

O TREINAMENTO DE FORÇA AUMENTA A ALTURA DA MANOBRA “OLLIE AIR” EM PRATICANTES DE “SKATEBOARD”? UM ESTUDO PILOTO.

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Resumo O treinamento de força (RT) é uma importante estratégia com objetivo de aumentar a força muscular, levando a adaptações positivas relacionadas à saúde, condicionamento físico e performance esportiva. O *skateboarding* é um esporte radical, cuja proficiência é classificada de acordo com o grau de dificuldade dos movimentos e manobras executadas. O objetivo do presente estudo foi mensurar os efeitos do RT na força máxima de membros inferiores e na altura da manobra *Ollie Air* (OA). Doze praticantes recreativos da modalidade (idade: 23.6 ± 2.8 anos; estatura: 1.77 ± 0.1 metros; massa corporal: 66.2 ± 4.0 quilogramas; experiência com a modalidade: 8.9 ± 3.1 anos; força relativa no exercício agachamento: 1.0 ± 0.2) sem experiência prévia com o TF foram aleatorizados em um dos seguintes grupos: RTG (grupo treinamento de força) e CG (grupo controle). Durante 4 semanas consecutivas, os participantes do grupo RTG foram submetidos a 2 sessões semanais de RT. A força máxima dinâmica de membros inferiores e a altura da manobra OA foram mensuradas pelo teste de uma repetição máxima (1RM) e pelo aplicativo My Jump®, respectivamente. Na altura do OA, não foi observada diferença significativa nas mudanças relativas pré-pós intervenção entre os grupos ($p = 0.523$). Uma diferença significativa foi observada na mudança relativa pré-pós intervenção no teste de 1RM para o grupo RTG mas não para CG ($p < 0.001$; $\Delta\% = 28.5 \pm 6.7$ and 3.0 ± 5.8 , respectivamente). Portanto, a prática do RT não promoveu incrementos significantes na performance da manobra OA em praticantes recreativos de *skateboarding*.

Palavras- exercício; esportes radicais; skateboarding; desempenho

Afiliação

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DOES RESISTANCE TRAINING INCREASE THE HEIGHT OF THE “OLLIE AIR” TRICK IN SKATEBOARDERS? A PILOT STUDY.

Abstract: Resistance training (RT) is an important strategy to enhance muscle strength, leading to positive adaptations related to health, fitness and sport performance outcomes. Skateboarding is an extreme sport, which proficiency is classified according to the extent of the difficulty of movements and tricks performed. The purpose of this study was to assess the effects of RT on lower limbs maximal strength and the height of the Ollie Air trick (OA). Twelve recreational skateboarders (age: 23.6 ± 2.8 years; height: 1.77 ± 0.1 meters; body mass: 66.2 ± 4.0 kilograms; experience with skateboarding: 8.9 ± 3.1 years; relative strength in parallel back squat exercise: 1.0 ± 0.2) with no previous experience in RT were randomly assigned to one of the following groups: RTG (resistance training group) and CG (control group). During 4 consecutive weeks, participants of RTG were submitted to 2 weekly RT sessions. Lower limbs maximal dynamic strength and the height of OA were assessed through one repetition-maximal (1RM) test and My Jump® app, respectively. For OA height, no significant difference was observed for relative pre to-post intervention changes between groups ($p = 0.523$). A significant difference was observed for the relative change in pre to post-intervention 1RM for RTG but not for CG ($p < 0.001$; $\Delta\% = 28.5 \pm 6.7$ and 3.0 ± 5.8 , respectively). Therefore, RT practice did not promote significant increments in OA performance in recreational skateboarders.

Key words: exercise; extreme sports; skateboarding; performance.

Introduction

Extreme sports represent a wide variety of modalities that differ from traditional ones, especially regarding the presence of unpredictable environmental conditions, high-speed actions, specific tricks techniques, and equipment. Skateboarding basically consists of performing tricks over the ground or obstacles through the use of a board (named as “shape”) which presents 4 small wheels and 2 axles (named trucks)¹.

