group, and lowest in the NNPC group.

Training Outcomes

Table XI shows the training outcomes of the three groups. For both men and women, the proportion of graduates was considerably less in the NPC group than in the NNPC and PC groups.

TABLE IV

COMPARISON OF PHYSICAL CHARACTERISTICS

		Men						Women					
Variable	Group	Mean	SD	p^a All 3 Groups	p^b NPC vs. PC	p^b NPC vs. NNPC	p^b PC vs. NNPC	Mean	SD	p^a All 3 Groups	p^b NPC vs. PC	p^b NPC vs. NNPC	p^b PC vs. NNPC
Age (years)	NPC	23.1	5.3					21.3	3.6				
	PC	23.0	4.4	0.02	0.99	0.17	0.07	22.2	4.5	0.32	0.33	0.81	0.39
	NNPC	21.8	3.9					21.6	4.1				
Weight (pounds)	NPC	185.5	25.7					144.7	24.2				
	PC	197.3	33.2	<0.01	0.15	0.02	<0.01	145.9	23.9	<0.01	0.92	<0.01	<0.01
	NNPC	171.3	29.2					136.7	20.2				
Height (inches)	NPC	69.2	2.8					64.1	2.6				
	PC	69.7	3.6	0.51	0.65	0.96	0.51	64.9	2.5	0.07	0.10	0.76	0.08
	NNPC	69.3	2.8					64.3	2.5				
BMI (kg/m^2)	NPC	27.2	3.7					24.6	3.2				
	PC	28.4	3.8	<0.01	0.31	<0.01	<0.01	24.3	3.4	<0.01	0.71	<0.01	<0.01
	NNPC	25.0	3.8					23.2	2.8				

[a] From one-way ANOVA comparing all three groups.
[b] From Tukey's test.

TABLE V

COMPARISON OF PROPORTIONS OF TRAINEES TAKING INITIAL FITNESS TEST AND APFT AT WEEK 7

Test	Group	*n*	Proportion Taking Test (%)	p^a All 3 Groups	NPC vs. PC[a]	NPC vs. NNPC[a]	PC vs. NNPC[a]
Initial	NPC	105	92.4				
fitness	PC	158	96.8	0.16	0.10	0.08	0.59
assessment	NNPC	1,809	96.0				
Week 7	NPC	105	62.9				
APFT	PC	158	83.5	<0.01	<0.01	<0.01	0.40
	NNPC	1,809	86.0				

[a] From χ^2 test of proportions.

TABLE VI

COMPARISON OF INITIAL FITNESS ASSESSMENT SCORES

Event	Group	Mean	SD	p^a All 3 Groups	p^b NPC vs. PC	p^b NPC vs. NNPC	p^b PC vs. NNPC
Men							
PUs (repetitions)	NPC	18	11				
	PC	21	10	<0.01	0.45	<0.01	<0.01
	NNPC	29	11				
SUs (repetitions)	NPC	24	8				
	PC	28	5	<0.01	0.05	<0.01	<0.01
	NNPC	31	7				
1-mile run	NPC	10.1	1.5				
(minutes)	PC	9.4	1.8	<0.01	0.02	<0.01	<0.01
	NNPC	8.3	1.3				
Women							
PUs (repetitions)	NPC	4	6				
	PC	4	5	<0.01	0.96	<0.01	<0.01
	NNPC	10	9				
SUs (repetitions	NPC	18	10				
	PC	22	8	<0.01	<0.01	<0.01	<0.01
	NNPC	25	9				
1-mile run	NPC	11.8	1.6				
(minutes)	PC	10.8	1.5	<0.01	<0.01	<0.01	<0.01
	NNPC	10.2	1.6				

[a] From one-way ANOVA.
[b] From Tukey's test.

