Original Research Article

The Science Behind the Limitations of Who Can and Who Cannot Dunk a Basketball Based on Their Genetics (Using 11 Participants and Measuring Vertical Increase)

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ABSTRACT

This study investigated how genetic traits interact with a structured sports science program to determine vertical jump performance and dunking capability in adolescent male athletes. Over 12 weeks, 11 male adolescent athletes ages 14–17 followed a periodized program concentrating on five variables: nutrition, recovery, strength, plyometrics, and jump technique. Performance was measured at five time points (Weeks 0, 3, 6, 9, and 12) across three primary outcomes: standing vertical, approach vertical, and vertical with ball. By Week 12, all 11 participants showed statistically significant improvements across all three measures. Standing vertical increased by a mean of 2.91 inches (SD = 0.70; $p < .001$; Cohen's d = 4.15), approach vertical by a mean of 3.73 inches (SD = 0.65; $p < .001$; d = 5.76), and vertical with ball by a mean of 3.64 inches (SD = 0.81; $p < .001$; d = 4.49). Effect sizes were very large across all outcomes. Seven of the 11 athletes (64%) successfully executed a regulation dunk by Week 12. Height was strongly associated with dunking success (rpb = 0.84, p = .001), and dunkers were significantly taller than non-dunkers (p = .001). These findings show that while neuromuscular performance is highly adaptable through a structured training program, fixed anthropometric factors such as height and standing reach ultimately determine whether training gains are sufficient to clear a 10-foot rim within a fixed timeframe.

Keywords: Vertical jump; dunking; biomechanics; plyometrics; strength training; recovery; nutrition; adolescent athletes

INTRODUCTION

The ability to dunk a basketball on a 10-foot hoop is an impressive benchmark of more than adequate lower-body power and torque. In exercise science, the vertical jump is held by the stretch-shortening cycle (SSC), rate of force development (RFD), and relative muscular strength (1, 2). Targeted resistance training and plyometrics can consistently improve these neuromuscular mechanisms, but an athlete's ultimate performance ceiling is heavily constrained by fixed genetic factors (3-6).

Genetics determines an athlete's physical baseline through many anthropometric variables, such as total height, limb length, and reach, as well as the distribution of muscle fiber types (the ratio of fast-twitch Type IIx to slow-twitch Type I fibers) (7, 8). Allowing athletes to maximize their takeoff velocity through periodized strength training and optimized biomechanical technique differs between shorter and taller individuals. Shorter individuals face a significantly higher mathematical and

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physical barrier to achieving a successful dunk (9).

Despite the very substantial body of literature on vertical jump training, a small number of studies have examined how fixed anthropometric constraints interact with structured training programs in adolescent athletes, specifically attempting to achieve unique performance milestones such as jumping. It remains unclear and unresolved whether a time-limited intervention can overcome the anthropometric barriers present in shorter athletes within a constricted time frame.

This study aimed to evaluate the efficiency of a 12-week training program on the vertical jump performance of 11 adolescent athletes with distinct physical profiles. It was hypothesized that all participants would experience at least some improvement in their vertical jump and strength output through systematic training adaptations. The specific skill of dunking would remain restricted by fixed anthropometric constraints, which means shorter athletes would require a higher, less attainable vertical jump to achieve the same athletic milestone within the 12-week timeframe compared to taller athletes.

METHODS AND MATERIALS

Study Design

A 12-week intervention study was conducted with performance measurements taken at Week 0, Week 3, Week 6, Week 9, and Week 12. All 11 participants were recruited from a single high school basketball program and represented the complete pool of eligible athletes who met the commitment and availability requirements for the full duration of the intervention. There was no additional selection criterion applied beyond willingness and availability; these athletes were chosen because of their known determination and commitment to a structured development process. This study is best understood as a pilot investigation, and future research should seek to replicate these findings with a larger sample to improve statistical power and generalizability.

