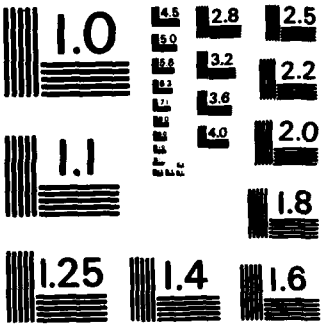
AD-A160 621 A COMPARISON OF SPRAIN AND STRAIN INJURY RATES DURING AEROBIC/CALISTHENIC.. (U) NAVAL HEALTH RESEARCH CENTER SAN DIEGO CA E J MARCINIK ET AL. AUG 85 1/1

UNCLASSIFIED NAVHLTHRSCHC-85-28 F/G 6/14 NL



A COMPARISON OF SPRAIN AND STRAIN INJURY RATES DURING AEROBIC/CALISTHENIC AND AEROBIC/CIRCUIT WEIGHT TRAINING PROGRAMS

E. J. MARCINIK
J. A. HODGDON
J. J. O'BRIEN

REPORT NO. 85-28

NAVAL HEALTH RESEARCH CENTER
P.O. BOX 85122
SAN DIEGO, CALIFORNIA 92138-9174

NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
BETHESDA, MARYLAND

A COMPARISON OF SPRAIN AND STRAIN INJURY RATES DURING AEROBIC/CALISTHENIC AND AEROBIC/CIRCUIT WEIGHT TRAINING PROGRAMS

E. J. MARCINIK

J. A. HODGDON

J. J. O'BRIEN

Report No. 85-28, supported by the Naval Medical Research and Development Command, Department of the Navy, under work unit M0096.PN.001-1050. The views presented in this paper are those of the authors. No endorsement by the Navy has been given or should be inferred.

SUMMARY

Sprain and strain (S/S) injury data was collected from 1169 male recruits receiving 8-week Navy basic training at the Recruit Training Command, San Diego, California. Subjects were randomly assigned to either the standard aerobic/calisthenic (A/CAL) program (N=722) or a circuit weight training regimen performed in conjunction with the standard running program (N=447). A/CAL training consisted of approximately 10 minutes of flexibility and calistenic exercises followed by an endurance run. Aerobic/circuit weight training (A/CWT) members performed two circuits (1 circuit = 15 exercises) on a multi-station gym following a 15 s work/ 15 s rest cycle also followed by a run. Both groups exercised on alternate days 3 times per week.

Findings show a significantly (X^2 = 13.3, $p \leq 0.05$) lower total number of injuries on the part of A/CWT trainees. A reduced (x^2 = 12.8, $p \leq 0.05$) number of injuries of the ankle/foot region seem to account for this finding. A/CWT also produced significantly (X^2 = 44.5, $p \leq 0.05$) fewer no march/no physical training (NM/NPT) days than A/CAL training with days lost from ankle/foot injuries again accounting for the difference between groups (X^2 = 41.4 $p \leq 0.05$).

It can be concluded that the addition of circuit weight training to the standard Navy recruit running program had a significant effect on the overall incidence of S/S injuries. Strengthening programs of this sort may be helpful in conditioning recruits for running induced orthopedic stress.

INTRODUCTION

Injuries sustained during basic training are a serious problem that may jeopardize an individual's successful entry into the military service. Injuries result in lost training time, increased medical costs, and place an administrative burden on recruit training center personnel. Kowal (1980), for example, has found the overall incidence of lower extremity injuries to be 62% among female and 26% among male Army basic trainees. According to Jones (1983) one of the more important factors influential in the development of these injuries is initial level of fitness. This is of practical importance to the Navy, as sedentary and muscularly deficient individuals may be especially prediposed to injuries precipatated by physical training.

To date, several studies have compared training outcomes of aerobic-based programs featuring either calisthenic (A/CAL) or circuit weight training exercises (A/CWT) (Marcinik, 1984a; Marcinik, 1984b). In brief, findings show circuit weight training leads to more pronounced relative changes in muscular strength. Strengthening regimes of this sort have been recommended by several authors as a means to reduce the frequency and severity of injuries (Snook, 1972; Cady, 1979). If improved strength is associated with lower rates of injury, A/CWT programs may have therapeutic value in a recruit training setting. In an effort to substantiate this hypothesis, an investigation was undertaken to compare rates of injury and subsequent training days lost during A/CAL and A/CWT.

