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*Original Research*

# Does Box Height Matter? A Comparative Analysis of Box Height on Box Jump Performance in Men and Women

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## ABSTRACT

***International Journal of Exercise Science 17(1): 720-729, 2024.*** This study aimed to analyze the effect of box height on box jump performance among recreationally active college students. Fourteen males (age = 20.8 ± 4.1 years, height = 178.3 ± 6.3 cm, weight = 82.3 ± 13.0 kg) and seventeen females (age = 20.8 ± 2.1 years, height = 167.1 ± 5.5 cm, weight = 64.5 ± 7.4 kg) completed box jumps at five different box heights that corresponded to 0, 20, 40, 60, and 80% of their maximal box jump height. Variables of interest included peak force, rate of force development, peak rate of force development, peak power, velocity at peak power, jump height, time to take-off, and reactive strength index modified. Peak force at 80% maximal box jump was significantly higher than 0% in the female cohort ($p = 0.001$). No significant differences for any of the other variables were observed in males, or at any other height lower than the 80% maximal box jump height for females ($p > 0.05$). Overall, variations in box height did not influence box jump performance in recreationally trained individuals when the intent to perform a maximal-effort jump was emphasized. This is important for strength and conditioning coaches and trainers, as they can utilize boxes of varied heights when teaching proper landing techniques to novice athletes with no decrements in propulsive performance.

KEY WORDS: Plyometric training, power, countermovement jump, jump training

## INTRODUCTION

Plyometric training is commonly used as a method of improving lower-body power (16, 28). Plyometric drills typically include bounding, hopping, and jumping movements. These movements focus on a rapid stretch-shortening cycle (i.e., a rapid eccentric muscle action, followed by a brief isometric phase and an immediate concentric muscle action) (7, 16). Specifically, the ability to utilize the stretch-shortening cycle is pivotal to storing elastic energy during eccentric muscle actions and then releasing it to produce forceful concentric contractions (7, 16).

Considerable debate exists amongst strength and conditioning coaches on the best ways to prescribe certain plyometric drills (12, 16). The box jump is a plyometric drill widely used in training programs but with limited scientific information about its prescription (11). When performing a box jump, an individual is typically required to execute a countermovement jump (CMJ) and propel the body up and forward and land with both feet onto a box (11, 26). Since this drill can be performed using boxes of varying heights, it is important to determine the most appropriate box height to elicit the greatest performance benefits. Koefoed et al. (14) investigated the effect of two different box heights: low (70% of CMJ) and high (90% of highest achievable box) on kinetic and kinematic variables. The authors reported no significant differences between low and high box heights in peak force, peak power, rate of force development, concentric time to take-off, and center of mass (COM) displacement. From these results, it can be assumed that the ability to train at a higher box height may not produce greater performance benefits (14); however, it is common practice for individuals to employ the highest available boxes that allow for successful landing execution. Having a greater understanding of which box height allows for maximal power development would be useful for both coaches and athletes seeking to enhance performance.

From a fundamental biomechanical standpoint, there is no difference in take-off mechanics when jumping to boxes of varying heights. However, when jumping to higher boxes, individuals may be required to increase their hip range of motion in order to pull the knees high enough to land both feet on top of the box. The adjustments in ankle, knee, and hip range of motion required to successfully execute a horizontal displacement and land on higher boxes may result in an increased risk of injuries (9). Furthermore, the inclusion of the horizontal displacement in vertical jumps may affect the jump technique. Specifically, it may negatively impact the jump concentric forces (19) as well as its eccentric kinematics during the propulsive phase of the jump (20). Consequently, prolonged training with higher boxes may be detrimental to sports performance as not achieving full hip extension during jumps may decrease torque and power production, and thereby limiting training adaptations (19, 29). Considering these factors, it might be advantageous to use boxes of low to moderate height during box jumps that allow for full hip extension. Using low to moderate heights may be just as effective as using higher boxes and could be safer than attempting higher jumps. This scenario holds relevance for strength and conditioning coaches managing substantial cohorts, instructing novice athletes, or operating with limited personnel and equipment. Another potential advantage of employing boxes of low to moderate height resides in the propensity of individuals to land in the universal athletic position, mirroring the biomechanical demands encountered in various sport-related motions (6). Based on this similarity, the utilization of low to moderate box heights may hold relevance in facilitating the learning of proper landing technique for novice athletes.

