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ORIGINAL RESEARCH

OFF-SEASON TRAINING HABITS AND PRESEASON FUNCTIONAL TEST MEASURES OF DIVISION III COLLEGIATE ATHLETES: A DESCRIPTIVE REPORT

Jason Brumitt, PT, PhD, ATC, CSCS[1,2]
Bryan C. Heiderscheit, PT, PhD[3]
Robert C. Manske, DPT, MEd, SCS, ATC[4]
Paul E. Niemuth, PT, DSc, OCS, ATC[5]
Mitchell J. Rauh, PT, PhD, MPH, FACSM[6]

ABSTRACT

Purpose/Background: Division III (D III) collegiate coaches are challenged to assess athletic readiness and condition their athletes during the preseason. However, there are few reports on off-season training habits and normative data of functional assessment tests among D III athletes. The purpose of this study was to examine off-season training habits of D III athletes and their relationships to the standing long jump (SLJ) and single-leg hop (SLH) tests.

Methods: One-hundred and ninety-three athletes (110 females, age 19.1 ± 1.1 y; 83 males, age 19.5 ± 1.3 y) were tested prior to the start of their sports seasons. Athletes reported their off-season training habits (weightlifting, cardiovascular exercise, plyometric exercise, and scrimmage) during the six weeks prior to the preseason. Athletes also performed three maximal effort SLJs and three SLHs.

Results: Male athletes reported training more hours per exercise category than their female counterparts. Mean SLJ distances (normalized to height) were 0.79 ± 0.10 for females and 0.94 ± 0.12 for males. Mean SLH distances for female athletes' right and left limbs were 0.66 (± 0.10) and 0.65 (± 0.10), respectively. Mean SLH distances for male athletes' right and left limbs were 0.75 (± 0.13) and 0.75 (± 0.12), respectively. Several significant differences between off-season training habits and functional test measures were found for both sexes: males [SLJ and weightlifting ($p = 0.04$); SLH and weightlifting ($p = 0.04$), plyometrics ($p = 0.05$)]; females [SLJ and plyometrics ($p = 0.04$); SLH and scrimmage ($p = 0.02$)].

Conclusion: This study provides normative data for off-season training habits and preseason functional test measures in a D III athlete population. Greater SLJ and SLH measures were associated with increased time during off-season training.

Clinical Relevance: The findings between functional tests and off-season training activities may be useful for sports medicine professionals and strength coaches when designing their preseason training programs.

Level of Evidence: 4

Keywords: college, field test, functional test, single-leg hop, standing long jump

[1] George Fox University, Newberg, OR, USA
[2] University of Medical Sciences Arizona, Avondale, AZ, USA
[3] University of Wisconsin, Madison, WI, USA
[4] Wichita State University, Wichita, KS, USA
[5] St. Catherine University, Minneapolis, MN, USA
[6] San Diego State University, San Diego, CA, USA

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CORRESPONDING AUTHOR
Jason Brumitt, PT, PhD, ATC, CSCS
George Fox University
Doctor of Physical Therapy Program
Newberg, OR, USA
University of Medical Sciences Arizona
Avondale, AZ, USA
E-mail: jbrumitt72@gmail.com
503-558-1323

INTRODUCTION

Many collegiate athletes train year round to maintain fitness and skills. However, NCAA rules define the quantity of allowed supervised practices (e.g. scrimmage, conditioning sessions) during the off-season, preseason, and regular season.[1] Coaches at the Division III (D III) level are especially challenged to assess and prepare their teams prior to the start of competition, due to 1) frequent inability to afford "high tech", expensive testing equipment available at Division I (D I) universities, 2) possible inability to employ a dedicated strength and conditioning coach/staff, and 3) the limitations of approximately two and one-half weeks of sanctioned practice prior to the first competition (e.g. sports other than football).[1] Therefore, some collegiate coaches conduct functional tests during the preseason to assess aspects of an athlete's baseline fitness level.[2-6] The results from these tests are used to assess athletic readiness and evaluate the effectiveness of a team's training programs.[3,7-10]