Participants

Eleven male adolescent basketball players participated in the study, ranging in age from 14 to 17 years (mean age 15.9 years). Heights ranged from 5 feet 10 inches to 6 feet 6 inches (mean 6 feet 2 inches), and body weight ranged from 139 to 176 pounds (mean 156 pounds). Body fat percentage ranged from 9% to 19% (mean 14%), measured using the InBody 270 Body Composition Analyzer via bioelectrical impedance analysis. Baseline standing ranged from 7 feet 8 inches to 8 feet 6 inches. Baseline standing vertical ranged from 18 to 25 inches, approach vertical from 21 to 27 inches, and vertical with ball from 19 to 26 inches. Baseline strength measures included squats ranging from 145 to 215 pounds, bench press from 100 to 155 pounds, and trap bar deadlift from 195 to 325 pounds. Forty-yard dash times ranged from 4.79 to 5.38 seconds. Six athletes competed at the varsity level and five at the junior varsity level. All measurements were conducted indoors on a standard 10-foot rim under consistent conditions throughout the study.

Testing Methods

Height was measured using a wall-mounted stadiometer in the school athletic trainer's office, with recommended devices including the Seca 213 or Charder HM200P Portable Stadiometer. Body weight was recorded using a calibrated digital floor scale, with recommended devices including the Seca 876 or Tanita WB-3000. Standing reach was measured using the Aihome Vertical Jump Measuring Tool with the athlete standing flat-footed with one arm fully extended overhead. Approach vertical was measured using the same tool, recording the highest point contacted during a full running approach jump without the ball. Vertical with the ball was assessed using the OVR Vertical Jump Training System, recording peak height achieved during an approach jump while the athlete controlled a basketball using the cuff method. Max touch reflected the highest point contacted at the peak of the approach vertical. All lifts were recorded at the athlete's maximum load completed with proper form during team weightlifting sessions supervised by coaching staff. Sprint times were recorded using a laser-based timing system, with the device used being the Dashr Automated Laser Timing System.

Outcome Definitions

Standing vertical was defined as the maximum height reached during a stationary two-foot jump from a flat-footed position and was calculated as the difference between standing reach and peak jump reach. Approach vertical was defined as the maximum height contacted during a self-selected running approach jump without the ball. Vertical with ball was defined as the maximum height reached during a full running approach jump while controlling a basketball.

Dunking success was defined as a legal one or two-handed dunk on a 10-foot rim, confirmed by direct observation from the supervising researcher and adult coaches.

Training Protocol

Participants followed a structured weekly program including strength training, plyometrics, technique work, and basketball practice. The program was divided into three phases: foundation (Weeks 1–4), power development (Weeks 5–8), and peak phase (Weeks 9–12) (10). A detailed breakdown of the exercises, sets, and repetition schemes for each phase is provided in Table 1.

Lifting Overview

Monday and Friday sessions are focused on primary resistance training and plyometrics. Wednesdays are dedicated to jump technique refinement and team basketball practice. Thursdays and Saturdays are reserved for team practices and competitive tournaments. Tuesdays are designated for optional 10-to-20-minute light recovery and mobility routines. Sundays serve as a mandatory full-rest day.

Technique Development

Technique training focused on jump mechanics, incorporating approach footwork, arm swing timing, and ball control during takeoff, including the cuff method, which helps maximize arm swing whilst controlling the ball on the way up (11, 12). Participants completed structured dunk or rim-touch progressions 2–3 times per week, with focus on consistent approach patterns and efficient force transfer.

Nutrition and Recovery

Participants followed general nutritional guidelines emphasizing a slight caloric intake surplus, sufficient protein consumption (approximately 0.7–1.0 grams per pound of body weight) (13, 14), and a good amount of carbohydrates to support the energy needed by each athlete. Recovery activities included a minimum of 7.5–9 hours of sleep per night (15, 16), good hydration and electrolytes, and light mobility work 2–3 times per week.

Rules and Regulations

Participants were not allowed to take performance-enhancing supplements. All testing was conducted on a regulation 10-foot rim indoors under consistent conditions, including the same surface and footwear. Participants were required to follow the training program, maintain proper sleep, and accurately report all data. Any injury resulted in temporary or full withdrawal depending on severity.