Despite these advantages, it is important to acknowledge a potential limitation pertaining to the submaximal intention to achieve the box height. Specifically, low to moderate box heights may inadvertently impose low motivation on individuals, resulting in the execution of box jumps with submaximal effort. In turn, kinetic and kinematic variables, crucial to performance enhancements, may be lower when employing low to moderate box heights compared to higher box heights. Regardless of this potential limitation, the performance of box jumps at varying heights has not been investigated. Therefore, the goal of this study was to analyze the effect of box height on box jump performance. The authors hypothesized that no significant differences in kinetic or kinematic variables would be observed in when performing jumps at various box heights in either sex, as long as maximal effort was provided.

## METHODS

### *Participants*

A convenience sample consisting of 14 males (age = 20.8 ± 4.1 years, height = 178.3 ± 6.3 cm, weight = 82.3 ± 13.0 kg, BF% = 16.3 ± 7.4 %, CMJ = 42.1 ± 12.7 cm) and 17 females (age = 20.8 ± 2.1 years, height = 167.1 ± 5.5 cm, weight = 64.5 ± 7.4 kg, BF% = 28.0 ± 4.7 %, CMJ = 25.1 ± 6.3 cm) were used in this study. A minimum of 13 subjects for each group was deemed appropriate based on an *a priori* power analysis using G*Power 3.1.9.7 (University of Düsseldorf, Düsseldorf, Germany) with a large effect size (F = 0.4), statistical power of 0.95, and a type 1 alpha level of 0.05 (25). All individuals in this study were considered recreationally active based on their current exercise habits (i.e., participated in ≥ 2.5 h of physical activities per week). The subjects were also required to have had no lower-body injuries for the 6 months prior to participation in the study. All subjects were informed of the risks and benefits of the investigation prior to signing an informed consent and were allowed to withdraw from the study at any time without penalty. This study was approved by the University Institutional Review Board for use of human subjects (IRB 21-343-STW) with conformity to the Declaration of Helsinki (29) and the ethical standards of the International Journal of Exercise Science (23).

### *Protocol*

The study was completed in two testing sessions. In the first session, upon arrival to the lab, the subjects had their height, body mass, and body composition collected. The subjects then performed a standard dynamic warm-up and had their maximal box jump height assessed. The warm-up consisted of performing 5 minutes of cycling on a Monark 828E cycle ergometer (Monark, Vansbro, Sweden) followed by two sets of five submaximal CMJs onto 6” (15.24 cm) and 12” (30.48 cm) boxes (8). The maximal box jump height was then assessed and following a short rest, the subjects were familiarized with the box jump heights that would be used in the second part of the study. Within a rest period of 48-72 hours from the first session, the subjects returned to the lab for the second testing session. During the second testing session, the subjects executed box jumps in relative heights of 0, 20, 40, 60, and 80% of their maximal box jump height, in a random order. To ensure the prevention of neuromuscular fatigue, the subjects were asked to refrain from strenuous activities within 24 hours prior to each testing session.

Age, Height, Body Mass, and Body Composition: Age was self-reported by the subjects. The subjects’ height (cm) was assessed using a portable stadiometer (Seca, Hamburg, Germany). Body mass and body composition assessments were performed via InBody270 (InBodyUSA, Cerritos, CA) using standard procedures (5).

Maximal Box Jump Height: The maximal box jump height protocol took place after the completion of the standardized dynamic and specific warm-up previously discussed. The subjects initiated the test by performing a CMJ on a Just Jump (ProBotics Inc., Huntsville, AL) electrical contact operated system. All the subjects were instructed to step on the mat and, when ready, perform a maximal effort CMJ with an arm-swing. The arm-swing motion was used because this is standard practice when performing the box jump (8). The subjects were also instructed to drop downward to a self-selected depth when performing the countermovement portion of the jump. The CMJ height indicated in the jump mat was used as a reference for the maximal box jump height. Plyometric boxes that corresponded to their jump mat CMJ height were placed in front of the subjects. Then, subjects were asked to perform a CMJ and land onto the boxes. In case of a successful attempt, the box height was either considered the subjects' maximal box jump height or small increments in box height were performed. Alternatively, in case of unsuccessful attempts, small decrements in box height were performed and subjects were asked to repeat the jump. The subjects were allowed 30 seconds of rest between trials and all subjects had their maximal box jump height determined within three trials. The highest box the subjects were able to execute a CMJ with proper form (26) and land on was used as the reference for the relative box height intensities in the second session.