There is limited literature related to off-season training habits and functional measures in the D III population. Schmidt presented preseason physical characteristics, upper- and lower-body power and strength measures, flexibility, muscular endurance, and speed endurance measures for 78 D III football players with data presented by position.[11] Schmidt identified significant differences in hip sled, seated medicine ball put, and bench press performances in starters versus non-starters.[11] Hoffman et al[5] assessed preseason anthropometric measures, aerobic fitness, anaerobic power, strength, speed, and agility in 22 D III female lacrosse players.[5] They found that defenders were significantly stronger with the 1RM squat than midfielders and that attackers had significantly greater Wingate anaerobic power test measures than other positions.[5] Barnes et al[2] compared mean preseason performances of a countermovement vertical jump (CMVJ) and a drop jump test in Division I, II, and III collegiate female volleyball athletes. D I female athletes jumped significantly ($p < 0.05$) higher during the CMVJ than their D III counterparts.[2] In sum, studies of baseline fitness levels and athletic readiness in D III athletes have only been described for a few athletic populations.

Several limitations of the aforementioned studies are that they have been confined to a few select sports and have used measures that may be time and cost intensive. Thus, there is a need to collect additional measures of athletic fitness and readiness of D III athletes from multiple sports with inexpensive, quick-to-perform, and easy-to-administer functional tests at the start of the preseason. Additionally, the relationship between an athlete's preseason performance and his/her off-season training habits has not been reported. Knowledge of athletes' off-season training habits may help D III coaches design and implement conditioning programs at the start of the preseason.

The purpose of this study was to describe off-season training habits of D III athletes via questionnaire, measure preseason performance of the standing long jump (SLJ) and the single-leg hop (SLH) for distance functional tests, and examine relationships between training habits and preseason athletic characteristics in D III athletes. The authors hypothesized that athletes who reported greater levels off-season training would jump and hop significantly farther than those who reported less time training.

METHODS

Subjects were recruited to participate in the preseason of their respective sport. One-hundred and ninety-three D III collegiate athletes (110 females, mean age 19.1 ± 1.1 y; 83 males, mean age 19.5 ± 1.3 y) from 15 university teams (volleyball, wrestling, women's lacrosse, baseball, softball; women's and men's tennis, track and field, cross-country, soccer, and basketball) participated in this study. An athlete was excluded from testing if she/he was under the age of 18 or was currently restricted from full sport participation by the team physician. The Institutional Review Boards of Rocky Mountain University of Health Professions and Pacific University approved this study. Signed informed consent was received from each subject prior to testing.

Procedures

Study Questionnaire. Prior to the start of the season, each athlete completed a questionnaire collecting demographic information including age, years at university, age starting their sport, and average time spent training per week during the six weeks prior to the start of the preseason (e.g. sanctioned practice) for each of the following activities: weightlifting, cardiovascular exercises, plyometric exercises, and scrimmages.

Height and weight. Subject's height (cloth tape) and weight without shoes (standard medical scale) were recorded for each participant. Height was measured to the nearest half inch and weight recorded to the nearest half pound.

Dynamic Warm-Up. After completing the study questionnaire and collecting anthropometric measures, each subject completed a dynamic warm-up prior to performing the functional tests. The dynamic warm-up consisted of 5 to 10 minutes of active lower extremity movements from sideline to sideline on a basketball court or across the width of the tennis court for the tennis players. This warm-up included forward walking, backward walking, heel walking, tip toe walking, forward lunging, backward lunging, and high knee marching.

Standing Long Jump Testing Protocol. Athletes were instructed to stand with feet approximately shoulder width apart behind a line (piece of tape) on the court. A cloth measuring tape was oriented perpendicular to the start line and taped to the floor. The athlete was instructed to perform 3 submaximal counter-movement SLJs with hands behind her/his back, followed by 3 jumps performed with hands clasped behind the back at maximal effort. An athlete had to land on both legs under control (maintaining center of mass within her/his base of support) holding this position for 5 seconds for a jump to be recorded.[12] If an athlete was unable to land successfully (e.g. loss of balance), the trial was repeated. The distance jumped was measured from starting line to the rear-most heel with mean of the three jumps ($\pm$ SD) scores utilized for data analyses.

