AFRL-RH-WP-TP-2020-0002

EFFECTS OF A FUNCTIONAL BRIDGE PROGRAM ON PHYSICAL PERFORMANCE AND INJURY RISK OF MILITARY POPULATION AT RISK FOR MUSCULOSKELETAL INJURY

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APRIL 2020
Final Report

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From – To)*
13-04-20	Final	April 2018-April 2020

4. TITLE AND SUBTITLE

Effects of a Functional Bridge Program on Physical Performance and Injury Status of Military Population at Risk for Musculoskeletal Injury

5a. CONTRACT NUMBER
FA8650-18-C-6932

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
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5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER
Legacy RHM

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
^Air Force Materiel Command
Air Force Research Laboratory
711th Human Performance Wing
Airman Systems Directorate
Airman Biosciences Division
Biomedical Impact of Flight Branch
Wright-Patterson AFB OH 45433

10. SPONSORING/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
AFRL-RH-WP-TP-2020-0002

12. DISTRIBUTION / AVAILABILITY STATEMENT
DISTRIBUTION A. Approved for public release. 88ABW-2020-3361, cleared 29 October 2020

13. SUPPLEMENTARY NOTES
This is a FINAL DELIVERABLE under Contract FA8650-18-C-6932. Report contains color.

14. ABSTRACT
Musculoskeletal injuries are the leading cause of medical encounters in the United States military and have a negative impact on readiness and lethality. Physical training is a leading cause of injury, particularly improperly executed programs. The primary purpose of this study is to assess the effectiveness of a 15-week progressive exercise program, called a functional bridge program, in active duty Air Force personnel.

The functional bridge program was assessed using a prospective longitudinal random control trial. The control and intervention groups included airmen who are at-risk of musculoskeletal injury (i.e. previously injured, low overall fitness). The intervention group participated in a functional bridge program guided by certified athletic trainers and strength coaches for 15 weeks. The control group completed workouts on their own following the USAF fitness guidelines outlined in AFI 36-2905.

Following 15 weeks of training, the intervention group saw significantly greater increases in leg strength when compared to the control group ($p < 0.004$). Leg strength is a key variable that contributes toward reduced injury risk. Similar improvements in both groups were found in lower body power and abdominal endurance. The investigators are currently evaluating the program when led by military members with less experience and education.

15. SUBJECT TERMS
Functional progression, injury prevention, functional fitness, fitness assessment, PT, PT test

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Molly Wade
Unclassified	Unclassified	Unclassified	SAR	34	19b. TELEPHONE NUMBER *(include area code)* N/A

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1.0 SUMMARY

Musculoskeletal injuries are the leading cause of medical encounters in the United States military and have a negative impact on readiness and lethality. Physical training has been identified as a leading cause of injuries in the military, particularly improperly executed programs. Traditional physical training in the military typically consists of running and calisthenics; however more advanced, movement-based progressive exercises are thought to improve functional fitness, which decreases the risk of musculoskeletal injury. The investigators developed a progressive exercise program for military personnel aiming to improve various aspects of functional fitness including biometrics, agility, power, speed, muscular strength, muscular endurance, and cardiovascular fitness. The primary purpose of this study is to assess the effectiveness of this 15-week progressive exercise program, called a functional bridge program, in improving functional fitness in active duty military personnel who are at-risk of musculoskeletal injury (i.e. previously injured, low overall fitness).

The functional bridge program was assessed using a prospective longitudinal random control trial consisting of two groups. The control and intervention groups included active duty members of the Air Force between the ages of 18 and 55 who have recovered from a recent injury indicated by being discharged from physical therapy within the last six months or those who have low overall fitness as indicated by failing or borderline scores on their previous fitness United States Air Force (USAF) assessment. The intervention consisted of participation in a functional bridge program guided by certified athletic trainers and strength coaches for 15 weeks. Three weeks of the program consisted of pre-testing, midpoint testing, and post-testing. The control group was instructed to complete workouts on their own following the USAF fitness guidelines outlined in AFI 36-2905 and to participate in pre-testing, midpoint testing, and post-testing.

Both groups saw operational improvements in scores over time. The intervention group saw significantly greater increases in leg strength from pre-testing to post-testing ($p < 0.004$) when compared to the control group. Similar differences between groups were found in improvements from pre-testing to midpoint testing in lower body power, leg strength, and abdominal endurance. Overall the intervention group who participated in the functional bridge program showed significant improvements in leg strength, which is a key variable that contributes towards reduced injury risk, when compared with the control group. The investigators are currently evaluating the use of the program when led by military members with less experience and education, and future research should be conducted to assess the use of the program in the hands of the user (Mobile app-based) rather than led by certified athletic trainers and strength coaches.

2.0 BACKGROUND

There is a lack of scientific validity regarding physical training (PT) advice for military populations who struggle to meet USAF fitness assessment standards due to previous injuries and/or a lack of functional physical fitness. Under Chapter 6 of the current Air Force Instruction 36-2905 (AFI 36-2905), the Fitness Improvement Program (FIP) is outlined to target changes in nutrition and exercise to improve the health and fitness of airmen. Airmen and their commanders are instructed to work together to devise an appropriate option to improve fitness. Three optional programs are listed for airmen to follow at their discretion: BE WELL online, a Healthy Weight program, and Military OneSource Health Coaching. No specific recommendations or other guidelines are given for PT. Section 6.2.6. of the AFI specifically states "Members are ultimately responsible for improving their fitness level to achieve a minimum Satisfactory FA score, and if appropriate, provide documentation of compliance with FIP to their leadership" (AFI 36-2905, p.46). In most cases, Physical Training Leaders with Advanced training (PTL-A) are those airmen in charge of leading command mandated PT along with FIP sessions. USAF PTLs are currently assigned a simple computer-based training video before advising and supervising their fellow airmen during PT. Research has shown that health care professionals such as athletic trainers, physical therapy assistants, strength and conditioning coaches, etc., who have higher and more specialized education can often produce more favorable programs and results than these PTLs.[2]

The USAF fitness assessment consists of four fitness components that include a 1.5 mile run (or 2k walk if on a profile for running), abdominal circumference measurement, one minute of pushups, and one minute of sit-ups. Airmen must meet all minimum fitness component standards regardless of their overall percentage score. If an airman fails to meet the minimum required score on any of the fitness components or receives an overall score below 75, the airman fails the assessment and then is given a 42- to 90-day reconditioning period before being re-tested.[1] A failure on a USAF fitness assessment for airmen, no matter the reason, has the potential to be detrimental to their career. This fact alone can cause airmen to train for their test in an improper and unsafe manner. The introduction of a functional bridge physical training program can address the needs of airmen who are striving to meet fitness standards while simultaneously reducing the risk of future musculoskeletal injuries.

Functional bridge programs are used in private sports medicine clinics and elite athletics to bridge the gap between low performance (whether due to fitness level or injury) and fully functioning at a high level. Quality bridge programs are constructed to mix the demands of specific endeavors (e.g., PT test components) on a continuum of difficulty progression. During these bridge programs professionals are also sure to blend exercise progression with any specific restrictions or deficits the athlete may have.[3] The fundamental components and complexities of these programs make the importance of implementation prevalent in the sports medicine world. Adversely, minimal research exists to examine the effectiveness of bridge programs on improving performance or reducing injury in the military. Goss and colleagues, physical therapists for the US Army, found that six weeks of a functional bridge program resulted in significant improvements for those recently discharged from physical therapy. [4] Scores in the Functional Movement Screen (FMS), t-test, single-leg hop, hop distance, body fat, and vertical jump all showed improvement. Subjects in this study met three times per week, focusing on

agility training, core strength and balance, and power and explosiveness, separately[4]. The study did not include a control group. Subjects' improvements were found to be significant enough for the authors to suggest a similar program for non-patients seeking to improve USAF fitness assessment scores and reduce risk of injury.[4]