Statistical Analysis

All statistical analyses were performed using paired-samples t-tests (double-tailed), which were aimed to evaluate changes in standing vertical, approach vertical, and vertical with ball from weeks 0 to 12. Effect sizes were calculated as Cohen's d using the mean change divided by the standard deviation of the difference scores. A Friedman test was used and applied across all five measurement time points (Weeks 0, 3, 6, 9, and 12) to assess whether performance changed significantly over time. An independent-samples t-test was used to compare the vertical jump gains and height between the athletes who successfully dunked and those who

Table 1. Training Program Overview by Phase. *Note: RDL = Romanian Deadlift. Sets x reps format indicates the number of sets multiplied by the number of repetitions performed per set. Load/intensity descriptors (e.g., moderate, high intensity, light, maintenance) connect and refer to the relative training load prescribed for each exercise within that phase.*

Training Phase	Workout / Focus	Exercises	Sets x Reps
Phase 1: Foundation (Weeks 1–4)	Workout A: Movement quality & coordination	Back Squat; Trap Bar Deadlift; Forward Lunges; Core / Plank Work	3×5 (moderate load); 3×5 (moderate load); 3×8 each leg; 5–8 min total
	Workout B: Upper body & posterior chain	Bench Press; Pull-ups; RDL; Standing Calf Raises	3×5; 3× max reps; 3×8; 3×12
Phase 2: Power Output (Weeks 5–8)	Force production: heavy loads & explosive movement	Back Squat; Trap Bar Deadlift; Weighted Jump Squats; Bulgarian Split Squats	4×3 (high intensity); 4×3 (high intensity); 3×5 (light load); 3×6 each leg
Phase 3: Peak (Weeks 9–12)	Maintenance & neural peaking: low volume, max velocity	Back Squat; Trap Bar Deadlift; Light Explosive Jumps; Mobility & Core	3×3 (maintenance); 3×3 (maintenance); 3×4; Targeted prescription

did not. Pearson correlation coefficients and a point-biserial correlation were used to examine the relationship between height and standing reach and performance outcomes. The alpha level was set at $p < .05$ for all tests, and the data were reported as mean ± standard deviation.

Ethics Statement

All participants and their legal guardians provided written informed consent before participation in the study. Participants additionally provided verbal assent and were informed that participation was voluntary and that they could withdraw at any time without consequence. Because the study involved minimal risk and consisted of standard athletic training activities commonly performed in school basketball programs, the project was reviewed and determined to be exempt from formal IRB review by the Central Academy of Technology and Arts research oversight administration/school authority. No experimental drugs, invasive procedures, or prohibited performance-enhancing interventions were used. To protect participant privacy, all athlete data were anonymized using numerical identifiers (Athlete 1–11). No personally identifying information was included in the publication. All performance records and measurements were stored securely and were accessible only to the researcher and supervising adults.

RESULTS

Vertical Jump Outcomes

All participants showed measurable improvements in vertical jump performance over the 12 weeks. The overall standing vertical jump numbers increased progressively across all five measurement points for every athlete. All 11 participants showed a positive gain from Week 0 to Week 12 (Table 2). Approach vertical numbers reflected a similar pattern, with consistent increases observed across all participants over the course of the intervention (Table 3). Vertical jump height whilst controlling a basketball improved for every athlete from baseline to Week 12 (Table 4). Performance gains were not completely linear, and small plateaus occurred during later weeks.

Strength and Sprint Outcomes

Strength increased across all participants. Improvements were observed in squat, bench press, and trap bar deadlift. Sprint times showed minor improvements. These changes in strength and sprint performance for each athlete from baseline to Week 12 are presented in Table 5. Even with 4 athletes not completing a dunk, all 11 participants showed performance gains and improvements.