Single-Leg Hop for Distance Testing Protocol. The six SLH (3 for each lower extremity) for distance tests were performed after the athlete completed three maximal effort SLJ tests. The SLH for distance test was also performed with hands clasped behind the athlete's back. For a test to be recorded an athlete would have to stick the landing (take-off and land with the same lower extremity) holding the position for 5 seconds.[12] If an athlete was unable to land successfully the SLH was repeated. The distance hopped was measured from the starting line to the heel with mean of the three hops on each leg ($\pm$ SD) scores utilized for data analyses.

Statistical Methods

Means ($\pm$ SD) were calculated for the subjects' baseline demographic characteristics, anthropometric measures, and SLJ and SLH scores. Mean SLJ and SLH scores were normalized as a percentage of body height. Comparison of means between genders for demographic characteristics and SLJ and SLH scores were calculated by performing independent *t*-tests. Height, weight, and body mass index (BMI) were categorized as (-1 SD [shortest, lightest, or lowest]/ Mean [average]/ +1 SD [tallest, heaviest, or highest]). Each of off-season training habits were categorized by the following groups: 0-1 / >1-3 / >3-5 / >5 hours per week. Analysis of variance (ANOVA) was performed to assess mean differences within gender for preseason training habits, height, weight, and BMI. A post-hoc Bonferroni test was performed after ANOVA to identify significant differences between subcategories within a group. Analysis of covariance (ANCOVA) was performed when necessary to control for weight or BMI. An a priori test-retest reliability for the SLJ and SLH was performed using intraclass correlation coefficients (ICCs). Data analysis was performed using SPSS Statistics 17 (Chicago, IL) with alpha level set at 0.05.

RESULTS

Baseline characteristics of the study sample are presented in Table 1. Men spent a higher average number of hours per week weightlifting ($p \leq 0.0001$) and scrimmaging ($p = 0.01$) than women during the six weeks prior to the start of their sports season.

Table 2 presents normalized SLJ mean ($\pm$ SD) distances by age and anthropometric measures (categorized by $\pm$ 1 SD) for each sex. The test-retest reliability ($ICC_{3,3}$) for the SLJ was 0.96 (95% CI: 0.83, 0.97). On average, men jumped significantly farther (0.94 $\pm$ 0.12) than female athletes (0.79 $\pm$ 0.10) ($p \leq 0.0001$). After controlling for BMI (ANCOVA), SLJ distance jumped was still significantly greater among male athletes than female athletes ($p \leq 0.0001$). There was no difference in distanced jumped with age as a factor for female or male athletes. A significant difference was observed between SLJ distance based on

Table 1. *Baseline Characteristics (Mean ± SD) of Division III Collegiate Athletes*

Characteristic	Total (n = 193)	Women (n = 110)	Men (n = 83)	p-value*
Age (y)	19.3 ± 1.2	19.1 ± 1.1	19.5 ± 1.3	0.05
Years in School	2.2 ± 1.1	2.1 ± 1.0	2.2 ± 1.1	0.40
Age Starting Sport (y)	10.8 ± 3.6	11.0 ± 3.7	10.4 ± 3.6	0.23
Preseason Training (hr/wk)				
Weightlifting	3.8 ± 3.3	3.0 ± 2.1	4.9 ± 4.0	≤0.0001
Cardiovascular Exercise	5.5 ± 3.8	5.2 ± 3.5	6.2 ± 4.1	0.07
Plyometric Exercise	2.1 ± 2.2	2.0 ± 1.9	2.5 ± 2.6	0.12
Scrimmage	3.9 ± 4.1	3.3 ± 3.5	4.8 ± 4.4	0.01
Height (m)	1.72 ± 0.1	1.66 ± 0.1	1.80 ± 0.1	≤0.0001
Weight (kg)	70.5 ± 13.9	64.2 ± 9.1	79.8 ± 14.4	≤0.0001
BMI (kg/m^2)	23.8 ± 3.3	23.3 ± 3.1	24.6 ± 3.3	0.005