Box Jump Test: The box jump test took place in the second testing session. Upon arrival to the lab, subjects performed the same standard and dynamic warm-ups from the maximal box jump test (8). The subjects performed jumps at the five different relative box heights while standing on two force platforms (PASCO scientific, Roseville, CA). All subjects were instructed to step on the force platforms (one foot on each platform) and, when ready, to perform a box jump as high as possible. A combination of plyometric boxes (Rogue Fitness, Columbus, OH) were used and corresponded to approximately 0, 20, 40, 60, and 80% of the subjects' individual maximal box jump height. The boxes were placed 5 cm from the force plates on a heavy-duty non-slip flooring mat that was placed strategically in front of the force plates to match their height (jumps at 0% were performed directly on the mat). The relative box height order was randomized to prevent bias. Each box jump began with the subject standing still in front of the boxes with arms resting on the sides of the body. All jumps were executed upon the investigator's command and the subjects were reminded before every trial to jump as high as possible regardless of box height. This was reinforced because of the principle of specificity of plyometric training (7, 16). Training at maximal intensity closely replicates the neuromuscular demands of high intensity sport-related actions, making the training more specific and transferable to performance (16). Only trials with correct CMJ technique (i.e., the subjects had to use arm-swing motion and they were not allowed to tuck their knees during the upward portion of jumps) were considered for further analysis. For each relative height, the subjects executed three box jumps. Rest intervals of 30 seconds between jumps and one minute after each height were provided.

Data Collection and Processing: The subjects' force-time data was collected via 2 portable PASCO force platforms PS 2142 sampling at 1000 Hz connected to an interface UI-5000 (PASCO scientific, Roseville, CA). Vertical ground reaction force (vGRF) from each force platform were combined into a net value and initially analyzed through the PASCO Capstone v2.4.1.8 software

(PASCO scientific, Roseville, CA). From the vGRF data, the subjects' impulse, acceleration, velocity, displacement, and power were calculated through a forward dynamics approach (4, 18). After the initial calculations, the variables of interest were calculated. These included peak force (PF), peak power (PP), rate of force development (RFD), peak RFD (pRFD), time to take off (TToff), jump height (JH), reactive strength index modified (RSImod), and velocity at peak power (vPP). The PF and PP were calculated from the force and power data, respectively. The RFD was calculated by dividing the change in force by the change in time during the CMJ braking phase (13, 21, 27) and pRFD was calculated as the largest force increase in a set of two consecutive data points of the force-time slope during the CMJ braking phase (14). The TToff was calculated from the point at which vGRF fell below a value equal to 5 times the standard deviation of body weight (i.e., onset of movement) (18, 24) to the point at which vGRF reached a threshold of 5 times the standard deviation of the vGRF of the unloaded force plates taken over 300 ms (i.e., take-off) (17, 18, 24). Jump height was calculated as COM velocity at take-off squared divided by two times gravity (i.e., 9.81 $m/sec^2$) (3, 4) and RSImod was calculated by dividing JH by TToff (4, 27). Lastly, vPP was defined as the COM velocity value at the point of PP. All calculations were analyzed by a customized Microsoft Excel spreadsheet (Microsoft Corporation, Redmond, VA).

### *Statistical Analysis*

An initial visual inspection of the data (boxplot) was conducted and *z*-scores distribution were analyzed to detect the presence of outliers. Data normality was assessed via Shapiro-Wilk's test and Levene's test was conducted to assess the homogeneity of variances. Reliability between repetitions was determined using a 2-way mixed effects model intraclass correlation coefficients (ICCs) for relative reliability and coefficients of variation (CV) for absolute reliability (10). The ICC reliability values were considered poor (≤ 0.50), moderate (0.51-0.74), good (0.75-0.89), and excellent (≥ 0.90) (15). The CV values were considered good (≤ 5%), moderate (5.1-10%) and poor (> 10%) (1,8). A series of one-way repeated measures ANOVA tests were performed to examine significant differences in the dependent variables across the range of relative heights for each group (i.e., men and women). Follow-up analysis included Bonferroni *post-hoc* comparisons. Greenhouse-Geisser values were reported if the assumption of sphericity was violated. Confidence intervals (CIs) for mean differences were calculated for all pairwise comparisons at a 95% confidence level. Data were reported as mean ± standard deviation and alpha was set at $p \leq 0.05$. All analyses were performed using IBM SPSS v.23 (IBM, New York, NY, USA).