Table 2. Standing Vertical Jump (inches) of All 11 Participants. *Note: Standing vertical (SV) is defined as the maximum height reached during a stationary two-foot jump from a flat-footed position, calculated as the difference between standing reach and peak jump reach. All values are reported in inches. Wk = Week; V = Varsity; JV = Junior Varsity. Gain = Week 12 value minus Week 0 baseline value. ✓ = athlete completed a regulation dunk on a standard 10-foot rim by Week 12.*

Athlete ID	Height	Level	Wk 0	Wk 3	Wk 6	Wk 9	Wk 12	Gain
Athlete 1 ✓	6’2”	Varsity	24	25	26	27	27	+3
Athlete 2 ✓	6’6”	Varsity	21	23	23	24	25	+4
Athlete 3	5’10”	JV	25	26	26	27	27	+2
Athlete 4 ✓	6’2”	Varsity	24	24	25	26	27	+3
Athlete 5	5’11”	JV	20	20	21	21	22	+2
Athlete 6 ✓	6’3”	Varsity	22	23	24	25	26	+4
Athlete 7 ✓	6’4”	Varsity	22	22	23	24	25	+3
Athlete 8	5’10”	JV	21	21	22	23	24	+3
Athlete 9 ✓	6’5”	Varsity	23	24	25	25	26	+3
Athlete 10 ✓	6’2”	Varsity	23	24	25	25	26	+3
Athlete 11	6’1”	JV	18	18	19	20	20	+2

Table 3. Approach Vertical Jump (inches) of All 11 Participants. *Note: Approach vertical (AV) is defined as the maximum height contacted during a self-selected full running approach jump without the ball, measured using the Aihome Vertical Jump Measuring Tool. All values are reported in inches. Wk = Week; V = Varsity; JV = Junior Varsity. Gain = Week 12 value minus Week 0 baseline value. ✓ = athlete completed a regulation dunk on a standard 10-foot rim by Week 12.*

Athlete ID	Height	Level	Wk 0	Wk 3	Wk 6	Wk 9	Wk 12	Gain
Athlete 1 ✓	6’2”	Varsity	27	28	29	30	30	+3
Athlete 2 ✓	6’6”	Varsity	22	24	25	26	27	+5
Athlete 3	5’10”	JV	27	28	29	30	31	+4
Athlete 4 ✓	6’2”	Varsity	27	28	29	30	31	+4
Athlete 5	5’11”	JV	23	24	25	25	26	+3
Athlete 6 ✓	6’3”	Varsity	25	26	27	28	29	+4
Athlete 7 ✓	6’4”	Varsity	24	25	26	27	26	+2
Athlete 8	5’10”	JV	24	25	25	26	27	+3
Athlete 9 ✓	6’5”	Varsity	26	27	28	29	30	+4
Athlete 10 ✓	6’2”	Varsity	25	26	27	28	29	+4
Athlete 11	6’1”	JV	21	22	23	24	24	+3

Table 4. Vertical Jump with Ball (inches) of All 11 Participants. *Note: Vertical with ball (VwB) is defined as the maximum height reached during a full running approach jump while the athlete controlled a basketball using the cuff method, assessed using the OVR Vertical Jump Training System. All values are reported in inches. Wk = Week; V = Varsity; JV = Junior Varsity. Gain = Week 12 value minus Week 0 baseline value. ✓ = athlete completed a regulation dunk on a standard 10-foot rim by Week 12.*

Athlete ID	Height	Level	Wk 0	Wk 3	Wk 6	Wk 9	Wk 12	Gain
Athlete 1 ✓	6’2”	Varsity	25	25	26	27	27	+2
Athlete 2 ✓	6’6”	Varsity	21	22	24	25	26	+5
Athlete 3	5’10”	JV	26	27	28	29	30	+4
Athlete 4 ✓	6’2”	Varsity	25	26	27	28	29	+4
Athlete 5	5’11”	JV	21	22	23	23	24	+3
Athlete 6 ✓	6’3”	Varsity	23	24	25	26	27	+4
Athlete 7 ✓	6’4”	Varsity	22	23	24	25	26	+3
Athlete 8	5’10”	JV	22	22	23	24	25	+3
Athlete 9 ✓	6’5”	Varsity	24	25	26	27	28	+4
Athlete 10 ✓	6’2”	Varsity	24	25	25	26	27	+4
Athlete 11	6’1”	JV	19	20	21	22	22	+3