*Independent *t*-tests; women vs. men.
SD= standard deviation; BMI= Body mass index.

women's weight (p = 0.05); however, no significant within group differences were found after Bonferroni correction. Male athletes in the shortest height (1.69 m or less) group jumped significantly farther on average than those in the tallest height (1.91 m or more) group when jump distance was normalized for height (p = 0.04). Finally, male SLJ distances differed between the BMI categories (p = 0.03);

Table 2. *Normalized Standing Long Jump Mean (± SD) Distances By Age and Anthropometric Measures for Division III Athletes*

	Women (n = 110)			Men (n = 83)		
Variable	N	Mean ± SD	p-value*	N	Mean ± SD	p-value*
Age (y)						
18	39	0.78 ± 0.11	0.97	24	0.97 ± 0.12	0.07
19	34	0.79 ± 0.10		21	0.94 ± 0.11	
20	24	0.79 ± 0.09		20	0.89 ± 0.10	
21 and older	13	0.79 ± 0.09		18	0.98 ± 0.12	
Totals	110	0.79 ± 0.10		83	0.94 ± 0.12	
Height (m)						
Shortest (-1 SD)	18	0.79 ± 0.09	0.07	15	0.99 ± 0.12†	0.04
Average	80	0.80 ± 0.10		54	0.95 ± 0.11	
Tallest (+1 SD)	12	0.73 ± 0.10		14	0.88 ± 0.12†	
Weight (kg)						
Lightest (-1 SD)	17	0.76 ± 0.08	0.05	12	0.95 ± 0.11	0.23
Average	80	0.80 ± 0.10		63	0.95 ± 0.12	
Heaviest (+1 SD)	13	0.74 ± 0.10		8	0.88 ± 0.12	
BMI						
Lowest (-1 SD)	17	0.76 ± 0.10	0.31	8	0.92 ± 0.10	0.03
Average	77	0.80 ± 0.10		67	0.96 ± 0.12	
Highest (+1 SD)	16	0.78 ± 0.09		8	0.86 ± 0.09	

*ANOVA= Analysis of Variance; SD= standard deviation; BMI= Body mass index.
† Difference between -1 SD below mean range and +1 SD above mean range; p-value= 0.03 post-hoc.

Table 3. *Normalized Standing Long Jump Mean (± SD) Distances by Off-Season Training Habits of Division III Athletes*

Variable	Women (n = 110) N	Mean ± SD	p-value*	Men (n = 83) N	Mean ± SD	p-value*
Off-Season Training (hr/wk)						
Weightlifting						
0-1	31	0.77 ± 0.10	0.50	10	0.92 ± 0.12	0.04
>1 – 3	38	0.79 ± 0.10		23	0.90 ± 0.12‡	
>3 – 5	28	0.80 ± 0.12		23	0.94 ± 0.12	
>5	13	0.80 ± 0.09		27	0.99 ± 0.10‡	
Cardiovascular Exercise						
0-1	6	0.83 ± 0.06	0.53	10	1.00 ± 0.12	0.10
>1 – 3	30	0.77 ± 0.11		15	0.91 ± 0.09	
>3 – 5	35	0.79 ± 0.10		13	1.00 ± 0.12	
>5	39	0.79 ± 0.09		45	0.93 ± 0.12	
Plyometric Exercise						
0-1	48	0.76 ± 0.09†	0.02	38	0.95 ± 0.12	0.86
>1 – 3	47	0.82 ± 0.11†		23	0.93 ± 0.11	
>3 – 5	9	0.79 ± 0.10		11	0.93 ± 0.13	
>5	6	0.82 ± 0.08		11	0.97 ± 0.11	
Scrimmage						
0-1	40	0.77 ± 0.08	0.01	24	0.95 ± 0.09	0.58
>1 – 3	26	0.83 ± 0.11		14	0.91 ± 0.12	
>3 – 5	22	0.76 ± 0.10		13	0.93 ± 0.12	
>5	22	0.82 ± 0.09		32	0.96 ± 0.13	