MATERIALS AND METHODS

Injury data was collected from 1169 male recruits receiving 8-week Navy basic training at the Recruit Training Command, San Diego, California between the period August, 1984 to February, 1985. Subjects were randomly assigned to either the standard A/CAL program (N=722) or a circuit weight training regimen performed in conjunction with the standard running program (A/CWT, N=447).

Training Programs

The standard A/CAL program consisted of approximately 10 minutes of flexibility and calisthenic exercises followed by an endurance run. Exercise sessions were performed on alternate days, 3 times per week. Runs were progressive in nature, extending from a 2.4 km run without time requirement in week 1, to 3.6 km performed at an 5 minute/km pace in week 8. During week 2, run distance remained at 2.4 km but at the 5 minute/km pace. Thereafter, run distance increased by .4 km every 2 weeks without a change in pace. (Instructor's Guide for U.S. Navy Recruit Training). Calisthenic exercises (viz. sit-ups, push-ups, flutter kicks, 8 count-body builders, and jumping jacks) also increased in volume during the training period.

Recruits participating in the A/CWT program followed the identical running program as standard trainees. In lieu of the calisthenics however, two circuits (1 circuit = 15 exercises) of CWT exercises were performed each training session. During the CWT sessions subjects rotated from station to station following a 15 s work/15 s rest schedule. Specific exercises included the bench press,

shoulder press, hip flexor, knee extension, pull-up, arm-curl, lat-pulldown, leg press, arm dip, and inclined sit-ups performed on a Universal® Gym. Run-in place, push-ups, flutter kicks, body builders, and jumping jacks were performed at ancillary stations. Work on the weight machine was performed at 60% of determined 1 repetition maximum (1RM) strength for each exercise. Weights were readjusted during the fourth week of training to account for changes in strength.

Injury Survey

This survey was limited to the study of S/S injuries due to the difficulty in tracking and obtaining valid injury data on a cohort of this size. A sprain was defined as a joint injury in which fibers of a supporting ligament were ruptured. Strains were regarded as pulls or tears in some part of the body musculature. For purposes of this investigation, only injuries sustained as a result of the physical training curriculum which required medical attention were recorded. Information was obtained through the use of medical vouchers issued by the medical department at the Naval Training Center, San Diego, California, dispensary. These vouchers were then collected by recruit training command staff personnel at the Camp Nimitz barracks training site. Collected data included the particular location of the S/S injury (e.g., shoulder/arm, knee/leg, ankle/foot, and lower back) and the number of no march/no physical training (NM/NPT) days lost on account of injury.

ANALYSIS PROCEDURES

Total number of S/S injuries and subsequent NM/NPT incurred during basic training were recorded and relative percentages for each of the anatomical regions calculated. A chi square test utilizing a two way contingency table was used to assess differences between training groups for numbers of S/S injuries and number of NM/NPT days incurred. Statistical significance was set at the $p \leq 0.05$ level.

RESULTS

The overall injury rate for the recruit cohort was 11.8% (Table 1). Injuries of the ankle/foot region accounted for the majority of injuries (56.5%), followed by injuries of the knee/leg (27.5%), lower back (8.7%), and shoulder/arm (7.2%). Lower extremity injuries (i.e., knee/leg and ankle/foot) resulted in 388 NM/NPT days or 85.6% of the total.

Recruits training with A/CWT experienced a significantly ($X^2 = 13.3$, $P \leq 0.05$) lower total number of S/S injuries (Table 2). A significant ($X^2 = 12.8$, $P \leq 0.05$) reduction in the frequency of ankle/foot injuries seems to account for this finding.

A/CWT also produced significantly ($X^2 = 44.5$, $p \leq 0.05$) fewer NM/NPT days than A/CAL training (Table 3). Again, days lost due to ankle/foot injuries were responsible for the difference between groups ($X^2 = 41.4$, $p \leq 0.05$)

DISCUSSION

Incidence rates for injury observed here are lower than reported elsewhere during military basic training (Bensel, 1976; Kowal, 1980). These studies, however, have reported on a wider litany of overuse injuries including stress fractures, chondromalacia/patello-femoral syndrome, etc. The present study documented only S/S injuries sustained as a part of physical training which required medical attention. Injuries occurring during other aspects of basic training (e.g. marching, sports activities) were not reported. Additionally, data was presented according to training group (A/CAL and A/CWT) and not to any specific element within each program (i.e., running versus calisthenics). Thus it is unclear whether injuries were associated with running or with other components of the curriculum. A review of the literature by Jones (1983), however, suggests basic training related injuries are predominantly running induced lower extremity injuries. The high precentage of lower torso injuries found among Navy recruits (84.0% of total) seems to be in concert with these findings.

