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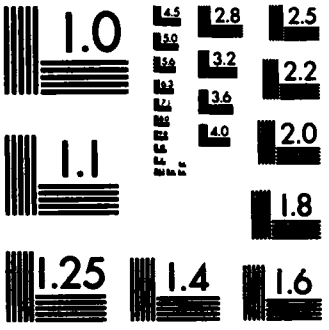

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THE EFFECTS OF AN AUGMENTED AND THE STANDARD RECRUIT PHYSICAL TRAINING PROGRAM ON FITNESS PARAMETERS

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TABLE OF CONTENTS

TABLES

SUMMARY

An investigation was conducted to compare fitness changes produced by standard Navy recruit physical training with an augmented program featuring increased physical training. The sample population included 224 Navy personnel between the ages of 17-30 ($\bar{X}$ = 19.7) participating in 8-week Navy basic training at the Recruit Training Command, San Diego, CA. Recruits were drawn from either an experimental or one of two control companies. The experimental company engaged in a similar, but more intense version of the current physical conditioning program. Two control companies participated in the standard Navy recruit physical training program. A battery of physical fitness measures collected during the initial and final stages of training provided data to contrast training group effects.

The study findings suggest that the standard program does not significantly change all components of fitness, especially upper torso muscular strength and endurance. Furthermore, results imply that the standard physical conditioning program is not administered uniformly to recruits. Consequently, changes in certain aspects of physical fitness between companies following recruit training are significantly different.

An experimental augmented version of the standard curriculum also failed to meet the current training objectives of total body fitness. Participation in this more intense aerobic/calisthenic program enhanced stamina but not upper torso strength capability.

Since the standard training program apparently does not appear to optimally develop stamina for all recruits, implementation of a more intense running program is advised. Furthermore, since recently conducted shipboard studies have identified muscular strength as the primary limiting factor in both general shipboard and occupationally-related work, it is suggested that presently employed calisthenic exercises be eliminated and replaced with progressive resistance exercises for efficient development of total body strength.

INTRODUCTION

In the Navy young men and women receive an initial introduction to Navy physical training methods at recruit training commands. Here the recruit receives a curriculum of stretching and running exercises designed primarily to develop flexibility and cardiorespiratory fitness (5). Recently recruit training command officials have indicated that the standard conditioning program is demotivating and does not adequately physically challenge recruits. These circumstances are disturbing since recruit physical training may leave a lasting impression on recruits and may impact on future participation in Navy sponsored physical readiness and lifestyle enhancement programs. This research project grew out of a Recruit Training Command interest in determining the effectiveness of recruit physical training both in terms of fitness outcomes and recruit attitudes towards fitness and the Navy. This particular paper will deal with fitness outcomes, specifically 1) the effects of the standard recruit physical training program on recruit fitness, and 2) the effects of a similar but more intensive version of standard training on recruit fitness. Data gathered from this study will enable us to determine whether desirable changes in muscular strength, muscular endurance and stamina can be attained by the standard running/calisthenic program or by simply increasing the volume of exercises performed.

MATERIALS AND METHODS

Participants.

Subjects were 224 male Navy personnel between the ages of 17-30 ($\bar{X}$ = 19.7 years) undergoing recruit training at the Recruit Training Command, San Diego, CA. All recruits were volunteers and each individual signed an informed consent document prior to participating.

Training Programs.

Recruits were drawn from three training companies. Two companies served as controls (Standard I, N=74; Standard II, N=74) and one company was designated as experimental (Augmented, N=76). The two control companies participated in the current recruit physical training program consisting of thirty-two 40-minute exercise sessions during the 8-week basic training period. Each of these sessions consisted of approximately 10 minutes of flexibility and calisthenic exercises followed by an endurance run. Runs were progressive in nature, extending from 1.25-2.25 miles performed at an 8-minute/mile pace (3). The purpose of following two control companies over the course of the 8-week training period was to assess whether the standard physical training program was being administered identically to all recruit companies.

The experimental company received physical training similar in content but more intensive than the standard training regimen and with greater aerobic emphasis. This augmented training company exercised twice daily six days per week. Sessions lasted approximately 40 minutes and included flexibility and calisthenic exercises as well as a 3.5 mile run performed at an 8-minute/mile pace.