*ANOVA=Analysis of Variance

†Difference between 0-1 hrs/wk and >1-3 hrs/wk; p-value= 0.01 post-hoc

‡Difference between >1-3 hrs/wk and >5 hrs/wk; p-value= 0.04 post-hoc

however, after Bonferroni correction there were no within group differences.

Mean distance jumped by reported off-season training habits are presented in Table 3. Women who reported performing greater than one and up to three hours per week of plyometric exercises jumped significantly further ($p = 0.02$) on average than those who performed one hour or less per week. While a significant mean difference ($p = 0.01$) in distance jumped by females in the scrimmage exercise category was also observed; no significant within group differences in SLJ distances by scrimmage hour categories were found. Men who reported weightlifting greater than five hours per week jumped significantly farther on average than those who reported weightlifting between greater than 1 and up to 3 hours per week ($p = 0.04$).

Normalized SLH distances per age group and anthropometric measures are shown in Table 4. The test-retest reliability ($ICC_{3,3}$) for SLH distances were 0.95 (95% CI: 0.89, 0.98) on the right and 0.96 (95% CI: 0.89, 0.98) on the left. Mean normalized SLH distances for female athletes were 0.66 (± 0.10) for the right leg and 0.65 (± 0.10) on the left leg. Mean SLH distances for male athletes were 0.75 (± 0.13) for the right leg and 0.75 (± 0.12) on the left leg. Male SLH distances were significantly greater for each leg than their female counterparts ($p \leq 0.0001$). There was no within group differences between SLH distances and age category per gender. Female athletes in the mean height range hopped significantly further with the left leg than the tallest female athletes ($p = 0.02$). Female athletes in the mean BMI range also hopped significantly further with each leg

Table 4. *Normalized Single-Leg Hop Mean (± SD) Distances Per Age and Anthropometric Measures for Division III Athletes*

Variable	Females N	Females Mean ± SD (R)	Females Mean ± SD (L)	p-value*	Males N	Males Mean ±SD (R)	Males Mean ±SD (L)	p-value*
Age								
18	39	0.66 ± 0.10	0.65 ± 0.11	(R) 0.84	24	0.74 ± 0.15	0.76 ± 0.14	(R) 0.11
19	34	0.65 ± 0.09	0.64 ± 0.09	(L) 0.68	21	0.77 ± 0.15	0.75 ± 0.13	(L) 0.16
20	24	0.67 ± 0.11	0.67 ± 0.11		20	0.71 ± 0.07	0.71 ± 0.09	
21 and older	13	0.64 ± 0.14	0.63 ± 0.13		18	0.81 ± 0.10	0.80 ± 0.09	
Totals	110	0.66 ± 0.10	0.65 ± 0.10		83	0.75 ± 0.13	0.75 ± 0.12	
Height (m)								
Shortest (-1 SD)	18	0.64 ± 0.10	0.65 ± 0.10	(R) 0.05	15	0.79 ± 0.14	0.79 ± 0.11	(R) 0.28
Average	80	0.67 ± 0.10	0.66 ± 0.10††	(L) 0.02	54	0.76 ± 0.13	0.75 ± 0.12	(L) 0.48
Tallest (+1 SD)	12	0.60 ± 0.10	0.57 ± 0.10††		14	0.71 ± 0.10	0.74 ± 0.11	
Weight (kg)								
Lightest (-1 SD)	17	0.66 ± 0.10	0.65 ± 0.10	(R) 0.07	12	0.78 ± 0.14	0.77 ± 0.11	(R) 0.26
Average	80	0.67 ± 0.10	0.66 ± 0.10	(L) 0.06	63	0.76 ± 0.13	0.76 ± 0.12	(L) 0.50
Heaviest (+1 SD)	13	0.60 ± 0.11	0.58 ± 0.12		8	0.69 ± 0.10	0.72 ± 0.09	
BMI								
Lowest (-1 SD)	17	0.64 ± 0.11	0.61 ± 0.10	(R) 0.03	8	0.70 ± 0.16	0.72 ± 0.12	(R) 0.05
Average	77	0.67 ± 0.09†	0.67 ± 0.10‡	(L) 0.02	67	0.77 ± 0.12	0.77 ± 0.12	(L) 0.08
Highest (+1 SD)	16	0.60 ± 0.12†	0.60 ± 0.11‡		8	0.67 ± 0.06	0.68 ± 0.05	