Among the several tricks performed in skateboarding, the “Ollie Air” (OA) is considered the main one, being the basis for the other ones. Briefly, OA consists of a jump movement, which goal is to perform a vertical displacement of both the athlete and the board¹. Given the influence of this trick in general skateboarding performance, assessing an athlete’s OA height may be of great relevance in order to implement appropriate new training and techniques approaches. Several extrinsic variables as feet’s positioning, size of the “shape” and the weight of the skateboarding, may influence an individual’s ability to perform this trick². Additionally, it can be suggested that, since OA is basically a vertical jump, increased strength and power levels may improve the height of the mentioned trick.

Resistance training (RT) is a relevant tool to promote increases in muscle strength and power^{3,4}. Significant increases of 9.1% and 9.8% in vertical jump have been reported following 6-8 weeks of RT programs^{5,6}. Then, one can assume that an individual engaged in modalities with a high demand of vertical components may benefit from a structured RT program. However, it still remains to be studied whether strength gains induced by RT may positively influence specific skateboarding skills. Therefore, the purpose of the present study was to assess the chronic effects of an RT protocol in the height of the OA trick in recreational-level skateboarders. Our hypothesis was that significant increases in the dependent variables assessed would be observed only for the group performing the RT protocol.

Materials and methods

Participants

The sample was composed of 12 healthy young men (age: 23.6 ± 2.8 years; height: 1.77 ± 0.1 meters; body mass: 66.2 ± 4.0 kilograms; experience with skateboarding: 8.9 ± 3.1 years; relative strength in half-squat exercise: 1.0 ± 0.2). To participate in the experiment, participants should present a minimal previous experience in the “street” skateboarding modality and OA tricks of 1 year, performing at least 3 skateboarding sessions per week and not present any

skeletal-muscle injury that could limit the performance of strength tests and/or training sessions. All participants should present a minimal training frequency of 85% in order to be submitted to the post-intervention assessments. During the intervention period, volunteers that presented any injury or abstained from 3 consecutively training sessions would be excluded from the analysis. All participants recruited met the inclusion criteria. In addition, all volunteers were instructed to maintain their usual nutritional habits and to avoid the consumption of any nutritional supplement that could influence training performance. All procedures were in accordance with the Declaration of Helsinki. Institutional Review Board at Methodist University of Piracicaba (Sao Paulo) approved the protocol (3.490.840). All subjects read and signed an informed consent document for the research.

Study design

The present study followed a randomized-longitudinal design. The experiment lasted 7 weeks. The 1st week consisted of the collection of individual (age, skateboarding experience) and anthropometric (body mass and height) data, plus a session of familiarization with OA height and maximal dynamic strength (separated by 8 hours) tests. Forty-eight hours later, participants were submitted to one repetition-maximum test (1RM) in the exercises adopted during the intervention period. In the 2nd week, OA height and maximal dynamic strength were assessed again in order to calculate the reliability values of each dependent variable. After the first two weeks, participants were then allocated, according to baseline OA height values, in one of the following groups: Resistance training group (RTG; n=6), which performed a 4-week RT program or Control group (CG; n=6) (figure 1), with no training intervention. The intervention period lasted from weeks 3 to 6. The last week (7th) consisted of the post-intervention assessments of OA height and maximal dynamic strength. Subjects were instructed to refrain from any exercise modality 72 hours previously to pre and post-intervention testing. All tests were performed by the same researchers, who were not informed about which group each participant was allocated to.