Fitness Assessment.

To determine fitness changes associated with participation in the training programs, individuals underwent a physical fitness evaluation prior to and upon completion of the 8-week training program. This evaluation consisted of a series of tests to measure static and dynamic muscular strength, muscular endurance, and relative body fat content.

Upper Torso Static Strength Tests.

Two different assessments of arm and shoulder muscle static strength were made using a bench press device (Cybex, Lumex, Inc., Bayshore, NY) set at zero velocity. The subject was securely fastened onto the testing apparatus with arms at right angles to the pressing bar. Subjects were tested during both extension and flexion contractions.

Upper torso static strength was assessed using a 2-arm lift test utilizing a Chatillon dynamometer. This device was designed by researchers at the Navy Personnel Research and Development Center (NPRDC), San Diego, (6). The subject was instructed to hold a handle by its side bars and lift while keeping his back and legs straight and heels flat on the deck. Chain length was adjusted so that the bottom of the subject's forearm was horizontal to the deck surface with fists vertical and elbows at sides.

Static strength of the arms and shoulder muscles was also assessed using a 1-arm pull test utilizing a Chatillon dynamometer. Subjects were instructed to pull a handle while bracing the other hand on a pole. Two trials were performed for each arm alternating right, left, right, left.

Static strength of the hands was assessed using a JAMAR hand dynamometer. Two trials were performed for each hand alternating right, left, right, left.

The static strength of trunk extensors and flexors was assessed using a device designed by Army researchers (2). The subject was placed in a standing position with the shoulder strapped to a stabilizing bar connected to a tensiometer. To assess trunk extension, the subject was instructed to bend back against the shoulder harness while supporting the pelvic girdle against a plate. To measure trunk flexion, the subject was instructed to bend forward against the shoulder harness while supporting his posterior against the plate.

During static strength testing subjects were instructed to increase their exertion to a maximum and hold it within a period of five seconds. Two trials were given for each test and the highest value was recorded. The procedures and instructions to the subjects were conducted according to the Ergonomics Guide for the Assessment of Human Static Strength (1).

Upper Torso Dynamic Strength.

The dynamic strength of arm and shoulder muscles was determined by measuring the peak torque generated through a range of constant velocities by the use of a Cybex isokinetic bench press device. The torque generated during the exercises was measured by means of a hydraulic pressure sensitive transducer (BIH, Waltham, MA) which was recorded on a Beckman dynograph recorder.

For isokinetic testing, the subject was asked to move "as hard and as fast as possible" through the entire range of motion. Testing sessions for the bench press consisted of both extension and flexion movements performed at a limb velocity of 60° per second. The highest as well as the final torque values were obtained during this repetitive sequence and the difference in these values represent an estimation of endurance (i.e., a small fatigue decrement represents a high endurance level).

To standardize the experiments and localize the contractions of the proper muscle groups, the subjects were securely strapped at the waist while performing the bench press exercises. All strength testing equipment was calibrated before testing to insure reliable measurements.

Cardiorespiratory Tests.

Cardiorespiratory fitness was assessed from a maximal work capacity test on a Monark bicycle ergometer using a protocol developed by NATO for assessment of fitness among military forces (4). Subjects were instructed to pedal at a constant rate of 76 RPM against a progressively increasing resistance for as long as possible. Warm-up lasted for a period of two minutes against a resistance of .5 Kilopond. Thereafter the resistance was increased every minute by .5 Kilopond. The greatest workload that the participant could maintain for 50 seconds was recorded as the measure of physical work capacity.

Analysis Procedures.