With respect to the epidemiology of injury, available evidence suggests that increasing the duration, frequency, or intensity of running too rapidly leads to increased likelihood of trauma (Clement, 1981). During the present investigation subjects were required to run between 2.4 km to 3.6 km during the 8 week training period. Training frequency (3x/wk) was maintained throughout training. Training pace (5 min/kg) was constant after the first week of training. Adherence to these moderate running guidelines does not appear to have placed the average recruit at increased risk for injury. Unfit recruits, however, may have been unprepared for the orthopedic stress associated with running and as a result were injury victims. In support of this hypothesis, Kowal (1980) has reported that weight, percent body fat, and limited leg strength were related to increased incidence of injury in women during Army basic training.

The finding of a lower rate of ankle/foot injuries among CWT members during the present study may be the result of training induced strength gains. In physical activities, such as running, nearly every muscle in the leg must contract to stabilize the intertarsal and talocrural joints and prevent inversion, eversion, or dorsiflexion of the foot. Since the ankle joint is poorly stablized by muscles and ligaments, the effect of strengthening regimes may be most evident in this anatomical region. Training responses to A/CAL and A/CWT have previously been investigated in a male recruit population (Marcinik, 1984a) Findings showed that A/CWT elicted greater relative changes in lower torso strength (knee extension and leg press test) and leg muscular endurance. Improved leg endurance among CWT recruits may have also delayed the onset of fatigue generally considered to be associated with increased rates of injury
during bouts of running.

CONCLUSION

This investigation enabled us to compare the effects of different training regimes on injuries and

training days lost. The addition of circuit weight training to the standard Navy recruit running program was found to have a significant effect on the frequency of S/S type injuries. The practical significance of these results is that due to its progressive nature, circuit weight training may be a suitable form of exercise for individuals who do not easily tolerate the physical stress of running. Programs of this sort may be especially helpfull in conditioning individuals for aerobic training who have previously lead sedentary lifestyles or may be predisposed to lower extremity trauma.

References

Bensel, C.K.: The effects of tropical and leather combat boots on lower extremity disorders among Marine Corps recruits. Clothing, Equipment, and Materials Engineering Laboratory, Natick Army Labs, Tech Report No. 76-49-GEMEL, 1976.

Cady, L.D.: Strength and fitness and subsequent back injuries in firefighters. J. Occup. Med., 21(4):269-272, 1979.

Clement, D.B.: A survey of overuse running injuries. Physicians Sports Med. 9:47-58, 1981.

Instructor's Guide for U.S. Navy Recruit Training. NAVCRUITRACOMSDIEGOINST 5400.17D.

Jones, B.H. Overuse injuries of the lower extremities associated with marching, jogging, and running: A review. Military Medicine, 148:783-786, 1983.

Kowal, D: Nature and Causes of Injuries in Women Resulting from an Endurance Training program. Am J Sports Med. 8:265-261, 1980.

Marcinik, E.J., Hodgdon, J.A., and O'Brien, J.J.: Aerobic/calisthenic and aerobic/circuit weight training programs for Navy men: A comparative study. NHRC Report No. 84-6, San Diego, CA 92138-9174, 1984a.

Marcinik, E.J., Hodgdon, J.A., and O'Brien, J.J. Changes in fitness of Navy women following aerobic/calisthenic and aerobic/circuit weight training programs. NHRC Report No. 84-19, San Diego, CA 92138-9174, 1984b.

Snook, S.H. and Ciriello, V.: Low Back Pain in Industry. Am Soc Saf Eng J. 17(4):17-23, 1972.