Functional bridge programs for service members with poor physical performance and/or previous injuries typically start at a basic level of difficulty and progress based on the individual's pain levels, abilities, and rate of safe progression. Ageberg et al.[5] described a neuromuscular exercise training program for patients who have had a knee or hip total joint replacement. Exercises in this program consist of lunges, pelvic lifts, step-ups, and squats that begin at an easy and safe level, and are progressed based on the individual.[6] Each exercise session begins with patients rating their pain on a visual analog scale, moves to warm up, then to circuit training, and finally a cool down.[6] This type of training is very appropriate for patients in a bridge program, and the exercise protocol in the present study will be based on Ageberg's findings along with the regimen used by Goss.[4,6]

Given the preceding considerations, the following hypotheses guided this study:

H1: It was expected that both groups would see the following within group changes from pre-testing to midpoint testing:

- *H1a:* A decrease in body fat percentage, pro-agility times (both right and left), 300-yard shuttle time, abdominal circumference, and 1.5 mile run time.
- *H1b:* An increase in lower body power as measured by broad jump, single-leg hop distance (both right and left),one repetition maximum leg press, one repetition maximum of single-leg leg press (both right and left), Functional Movement Screen score, number of completed push-ups, number of completed sit-ups, and overall Fitness Assessment score

H2: It was expected that both groups would see the following within group changes from pre-testing to post-testing:

- *H2a:* A decrease in body fat percentage, pro-agility times (both right and left), 300-yard shuttle time, abdominal circumference, and 1.5 mile run time.
- *H2b:* An increase in lower body power as measured by broad jump, single-leg hop distance (both right and left), one repetition maximum leg press, one repetition maximum of single-leg leg press (both right and left), Functional Movement Screen score, number of completed push-ups, number of completed sit-ups, and overall Fitness Assessment score

H3: It was expected that subjects completing the Functional Bridge Program when compared to the controls from pre-testing to midpoint testing would have:

- *H3a:* A greater decrease in body fat percentage, pro-agility times (both right and left), 300-yard shuttle time, abdominal circumference, and 1.5 mile run time.
- *H3b:* A greater increase in lower body power as measured by broad jump, single-leg hop distance (both right and left), one repetition maximum leg press, one repetition maximum of single-leg leg press (both right and left), Functional Movement Screen

score, number of completed push-ups, number of completed sit-ups, and overall Fitness Assessment score.

H4: It was expected that subjects completing the Functional Bridge Program when compared to the controls from pre-testing to post-testing would have:

- *H4a:* A greater decrease in body fat percentage, pro-agility times (both right and left), 300 yard shuttle time, abdominal circumference, and 1.5 mile run time.
- *H4b:* A greater increase in lower body power as measured by broad bump, single leg hop distance (both right and left), 1 repetition maximum leg press, 1 repetition maximum of single-leg leg press (both right and left), Functional Movement Screen score, number of completed push-ups, number of completed sit-ups, and overall Fitness Assessment score.

3.0 METHODS

3.1 Study Location and Participants

This study took place in Dayton, OH, at Wright-Patterson Air Force Base. Subjects volunteered for the study after hearing about it from various modes of marketing and communication. Subjects contacted investigators through email or in person about their interest in participating in the study. They had to meet inclusion criteria before enrollment into the study. Enrollment criteria included the following: active duty status; 18-55 years of age; non-smoker for the past 6 months; and either have been discharged from physical therapy within the last 6 months, or scored an 85 or lower on their most recent official fitness assessment. Once it was determined the criteria was met, the subject discussed individual current issues, limitations, and overall goals with the researcher. If the researcher decided that the exercise program could be beneficial for the prospective subject, then he or she was asked to participate in a 15-week fitness research study and a time was set to administer the informed consent on their first day of pre-testing.

3.2 Study Design

This prospective longitudinal random control trial consisted of two groups. Subjects were assigned a number once they consented to participate. That number was randomly assigned to either the control or the intervention group. The control group completed the same three separate days of testing as the intervention group. This study followed an open enrollment plan. Subjects could volunteer as needed and there were no set dates for enrollment.

3.2.1. Control Group

At the end of pre-testing, researchers provided control subjects with a binder which included an example workout log designed by the researchers with 12 blank workout packets for use. The binder also contained the Air Force Physical Fitness Guidance, AFI-36-2905, and two peer-reviewed journal articles from the American College of Sports Medicine pertaining to building and maintaining fitness. All control subjects were instructed to record if they completed workouts, and daily measurements of any injuries, associated pain and severity, unusual muscle soreness, and the amount of pre-workout motivation in these training logs. The control group subjects were given Polar heart rate monitors with coordinating chest straps to wear during workouts. Researchers suggested they keep track of their workout duration, calorie burn, average heart rate and maximum heart rate to monitor their progress and ensure the workouts were getting progressively harder. The control group members were asked to track their workouts on a regular basis and turn in the completed binder at post-testing. Researchers also informed the control subjects that they were allowed to, and encouraged to utilize the researchers for help in attaining their goals. It was up to the control subject if they chose to utilize the researcher as a resource in their 15-week fitness journey. Once they completed post-testing, the subjects were given the approved compensation and letters of appreciation for participation signed by the principal investigator.

3.2.2. Intervention Group

After completion of pre-testing, the subjects were randomly assigned into the intervention group which then began the 12-week exercise program designed by the research team. It consisted of three supervised training sessions per week. The comprehensive, progressive exercise protocol used in these sessions consisted of: functional/dynamic warm-up; injury prevention exercises; total body, multi-joint, and core strengthening exercises; interval training; agility and movement based exercises; cardiorespiratory endurance; and stretching for improved flexibility. Exercise sessions were conducted three times each week beginning with basic movement patterns for each participant and progressing on an individual level at the researchers' discretion. An example of the exercise sheet is included as Appendix A. The exercise program consisted of four total phases, each phase containing 4 weeks of workouts, with increases in difficulty each week. This type of progression was followed for all prescribed exercises to ensure safety and to enhance strength and stability in the subjects. The intervention subjects were also given Polar heart rate monitors with chest straps to monitor maximum heart rate, average heart rate, calorie burn, and workout duration during each training session. The researchers were able to use the information during the training sessions to modify and change the workouts as needed. Every workout was supervised by the researchers (athletic trainers and strength and conditioning coaches) and lasted approximately one hour. The subjects were given instructions on how to complete the exercises, tips for ensuring correct form, and necessary modifications. Due to the open enrollment structure, not all intervention subjects were in the same week or phase during these workout times. Once subjects completed post-testing, the subjects were given the approved compensation and letters of appreciation for participation signed by the principal investigator.

3.3 Data Collection

Data collection for both the control and intervention group followed the same process. Each round of testing consisted of the same measures. Each subject was taken through a battery of tests and measurements to form a baseline of their current performance levels. There were three types of measurements taken: anthropometric, functional testing, and the USAF Fitness Assessment Mock Test. The anthropometric measurements included; age, height, weight, and body fat percentage taken with a Lange Skin-Fold caliper. The functional testing metrics included broad jump, single leg hop, pro-agility, 300-yard shuttle, one repetition maximum (RM) leg press derived from a 5 RM test, a single leg one RM derived from a five RM tests, and a functional movement screen. The USAF Fitness Assessment Mock test followed AFI 36-2905 which included abdominal circumference, one minute of push-ups, one minute of sit-ups and 1.5-mile cardiorespiratory endurance. All subjects performed this same test battery in the same order at pre-testing, after following six weeks of training (mid-point), and following six more weeks of training (post-testing). The battery was separated into two days with 72 hours of rest between each session.

3.4 Variables

3.4.1 Day 1

Height

Each subject's height was measured by an Accustat Genetech Stadiometer (Genentech, South San Francisco, California). Each subject was instructed to remove both of their shoes, stand with their heels together and keep their head upright before the measurement was taken. The measurement was read to the nearest ½ inch.

Weight

The weight of each subject was measured using a Tanita BWB-627A Class III scale (Tanita Corp., Tokyo Japan). With shoes still off from height measurements, subjects stepped on the digital scale and the researcher recorded their weight in pounds and measured to the nearest tenth of a pound.