*ANOVA= Analysis of Variance; SD= Standard Deviation
†Difference between Mean and +1 SD; p= 0.03 post-hoc
‡Difference between Mean and +1 SD; p= 0.05 post-hoc
††Difference between Mean and +1 SD; p= 0.02 post-hoc

(right: $p = 0.03$; left: $p = 0.02$) than female athletes in the highest BMI range. A significant group difference in mean distance hopped by males in the BMI categories (right leg: $p = 0.05$) occurred; however, after post-hoc correction there were no intragroup differences between BMI categories.

Mean distance hopped by reported preseason training habits is presented in Table 5. Women who reported scrimmaging more than 1 hour and up to 3 hours a week jumped significantly further with the left leg ($p = 0.02$) than those who scrimmaged less than 1 hour a week. Male athletes who reported performing more than 5 hours of plyometric exercise a week hopped significantly farther on average with their left leg ($p = 0.05$) than males who reported more than 1 hour and up to 3 hours of plyometrics each week. Male athletes who also performed more than 5 hours of weightlifting each week hopped significantly farther ($p = 0.04$) with their right leg compared to male athletes who reported more than 1 and up to 3 hours of weightlifting per week.

DISCUSSION

This is the first study to report off-season training habits 6 weeks prior to formal preseason training and preseason measures of the SLJ and SLH functional tests for D III collegiate athletes. Male athletes reported exercising more during the off-season than their female counterparts. While total time spent exercising did not describe the quantity (e.g. total sets and repetitions, intensity) or the quality of the exercise performed these data provided insight as to off-season training habits in this population.

A novel feature of this study was the analysis of the differences between off-season training habits and preseason functional measures. Several significant associations between jump (SLJ) and hop (SLH) distance and reported off-season training habits were found. In each instance where a significant difference in jump or hop distance as a factor of off-season training habits occurred, greater reported time devoted to training was observed. While the study's methodology did not allow for the examination of

Table 5. *Normalized Single-Leg Hop Mean (± SD) Distances Per Age and Anthropometric Measures for Division III Athletes*