Table 5. Strength and Sprint Performance — Baseline (Week 0) vs. Final (Week 12) for All 11 Participants. *Note: All lifts were recorded at the athlete's maximum load capacity completed with proper form during team weightlifting sessions supervised by coaching staff. Squat = back squat; Bench = bench press; TBDL = trap bar deadlift. 40yd = 40-yard sprint time (s), recorded using the Dashr Automated Laser Timing System; lower values indicate faster sprint performance. Base = Week 0 baseline; Week 12 = final measurement at Week 12. V = Varsity; JV = Junior Varsity. ✓ = athlete completed a regulation dunk by Week 12.*

Athlete ID	Height	Level	Squat Base	Squat Wk12	Bench Base	Bench Wk12	TBDL Base	TBDL Wk12	40yd Base	40yd Wk12
Athlete 1 ✓	6'2"	Varsity	195	200	155	165	325	355	5.23	5.19
Athlete 2 ✓	6'6"	Varsity	175	195	135	145	290	305	4.79	4.77
Athlete 3	5'10"	JV	175	195	120	140	225	255	5.17	5.13
Athlete 4 ✓	6'2"	Varsity	195	235	110	135	245	285	5.08	4.97
Athlete 5	5'11"	JV	155	180	95	120	205	235	5.31	5.19
Athlete 6 ✓	6'3"	Varsity	215	250	115	150	265	300	4.98	4.87
Athlete 7 ✓	6'4"	Varsity	185	225	145	145	235	275	5.02	4.89
Athlete 8	5'10"	JV	165	195	120	135	215	248	5.22	5.08
Athlete 9 ✓	6'5"	Varsity	205	240	130	145	260	290	5.11	4.99
Athlete 10 ✓	6'2"	Varsity	180	218	110	127	220	258	5.19	5.06
Athlete 11	6'1"	JV	145	172	100	113	195	225	5.38	5.28

Statistical Significance and Effect Sizes

Paired-samples t-test results confirmed that the increases in standing vertical, approach vertical, and vertical with ball from Week 0 to Week 12 were statistically significant for the group as a whole (Table 6). The effect sizes were very large for all three measures (Table 7). The Friedman test showed that performance differed significantly across all five measurement points. Group-mean performance for standing vertical, approach vertical, and vertical with ball increased across each measurement period (Table 8).

Table 6. Paired-Samples t-Test Results, Weeks 0 to 12. *Note: SD = standard deviation; Δ = mean change from Week 0 to Week 12; 95% CI = 95% confidence interval for the mean change; t(10) = t-statistic with 10 degrees of freedom; p = probability value indicating statistical significance, with values below .05 considered significant. In = Inches; Pre = Before intervention; Post = After intervention.*

Outcome Measure	Pre M (SD)	Post M (SD)	Mean Δ (SD)	95% CI	t(10)	p
Standing Vertical (in)	22.0 (2.0)	24.9 (2.2)	+2.91 (0.70)	[2.44, 3.38]	13.77	< .001
Approach Vertical (in)	24.6 (2.1)	28.4 (2.2)	+3.73 (0.65)	[3.29, 4.16]	19.12	< .001
Vertical with Ball (in)	22.9 (2.1)	26.5 (2.3)	+3.64 (0.81)	[3.09, 4.18]	14.91	< .001

Table 7. Effect Sizes and Friedman Test Results. *Note. Cohen's d is a statistical measure of effect size that quantifies the standardized difference between two group means. Friedman's test is used to detect differences in tests across multiple test attempts when the data are not normally distributed. Classification: small ≥ 0.2, medium ≥ 0.5, large ≥ 0.8, very large > 2.0 (Cohen, 1988). Friedman's $\chi^2(4)$ = non-parametric test assessing whether performance differed significantly across all five points (Weeks 0, 3, 6, 9, and 12).*

Outcome Measure	Cohen's d	Classification	Friedman $\chi^2(4)$	p (Friedman)
Standing Vertical	4.15	Very Large	41.77	< .001
Approach Vertical	5.76	Very Large	43.48	< .001
Vertical with Ball	4.49	Very Large	43.29	< .001