Body Fat Measurement

To measure subjects' body fat, the researchers used the Lange Skinfold Calipers (Beta Technology, Inc, Cambridge Maryland) to do a three-site skinfold test with the Jackson and Pollock method. The Jackson-Pollock skinfold bodyfat measurement has been shown to have reasonably good agreement with the gold-standard underwater weighing method (r=0.923 for males, r=0.934 females). The standard error of estimate when compared to underwater weighing was 2.73 percent (%) for males and 2.27% females (Burns, 1999).

Subjects were told ahead of time to wear shorts for testing to provide better access to test points. The testing was completed in a closed room with two researchers present. Men's skinfold measurements were taken from chest, abdomen, and thigh, and while the researchers measured the triceps, suprailiac, and thigh on women. All measurements were taken on the right side of all subjects. The researchers pulled the body fat away from the muscle and used the calipers to measure the lengths at the different sites. Each site was measured twice. If there was a difference of two or more between these two measurements, then the site was measured a third time. The average measurement of each site was then plugged into the Jackson-Pollock equation to determine body fat composition. That number was then entered into the Siri equation to determine body fat percentage.

Broad Jump

The standing broad jump has been found to be a reliable measurement of lower body muscular power (r=0.99, Standard Error of the Measurement (SEM)=0.04) (Reid, Dolan, DeBeliso, 2017) and lower body muscular strength (r2=0.700) (Fernandez-Santos, Ruiz, Cohen, Gonzalez-Montesinos, Castro-Pinero, 2015). To complete the broad jump, each subject was instructed to stand with their feet in a fixed parallel position at a basketball court baseline. A tape measure was taped down on the basketball floor running forward from the subjects' feet. When they were ready, the subjects jumped forward, lifting both feet off the ground at the same time and then landing with both feet at the same time (on either side of the tape measure). The researchers measured the subjects' jump lengths at

the point of the heel closest to the baseline (to the nearest ½ inch). If the subject double jumped, or did not land with both feet in sync, they were instructed to complete the jump again. The subject completed the broad jump process three successful times and the best (longest) measurement of three was recorded.

Single-Leg Hop

Traditionally, the single-leg hop test is used to measure lower body muscle strength and power along with neuromuscular control (Williams, Heidloff, Haglage, Schumacher, Cole, Campbell, 2015). This test is also used in the rehabilitation field to determine confidence in an injured knee and ability to tolerate various loads. For the single-leg hop test, the subject was instructed to stand on one foot at a basketball court baseline (the same spot utilized for the broad jump). A tape measure was taped down on the basketball floor running forward from the subject's foot. The tape measure ran on the medial side of the leg being tested. The subject hopped forward lifting off from one foot and then landing on that same foot. The measurement was taken at the nearest half-inch from the heel. If the subject double jumped or utilized the opposite foot during take-off or landing, they were instructed to complete the hop test again. Each subject completed three successful hops for each leg and the best score for each leg was recorded.

Pro-Agility

The pro-agility test, also known as the 5-10-5 agility shuttle, requires the subject to change direction quickly while maintaining their control and balance. Three cones were placed in a straight line, five yards apart (see Figure 1). The subject started at the center cone, facing the researcher, with the other cones to their left and right. On the subject first move, the researcher began the stopwatch. The subject ran toward the right cone as fast as possible. Their right foot crossed the line of the cone and their right hand touched the ground simultaneously. The subject then changed direction to run toward the far left cone. Once the subject reached that cone, they crossed the line with their left foot and touched the ground with their left hand simultaneously. The subject then changed direction again and ran back toward the center cone (finish line). Once they crossed this cone, the researcher stopped the time. The subject completed three tests starting to the right, and three tests starting to the left. Their best time was recorded.

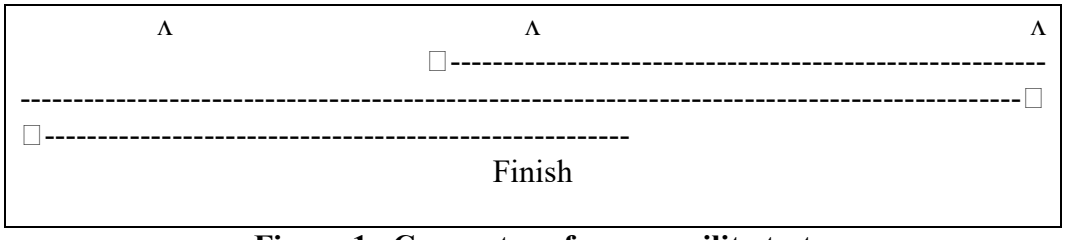

Figure 1. Cone set-up for pro-agility test

300-Yard Shuttle

The 300-yard shuttle run is commonly used to test anaerobic capacity in active populations. The test has been shown to have a high ICC (r=0.84) and low SEM (SEM=

2.2 seconds). For this test, the subject ran back and forth between two cones that were placed 25 yards apart. The subject ran down and back six times, placing a foot through the line of either cone each time, for a total of 300-yards. The researcher then recorded their total time in minutes and seconds.

One-Repetition Max (RM) Leg Press

The 1RM leg press is a standard test used in strength and conditioning to measure lower body strength. A 1RM is done by lifting maximum weight in a single lift. It can also be calculated out by lifting maximal weight up to ten times.

For safety and consistency purposes, the researchers chose to utilize a 5RM method and calculated each subject's estimated 1RM from that number. Researchers first oriented the subjects to the Hammer Strength Linear Leg Press machine. The researchers explained proper and safe use of the machine, as well as proper form. The subjects were instructed to complete each repetition to 90 degrees of knee flexion. The subject then completed a light warm up of 8-10 repetitions with low weight. At that point, the researcher, a Certified Athletic Trainer began loading the sled with appropriate weight for the subject. Weight management and changes varied from subject to subject and required a subject matter expert for determination. The overall goal was to get to a subjects 5RM within three to five rounds of lifting. Once the subject reached their maximum weight, ideally at five repetitions, the researcher recorded that weight and repetition number.

One RM Single-leg Leg Press

The single-leg leg press is used to measure single-leg strength in the same method as the leg press. In the field of strength and conditioning, this measurement is often utilized to track differences and changes between the strength of both legs, especially following a lower extremity injury. Ideally, subjects' strength is equal from side to side. If a subject pre-tested with a strength deficiency on one side, then equal strength would be an ideal finding at post-testing.

The researchers ran the testing process for the single-leg leg press identical to the standard leg press test. Subjects did not complete a warm-up as they were already warm from completing the standard leg press test. After a demonstration of foot placement options (either stacked below hip, or at the center of the body) the subject began lifting. Again, the researcher and expert in strength and conditioning determined the loads to be used for each lift to guide the subject to a 5RM single-leg leg press. The subjects were instructed to complete each repetition to 90 degrees of knee flexion. The goal was to still have the subject reach their maximum weight within three to five lifts, ideally at five repetitions. Once the subject indicated they were at their maximum weight the researcher recorded that weight and repetition number for each leg individually.

3.4.2 Day 2

Functional Movement Screen

The FMS (Functional Movement Systems, Inc., Chatham, Virginia) is an evaluative tool used to assess function, stability, and movement quality in subjects. The FMS focuses on highlighting poor movement patterns to prevent long-term biomechanical issues, and

potential injury. The FMS consists of seven movement tests with a basic 0-3 grading scale. The subject completes each movement, and the researcher grades the movement based on the criteria set forth by the FMS literature. Those subjects with a score ≤ 14 on the FMS are 2.74 times more likely to sustain an injury (Bonazza, Smuin, Onks, 2016). The FMS system has a high intrarater reliability (r=0.81, 95% Confidence Interval(CI)) and high interrater reliability (r=0.81, 95% CI).