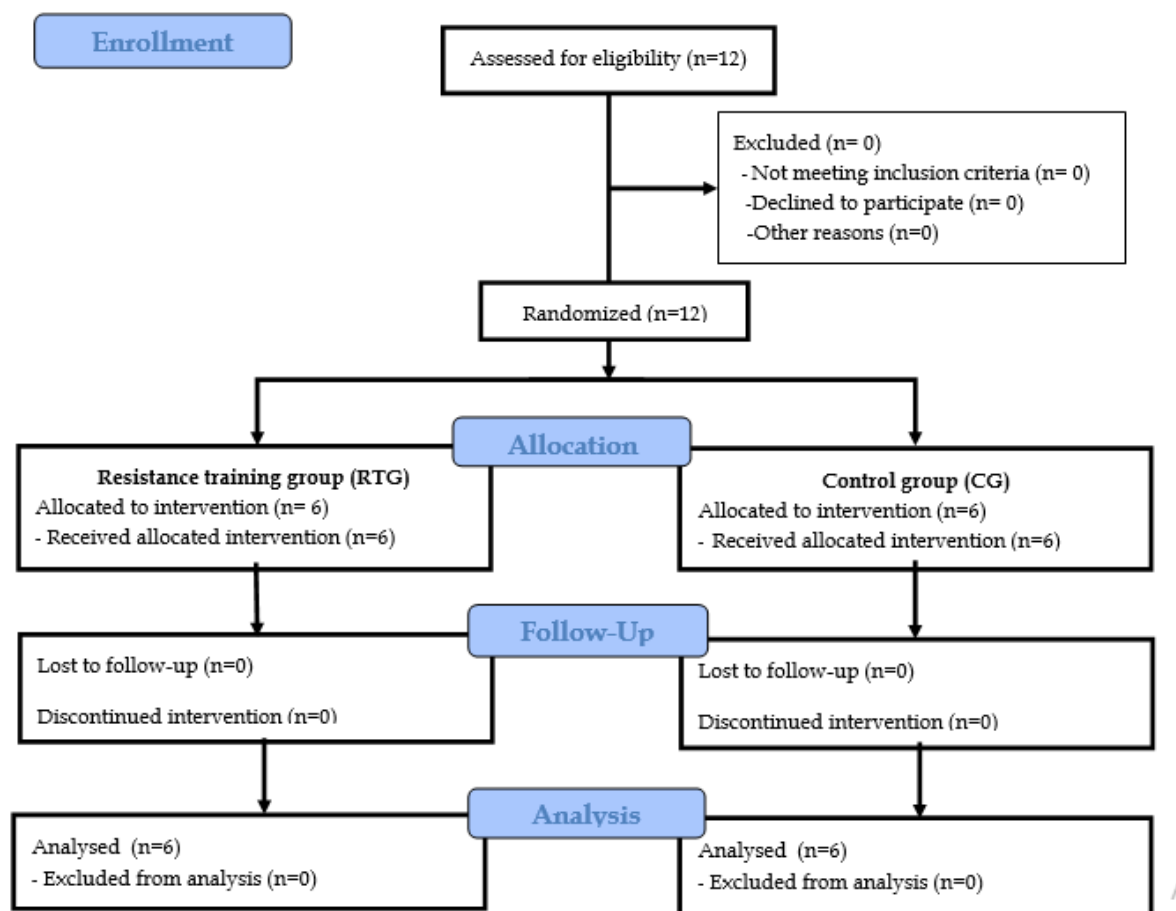


Figure 1- Flowchart of the experimental design of the study. RTG= resistance training group; CG= control group.