Due to attrition, a number of recruits tested prior to training were not available for post-training testing. The final N's for each company are listed in Table I. Data analysis was confined to 171 recruits who completed both the pre- and post-training testing. A three-group analysis of covariance tested for group differences in fitness changes (10). The analysis was performed using the "Statistical Package for the Social Sciences" (11), with the initial values of the individual fitness measures as covariates. "Adjusted values" (12) of fitness measures are reported to remove differences in pre-training fitness measures between groups. In those instances for which analysis of covariance did not yield parallel within-group regressions, Johnson-Neyman significance regions were determined (8,12). In no instance were there identifiable regions of significant differences, so the results reported below involve only instances in which the parallel regression lines assumption was met. When significant ($p<.05$) group differences were observed, Tukey's (a) procedure was used for post hoc comparison of the three groups (13). An effect for the augmented program was regarded as significant only if the difference between that program and the two control groups was statistically significant ($p<.05$) and in the same direction for both contrasts. Again, a $p<.05$ significance level was used even though it is lenient given the number of tests performed. The pre- and post-training data were analyzed for significant within-group differences using the paired t-test.

RESULTS

Tables I and II list F values (group x time) and report significantly different training group effects. The extent of change between pre- and post-training are also reported for each group. Overall a significant difference was found between augmented training and both standard programs for 4 of 12 fitness variables measured.

The effects of the physical conditioning programs on dynamic and static strength were mixed. Higher values for dynamic bench press flexion but lower values for static trunk flexion were observed when the augmented group was compared to the standard training companies. Mixed results were also obtained for indices of muscular endurance with the augmented group demonstrating enhanced bench press extension scores and lower bench press flexion scores compared to results for the standard companies. The augmented program produced significantly higher scores than the standard programs in measured stamina (maximal work capacity on bicycle ergometer).

Augmented group fitness scores that differed significantly from only one standard company included dynamic bench press extension, handgrip, and trunk extension. No significant difference between augmented and standard training groups was found for 1-arm pull,

2-arm lift, static bench press extension, static bench press flexion or % body fat tests. Significant differences in training effects were found between standard groups for the following fitness measures: trunk flexion, bench press extension, bench press flexion, bench press extension (muscular endurance), and maximal work capacity on the bicycle ergometer.

DISCUSSION

While the standard Navy recruit physical training program purports to primarily emphasize aerobic conditioning, this investigation found that only one standard company showed a significant increase in stamina. This finding was unexpected and implies that the standard program may not be uniformly administered and as a result all recruits may not positively benefit from the physical training curriculum.

As anticipated, augmented training members receiving a more intense running program showed significantly greater gains in stamina when compared to the standard training groups. Likewise, increasing the volume of calisthenic exercises lead to a significantly greater gain in muscular endurance (bench press extension) by the augmented training group.

Simply increasing the volume of calisthenic exercises however appears to offer no distinct advantage for development of upper torso muscular strength. The augmented training group exhibited significantly greater scores than standard training participants for only one of nine indices of static and dynamic strength (bench press flexion). In fact, both augmented and standard company participants experienced significant reductions in a variety of upper torso dynamic and static strength tests.

Decrements in strength abilities following participation in the standard recruit physical training program has previously been reported in a study conducted at the Recruit Training Command, Orlando, FL. This investigation found that subjects displaying high initial strength abilities showed an 8% decrement in pull-up test scores, an 11% decrease in bent-arm hang scores, and a 14% reduction in 2-arm lift test performance (7).

Reductions in upper torso strength following programs that primarily emphasize running exercise, such as both the standard and augmented programs, have been documented by several researchers (2,3). A recent study found significant reductions in upper torso strength measures (isotonic bench press, shoulder press, arm-curl, isokinetic bench press, and power endurance) in a sample of circuit strength trained subjects following an 8-week jogging program. The authors theorize the loss of upper torso strength was due to the minimal use of body musculature while jogging and suggest that if upper torso strength is desired, progressive resistance exercises should be performed as a supplement to jogging programs (3).

Due to the emphasis of both augmented and standard training programs on aerobic development, enhancement of muscular strength was dependent solely on calisthenic conditioning. Research data suggest that calisthenic conditioning does not optimally enhance muscular strength development (9). This has been attributed to the low intensity training stimulus delivered by calisthenic training. It is a generally accepted fact that a training intensity between 70-90% of maximum strength is needed for optimal strength development. Progressive resistance training has been demonstrated to be the most efficient method of improving muscular strength since it provides a training stimulus of sufficient intensity to overload muscles. Muscles adapt to this overload by gains in

strength.