TABLE VII

APFT RAW SCORES (MEANS ± SD)

		Men			Women		
Test	Group	PUs (repetitions)	SUs (repetitions)	2-Mile Run (Minutes)	PUs (repetitions)	SUs (repetitions)	2-Mile Run (Minutes)
Week 5 APFT	NPC	36 ± 12	46 ± 11	17.3 ± 1.6	15 ± 10	44 ± 14	20.4 ± 2.6
	PC	33 ± 12	49 ± 10	17.3 ± 1.6	13 ± 9	46 ± 12	20.3 ± 2.5
	NNPC	44 ± 12	56 ± 11	15.4 ± 1.6	23 ± 9	54 ± 12	18.6 ± 2.2
Week 7 APFT	NPC	37 ± 12	54 ± 9	16.5 ± 1.4	18 ± 9	52 ± 12	19.2 ± 2.0
	PC	36 ± 11	54 ± 9	16.7 ± 1.1	18 ± 9	55 ± 10	19.2 ± 1.7
	NNPC	47 ± 12	61 ± 11	14.7 ± 1.2	26 ± 10	60 ± 11	17.7 ± 1.6

For men, there was only a small difference in the proportions of graduates between the NNPC group and the PC group. For women, there was a greater proportion of NNPC graduates than PC graduates.

Among the men, the proportion of discharges in the NPC group was ~3 times higher than in the PC and NNPC groups; the latter two groups did not differ from each other. Among the women, the proportion of discharges in the NPC group was about twice as high as in the PC and NNPC groups; the latter two groups did not differ from each other.

Among the men, the proportion of newstarts in the NPC group was ~3 to 4 times higher than in the PC and NNPC groups; the

TABLE VIII

COMPARISON OF PROPORTION OF THREE GROUPS PASSING THE APFT

	Group	Proportion Passing (%)	p^a All 3 Groups	p^a NPC vs. PC	p^a NPC vs. NNPC	p^a PC vs. NNPC
Men						
Week 5	NPC	20.0				
	PC	32.6	<0.01	0.30	<0.01	0.01
	NNPC	67.1				
Week 7	NPC	54.5				
	PC	64.4	<0.01	0.42	<0.01	<0.01
	NNPC	90.3				
After all retakes	NPC	87.5				
	PC	92.2	<0.01	0.46	<0.01	<0.01
	NNPC	98.3				
Women						
Week 5	NPC	24.3				
	PC	16.2	<0.01	0.32	<0.01	<0.01
	NNPC	55.2				
Week 7	NPC	54.5				
	PC	60.3	<0.01	0.54	<0.01	<0.01
	NNPC	84.6				
After all retakes	NPC	89.0				
PC	91.5	<0.01	0.59	<0.01	<0.01	
	NNPC	97.3				

[a] From χ^2 test of proportions.

latter two groups did not differ from each other. Among the women, the proportion of newstarts in the NPC group was 1.4 times higher than in the PC group, but this difference was not statistically significant. The female NPC group had approximately twice as many newstarts as the NNPC group. There were no significant differences in the proportions of female newstarts in the PC and NNPC groups.

The proportion of NNPC group trainees sent to the APFTEP was considerably less than those in the NPC and PC groups. There were no statistically significant differences in the proportions of NPC and PC group trainees sent to the APFTEP, although NPC group trainees were 1.6 (men) and 1.3 (women) times more likely to be sent, compared with PC group trainees.

Discussion

The results of this investigation suggest that preconditioning in the FAP reduces attrition and tends to lower injury risk in BCT. The low-fit recruits (PC group) who physically trained in the FAP before entering BCT had more graduates, had fewer discharges, and tended to have lower injury risk than did low-fit recruits who did not physically train before entering BCT (NPC group). Low-fit recruits who did not train before BCT were 34% less likely to complete BCT than were normal-fit recruits (the NNPC group), whereas low-fit recruits who did train before BCT were only 9% less likely to complete BCT, compared with normal-fit recruits (men and women combined). Low-fit recruits who did not train before BCT were less likely to complete BCT because of greater proportions of discharges, newstarts, and individuals sent to the APFTEP. Low-fit recruits who did not train before BCT and completed the week 7 APFT had similar raw scores and APFT pass rates, compared with low-fit recruits who did train before BCT.