Ollie Air (OA) height

The iOS system “My Jump ®” app was adopted in order to assess the height of the OA trick (figure 2). Such a tool has been previously validated, presenting a high correlation ($r=0.96$) with values of vertical jump assessed in force platforms (10). A tablet was used to record the app images, being assessed in 240 frames/second samples, disposed on sagittal plan. The device was positioned in a tripod (118 cm), located 325 cm (measuring tape FORTG, SP, BR) away from the volunteers, allowing a whole view of the lower limbs and the skateboard in order to check the take-off and landing phases of the trick. The same skateboard was used from all volunteers in each test (Truck: Independent ®, Santa Cruz, CA, USA; Shape: Zero Skateboards®, Carlsbad, CA, USA; Wheels: Black Sheep 51 mm, CA, USA). One week before initiating the study, all volunteers were submitted to a familiarization process (30 min/day during 5 days) with the skateboard used in the tests. Testing protocol was initiated with a general (5 minutes cycling [[Schwinn, AC Sport] with cadence of 60-70 rpm, and a load of 50

watts) and specific warm-ups (5 submaximal OA). Then, participants were properly informed about the characteristics of the test and the device adopted, being instructed to perform the highest possible height in the OA trick. Three attempts for each participant were adopted, with 1 minute of passive rest between them. An initial standing position was standardized, with knees in complete extension. The mean of the 3 attempts was used for data analysis. The coefficient of variation (CV) and typical error of measurement (TEM) for OA height were 5.0% and 2.4 cm, respectively.

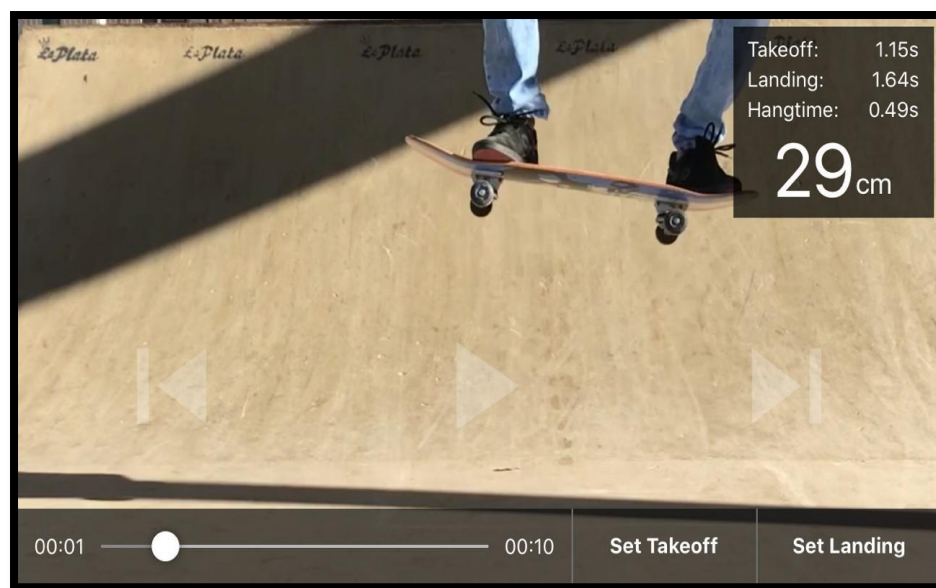


Figure 2. Image of the OA height provided by “My Jump ®” app.

Maximal dynamic strength

Lower body maximal strength was assessed through one maximal repetition test (1RM) in parallel back squat exercise. Testing procedures were conducted according to the recommendations of Brown and Weir⁸. Prior to testing, subjects performed a general warm-up consisting of 5 minutes of cycling (Schwinn. AC Sport) at 60-70 rpm and 50W. Then, a specific warm-up set consisting of 5 repetitions was performed at ~50% of the self-predicted 1RM followed by 1 to 2 sets of 2–3 repetitions at a load corresponding to ~60–80% 1RM. Subjects then performed sets of 1 repetition of increasing weight for 1RM determination. The external load was adjusted by ~5-10% in subsequent attempts until the participant was unable to complete 1 maximal concentric muscle action. The 1RM was considered the highest external load lifted. A 3- to 5-minute rest was afforded between each successive attempt. All 1RM determinations were made within 5 attempts. Subjects were required to squat down so that the

top of the thigh was parallel to the ground (90° degrees; Manual goniometer [Carci ind.; Sao Paulo; Brazil]) for the attempt to be considered successful as determined by a research assistant who was positioned laterally to the subject⁹. The barbell was positioned on the shoulders (high bar position) and the subjects' feet were positioned at hip-width. The CV and TEM for 1RM test were 7.4% and 4.1 kg, respectively.