Table 8. Group Mean Performance Across Measurement Periods. *Note: Values are group means in inches with standard deviations in parentheses. All three measures show consistent, increasing improvement across measurement periods. SV = standing vertical; AV = approach vertical; VB = Vertical with ball.*

Measure	Week 0	Week 3	Week 6	Week 9	Week 12
Standing Vertical M (SD)	22.0 (2.0)	23.0 (2.0)	23.6 (2.1)	24.3 (2.1)	24.9 (2.2)
Approach Vertical M (SD)	24.6 (2.1)	25.6 (2.1)	26.3 (2.3)	27.3 (2.3)	28.4 (2.2)
Vertical with Ball M (SD)	22.9 (2.1)	23.9 (2.1)	24.5 (2.2)	25.5 (2.3)	26.5 (2.3)

Dunker versus Non-Dunker Comparisons

Comparisons between the athletes who dunked and those who did not showed that dunkers had significantly greater height and vertical jump gains than non-dunkers (Table 9).

Correlation Analyses

Correlation analyses indicated that height and standing reach were strongly associated with dunking success (Table 10).

Power Analysis

Post-hoc statistical power was calculated for each primary outcome using the observed Cohen's d values and $n = 11$ at $\alpha = .05$ (two-tailed). Given the very large effect sizes obtained ($d = 4.15$–5.76), the given and estimated power exceeded 99.9% for all three vertical jump measures, which highlights that the sample was adequate to detect the effects present in this study. Even with this information, $n = 11$ would be underpowered for detecting small ($d = 0.2$; requiring $n \approx 197$) or medium ($d = 0.5$; requiring $n \approx 32$) effects. These findings show that the results should be interpreted as applicable to large, practically meaningful training effects, and not to be used as evidence for or against smaller and more subtle effects that a larger sample would be needed to detect.

Dunk Outcome Summary

Between the 11 participants, 7 completed a regulation dunk by Week 12, while 4 did not, even with showing measurable vertical jump improvement (Table 11).

Table 9. Comparison of Dunkers vs. Non-Dunkers. *Note: Dunkers = Athletes 1, 2, 4, 6, 7, 9, 10 (n = 7). Non-dunkers = Athletes 3, 5, 8, 11 (n = 4). Δ = gain from Week 0 to Week 12. * p < .05; ** p < .01.*

Variable	Dunkers M (SD) n=7	Non-Dunkers M (SD) n=4	Mean Diff	t	p
Height (in)	75.4 (1.6)	71.0 (1.4)	+4.4”	4.55	.001**
Δ Standing Vertical	3.29 (0.49)	2.25 (0.50)	+1.04”	3.36	.008*
Δ Approach Vertical	4.00 (0.58)	3.25 (0.50)	+0.75”	2.17	.059
Δ Vertical with Ball	3.86 (0.90)	3.25 (0.50)	+0.61”	1.23	.251

Table 10. Correlation Analyses. *Note: rpb = point-biserial correlation is used when one variable is dichotomous. Dunking success coded as (1 = dunked, 0 = did not dunk). * p < .05; ** p < .01. Pearson's r is a statistical measure that calculates the strength and direction of a linear relationship between two continuous variables.*

Correlation	Pearson r	p-value	Interpretation
Height vs. Final Approach Vertical	r = 0.10	.776	Not significant
Height vs. Approach Vertical Gain	r = 0.66	.027*	Moderate-strong
Standing Reach vs. Final Approach Vertical	r = 0.20	.547	Not significant
Dunking Success (binary) vs. Height	rpb = 0.84	.001**	Very strong

Table 11. Summary of Dunking Outcomes by Athlete. *Note. This table summarizes the outcome of the study. Each row corresponds directly to each athlete (Athletes 1–11). The columns indicate whether the athlete completed a regulation dunk by Week 12 ("Can Dunk") or did not complete a dunk despite showing measurable vertical jump improvement ("Cannot Dunk — still showed vertical increase"). Out of the 11 participants, 7 successfully achieved a dunk (Athletes 1, 2, 4, 6, 7, 9, and 10) and 4 did not (Athletes 3, 5, 8, and 11).*