In our initial analysis, we considered only training outcomes while recruits were in BCT. One question that arises is what the training outcomes would be if the discharges that occurred among PC trainees while they were in the FAP were included in the analysis. The FAP company in the reception station provided us with a list of PC trainees who were discharged while training in the FAP. This included three men and 10 women. A comparison of the NPC and PC groups was made with these additional 13 discharges included in the analysis, and the results are shown in Table XII. For the men, the PC group still had a greater proportion of trainees completing the cycle, compared with the NPC group; the trend was similar, although not statistically significant, among the women. When men and women were combined to increase statistical power, the proportion of trainees completing the cycle was still higher in the PC group than in the NPC group.

One advantage of the FAP appears to be its ability to identify some marginal trainees (those likely to be discharged) before they enter BCT. Conversations with drill sergeants, company commanders, a battalion commander, and two brigade commanders revealed an appreciation for this screening function, and virtually everyone placed great value on the FAP for this reason. This support was obviously anecdotal, because no comparison of FAP participants and nonparticipants had previously been conducted. However, no one with whom we discussed the issue desired to move attrition "downrange" into the BCT unit. Virtually everyone we talked to who had an opinion on the issue desired to retain the FAP.

An unfavorable training outcome for the PC group involved the APFTEP. The PC and NPC groups sent similar proportions of trainees to the APFTEP, and these were considerably larger proportions than that sent from the NNPC group. Individuals who fail the entry-level physical fitness test obviously demon-

TABLE IX

UNIVARIATE COX REGRESSION RESULTS FOR RISK OF ANY INJURY

	Men				Women			
Variable	Variable Category or Level	Risk Ratio	95% CI	p^a	Variable Category or Level	Risk Ratio	95% CI	p^a
Group	NPC	1.71	0.97–3.05	0.07	NPC	1.54	1.13–2.09	<0.01
	PC	1.48	0.97–2.26	0.07	PC	1.19	0.89–1.59	0.25
	NNPC	1.00	—	—	NNPC	1.00	—	—
Age (years)	17–19	1.00	—	—	17–19	1.00	—	—
	20–24	1.06	0.8–1.37	0.64	20–24	1.31	1.06–1.61	0.01
	>24	1.36	1.0–1.83	0.04	>24	1.20	0.92–1.55	0.18
Height (inches)	59–67	0.82	0.6–1.10	0.19	57–62	0.95	0.72–1.25	0.69
	68–69	0.85	0.6–1.15	0.29	63–64	1.01	0.78–1.32	0.92
	70–71	0.73	0.5–1.00	0.05	65–66	0.78	0.60–1.03	0.08
	72–79	1.00	—	—	67–72	1.00	—	—
Weight (pounds)	104–150	1.00	—	—	87–122	1.00	—	—
	151–169	1.12	0.8–1.55	0.50	123–136	0.94	0.73–1.22	0.64
	170–192	1.10	0.8–1.51	0.58	137–150	0.70	0.53–0.91	<0.01
	193–307	1.32	0.9–1.80	0.08	151–206	0.93	0.72–1.20	0.56
BMI (kg/m^2)	17.13–22.18	1.00	—	—	16.67–21.13	1.00	—	—
	22.19–24.93	0.84	0.6–1.16	0.28	21.14–23.18	0.90	0.69–1.17	0.42
	24.94–27.80	1.14	0.8–1.55	0.39	23.19–25.31	0.79	0.61–1.03	0.08
	27.81–37.32	1.03	0.7–1.41	0.83	25.32–34.14	0.91	0.71–1.18	0.49
PUs (repetitions)	0–20	1.93	1.3–2.70	<0.01	0–2	1.48	1.14–1.93	<0.01
	21–28	1.63	1.1–2.27	<0.01	3–7	1.29	0.97–1.72	0.08
	29–35	1.17	0.8–1.68	0.40	8–14	1.25	0.94–1.72	0.12
	36–78	1.00	—	—	15–60	1.00	—	—
SUs (repetitions)	0–26	1.40	1.0–1.92	0.03	0–19	1.56	1.19–2.04	<0.01
	27–31	1.07	0.7–1.48	0.66	20–25	1.36	1.04–1.78	0.03
	32–35	0.93	0.6–1.31	0.66	26–30	1.16	0.87–1.55	0.32
	36–59	1.00	—	—	31–50	1.00	—	—
1-mile run (minutes)	5.43–7.50	1.00	—	—	6.23–9.33	1.00	—	—
	7.51–8.25	1.02	0.7–1.43	0.92	9.34–10.18	1.36	1.02–1.82	0.04
	8.26–9.17	1.20	0.8–1.66	0.29	10.19–11.25	1.30	0.97–1.74	0.08
	9.18–20.50	1.43	1.0–1.96	0.03	11.26–25.00	2.01	1.52–2.66	<0.01

CI, confidence interval.
[a] From Wald statistic.