The Functional Movement Screen was the first test the subjects completed on Day 3 of testing. Each subject completed all seven of the standard FMS motions: Deep Squat, Hurdle Step, In-Line Lunge, Active Straight-Leg Raise, Trunk Stability Push-Up, Shoulder Mobility, and Rotary Stability. These movements were directed and completed according to FMS standard training protocol. Two researchers, each of whom completed Functional Movement Screen training, scored the subjects seven movements. Of the two score sheets, the researchers recorded the lowest score for each movement, then those seven scores were totaled for the subjects overall FMS score.

USAF Fitness Assessment Mock Test

The United States Air Force Fitness Assessment consists of fitness testing in three categories: body composition, aerobic fitness, and muscular fitness. Body composition is measured by an abdominal circumference measurement above the anterior iliac crest using a tape measure. Aerobic fitness is measured by a timed 1.5-mile run. Muscular fitness is measured by a one minute round of push-ups followed by a one minute round of sit-ups. Scoring for the USAF Fitness Assessment consists of a composite score achieved by adding up individual scores for each category. Points awarded per category are dependent on gender and age. An overall score over 90 is considered excellent and a score less than 75 (or failing one or more individual components) is considered unsatisfactory and a failure.[1]

For this research, the subjects completed a Mock Fitness Assessment with the researchers. One researcher read each subject the Air Force Instruction concerning the fitness assessment (AFI 36-2905) as another researcher measured the subjects' abdominal circumference. The subject then completed the push-up test, sit-up test, and the 1.5 mile run in accordance with AFI 36-2905 guidelines. All subjects ran indoors on the Wright Field Fitness Center running track (13.75 laps) to keep methods consistent throughout. Abdominal circumference (in inches), number of push-ups, number of sit-ups, and run time were all recorded for analysis.

3.3 |Data Analysis

Data from this study were analyzed using SPSS (IBM Corp., Armonk, NT) version 25 and Microsoft Excel 2016 (Microsoft Technology, Redmond, Washington). The level of statistical significance was set at $p < 0.05$. The bonferroni correction was then applied to account for number of comparisons and produced an adjusted p-value < 0.004. An a priori power analysis was conducted by research support staff and it was determined that 50 subjects per group should be retained for both the control and intervention groups with a goal total of 100 participants. Assuming a 25% attrition rate, approximately 125 subjects were

needed to complete the study and see a large effect size between groups with a power of 0.80 and alpha level set at 0.05. Means and standard deviations were used to summarize continuous variables, and counts and percent were used to summarize ordinal data. Baseline difference between groups were assessed using t-tests. Changes over time within groups were assessed using t-tests. Hypothesis testing predicting mean difference change between groups from pre-testing to midpoint testing and pre-testing to post-testing was completed using two-tailed *t*-tests. Cohen's *d* was used to measure effect size and the meaningful difference threshold was set at |0.3|,

4.0 RESULTS

4.1 Descriptive Statistics

A total of 172 subjects were initially enrolled in the study and randomly assigned to either the control or intervention group. Forty-five (40.5%) subjects in the control group and 66 (59.5%) subjects in the intervention group completed at least two data testing time points (pre, mid, and/or post) and were included in the data analysis for a total of 111. Sixty-one (35.5%) subjects completed pre-testing only and did not follow-up with subsequent testing and, therefore, were considered dropouts and were not included in data analysis. Age of participants ranged from 20-55 years of age with an average age of 33.42 years. Table 1 provides the breakdown of the demographical statistics of participants. The two groups were not significantly different on height (p=0.991), weight (p=0.226) or age (0.860). Fifty-two males (46.8%) and 59 females (53.2%) participated. Of the 111 participants included in data, 91 (82.0%) completed post-testing. A *t*-test was completed to test for differences in number of total weeks that subjects participated in workouts. There was no significant difference (p=0.169) between the control and intervention group for number of weeks completed.

Table 1: Subject Demographics

Variables	Intervention			Control			*p* – Value
	N	Mean	SD	*N*	Mean	SD	
Height (in)	66	67.708	3.871	45	67.7	3.358	0.991
Age	66	33.545	8.597	45	33.244	7.972	0.860
Weight Pre (lbs.)	66	198.626	33.573	45	190.804	32.662	0.226
Weight Mid (lbs.)	66	198.155	32.619	44	190.082	32.989	0.208
Weight Post (lbs.)	56	200.398	32.825	35	190.371	33.371	0.162

Table 2 provides the descriptive statistics for pre-testing measures. Although there were no significant differences between groups at the adjusted p< 0.004 at baseline, the intervention group tended to have higher baseline leg strength and power measures, with four variables trending toward significance (p < 0.05). These included broad jump, leg press, right single-leg leg press, and left single-leg leg press. Means for all variables measured at all time-points are included in Appendix B.

Table 2. Baseline Statistics by Group

	Variable	Intervention			Control			Test Statistic *(t)*	*p* – Value	Effect size |*d*|	Degrees of Freedom *df*
		N	Mean	SD	*N*	Mean	SD				
	Body Fat (%)	66	0.284	0.060	45	0.292	0.052	0.784	0.435	0.144	102.475
Functional Fitness Measures	Broad Jump (in.)	66	66.336	17.123	45	58.967	13.944	-2.395	0.018	0.430	105.498
	Right Single Leg Hop (in.)	66	48.863	12.916	45	44.611	12.311	-1.735	0.085	0.329	97.609
	Left Single Leg Hop (in.)	66	49.386	12.916	45	44.578	12.965	-1.822	0.071	0.341	99.664
	Leg Press (lbs.)	66	495.259	229.901	45	409.989	186.054	-2.068	0.041	0.371	105.731
	Right Leg Leg Press (lbs.)	63	217.921	128.873	43	165.756	106.096	-2.194	0.030	0.405	100.288
	Left Leg Leg Press (lbs.)	64	225.084	136.241	44	161.811	103.422	-2.606	0.010	0.464	104.898
	Pro Agility (sec)	66	6.120	0.866	45	6.408	0.936	1.642	.104	0.333	0.637
	300 yd Shuttle (sec.)	66	87.818	14.316	45	90.022	19.160	0.693	0.490	0.490	76.380
	FMS	66	15.364	2.291	45	15.044	2.099	-0.745	0.458	0.139	99.895
USAF Fitness Assessment	Abdominal Circumference (in.)	66	35.136	3.680	45	34.211	3.679	-1.301	0.197	0.251	94.703
	Push Ups	64	29.734	16.051	43	26.442	13.129	-1.116	0.267	0.205	100.916
	Sit Ups	65	38.062	13.671	45	39.578	10.728	0.628	0.531	0.111	106.926
	1.5-mile Run (min.)	62	16.461	2.828	44	16.51	29.978	0.080	0.936	0.016	89.743
	Fitness Assessment Score	66	43.945	28.322	45	46.642	29.020	0.488	0.627	0.120	93.122

*Significance p <0.004

Subjects in both groups were asked to record daily numbers from heart rate monitors including average heart rate, workout length, and calorie burn. The data was meant to be used as a guide for the participant to judge the intensity of their workout and adjust as needed. Subjects were requested to turn in these daily workout data sheets at the completion of their participation, no matter how many weeks they chose to participate. One-hundred eleven subjects turned in their daily workout sheets. Seventy-nine (71.2%) were intervention subjects, and 32 (28.8%) were control subjects. Table 3 provides the descriptive details for this daily data.

Table 3. Descriptive Details for Daily Workout Metrics

Variable	Intervention			Control		
	N	Mean	SD	*N*	Mean	SD
Number of workouts completed (40 total)	79	28.165	9.174	32	24.188	12.594
Average Heartrate (bpm)	40	136.661	3.027	40	139.177	34.516
Workout Duration (minutes)	40	53:56	35:01	40	51:03	7:26
Calorie Burn	40	517.240	62.936	40	457.67	106.504

4.2 Hypothesis Testing

The guiding hypotheses for this study purported that all subjects would see an overall improvement in measures over time and that the intervention group would have more favorable changes in performance measures when compared to the control group. The hypotheses were analyzed using *t*-tests to compare within group differences across the testing periods (pre-testing to midpoint testing and pre-testing to post-testing), as well as between group differences across testing periods.