Variable	Females N	Females Mean ± SD (R)	Females Mean ± SD (L)	p-value*	Males N	Males Mean ± SD (R)	Males Mean ± SD (L)	p-value*
Off-Season Training (hr/wk)								
Weightlifting								
0-1	31	0.65 ± 0.10	0.63 ± 0.10	(R) 0.90	10	0.75 ± 0.14	0.77 ± 0.11	(R) 0.04
>1-3	38	0.66 ± 0.08	0.66 ± 0.09	(L) 0.72	23	0.71 ± 0.15††	0.71 ± 0.11	(L) 0.16
>3-5	28	0.66 ± 0.12	0.66 ± 0.12		23	0.75 ± 0.10	0.76 ± 0.12	
>5	13	0.67 ± 0.10	0.65 ± 0.12		27	0.81 ± 0.10††	0.78 ± 0.12	
Cardiovascular Exercise								
0-1	6	0.65 ± 0.12	0.65 ± 0.09	(R) 0.71	10	0.82 ± 0.12	0.81 ± 0.12	(R) 0.10
>1-3	30	0.64 ± 0.10	0.64 ± 0.12	(L) 0.96	15	0.72 ± 0.13	0.72 ± 0.11	(L) 0.07
>3-5	35	0.67 ± 0.11	0.65 ± 0.11		13	0.80 ± 0.08	0.80 ± 0.09	
>5	39	0.66 ± 0.09	0.65 ± 0.10		45	0.74 ± 0.13	0.74 ± 0.12	
Plyometric Exercise								
0-1	48	0.65 ± 0.09	0.63 ± 0.09	(R) 0.60	38	0.76 ± 0.11	0.76 ± 0.10	(R) 0.08
>1-3	47	0.67 ± 0.10	0.67 ± 0.11	(L) 0.37	23	0.71 ± 0.15	0.71 ± 0.13‡	(L) 0.05
>3-5	9	0.65 ± 0.13	0.63 ± 0.11		11	0.75 ± 0.11	0.75 ± 0.10	
>5	6	0.68 ± 0.13	0.67 ± 0.10		11	0.83 ± 0.11	0.83 ± 0.11‡	
Scrimmage								
0-1	40	0.64 ± 0.09	0.62 ± 0.09†	(R) 0.21	24	0.76 ± 0.10	0.74 ± 0.09	(R) 0.63
>1-3	26	0.69 ± 0.09	0.70 ± 0.10†	(L) 0.02	14	0.72 ± 0.13	0.70 ± 0.12	(L) 0.06
>3-5	22	0.64 ± 0.12	0.62 ± 0.11		13	0.74 ± 0.11	0.73 ± 0.13	
>5	22	0.67 ± 0.10	0.66 ± 0.10		32	0.77 ± 0.15	0.80 ± 0.12	

*ANOVA= Analysis of Variance
†Difference between 0-1 hrs/wk and >1-3 hrs/wk; p-value= 0.03 post hoc.
††Difference between >1-3 hrs/wk and 5+ hrs/wk; p-value= 0.03 post hoc.
‡Difference between >1-3 hrs/wk and 5+ hrs/wk; p-value= 0.04 post hoc.

a causal relationship between the off-season training methods and increased distance reached, these exploratory findings might help guide coaches and sports medicine professionals when designing training programs for D III athletes.

Few studies have reported normative values for the SLJ and SLH in collegiate or other sport populations. Thus, the current data may be beneficial to coaches and sports medicine professionals when evaluating their athletes/patients or making comparisons to other populations. Previously reported non-normalized SLJ mean distances in male populations range from 2.01 m (adolescent male athletes) to 3.05 m (± 0.15) (NFL drafted skill players), whereas we observed male D III athletes jumped a mean distance of 1.69 m (± 0.20) (not normalized to height).[13-16] The observed mean SLJ distance of 1.31 m (± 0.17) (not normalized to height) in our collegiate D III female population was also less than those reported in prior studies: 1.59 m (adolescent female athletes) to 2.28 m (± 0.16) (Division I track and field athletes)[13,14] The mean (not normalized) hop distance for females in this study [right LE = 1.09 m (± 0.17); left LE = 1.07 m (± 0.17)] was lower than previously reported values from 1.14 m (± 19.3) to 1.23 m (± 19.5).[17,18] The mean (not normalized) hop distances for males in this study [right LE = 1.35 (± 0.22); left LE = 1.35 (± 0.22)] were also lower than previously reported values from 1.43 m (± 27) to 2.04 m (± 14.9).[18,19] A potential explanation for the difference in means between the D III athlete population in the current study and prior studies may be the difference in testing procedures. In this study, athletes were restricted from performing a countermovement arm swing prior to jumping (hands clasped behind back consistent with clinical testing recommendations).[12] Ashby et al[20] reported subjects who are able to swing their arms when performing the SLJ were able to jump 21% farther than when arm motion was restricted [SLJ with arm swing = 2.09 m ($\pm$ 0.03); SLJ without arm swing = 1.72 m ($\pm$ 0.03)].