Resistance training protocol

Training sessions were performed twice weekly (sessions separated by 72 hours) and consisted of parallel back squat and leg press exercises. Three sets of 8-10 RM were performed. The initial loads of each exercise were assessed during the first week of the study (familiarization period). In case of exceeding 10RM in the last set of a given exercise, participants should implement, from the next training session, load increases ranging from 5% to 10%. For the leg press exercise, participants were required to perform the descending (eccentric) phase of each repetition to the point of ~ 90 degrees of knee joint flexion visually determined by a research assistant who was positioned laterally to the subject. Passive rest intervals of 90 and 120 seconds were adopted between sets and exercises, respectively¹⁰. In addition, all participants were instructed to maintain their usual weekly skateboarding sessions during the intervention period.

Statistical analysis

Data are presented as means $\pm$ standard deviations (SD). Initially, a Shapiro-Wilk and Levene's test was used to analyze the normality and homogeneity of the data, respectively. Two-way analysis of variance (ANOVA) for repeated measures was used for intra- and inter-group comparisons followed by Fisher's post hoc. Assumptions of sphericity were evaluated using Mauchly's test. Where sphericity was violated ($p < 0.05$), the Greenhouse-Geisser correction factor was applied. Baseline scores as well as the relative change (%) differences between groups were explored using an independent t-test. In addition, the effect size (ES) of both groups was calculated by Cohen's d through the formula: $d = (\text{mean 1} - \text{mean 2} / \text{combined SD})$. The combined SD was calculated by the formula $\sqrt{((DP^2 \text{ of variable 1} + DP^2 \text{ of variable 2}) / 2)}$ ¹¹. Values of $d < 0.2$, 0.2-0.6, 0.6-1.2, 1.2-2.0, 2.0-4.0 and 4.0 were considered to be trivial, small, moderate, large, very large and extremely large, respectively¹². The 95% confidence interval (CI 95%) of post-pre mean difference was also calculated. Pearson's correlation coefficient (r) was used to calculate the correlation between the percentages

variations of 1RM and OA height. Individual responses were also calculated through the use of TEM. Participants with pre-to post-intervention increases above 2 x TEM in each variable were considered as “responders”. Significance was set at an alpha level of 0.05. All data were analyzed in Microsoft Excel (2016).

Results

Table 1 displays participants’ characteristics at baseline. No significant differences were observed between groups for age, body mass, height, relative lower limbs maximal strength and previous experience with skateboarding practice ($p > 0.05$). In addition, participants allocated in RTG presented a relative training frequency of $97.6 \pm 3.6\%$ (mean $\pm$ standard deviation) by the end of the intervention period.

Table I. Baseline descriptive statistics (mean $\pm$ SD).

Variables	CG (n=6)	RTG (n=6)	<i>P</i> value
Age (years)	24.0 $\pm$ 2.1	23.2 $\pm$ 2.6	0.634
Total Body Mass (kg)	65.2 $\pm$ 4.8	67.3 $\pm$ 3.2	0.386
Height (cm)	178 $\pm$ 0.06	177 $\pm$ 0.08	0.621
R1RM _{SQUAT}	1.0 $\pm$ 0.3	0.9 $\pm$ 0.2	0.392
Skateboarding experience (years)	8.7 $\pm$ 2.3	9.2 $\pm$ 3.9	0.791

CG = control group RTG = resistance-training group; R1RM_{SQUAT} = relative maximal strength in parallel back squat exercise.

Table 2 presents the pre and post-intervention values, relative (%) and absolute mean differences, as well as the effect size values for each group in OA and 1RM variables. No significant difference was observed between groups in both pre and post-intervention moments for both variables ($p > 0.05$).