4.2.1. Within Groups Pre-testing to Midpoint Testing Results

Hypothesis 1a predicted a decrease in body fat percentage, pro-agility time, 300-yard shuttle time, abdominal circumference, and 1.5 mile run time from pre-testing to midpoint testing for all subjects. The control group had significant improvements in pro-agility time ($p = 0.001$), and 1.5 mile run time ($p < 0.001$) (Table 4). The intervention group had significant improvements in pro- agility time ($p = 0.004$), 300-yard shuttle ($p < 0.001$), and 1.5 mile run time ($p < 0.001$) (Table 5).

Hypothesis 1b foresaw an increase in lower body power as measured by broad jump, single-leg hop distance (both right and left), one repetition maximum leg press, one repetition maximum of single-leg leg press (both right and left), Functional Movement Screen Score, number of completed push-ups, number of completed sit-ups, and overall Fitness Assessment score as measured from pre-testing to midpoint testing for all subjects. The control groups significantly improved in left single-leg hop ($p = 0.001$), right, left and double-leg leg press ($p < 0.001$), and number of push-ups ($p < 0.001$). The intervention groups significantly increased scores for broad jump ($p < 0.001$), both single-leg broad jumps ($p < 0.001$), all leg press measures (right, left and double leg) ($p < 0.001$), Functional Movement Screen Score ($p < 0.001$), number of push-ups ($p < 0.001$), number of sit-ups ($p < 0.001$), and 300-yard shuttle ($p = 0.004$).

Table 4. Control Group Means (Pre-testing to Midpoint Testing)

	Variable	Control Pre			Control Mid			Test Statistic (t)	p – Value	Effect size $\lvert d \rvert$	Degrees of Freedom (df)
		N	Mean	SD	*N*	Mean	SD				
	Body Fat (%)	45	0.2944	0.052	43	0.290	0.050	0.806	0.425	0.125	42
Functional Fitness Measures	Broad Jump (in)	41	57.598	13.167	41	59.793	13.593	-2.481	0.017	0.388	40
	Right Single Leg Hop (in)	41	43.378	11.874	41	45.841	11.947	-2.391	0.022	0.373	40
	Left Single Leg Hop (in)	41	43.317	12.600	41	46.110	12.591	-3.518	0.001*	0.549	40
	Leg Press (lbs.)	40	408.040	192.889	40	530.730	200.990	-8.473	<0.001*	1.340	39
	Right Leg Leg Press (lbs.)	38	163.545	11.150	38	242.147	116.181	-6.455	<0.001*	1.047	37
	Left Leg Leg Press (lbs.)	39	158.527	107.965	39	242.061	117.309	-7.782	<0.001*	1.246	38
	Pro Agility (sec)	41	6.479	0.935	41	6.229	0.719	3.615	0.001*	0.563	40
	300 yd Shuttle (sec)	41	90.71	19.785	41	86.95	13.544	2.021	0.050	0.316	40
	FMS	37	15.05	2.121	37	15.812	2.172	-2.192	0.035	0.360	36
USAF Fitness Assessment	Abdominal Circumference (in)	39	34.244	3.473	39	33.808	3.672	1.976	0.055	0.316	38
	Push Ups	36	26.640	13.273	36	29.583	13.426	-3.842	<0.001*	0.640	35
	Sit Ups	37	41.730	9.608	37	41.730	9.608	-1.952	0.059	0.321	37
	1.5-mile Run (min)	37	16.572	3.203	37	15.516	2.620	3.921	<0.001*	0.645	36
	Fitness Assessment Score	39	49.910	29.621	39	59.265	32.218	-2.723	0.010	0.436	38

*Significance at $p < 0.004$

Table 5. Intervention Group Means (Pre-testing to Midpoint-Testing)

	Variable	Intervention Pre			Intervention Mid			Test Statistic (*t*)	*p* – Value	Effect size |d|	Degrees of Freedom (df)
		N	Mean	SD	*N*	Mean	SD				
	Body Fat (%)	66	0.284	0.060	66	0.272	0.060	2.590	0.12	0.319	65
Functional Fitness Measures	Broad Jump (in)	65	66.680	17.025	65	71.223	16.199	-7.044	<0.001*	0.874	64
	Right Single Leg Hop (in)	65	49.354	12.382	65	53.331	12.849	-5.224	<0.001*	0.648	64
	Left Single Leg Hop (in)	65	49.654	14.093	65	53.200	13.603	-5.193	<0.001*	0.644	64
	Leg Press (lbs.)	64	493.256	228.792	64	660.997	247.567	-14.638	<0.001*	1.830	63
	Right Leg Leg Press (lbs.)	60	216.764	128.573	60	317.455	136.362	-9.841	<0.001*	1.270	59
	Left Leg Leg Press (lbs.)	61	223.930	136.806	61	317.720	138.485	-9.881	<0.001*	1.265	60
	Pro Agility (sec)	65	6.094	0.847	65	5.916	0.789	2.983	0.004*	0.371	64
	300 yd Shuttle (sec)	64	87.800	14.276	64	82.063	11.246	5.947	<0.001*	0.743	63
	FMS	62	15.520	2.186	62	16.694	2.013	-4.645	<0.001*	0.590	61
USAF Fitness Assessment	Abdominal Circumference (in)	64	35.078	3.713	64	34.727	3.378	2.349	0.022	0.294	63
	Push Ups	61	29.980	16.134	61	34.690	15.036	-6.674	<0.001*	0.855	60
	Sit Ups	63	37.830	13.800	63	43.492	11.390	-5.693	<0.001*	0.717	62
	1.5 Mile Run (min)	57	16.245	2.739	57	15.210	2.240	4.743	<0.001*	0.628	56
	Fitness Assessment Score	64	43.766	28.550	64	55.816	28.748	-4.204	<0.001*	0.526	63

*Significance at $p < 0.004$

4.2.2 Within Groups Pre-testing to Post-testing Results

Hypothesis 2a predicted a decrease in body fat percentage, pro-agility time, 300-yard shuttle time, abdominal circumference, and 1.5 mile run time from pre-testing to post-testing for all subjects. The control group had significant improvements in pro-agility time ($p < 0.001$) (Table 6). The intervention group had significant improvements in ALL predicted measures ($p < 0.001$), excluding body fat percentage (Table 7).

Hypothesis 2b foresaw an increase in lower body power as measured by broad jump, single-leg hop distance (both right and left), 1 repetition maximum leg press, 1 repetition maximum of single-leg leg press (both right and left), Functional Movement Screen Score, number of completed push-ups, number of completed sit-ups, and overall Fitness Assessment score as measured from pre-testing to midpoint testing for all subjects. The control groups significantly improved in right single-leg hop ($p = 0.001$), right, left and double-leg leg press ($p < 0.001$), and

number of push-ups ($p < 0.001$). The intervention groups significantly increased scores for ALL measures ($p < 0.001$).