## RESULTS

No outliers were detected and data were normally distributed and presented similar variance. Relative reliability of all variables for both sexes was good to excellent, except for pRFD and RFD at 20% maximal box height in the female cohort, which presented a moderate ICC. Absolute reliability was poor for pRFD and RFD and good to moderate for all the other variables. All reliability data are depicted in Table 1. Descriptive data of box jump performance variables are presented in Table 2. Peak force at 80% maximal box height was significantly higher from 0% only in the female cohort ($p = 0.001$). No significant differences for any of the other performance variables were observed in males, or at any other height beyond the 80% maximal box height for females ($p > 0.05$).

**Table 1.** Reliability (ICC (95% CI and % CV) of performance variables during box jumps.

| Variable | | Box Height (% of maximal) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0% | | 20% | | 40% | | 60% | | 80% | |
| | | ICC | %CV | ICC | %CV | ICC | %CV | ICC | %CV | ICC | %CV |
| Males | PF | .99 (.98- | 1.79 | .99 (.97- | 2.21 | .99 (.97- | 2.45 | .99 (.97- | 2.14 | .99 (.97- | 1.97 |
| | RFD | .97 (.92- | 12.17 | .96 (.91- | 11.01 | .90 (.77- | 12.40 | .96 (.84- | 13.75 | .93 (.84- | 13.35 |
| | pRFD | .86 (.65- | 19.70 | .83 (.60- | 19.43 | .84 (.61- | 23.15 | .77 (.45- | 16.05 | .88 (.66- | 15.77 |
| | PP | .99 (.98- | 3.10 | .99 (.98- | 2.49 | .99 (.98- | 2.58 | .99 (.99- | 1.74 | .99 (.98- | 2.17 |
| | VelPP | .98 (.95- | 2.15 | .99 (.98- | 1.38 | .99 (.98- | 1.36 | .99 (.97- | 1.56 | .99 (.97- | 1.59 |
| | JH | .99 (.96- | 4.22 | .99 (.99- | 2.80 | .99 (.98- | 2.97 | .99 (.98- | 3.02 | .99 (.97- | 3.45 |
| | TToff | .91 (.77- | 4.83 | .94 (.85- | 3.82 | .93 (.82- | 4.43 | .96 (.91- | 3.95 | .93 (.83- | 4.22 |
| | RSImod | .98 (.96- | 6.40 | .98 (.96- | 5.22 | .99 (.97- | 5.07 | .99 (.97- | 5.19 | .97 (.93- | 6.37 |
| Females | PF | .98 (.96- | 2.65 | .98 (.96- | 2.07 | .98 (.95- | 2.56 | .99 (.97- | 2.03 | .98 (.96- | 2.25 |
| | RFD | .81 (.57- | 21.15 | .69 (.27- | 2.23 | .91 (.80- | 15.65 | .90 (.77- | 17.00 | .84 (.65- | 2.13 |
| | pRFD | .86 (.68- | 14.70 | .71 (.37- | 15.55 | .76 (.46- | 21.08 | .83 (.62- | 15.96 | .83 (.63- | 16.86 |
| | PP | .97 (.93- | 3.63 | .98 (.94- | 2.85 | .98 (.94- | 3.01 | .98 (.95- | 2.61 | .97 (.94- | 2.93 |
| | VelPP | .97 (.94- | 2.36 | .95 (.89- | 2.80 | .99 (.97- | 1.71 | .98 (.95- | 1.79 | .98 (.95- | 1.89 |
| | JH | .97 (.93- | 5.16 | .96 (.91- | 5.42 | .98 (.95- | 4.25 | .98 (.95- | 3.95 | .97 (.94- | 4.15 |
| | TToff | .92 (.82- | 5.60 | .94 (.87- | 4.41 | .89 (.75- | 4.16 | .93 (.85- | 5.22 | .95 (.89- | 5.09 |
| | RSImod | .96 (.90- | 8.37 | .92 (.83- | 8.06 | .96 (.90- | 6.26 | .96 (.91- | 6.49 | .97 (.94- | 6.74 |

ICC: intraclass correlation coefficient; %CV: coefficient of variation; PF: peak force; RFD: rate of force development; pRFD: peak rate of force development; PP: peak power; VelPP: velocity at peak power; JH: jump height; TToff: time to take-off; RSImod: reactive strength index modified.