For OA height, no significant main effect of time was observed for both CG ($p = 0.533$) and RTG ($p = 0.909$). No significant group x time interaction was observed ($F_{3,15} = 0.914$; $p = 0.457$)

For 1RM, a significant main effect of time was for RTG ($p = 0.04$) but not for CG ($p =$

0.984). No significant group x time interaction was observed ($F_{3,15} = 3.043$; $p = 0.061$).

Table 2. Pre and Post intervention maximal strength and ollie air height values (mean $\pm$ SD).

Variables	Pre	Post	$\Delta\%$	MD [95%CI]	<i>d</i>
OA (cm)					
CG	29.4 $\pm$ 3.9	33.2 $\pm$ 3.4	12.7	3.7 [0.8 to 6.7]	1.4
RTG	31.6 $\pm$ 5.9	33.4 $\pm$ 3.8	5.7	1.8 [-1.9 to 5.5]	0.5
1RM (kg)					
CG	56.0 $\pm$ 12.7	57.7 $\pm$ 14.1	3.0	1.7 [-0.7 to 4.0]	0.2
RTG	50.3 $\pm$ 7.6	64.7 $\pm$ 10.3*	28.5	14.4 [11.2 to 17.4]	2.2

CG = control group; RTG = resistance training group; MD = Mean Difference; CI= Confidence Interval; *d*= effect size. *Significantly different ($p < 0.001$) from corresponding pre- intervention value.

Figure 3 presents pre- to post-intervention relative changes (%) for the assessed variables. For OA height, no significant difference was observed between groups ($p = 0.523$). A significant difference was observed for relative changes in pre to post-intervention 1RM, with the RTG showing greater increases ($p < 0.001$) compared to the CG.

Moderate ($d = 0.7$, CI 95% = -1.0 to 2.3) and extremely large ($d = -5.2$, CI 95% = -6.5 to -3.8) effects were observed in the ES between-group analysis for OA height and 1RM, respectively.

Individual analysis showed that, for OA height, only 1 subject (17%) of RTG was considered as a “responder” (absolute increases above 2x TEM), while for 1RM, all subjects (100%) from RTG were considered as “responders” (absolute increases above 2x TEM).