Table 6. Control Group Means (Pre-testing to Post-testing)

	Variable	Control Pre			Control Post			*Test Statistic (t)*	*p* – Value	Effect size |*d*|	Degrees of Freedom (df)
		N	Mean	SD	*N*	Mean	SD				
	Body Fat (%)	35	0.286	0.053	35	0.285	0.056	0.243	0.809	0.041	34
Functional Fitness Measures	Broad Jump (in)	34	61.838	13.781	34	64.265	15.414	-1.798	0.081	0.308	33
	Right Single Leg Hop (in)	34	47.044	12.225	34	50.853	13.322	-3.802	0.001*	0.652	33
	Left Single Leg Hop (in)	34	47.162	12.033	34	49.853	13.407	-2.682	0.011	0.460	33
	Leg Press (lbs.)	34	438.885	181.016	34	641.577	221.616	-8.691	<0.001*	1.490	33
	Right Leg Leg Press (lbs.)	32	184.950	103.633	32	296.478	128.812	-6.509	<0.001*	1.151	31
	Left Leg Leg Press (lbs.)	33	182.173	103.592	33	292.091	126.323	-6.922	<0.001*	1.205	32
	Pro Agility (sec)	34	6.243	0.818	34	5.057	0.856	3.579	<0.001*	0.616	33
	300 yd Shuttle (lbs.)	33	85.94	12.774	33	86.580	15.768	-0.415	0.681	0.072	32
	FMS	29	15.07	2.219	29	16.207	2.336	-2.967	0.006	0.551	28
USAF Fitness Assessment	Abdominal Circumference (in)	32	34.189	3.636	32	33.727	3.696	2.480	0.019	0.438	31
	Push Ups	29	30.17	12.887	29	34.45	12.161	-4.694	<0.001*	0.872	28
	Sit Ups	30	42.50	8.390	30	46.033	9.091	-3.002	0.005	0.548	29
	1.5-mile Run (min)	30	16.0827	3.150	30	15.406	2.803	1.467	0.153	0.268	29
	Fitness Assessment Score	33	49.255	29.617	33	63.063	27.939	-2.705	0.011	0.471	32

*Significance at $p < 0.004$

Table 7. Intervention Groups Means (Pre-Testing to Post-Testing)

	Variable	Intervention Pre			Intervention Post			Test Statistic *(t)*	*p* – Value	Effect size |*d*|	Degrees of Freedom (df)
		N	Mean	SD	*N*	Mean	SD				
	Body Fat (%)	57	0.282	0.062	57	0.271	0.062	2.377	0.021	0.315	56
Functional Fitness Measures	Broad Jump (in)	56	69.045	16.541	56	75.348	16.591	-7.777	<0.001*	1.040	55
	Right Single Leg Hop (in)	56	50.875	12.496	56	57.107	12.866	-8.052	<0.001*	1.076	55
	Left Single Leg Hop (in)	55	52.455	12.914	55	57.509	13.843	-6.312	<0.001*	0.851	54
	Leg Press (lbs.)	55	527.480	217.888	55	821.006	269.796	-13.991	<0.001*	1.887	54
	Right Leg Leg Press (lbs.)	52	235.468	121.074	52	404.313	126.095	-13.904	<0.001*	1.928	51
	Left Leg Leg Press (lbs.)	52	244.073	128.535	52	405.853	130.169	-13.198	<0.001*	1.830	51
	Pro Agility (sec)	56	5.958	0.745	56	5.669	0.687	7.158	<0.001*	0.960	55
	300 yd Shuttle (sec)	54	85.560	13.219	54	79.167	11.739	5.694	<0.001*	0.812	53
	FMS	52	15.691	1.842	52	17.423	1.673	-6.207	<0.001*	0.861	51
USAF Fitness Assessment	Abdominal Circumference (in)	56	35.357	3.589	56	34.424	3.394	5.098	<0.001*	0.681	55
	Push Ups	53	31.771	16.079	53	39.792	15.211	-7.301	<0.001*	1.003	52
	Sit Ups	54	39.702	12.693	54	46.130	10.107	-5.393	<0.001*	**0.734**	53
	1.5-mile Run (min)	48	16.125	2.780	48	14.965	2.514	4.117	<0.001*	0.594	47
	Fitness Assessment Score	57	44.279	27.884	57	60.281	30.220	-4.769	<0.001*	0.632	56

*Significance at $p < 0.004$

4.2.3 Between Groups Pre-testing to Midpoint Testing Results

Hypothesis 3a anticipated a greater decrease in the intervention group in body fat percentage, pro-agility times, 300-yard shuttle time, abdominal circumference, and 1.5 mile run time in the intervention group from pre-testing to midpoint testing. There were decreases in all measurements for both control and intervention groups in these measurements (Table 8). There were no significant differences between the control and intervention groups in these measured changes.

Hypothesis 3b predicted a greater increase for the intervention in lower body power as measured by broad jump, single-leg hop distance (both right and left), one repetition maximum leg press, one repetition maximum of single-leg leg press (both right and left), Functional Movement Screen score, number of completed push-ups, number of completed sit-ups, and overall Fitness

Assessment score from pre-testing to midpoint testing. No measurements were significantly different using the adjusted p value ($p < 0.004$); however there were variables that trended towards significance between groups. Subjects in both groups had an increase in broad jump, leg press, and sit-ups with subjects in the intervention group trending towards significantly greater improvements than control in all three measures (p=0.031, p=0.016, p=0.045 respectively).

Table 8. Mean Differences Between Pre-testing and Midpoint testing Measurements by Group

	Variable	Intervention			Control			Test Statistic (*t*)	*p* – Value	Effect size |*d*|	Degrees of Freedom (*df*)
		N	Mean	SD	*N*	Mean	SD				
	Body Fat (%)	66	-0.011	0.111	43	-0.005	0.040	0.886	0.377	0.182	82.882
Functional Fitness Measures	Broad Jump (in)	65	4.543	5.200	41	2.195	5.664	-2.187	0.031	0.452	79.744
	Right Single Leg Hop (in)	65	3.977	1.855	41	2.463	6.596	-1.201	0.232	0.247	80.603
	Left Single Leg Hop (in)	66	0.008	7.000	45	-2.567	18.213	-2.258	0.026	0.797	52.944
	Leg Press (lbs.)	64	167.741	91.674	40	122.69	91.584	-2.439	0.016	0.491	82.993
	Right Leg Leg Press (lbs.)	60	91.494	72.539	39	78.199	77.413	-0.868	0.388	0.183	77.496
	Left Leg Leg Press (lbs.)	66	79.342	104.995	45	52.826	107.608	-1.292	0.199	0.252	93.106
	Pro Agility (sec)	65	-1.777	.480	41	-0.250	.444	-0.797	0.435	0.152	90.190
	300 yd Shuttle (sec)	64	-5.734	7.714	41	-3.756	11.901	1.034	0.303	0.256	61.594
	FMS	62	1.1774	1.996	37	0.757	2.100	-0.995	0.322	0.213	72.788
USAF Fitness Assessment Measures	Abdominal Circumference (in)	64	-0.352	1.197	39	-0.436	1.377	-0.327	0.744	0.040	71.871
	Push Ups	61	4.705	5.506	37	2.486	5.321	-1.958	0.053	0.403	78.161
	Sit Ups	63	5.667	7.901	37	2.405	7.500	-2.031	0.045	0.413	78.816
	1.5 Mile Run (min)	59	-1.035	1.647	37	-1.055	1.637	-0.058	0.954	0.012	77.392
	Fitness Assessment Score	64	12.05	22.930	39	9.355	21.459	-0.593	0.555	0.118	84.580

*Significant at p< 0.004

4.2.4 Between Groups Pre-testing to Post-testing Results

Hypothesis 4a predicted a greater decrease (i.e. improvement) for the intervention group in body fat percentage, pro-agility time, 300-yard shuttle time, abdominal circumference, and 1.5 mile run time from pre-testing to post-testing, indicating a favorable outcome in these measures. All subjects in both groups had decreases in these scores from pre-testing to post-testing (Table 9). There were no significant differences in the mean changes of these scores between groups.

Hypothesis 4b anticipated a greater increase for the intervention group in lower body power as measured by broad jump, single leg hop distance (both right and left), one repetition maximum leg press, one repetition maximum of single-leg leg press (both right and left), Functional Movement Screen Score, number of completed push-ups, number of completed sit-ups, and overall Fitness Assessment score as measured from pre-testing to post-testing. Subjects in the intervention group had significantly greater increases in leg press strength measures and single-leg right leg press (p =0.006 p =0.006 respectively). Other variables where the intervention group had greater increases in scores compared with the control group that trended toward significance include broad jump score, single-leg left leg press and push-ups (p =0.045, p =0.011, p =0.025 respectively).