**Table 2**. Performance variables during box jumps.

| Variable | | Box Height (% of maximal) | | | | |
|---|---|---|---|---|---|---|
| | | 0% | 20% | 40% | 60% | 80% |
| Males | Box Height | | 13.3 ± 2.9 | 26.7 ± 5.9 | 40.0 ± 8.8 | 53.3 ± 11.8 |
| | PF (N) | 2110.4 ± 383.9 | 2070.7 ± | 2135.4 ± | 2125.5 ± | 2112.9 ± 34.2 |
| | RFD (N·s$^{-1}$) | 4413.4 ± 2695.0 | 4188.2 ± | 4267.0 ± | 4586.8 ± | 4585.0 ± |
| | pRFD (N·s$^{-}$ | 13082.3 ± | 12096.7 ± | 12725.2 ± | 1255.5 ± | 10869.0 ± |
| | PP (W) | 5189.2 ± 133.4 | 5187.9 ± | 5263.6 ± | 5177.4 ± | 5209.9 ± |
| | VelPP (m·s$^{-}$ | 2.65 ± .34 | 2.67 ± .33 | 2.62 ± .31 | 2.60 ± .32 | 2.62 ± .30 |
| | JH (m) | .42 ± .12 | .42 ± .11 | .41 ± .11 | .41 ± .11 | .41 ± .10 |
| | TToff (s) | .94 ± .13 | .90 ± .12 | .88 ± .13 | .90 ± .12 | .87 ± .12 |
| | RSImod | .47 ± .18 | .49 ± .18 | .49 ± .19 | .48 ± .18 | .50 ± .18 |
| Females | Box Height | | 9.2 ± 1.1 | 18.4 ± 2.2 | 27.6 ± 3.4 | 36.9 ± 4.5 |
| | PF (N) | 1462.9 ± 228.3 | 1452.0 ± | 1454.3 ± | 1487.1 ± | 1514.3 ± |
| | RFD (N·s$^{-1}$) | 3054.6 ± 1339.4 | 3036.9 ± | 2820.9 ± | 3115.1 ± | 3381.5 ± |
| | pRFD (N·s$^{-}$ | 9092.4 ± 3167.4 | 8094.1 ± | 9449.0 ± | 9196.1 ± | 8911.6 ± |
| | PP (W) | 2861.1 ± 49.6 | 2846.1 ± | 2838.3 ± | 2933.9 ± | 2978.2 ± |

| | | | | | |
|---|---|---|---|---|---|
| VelPP ($\mathrm{m \cdot s^{-}}$ | 2.10 ± .26 | 2.09 ± .24 | 2.09 ± .24 | 2.13 ± .22 | 2.12 ± .21 |
| JH (m) | .25 ± .06 | .25 ± .06 | .25 ± .06 | .26 ± .06 | .26 ± .05 |
| TToff (s) | .89 ± .16 | .91 ± .16 | .90 ± .10 | .89 ± .14 | .88 ± .18 |
| RSImod | .29 ± .10 | .28 ± .08 | .28 ± .07 | .30 ± .08 | .31 ± .12 |

PF: peak force; RFD: rate of force development; pRFD: peak rate of force development; PP: peak power; VelPP: velocity at peak power; JH: jump height; TToff: time to take-off; RSImod: reactive strength index modified.

* Significantly different from 0%

## DISCUSSION

This study aimed to identify the effect of box height on box jump performance in recreationally trained males and females. As expected, no significant differences in kinetic or kinematic variables were observed in box jumps performed on boxes of varying heights in the male cohort. However, PF at 80% maximal box height was significantly greater than PF at 0% with no other significant differences in kinetic or kinematic variables for the female cohort. Consequently, the authors' original hypothesis was partially accepted. These findings suggest that the height of the box does not affect the box jump performance in jumps that are executed at maximal effort. Also, the observed significant difference in force output within the female cohort implies that incorporating boxes in jump training could serve as a motivational tool for non-athletes to perform jumps at maximal intended effort.

As mentioned, kinetic and kinematic variables were not affected by different box heights in the male cohort (Table 2). To date, only Koefoed et al. (14) has investigated the effect of box height on jump performance. However, these investigators only assessed two box heights and their sample was comprised of elite female handball players. Nevertheless, the findings of the present investigation align with this work. Koefoed et al. (14) did not observe significant differences between high boxes for PF, PP, pRFD, concentric TToff, and COM displacement. In the present study, no significant differences between the highest boxes (60 and 80% of maximal box height) were observed in any of the measured variables (Table 2). Furthermore, it is the authors' belief that this study mxakes a novel contribution to the literature by examining and comparing low and moderate box heights, and once again, no statistically significant differences were observed across any of the variables (Table 2). The lack of significant differences between box heights in the performance variables measured may be attributed to the maximal intention exerted during the execution of each jump. As discussed, the subjects were consistently reminded to perform the box jumps as high as possible regardless of box height. In this context, the primary and hence, the most relevant factor appears to be the maximal intention to execute the box jump, rather than the height of the box utilized, at least when utilizing boxes that are lower than the subject's peak CMJ.