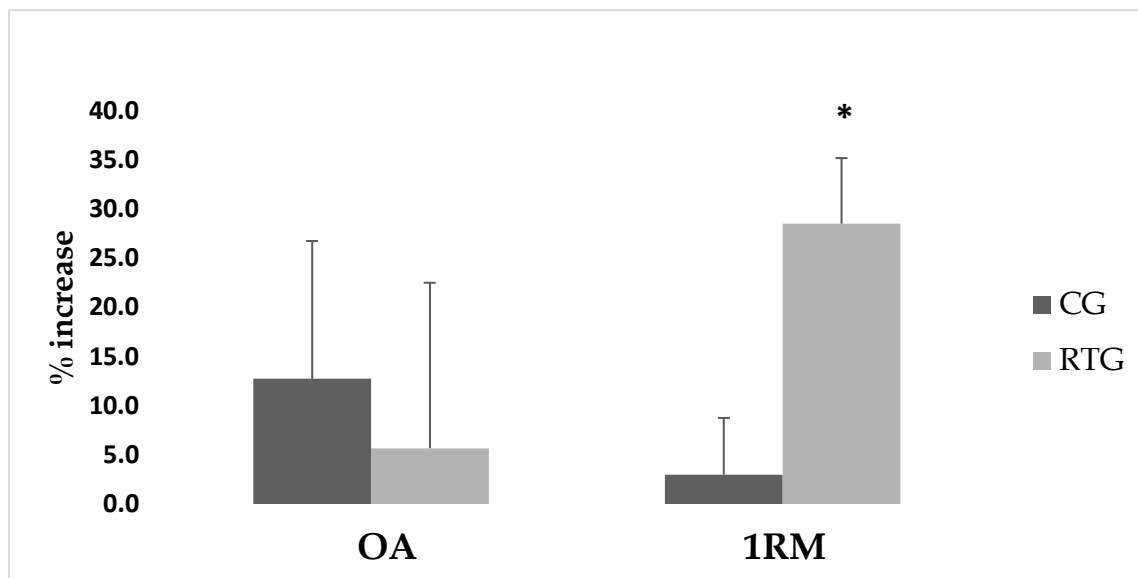


Figure 3. Percentage increases from pre-to post- training according to groups. CG=control group; RTG= resistance training group. * $p < 0.05$ RTG vs CG. Data are presented as mean and standard deviation.

A weak, negative, non-significant correlation was observed ($r = -0.29$, CI 95% = -0.74 to 0.34, $p = 0.36$) between percentages variations (pre to post) of 1RM and OA height (figure 4).

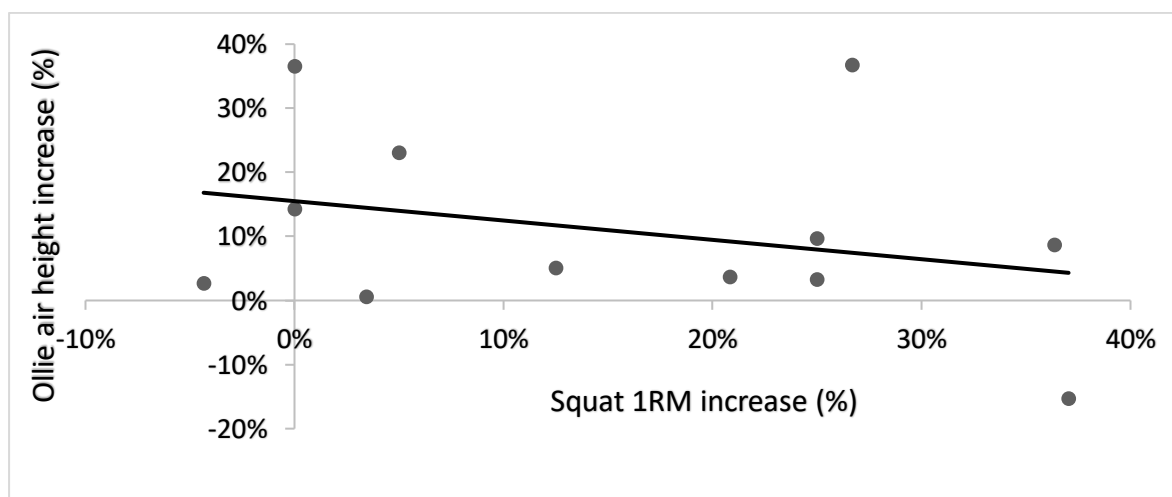


Figure 4. Correlation between % changes of 1RM in parallel back squat exercise and the height of OA trick.

Discussion

The aim of the present study was to assess the effects of RT on OA height in recreational skateboarders. To the best of our knowledge, this is the first study investigating eventual chronic effects of strength exercises on an extreme sport's specific trick. The main and novel finding was that the RT program adopted in the current study (two exercises only for the quadriceps

muscle) does not seem to significantly influence the performance in OA trick, refuting the initial hypothesis. The absence of previous investigations in the population studied limits comparisons with the literature.