Table 9. Mean Differences Between Pre-testing and Post-testing Measurements by Group

	Variable	Intervention			Control			Test Statistic *(t)*	*p* – Value	Effect size |*d*|	Degrees of Freedom (*df*)
		N	Δ Mean	SD	*N*	Δ Mean	SD				
	Body Fat (%)	57	-0.011	0.036	35	-0.002	0.042	1.64	0.247	0.267	63.615
Functional Fitness Measures	Broad Jump (in)	56	6.303	6.065	34	2.426	7.871	-2.623	0.010	0.639	56.664
	Right Single Leg Hop (in)	66	-0.409	17.055	45	-6.189	19.035	-1.672	0.097	0.339	87.588
	Left Single Leg Hop (in)	55	5.055	5.934	34	2.691	5.852	-1.834	0.070	0.030	70.846
	Leg Press (lbs.)	55	293.525	155.589	34	202.691	135.993	-2.805	0.006*	0.584	77.145
	Right Leg Leg Press (lbs.)	52	168.845	87.572	32	111.528	96.927	-2.797	0.006*	0.655	60.662
	Left Leg Leg Press (lbs.)	52	161.780	88.396	33	109.918	91.216	-2.604	0.011	0.587	66.654
	Pro Agility (sec)	56	-.289	0.301	35	-0.195	1.071	-0.467	0.642	0.234	37.405
	300 yd Shuttle (sec)	54	-1.41	4.432	33	4.18	26.168	1.539	0.127	0.892	33.126
	FMS	52	1.73	2.011	29	1.14	2.065	-1.260	0.211	0.295	56.725
USAF Fitness Assessment Measures	Abdominal Circumference (in)	56	-0.933	1.370	32	-0.461	1.051	1.685	0.096	0.345	78.615
	Push Ups	53	8.02	7.996	29	4.28	4.906	-2.292	0.025	0.468	78.854
	Sit Ups	54	6.43	8.756	30	3.53	6.447	-1.585	0.117	0.330	75.502
	1.5-mile Run (min)	48	-1.160	1.953	30	-0.677	2.572	0.948	0.346	0.247	50.349
	Fitness Assessment Score	57	16.003	25.335	33	13.808	29.330	-0.374	0.710	0.087	59.296

*Significant at $p < 0.004$

5.0 DISCUSSION

5.1 Overview of the Study

In this study of airmen seeking help in improvement of USAF fitness assessment score or fitness improvement after release from physical therapy, all subjects saw some significant improvements in measures over time (more so in the intervention group). However, the Functional Bridge program intervention was associated with improvement in one of the functional fitness variables, leg strength, when compared with traditional Air Force physical training ($p < 0.004$). The increase in lower body strength facilitates the neuromuscular balances that decreases the risk for injury[7]. This finding also supports prior research showing that programs led by health care professionals can be beneficial to the improvement of functional fitness in the military population.

The bonferonni correction is considered a simple and conservative way to control for Type I errors during hypothesis testing. By dividing the alpha level by number of comparisons, the researcher is able to compensate for possibility of Type I errors. The bonferonni correction yielded fewer variables that were significantly different between groups than initially expected. There were several variables that trended towards significance including improvements in broad jump, one-repetition maximum leg press, one-repetition maximum single-leg leg press (both sides), and number of push-ups completed after 12 weeks of program implementation. These variables describe potential strength and power improvements gained from the functional bridge program and should be investigated further with a larger sample size.

5.2 Operational Relevance

Although the majority of the results between the two groups were not statistically significant, it is important to note that some of these results are still operationally significant. Specifically focusing on pre-testing to post-testing results, operationally significant results were seen in the intervention group on all leg strength measurements, the abdominal circumference measurement, number of push-ups, number of sit-ups, and fitness assessment score. Relative to the population of interest, the Air Force, the improvements on abdominal circumference (-0.93 inches, -2.65% from pre-test), push-ups (8.02, +26.96% from pre-test), sit-ups (6.43, +16.89% from pre-test) and Fitness Assessment score (16.00, +36.41% from pre-test) are important findings. For those airmen wishing to pass their Fitness Assessment or improve their overall score, all of the measured changes could be a meaningful difference.

It is also important to note that the control group made operationally significant improvements as well. Again, when focusing on the pre-testing to post-testing results within the control group, there were operationally significant changes in all leg strength measures; however the intervention group saw significantly larger improvements when compared with control. Although not as large as the intervention group, the control group also saw an increase in number of push-ups (4.28, +16.19% from pre-test), sit-ups (3.53, +8.9% from pre-test) and Fitness Assessment score (12.81, +26.61% from pre-test). These improvements in scores are beneficial to the target population as well. These results for the control group show plausibility in having a

point of contact that is periodically checking fitness changes and results to foster improvement in Fitness Assessment scores.

To execute the 12-week functional bridge intervention as it is written, one full-time ATC, which costs the Air Force roughly $52,000 per year, can train approximately 220 patients per year with a ratio of 5 patients per 1 ATC per hour. If physical therapy costs ~$1200 per patient per episode of care, then the bridge program would pay for itself by saving in future physical therapy costs if at least 44 of the patients who worked with the ATC (or roughly 20%) did not experience another injury that year. Despite this particular effort not examining the long term effects of the functional bridge program on re-injury rates, past research has shown that similar functional fitness improvements result in a reduced injury risk[7].
For the level of care required for the control condition, it would cost roughly $7,000 per year to employ a part-time certified athletic trainer (ATC) consultant to give standard exercise guidance (without specialized hands-on training) to small groups of individuals and check in approximately 3 times during a 12-week period for 220 subjects. Similair fitness outcomes to the control group in this study would be anticipated.

Based on the findings of this research, military organizations should consider funding ATC positions that could be integrated into the physical therapy clinic or the fitness center as a resource for patients post physical therapy to progress their fitness levels safely and improve functional fitness via functional bridge programs. These improvements may mitigate the risk of re-injury/future injury and save money on future physical therapy costs.

5.3 Limitations

The study had several limitations. First, even though subjects were randomly assigned to the control or the intervention group, due to subjects dropping out of the study or not participating in all of data collection, the N for the two groups was not equal (45=control group, 66=intervention group). Second, because this was a physical study, subjects were allowed to opt out of any of the testing or exercises as they deemed necessary. Some subjects did not complete entire sets of data collection while some did. This accounts for the varied numbers of participants in the results. Also, those subjects who worked in the intervention group were working with three Certified Athletic Trainers during their training sessions. Subjects were required to sign up for training times and were held accountable if they did not show up. These professionals were also able to use their professional judgement and years of experience to modify workouts or sit a subject out if they felt the activity wasn't in the subject's best interest. The addition of this professional relationship could have helped the subjects' willingness and motivation to participate and therefore could have had an effect on the results and the success of the program. This limits the assessment of the true effectiveness of the program, as it was not completed without some professional guidance. Finally, all subjects in this study had varying levels of motivation to improve their physical fitness. Those subjects who were facing disciplinary actions from the Air Force due to low PT test scores may have been more motivated to complete workouts on their own, extra workouts, or apply more effort during their workouts whether they were in the control or intervention group. This outside source of stress and motivation could have altered a subjects' efforts and results.

5.4 Suggestions for Future Work

This study should serve as an initial foundation for future studies focusing on the application of this program in the hands of the real-world setting user. This study showed that the Functional Bridge program, when applied in a controlled environment with the athletic trainers and strength coaches who developed the program, can prove to be beneficial to the airman. The next step should include quantifying results of the Functional Bridge program when it is put directly into the hands of the users (Unit Fitness Program Managers, PTLs, airmen, other related military healthcare professional) and used in a non-controlled setting.

This study also highlighted the fact that a fitness centric approach may not be enough for weight management in the military. Body fat percentage was the only component in which the intervention groups did not see significant improvement. An additional nutritional component to supplement an exercise program like the Functional Bridge Program could be vital in aiding the obesity problem in the military.

6.0 CONCLUSION

The Functional Bridge Program significantly improves measures of leg strength after 12 weeks when compared with traditional Air Force physical training. Improvements may vary dependent on the user and setting of the program and may need to be evaluated in future studies.