The descriptive data presented in the current study may also be useful for sports medicine professionals when assessing their injured athlete's readiness to return to sport after injury.[12] The SLJ and SLH tests are frequently used to assess lower extremity strength and power after injury.[12,21] Male athletes have been recommended to be able to jump (SLJ) at least 90% of their height and hop (SLH) at least 80% of their height (each test with hands clasped behind back) in order to be cleared to return.[12,21] In the current study, males, on average, jumped 94% of their height; however, they only hopped 75% of their height. Likewise, female athletes are recommended to be able to jump (SLJ) at least 80% of their height and hop (SLH) at least 70% of their height in order to be cleared to return.[12,21] In the current study, females, on average, jumped only 79% of their height and hopped only 65-66% of their height.[12,21] Interestingly, in the current study sample, many of the healthy, D III athletes failed to achieve jump or hop minimal distances recommended for injured athletes prior to returning to sport. Thus, future research is warranted to determine if the aforementioned functional testing discharge criteria are appropriate for this population prior to resuming sport.

This study included some important strengths. First, this study has presented data on one of the largest samples of D III collegiate student-athletes. One hundred and ninety-three athletes (females = 110) from 15 teams were tested. Second, the off-season training habit data was collected by an author who was not a member of any coaching staff. This independence may have increased the likelihood of athletes accurately reporting their training habits during the six weeks prior to the start of the preseason. Third, the functional tests assessed in this study, the SLJ and the SLH, were selected for their ease of use and their ability to assess lower extremity strength and power.[21] The SLJ and the SLH are also utilized frequently by rehabilitation professionals to guide decision making as to whether an athlete is able to return to sport.[12,18,21,22] These tests have also been used to assess athletic readiness and thus warrant assessment for associations with training habits.[21]

A few limitations of this study are recognized. First, the data presented here provides preseason functional performance measures for 193 D III athletes from several teams; however, specific analysis by sport is not possible at this time because some sports were represented by small sample sizes. This did not allow for specific subanalyses by specific sports. Future research should collect preseason training habits and functional measures for individual sport teams with larger sample sizes. Second, similarly, although statistically significant findings between off-season training practices were described by gender, the authors advise caution when interpreting the clinical significance of these findings, as some group sizes were small with wide standard deviations. Third, not all athletes at the university were tested. Some athletes had sustained an injury prior to testing (either during the off-season or during preseason prior to data collection) that impaired their ability to perform the tests. It is possible that injured athletes, who were unable to participate in testing, would have started the season with decreased strength or side-to-side differences in SLH measures.[23] Characteristics of injured athletes who were not assessed may have changed overall mean scores. A fourth limitation of this study is that the associations between preseason training habits and functional measures do not suggest a cause-and-effect relationship. To establish a cause-and-effect relationship, researchers would need to test the athletes prior to a training program intervention (e.g. plyometric training program or weight training program) followed by repeating the SLJ and SLH tests post-intervention. A final limitation is that the athletes were asked to self-report their time spent training during the prior six weeks. It is possible that this method of ascertaining their activities may have led to some recall bias. Future studies may want to have the athletes record their off-season training activities prospectively.

CONCLUSION

This study investigated the relationship between off-season training habits and preseason SLJ and SLH functional test measures in a general D III collegiate athlete population. The study indicates that greater SLJ and SLH measures may be associated with increased time during off-season training. These findings present data that may be useful for coaches to assess and prepare their athletes at the start of the preseason. D III coaches are limited in the amount of sanctioned training time and may be limited in available resources (e.g. staff, equipment). Appreciating off-season training habits and utilizing normative data that has been described for the SLJ and SLH functional tests may help D III coaches assess athletic readiness and develop training programs for their athletes. In addition, the descriptive functional test data may help guide clinical decision making for sports medicine professionals when assessing return to play status of an injured D III athlete.

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