Table 1 Total Number of Sprain and Strain (S/S) Injuries and No March/No Physical Training (NM/NPT) Days During Navy Basic Training (N=1169)

	Total Number of S/S Injuries	% of Total S/S Injuries	Total Number of NM/NPT Days	% of Total NM/NPT Days
Shoulder/Arm	10	7.2%	31	6.8%
Knee/Leg	38	27.5%	93	20.5%
Ankle/Foot	78	56.5%	295	65.1%
Lower Back	12	8.7%	34	7.5%
Total	138		453	

Table 2 Comparison of Sprain and Strain (S/S) Injuries Incurred Between Training Programs (Two Way Contingency Table)

	Shoulder/ Arm	Knee/ Leg	Ankle/ Foot	Lower/ Back	Total
A/CAL (N=722)	5	23	63	7	98
A/CWT (N=477)	5	15	15	5	40
(d.f.)	1	1	1	1	1
x^2	0.59087	9.02540	12.78491*	0.06036	13.27154*

* Significant ($P \leq 0.05$) difference between programs

Table 3 Comparison of Total Number of No March/No Physical Training (NM/NPT) Between Training Programs (Two Way Contingency Table)

	Shoulder/ Arm	Knee/ Leg	Ankle/ Foot	Lower/ Back	Total
A/CAL (N=722)	16	60	236	18	330
A/CWT (N=477)	15	33	59	16	123
(d.f.)	1	1	1	1	4
x^2	1.32770	0.31466	41.36612*	1.09719	44.48952*

* Significant ($P \leq 0.05$) difference between programs

TABLE 4 - MEAN FITNESS CHANGES FOLLOWING AEROBIC/CIRCUIT WEIGHT TRAINING AND THE STANDARD NAVY RECRUIT AEROBIC/CALISTHENIC TRAINING PROGRAM

	Initial Adjusted Mean All Groups (N=87)	Final[1] Adjusted Mean A/CWT-70 (N=41)	Final[1] Adjusted Mean A/Cal (N=46)	F Value
Upper Torso Dynamic Strength (kg)				
Shoulder Press	52.6	57.0 (8.3%) *	45.8 (-13.0%) a*	50.6 †
Bench Press	63.4	71.2 (12.3%) *	55.6 (-12.2%) a*	101.8 †
Arm Curl	30.4	36.1 (18.6%) *	30.1 (- 1.0%) a	39.5 †
Lat Pulldown	64.9	72.4 (11.6%) *	63.1 (- 2.8%) a	21.5 †
Lower Torso Dynamic Strength (kg)				
Leg Press	181.9	190.3 (4.6%) *	149.4 (-17.8%) a*	63.6 †
Knee Extension	66.4	86.5 (30.3%) *	75.2 (13.4%) a*	18.3 †
Muscular Endurance (No. of Repetitions)				
Bench Press	17.6	20.5 (16.5%) *	20.1 (14.2%) *	.3
Leg Press	48.7	52.7 (8.2%) *	38.8 (-20.3%) a*	13.3 †

[1]
* Final adjusted means shown with % change from initial means
a Significantly different from initial mean value ($p<0.05$)
† Significant F value

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 85-28	2. GOVT ACCESSION NO. AD-A160	3. RECIPIENT'S CATALOG NUMBER 621
4. TITLE (and Subtitle) (U) A COMPARISON OF SPRAIN AND STRAIN INJURY RATES DURING AEROBIC/CALESTHENIC AND AEROBIC/ CIRCUIT WEIGHT TRAINING PROGRAMS		5. TYPE OF REPORT & PERIOD COVERED INTERIM 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) E.J. Marcinik, J.A. Hodgdon, J.J. O'Brien		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Health Research Center PO Box 85122 San Diego, CA 92138		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS M0096-PN.001-1050
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Medical Research & Development Command Naval Medical Command, National Capitol Region Bethesda, MD 20814-5044		12. REPORT DATE August 1985 13. NUMBER OF PAGES 8
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Commander, Naval Medical Command Department of the Navy Washington, DC 20372		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

Approved for public release; distribution unlimited.

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Physical Fitness
Physical Training Injuries
Circuit Weight Training
Calisthenics
Remedial Training

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A comparison of sprain/strain (S/S) injuries and subsequent training days lost during aerobic based programs featuring either calisthenic or circuit weight training programs was undertaken. Findings showed a significant reduction in the total number of S/S injuries and subsequent no march/no physical training days among aerobic/circuit weight training (A/CWT) participants. Lower incidence of ankle/foot injuries following A/CWT appeared to account for these findings.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Results suggest that strengthening programs of this type may have therapeutic value in better preparing recruits for running induced orthopedic stress. Participation may be particularly beneficial for sedentary individuals or those predisposed to lower extremity trauma.

END

FILMED

12-85

DTIC