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LIST OF SYMBOLS, ABBREVIATIONS AND ACRONYMS

%	percent
AFI	Air Force Instruction
CI	Confidence Interval
FIP	Fitness Improvement Program
PT	Physical Training
PTL-A	Physical Training Leader- Advanced
USAF	United States Air Force
FMS	Functional Movement Screen
RM	Repetitions Max
SD	Standard Deviation
SEM	Standard Error of Measurement

APPENDIX A. Exercise Log Example

Subject ID:_____

Pre-workout Pain (Average within last 24 hrs)					State Body Region in Pain Below Number					
0	1	2	3	4	5	6	7	8	9	10
No Pain										Worst Pain

If Pain is 5 or Above State Why Here:					
Pre- Workout Soreness:	1 not at all	2 light	3 moderate	4 heavy	5 extreme
Pre-Workout Motivatio	1 not at all	2 slightly unmotivated	3 neutral	4 slightly motivated	5 extreme

**** Start HR Monitor immediately before Dynamic Warm Up****

Phase 1 Week 1 Day 1

Dynamic Warm up/Movement prep (~10 min, 10 yards each drill)	Check/ Modification
Jog	
Walking Knee Hug/ Quad Stretch Reach Out	
Lunge to Side Bend/ Walking Hamstring Toe Touch	
Side Shuffles/ Carioca	
Jog to Sprint Build Up	

Plyometrics	Sets x Reps	Check/ Modification

Strength Training		Weight used/ check completed		Modification	State Why	Check if Modified
SL RDL Body Weight hold table	2x8each			RDL BW hold table		
Tap Downs Hold Wall	2x10each			Low Height		
Squat body Weight Hold Table	2x8			Quarter Squats BW		
Plank	2x30 sec			Knees on Ground		
Stationary Alternating Lunge (F/B)	1x4each			30 Sec Lunge Hold		
Quadraped Reach Outs reset each time	2x10each			Lift just Arm		
Glute Bridges	2x10			Pelvic Tilt		
Asssisted V-Hold	1x30 sec			Arms Only		

Conditioning	Check if completed	Stretching (all 2x 20sec)	Check if completed
Warm up 3 min 50% HR		Hamstring Band Stretch	
		Cross Over IT Band Stretch	
20 sec >70% HR then 60 sec 50% HR, repeat 5 times		Groin Band Stretch	
		Down Dog Calf Stretch	
Cool Down 3 min 45% HR		Childs Pose	
		Pigeon Pose	

Stop HR Monitor Immediately after Conditioning before Stretching

Max HR:		Duration min:	
Average HR:		Calorie Burn:	

APPENDIX B. Means at All Time-points

Variable	Intervention			Control			Test Statistic *(t)*	*p* – Value	Effect size |*d*|	Degrees of Freedom *(df)*
	N	Mean	SD	*N*	Mean	SD				
Body Fat Pre	66	0.284	0.060	45	0.292	0.052	0.784	0.435	0.144	102.475
Body Fat Mid	66	0.272	0.060	43	0.290	0.050	1.554	0.123	0.286	100.601
Body Fat Post	57	0.271	0.062	35	0.285	0.056	1.075	0.285	0.223	77.613
Broad Jump Pre	66	66.336	17.123	45	58.967	13.944	-2.395	0.018	0.430	105.498
Broad Jump Mid	65	71.223	16.199	41	59.793	13.593	-3.758	0.000	0.706	95.742
Broad Jump Post	56	75.348	16.591	34	64.265	15.414	-3.155	0.002	0.668	73.834
Right Single Leg Hop Pre	66	48.863	12.916	45	44.611	12.311	-1.735	0.085	0.329	97.609
Right Single Leg Hop Mid	65	53.301	12.849	41	45.841	11.947	-3.002	0.003	0.583	89.789
Right Single Leg Hop Post	56	57.107	12.866	34	50.853	13.322	-2.206	0.030	0.486	67.894
Left Single Leg Hop Pre	66	49.386	12.916	45	44.578	12.965	-1.822	0.071	0.341	99.664
Left Single Leg Hop Mid	65	53.2	13.603	41	46.110	12.591	-2.689	0.008	0.521	90.068
Left Single Leg Hop Post	55	57.509	13.843	34	49.853	13.407	-2.566	0.012	0.553	71.779
Leg Press Pre	66	495.259	229.901	45	409.989	186.054	-2.068	0.041	0.371	105.731
Leg Press Mid	64	660.997	247.567	40	530.73	200.988	-2.799	0.005	0.526	95.097
Leg Press Post	55	821.006	269.797	34	641.577	221.616	-3.256	0.002	0.665	80.087
Right Leg Leg Press Pre	63	217.921	128.873	43	165.756	106.096	-2.194	0.030	0.405	100.288
Right Leg Leg Press Mid	63	310.403	137.327	40	237.758	117.359	-2.836	0.007	0.542	92.486
Right Leg Leg Press Post	55	394.869	130.297	33	290.576	131.239	-3.625	0.000	0.800	67.129
Left Leg Leg Press Pre	64	225.084	136.241	44	161.811	103.422	-2.696	0.010	0.464	104.898
Left Leg Leg Press Mid	63	311.759	140.308	40	237.422	119.454	-2.772	0.007	0.530	92.570
Left Leg Leg Press Post	54	297.596	135.057	34	286.412	128.728	-3.828	0.000	0.333	72.816
Pro Agility Pre	66	6.120	0.866	45	6.408	0.936	1.779	0.098	0.396	88.718
Pro Agility Mid	65	5.916	0.789	41	6.229	0.719	2.262	0.043	0.565	90.741
Pro Agility Post	56	5.669	0.687	34	6.057	0.856	2.476	0.020	0.609	55.949
300 yd Pre	66	87.818	14.316	45	90.022	19.160	0.693	0.490	0.490	76.380
300 yd Mid	64	82.063	11.246	41	86.951	13.544	2.005	0.048	0.435	73.974
300 yd Post	54	79.167	11.739	33	86.951	13.544	2.503	0.014	0.631	53.634
FMS Pre	66	15.364	2.291	45	15.044	2.099	-0.745	0.458	0.139	99.895
FMS Mid	62	16.693	2.013	37	15.811	2.171	-2.050	0.043	0.439	71.335
FMS Post	52	17.423	1.672	29	16.207	2.336	0.432	0.008	0.727	44.317
Abdominal Circumference Pre	66	35.136	3.680	45	34.211	3.679	-1.301	0.197	0.251	94.703

Abdominal Circumference Mid	64	34.727	3.378	39	33.808	3.672	-1.296	0.198	0.272	75.233
Abdominal Circumference Post	56	34.424	3.394	32	33.727	3.696	-0.898	0.372	0.205	60.206
Push Up Pre	64	29.734	16.051	43	26.442	13.129	-1.116	0.267	0.205	100.916
Push Up Mid	62	34.274	15.265	36	29.583	13.426	-1.531	0.129	0.307	81.060
Push Up Post	53	39.792	15.211	29	34.448	12.161	-1.627	0.108	0.351	69.162
Sit Up Pre	65	38.062	13.671	45	39.578	10.728	0.628	0.531	0.111	106.926
Sit Up Mid	63	43.492	11.390	37	41.730	9.608	-0.790	0.431	0.155	85.953
Sit Up Post	54	46.130	10.107	30	46.033	9.091	-0.043	0.970	0.010	65.579
1.5 mile Run Pre	62	16.461	2.828	44	16.51	29.978	0.080	0.936	0.0162	89.743
1.5 mile Run Mid	59	15.175	2.210	37	15.517	2.620	0,686	0.494	0.155	67.016
1.5 mile Run Post	50	14.918	2.478	30	15.406	2.803	0.812	0.419	0.197	55.282
Fitness Assessment Score Pre	66	43.945	28.322	45	46.642	29.020	0.488	0.627	0.120	93.122
Fitness Assessment Score Mid	64	55.816	28.748	39	59.265	32.218	0.564	0.574	0.092	73.398
Fitness Assessment Score Post	57	60.282	30.220	33	63.063	27.940	0.432	0.667	0.502	71.329