Within the female cohort, no significant differences in 7 out of 8 assessed variables were observed (Table 2). Only PF portrayed a significant difference between 0 and 80% maximal box height (Table 2). At least for the highest boxes, the results of the current investigation are also in line with the findings of Koefoed et al. (14). These investigators did not observe any significant differences in any kinetics and kinematics variables when comparing box jumps executed at 70% of CMJ (low box) and 90% of maximal box jump height (high box). In the present study, no significant differences were observed between the highest boxes (60-80% maximal box height) for all variables (Table 2) in the female cohort. However, when comparing the highest (80% maximal box height) with the lowest height (no box), a significant difference was observed for PF, with no changes in PP or TToff. While the exact reason for this outcome remains unknown, it could potentially be attributed to the implicit demand of overcoming a higher obstacle (11). In other words, even though they were asked to jump with maximal intent (i.e., as high as possible) in all box heights, the female subjects might have tried harder on the tallest box (80% CMJ). However, it is worth noting that 80% maximal box height was not statistically different from any of the other jumps in which the subjects had to land onto a box (20-60% maximal box height). In this sense, it can be assumed that a minimal box height (i.e., 20% maximal box height) is enough for individuals to perform box jumps with maximal intent. The lack of statistical significance in performance measures across box heights can be seen as positive since the mechanics needed to jump and land on higher boxes could potentially undermine the principle of specificity and increase the risk of injuries, particularly among novice female athletes (9,22). Nonetheless, it has been reported that female athletes can benefit from augmented feedback when learning proper landing techniques and reduce the likelihood of injuries (22). Furthermore, it has been reported that an athlete may be required to absorb a net force of up to 7 times their total body mass upon landing from a height of 40 cm (2). On the other hand, the peak impact force is reduced by approximately 51% when using boxes that match the athletes' maximal CMJ height (11). Therefore, jumping up to a box may reduce the overall level of stress placed on the athlete, as the total load absorbed upon landing would be minimized due to the height of the box. This is of particular significance for strength and conditioning coaches and trainers, as the utilization of low to moderate boxes can facilitate the teaching of proper landing techniques while allowing them to give augmented feedback to novice athletes and reduce the likelihood of injury.

While this study makes a novel and significant contribution to the current literature, some limitations should be acknowledged. First, the subjects in the present study were non-athletes. Further research is needed to confirm whether similar results can be seen in athletic populations. Second, the countermovement depth utilized by the subjects in this research was self-selected during the box jumps. The non-standardization of countermovement depth may affect the push-off phase and consequently, the kinetic and kinematic variables. Conversely, it is important to note that the standardization of countermovement depth is uncommon and impractical within the context of training, especially in large groups. Therefore, the investigators believe the absence of this control increases the ecological validity of the present study. The subjects were asked to perform an arm-swing prior to each jump, which may have affected the mechanics of the jumps. However, as previously mentioned, the arm-swing is a fundamental part of box jumps as it allows the subjects to coordinate the landing portion of the jump. Additionally, although kinetic and kinematic changes due to box height may occur during the landing portion of the box jumps, these were not explored in the current study. Further research is needed to investigate the effect of box height in kinematic and kinetic variables during the landing portion of box jumps. Lastly, since this study employed a within-session design, it is unclear whether the results would remain stable between training sessions. The inclusion of a between-session analysis may confirm the results observed in the first testing session. Finally, only boxes up to 80% of the subjects' maximal jump height were utilized in this research. It is unclear how utilizing box heights at supramaximal levels (i.e., > than maximal CMJ height) affect performance. It is the opinion of the investigators that this topic warrants further exploration.

This study showed that the box height, in general, does not affect propulsive performance in recreationally trained males and females when performing the box jump with maximal effort. When incorporating box jumps in a training program for less experienced individuals, it is recommended to use box heights that are relative to their maximal box height. This is because power and strength performance variables are not affected by box heights up to 80% of their maximal height. Based on these findings, it is recommended the utilization of low to moderate box heights (approximately 60% of maximal) when working with a population similar to that of the present study. The rationale behind this recommendation is associated with facilitating a secure landing onto a box, while also providing a stimulus to learning an appropriate landing technique. Finally, strength and conditioning coaches and trainers should consistently emphasize the importance of striving to achieve maximal jump height, regardless of the specific box height being used.

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