It is important to note that study results show that the standard program does not appear to be uniformly administered. Final fitness outcomes therefore may be influenced by factors other than exercise frequency, intensity, or mode of training. These include the Company Commanders: attitudes towards exercise, personal level of fitness, active participation in scheduled exercise sessions and overall leadership style. Since these elements may strongly affect the motivation of recruits to exercise, further studies should be undertaken to more fully identify and define this relationship.

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TABLE I - MEAN STATIC STRENGTH CHANGES WITH RECRUIT PHYSICAL TRAINING

	Initial Adjusted Mean All Groups	Final Adjusted Mean Standard Group I (N = 55)	Final Adjusted Mean Standard Group II (N = 56)	Final Adjusted Mean Augmented Group (N = 60)	(d.f.)	F Value
Upper Torso Static Strength						
1-Arm Pull (lbs)	140.2	151.8 (+ 8.3%) *	143.4 (+ 2.3%)	144.0 (+ 2.7%)	170	4.09
2-Arm Lift (lbs)	97.0	103.9 (+ 7.1%) *	121.3 (+25.1%) *	113.9 (+17.4%) *	110	19.2
Handgrip (lbs)	52.7	53.3 (+ 1.1%)	50.3 (- 4.6%) *	50.9 (- 3.4%) *a	170	5.09 †
Bench Press Extension (Kp)	134.6	120.1 (-10.8%) *	145.9 (+ 8.4%) *	115.9 (-13.9%) *	109	13.6
Bench Press Flexion (Kp)	68.4	58.9 (-13.9%) *	61.3 (-10.4%) *	76.2 (+11.4%) *	109	9.9
Trunk Static Strength						
Trunk Extension (Kp)	117.9	110.4 (- 6.4%)	125.2 (+ 6.2%) *	114.1 (- 3.2%) *b	170	6.2 †
Trunk Flexion (Kp)	85.5	97.1 (+13.6%) *b	107.0 (+25.2%) *a	87.0 (+ 1.8%) *ab	170	11.6 †

* Significantly different from initial mean value (.05 level)
a Significantly different from Standard Group I
b Significantly different from Standard Group II
† Significant F value (.05 level)

TABLE II - MEAN MUSCULAR STRENGTH, MUSCULAR ENDURANCE AND STAMINA CHANGES WITH RECRUIT PHYSICAL TRAINING

	Initial Adjusted Mean All Groups	Final Adjusted Mean Standard Group I (N = 55)	Final Adjusted Mean Standard Group II (N = 56)	Final Adjusted Mean Augmented Group (N = 60)	(d.f.)	F Value
Upper Torso Dynamic Strength						
Bench Press Extension (Kp)	96.4	71.1 (-26.3%) *b	87.4 (- 9.3%) a	74.8 (-22.4%) *b	167	22.1 †
Bench Press Flexion (Kp)	80.4	59.8 (-25.6%) *b	73.1 (- 9.1%) *a	89.3 (+11.1%) *ab	167	76.6 †
Upper Torso Muscular Endurance						
Bench Press Extension (Kp)	52.5	38.4 (-26.9%) *b	47.4 (- 9.7%) *a	34.5 (-34.3%) *b	170	21.2 †
Bench Press Flexion (Kp)	26.2	24.6 (- 6.1%)	25.2 (- 3.8%)	29.5 (+12.6%) ab	170	5.9 †
Stamina						
Maximal Work Capacity (Kp)	1572.5	1669.9 (+ 6.2%) *b	1565.8 (- 0.4%) a	1785.6 (+13.6%) *ab	154	17.4 †

* Significantly different from initial mean value
a Significantly different from Standard Group I
b Significantly different from Standard Group II
† Significant F value (.05 level)

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(U) Results of the present study indicate that the present physical conditioning program for Navy recruits is not well-suited to meet training objectives of developing total body fitness. Simply increasing the intensity of the current running/calisthenic format improves stamina but not upper torso muscular strength. It is advised that to provide a more all-around fitness enhancement program for recruits, current training methods need to be restructured. It is suggested that to better align recruit physical capabilities with shipboard

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work requirements, calisthenic conditioning be replaced with a more effective mode of training upper torso muscular strength.


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