Athlete	Can Dunk	Cannot Dunk (still showed vertical increase)
Athlete #1	Can Dunk	
Athlete #2	Can Dunk	
Athlete #3		Cannot Dunk (still showed vertical increase)
Athlete #4	Can Dunk	
Athlete #5		Cannot Dunk (still showed vertical increase)
Athlete #6	Can Dunk	
Athlete #7	Can Dunk	
Athlete #8		Cannot Dunk (still showed vertical increase)
Athlete #9	Can Dunk	
Athlete #10	Can Dunk	
Athlete #11		Cannot Dunk (still showed vertical increase)

DISCUSSION

The purpose of this study was to evaluate whether dunking a basketball relies on pushing the body to its limits and is a universally attainable skill by anyone, or if it largely depends on controllable performance factors and/or uncontrollable physical characteristics that some people are born with. Over the 12 weeks, with many parts for testing in between, all eleven participants showed very measurable improvements in the time given, especially in vertical jump performance, strength, and athletic output.

The results of this study obtained show that dunking is not universally reachable for all people within a fixed time frame, but it does respond to structured training with max effort (9, 17). Seven of the eleven participants successfully achieved a dunk by the end of the study, but the other four people, even though they had a great increase in vertical jump (plus 4 inches), were not able to dunk within the time frame because of their shorter height and reach compared to the other participants. If this time frame were extended by another 12 weeks, there are great signs that point to the fact that the other 4 participants would be able to dunk. This again indicates that training does have a certain level of impact on vertical (acknowledging the sample size); the anthropometric factors like height and standing reach play a big role in determining the outcome.

When circling back to what has an impact on output performance, the study shows and supports that a balanced focus on nutrition, recovery, plyometrics, strength training, and technique is more effective than simply trying to maximize effort or intensity with random workouts (3, 4, 10). This supports the statement that everything has to be structured and done with a purpose for optimal results. All participants followed a structured, sustainable program rather than overtraining, and improvements were consistent and progressive. It is important to know that the performance gains were not just linear; plateaus occurred in strength and vertical jump measurements, and in certain weeks, they came to a halt/roadblock. This further highlights the importance of neuromuscular development, recovery, and adaptation rather than just pushing your body to the limit with no intention of looking back (3, 5).

Although some find that nutrition and strength training prevail over the other three aspects of development, the data show that technique plays a bigger role than expected. The improvements in approach mechanics, jump timing, and certain arm swing coordination significantly increased the approach vertical jump as well as successful dunk attempts (11, 12). In participant 1's case, even with smaller increases in vertical jump, compared to a few of the other athletes, combining those performance changes with technique was sufficient to achieve a dunk, which reinforces the idea that the efficiency of movement can be just as or even more important than raw physical ability (18).

CONCLUSION

In addressing the question of what the maximum capability of the human body is really, this study supports the idea that certain human performance is better understood as a combination of fixed biological limits and adaptive performance variables, rather than just one alone. The "maximum" capability is not a single fixed number, but it is rather an individual ceiling that is determined by genetics, such as height, limb length, and body composition (7, 8), as well as how well an individual optimizes controllable factors like nutrition, recovery, and training.

Through and through, this study shows and demonstrates that even though every individual may not achieve the same outcome within a fixed timeframe, significant improvements in athletic performance are definitely attainable for all participants when the foundational principles are consistently applied (3, 4, 5, 6). The result highlights that, to an extent (height and reach), human potential is not defined just by initial conditions, but rather by the ability to refine the variables and systematically develop within one's control.

Future research could further expand on this study by expanding the sample size and duration of the training program and/or isolating each variable (nutrition, strength training, recovery, technique, and plyometrics) to further expand on these questions. Nonetheless, this study, data, and investigation provide strong evidence, to an extent, that certain limits of the human body are not fixed but are shaped by genetic traits and the drive to constantly apply training methods with the intention of the regimen to increase athletic performance.

CONFLICT OF INTEREST

The author declares no conflicts of interest related to this work.

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