The OA is a relevant trick regarding skateboarding performance. Then, the adoption of physical training modalities that could enhance its height may represent great advantage in individuals engaged in this sport. The results of the present study suggest that OA performance does not seem to be improved by RT programs (strength-endurance) similar to the one adopted by the current study. It seems reasonable to suggest that the addition of more exercises for different muscle groups (as the calf ones) and implementing further training protocols (as plyometrics) could induce different results. The training program adopted induced a small effect ($d=0.5$) in OA height, with only 1 subject being considered as a “responder”. The distinct predominant motor gestures observed in the RT exercises performed and the OA trick may help to explain such findings. Strength gains induced by a traditional RT schedule may not eventually influence vertical jump performance^{5,13,14}. Although speculative, the lacking effects of the RT protocol adopted in the height of OA may be justified by eventual kinetics and/or kinematics differences between the exercises performed during the intervention and the predominant movement in the trick. Then, eventual significant effects of a RT protocol consisting of similar exercises to the motor gestures observed in the OA, especially those with a high manifestation of the stretch-shorten cycle, must not be discarded.

For maximal strength, a higher magnitude increase was observed for the group submitted to the RT program (RTG) compared to the control one (CG) (extremely large effect size), confirming our initial hypothesis. In addition, all individuals allocated in RTG were considered “responders” to the training protocol. The percentage increase in 1RM described in the present study (28.5%) may be compared to data from Chelly et al.⁶, in which a 37% increase in back squat 1RM was observed in soccer players. The higher magnitude observed in the latter may be explained by the longer training period adopted (8 weeks) compared to our intervention (4 weeks). Then, it can be suggested that skateboarders may also present higher magnitude increases in lower limbs maximal strength if submitted to RT programs with longer duration.

A negative weak correlation ($r=-0.29$) was also noted between relative changes (%) in 1RM and OA height from pre-to post-intervention moments. Our findings may be comparable to those reported by Candotti et al.², where the maximal dynamic force was not correlated with the height reached in the OA trick. However, differently from the present study, data from Candotti et al.² were reported through the correlation between absolute

values of these dependent variables (lower limbs maximal strength and OA height). Additionally, no RT intervention was adopted in Candotti et al.², limiting eventual comparisons between studies. It still remains controversial in the literature the main elements influencing vertical jumps performance. Higher muscle strength levels and the ability in transferring mechanical energy from the proximal to the distal segments are usually two distinct factors influencing the height of a vertical jump^{15,16}. In addition, 76.3% of the variance in OA height can be explained by lower limbs muscle power, while only 50.6% by maximal dynamic strength². Therefore, it can be suggested that skateboarders attempting to increase their OA performance may benefit to a greater extent from a power type-RT protocol compared to a traditional one.

This study is not without limitations. First, the small sample size adopted reduced the statistical power needed to minimize a type 2 error. The difficulty in recruiting a minimal number of participants that met all the inclusion criteria in the place of development of the experiment, especially regarding previous experience with skateboarding, may justify the reduced number of assessed participants. Therefore, this study would best be classified as a pilot work and future research with larger samples are encouraged in order to clarify the chronic effects of RT in skateboarding performance. Second, the RT protocol adopted, with only two exercises for the lower limbs and a strength-endurance schedule might not have been appropriated, since skateboarding tricks seem to demand an elevated force production within a reduced time. Then, it can be suggested that RT-protocols designed to improve muscle power (light-moderate loads with high-speed movements) would induce different results from those observed by the current investigation. In addition, the 4-week duration of the training protocol might not have been long enough to detect eventual effects of RT in OA height. Third, an accurate control of the weekly specific-modality practice (e.g. frequency, time) was not adopted, which might have influenced some of the results observed. Another relevant limitation is that, when performing the trick, no standardized upper limbs movement was adopted. Significant positive increases in vertical jump have been previously reported using simultaneous upper limbs movement¹⁷. Then, possible influences of this variable in the values of OA height assessed must not be discarded. Additionally, no standardization regarding clothing and the shoes used during the tests was adopted. Lastly, the findings of this study must not be extrapolated to other populations, especially female practitioners and/or competitive-level skateboarders.

Conclusions

In conclusion, the findings of the present study suggest that the 4-week resistance training protocol adopted does not enhance the performance of the Ollie Air trick in recreational skateboarders.

Acknowledgments

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