TABLE X

MULTIVARIATE COX REGRESSION RESULTS FOR RISK OF ANY INJURY

	Men				Women			
Variable	Variable Category or Level	Risk Ratio	95% CI	p^a	Variable Category or Level	Risk Ratio	95% CI	p^a
Group	NPC	1.62	0.90–2.90	0.11	NPC	1.62	1.19–2.21	<0.01
	PC	1.38	0.90–2.13	0.15	PC	1.26	0.90–1.63	0.09
	NNPC	1.00	—	—	NNPC	1.00	—	—
Age (years)	17–19	1.00	—	—	17–19	1.00	—	—
	20–24	1.03	0.80–1.34	0.80	20–24	1.35	1.09–1.66	<0.01
	>24	1.31	0.97–1.77	0.08	>24	1.26	0.97–1.64	0.09
Height (inches)	59–67	0.84	0.60–1.17	0.30	57–62	0.87	0.63–1.19	0.37
	68–69	0.88	0.65–1.20	0.47	63–64	0.99	0.75–1.31	0.92
	70–71	0.74	0.54–1.03	0.07	65–66	0.79	0.59–1.04	0.09
	72–79	1.00	—	—	67–72	1.00	—	—
Weight (pounds)	104–150	1.00	—	—	87–122	1.00	—	—
	151–169	1.07	0.77–1.50	0.68	123–136	1.14	0.88–1.48	0.33
	170–192	1.01	0.72–1.42	0.95	137–150	0.91	0.69–1.20	0.50
	193–307	1.17	0.82–1.65	0.39	151–206	1.16	0.84–1.58	0.37

CI, confidence interval.
[a] From Wald statistic.

TABLE XI

COMPARISON OF TRAINING OUTCOMES

	Group	Proportion in Group (%)	p^a All 3 Groups	p^a NPC vs. PC	p^a NPC vs. NNPC	p^a PC vs. NNPC
Men						
Graduate	NPC	59.4				
	PC	82.8	<0.01	<0.01	<0.01	0.32
	NNPC	87.1				
Discharge	NPC	18.8				
	PC	6.3	0.03	0.06	<0.01	0.91
	NNPC	6.6				
New start	NPC	12.5				
	PC	3.1	0.10	0.07	0.04	0.57
	NNPC	4.6				
APFTEP	NPC	12.5				
	PC	7.8	<0.01	0.46	<0.01	<0.01
	NNPC	1.7				
Women						
Graduate	NPC	52.1				
	PC	69.1	<0.01	0.02	<0.01	0.06
	NNPC	77.8				
Discharge	NPC	21.9				
	PC	11.7	0.04	0.08	0.01	0.98
	NNPC	11.8				
New start	NPC	15.1				
	PC	10.6	0.09	0.39	0.03	0.34
	NNPC	7.8				
APFTEP	NPC	11.0				
	PC	8.5	<0.01	0.59	<0.01	<0.01
	NNPC	2.7				

[a] From χ^2 test of proportions.

TABLE XII

TRAINEES COMPLETING THE BCT CYCLE, WITH DISCHARGES IN THE FAP INCLUDED

	Group	Proportion of Trainees Completing BCT Cycle in Group (%)	p^a All 3 Groups	p^a NPC vs. PC	p^a NPC vs. NNPC	p^a PC vs. NNPC
Men	NPC	59.4				
	PC	79.1	<0.01	0.04	<0.01	0.06
	NNPC	87.1				
Women	NPC	52.1				
	PC	62.5	<0.01	0.17	<0.01	<0.01
	NNPC	77.8				
Men and women	NPC	54.3				
	PC	69.0	<0.01	0.01	<0.01	<0.01
	NNPC	83.4				

[a] From χ^2 test of proportions.

strate their low physical fitness at the time of entry to service. The FAP is designed to only minimally increase fitness, although in BCT recruits receive additional physical training designed to improve their physical fitness. However, both initial training status and genetic endowment play roles in the adaptive response to a physical training program. Past studies have shown that individuals engaged in exercise programs of virtually identical frequency, intensity, and duration show great variations in improvements in aerobic power, endurance performance,[15–17] and anaerobic capacity.[18] Groups with low initial aerobic fitness are those most likely to show the largest relative and absolute improvements in aerobic power,[19–21] and this may also be the case for absolute muscular endurance[22] and other components of fitness.[23] However, some studies suggest that some individuals with low initial aerobic power also demonstrate small absolute changes in performance,[15,21] possibly because of heritable factors.[17,24–26] Therefore, a small proportion of individuals may have difficulty meeting the minimal BCT passing standards on the APFT even with training, presumably because of low initial fitness combined with lower genetically related trainability.

A study in the Singaporean Army examined the influence of physically training low-fit recruits who failed a fitness test be-

fore BCT.[27] One group received 4 to 6 weeks of preconditioning, one group went directly to normal basic training without preconditioning, and one group went to a basic training program that was extended by 1 month. Preconditioning before basic training was more effective in reducing medically related attrition than was no preconditioning or extending basic training by 1 month. Although that study[27] broadly agrees with the results of the present study, there were considerable differences between the two investigations. These differences include the facts that U.S. and Singaporean basic training are conducted differently, our definition of attrition was not exactly the same as that of Lee et al.,[27] the pre-basic training fitness tests differed, and the length and types of physical conditioning programs differed.

The NPC and PC groups demonstrated similar performance on the entry-level physical fitness test, indicating similar initial fitness levels. The PC group then spent an average of 18 days in the FAP. On arrival at the BCT unit, the PC group demonstrated higher performance than the NPC group on the initial fitness assessment, indicating that the FAP had been successful in increasing the fitness of the PC group. Unfortunately, because of attrition, only 63% of NPC personnel could be included in the analysis of the week 5 and week 7 APFT, compared with 84% of the PC personnel. The APFT raw score performance of the NPC "survivors" who completed the week 7 APFT was almost identical to the performance of the PC personnel. In addition, the APFT pass rates after all retakes were similar in the two groups. Thus, low-fit individuals who did not precondition before BCT and who were not attrited achieved fitness levels similar to levels of those who did precondition.

In the present study, the NPC group had the highest injury risk, followed by the PC group and finally the NNPC group. It has been demonstrated in numerous studies that low aerobic fitness and low muscular endurance are risk factors for injuries, not only in U.S. BCT but also in basic training in other countries, including Australia, Norway, England, and Israel.[2,28–36] Higher fitness levels at the start of BCT appear to reduce injury risk. In fact, a past study[5] indicated that, when preconditioning increased the aerobic fitness level to that of a group that did not have to train in the FAP, BCT injury risk and attrition were similar for the two groups. In the present study, trainees were in the FAP an average of ~18 days and received ~16 days of training (physical training was conducted 6 days per week). This training period was not sufficient to bring the PC group to the same level of fitness as the NNPC group at the start of training but was sufficient to increase fitness and tended to reduce the risk of injury, compared with the NPC group that did not receive preconditioning.

Conclusions and Future Considerations

Our evaluation of the FAP has relevance for commanders, physical trainers, and recruiters. It shows that low-fit recruits who are preconditioned to meet the minimal standards of the entry-level physical fitness test at the reception station have reduced BCT attrition and tend to have lower injury risks, compared with low-fit recruits who do not precondition. Commanders and physical trainers should advocate and support a minimal level of physical fitness before entry into BCT.

In May 2004, the entry-level physical fitness test was discontinued at the reception station. In July 2004, recruiters were required to conduct the entry-level fitness test for new recruits before they shipped off to BCT. The U.S. Army Physical Fitness School designed a training manual for recruits who initially fail the test, to assist them in their physical training. However, since BCT attrition rose shortly after this, the decision was made to return the FAP to the reception station.

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