THE EFFECT OF UNILATERAL STRENGTH TRAINING ON CROSS-COUNTRY SKIING DOUBLE POLING PERFORMANCE

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ABSTRACT

At the highest level of sports performance, further progress is already very limited. Therefore, it is very important to implement more new training approaches and methods to our training process. The main purpose of our research was to find out if unilateral strength training is more efficient for developing cross-country skiing double poling performance than traditional bilateral strength training approach. Our research sample consisted of 8 probands (Age 17.94 ± 1.04), national and international level cross-country skiers. The experimental group implemented a unilateral and the control group a bilateral strength training program within 6 weeks (3 training sessions per week). For tests we used SkiErg machine from Concept 2. The experimental group achieved improvement in total distance of about 6.66% (9.25 m) and control group 2.69% (3.75 m). Although we did not register a statistically significant difference between groups ($p = 0.724$), the experimental group improved its performance with medium effect size level ($p = 0.11$, $r = 0.4$), while the control group achieved a small effect size level only ($p = 0.19$, $r = 0.17$). The gap at the finish line between a winner and a loser in cross-country skiing is often just a few centimetres, so our result (difference of almost 6 meters between our groups) would make a big difference in real races.

Keywords: Cross-country skiing, double poling, unilateral strength training

INTRODUCTION

At the highest level of athletes' sport performance, progress is already very limited. Therefore, athletes and coaches have to look for other new or alternative training methods to increase their performance (Billat, 2001).

In our research, we wanted to find out how unilateral character of strength training will affect performance in cross-country skiing double poling technique. We would like to bring forward the answer whether cross-country skiers should use unilateral strength training in their training process or whether unilateral strength training will not affect their performance in a significant way.

Cross-country skiing is a very difficult sport when it comes to technique and coordination demands (Ilavský & Suk, 2005).

Cross-country skiing classic technique includes a few technique variations which we use according to a specific track profile or track sections (Bolek, Ilavský, Soumar, 2008). In today's cross-country skiing, we are dealing with a very specific case. Double poling skiing technique is now used not only for flat terrain but athletes are choosing this technique to compete also on very demanding courses (Brűnn, 2015). The double poling technique is becoming the phenomenon of this sport and a game-changing technique. When you are good at the double poling technique, you have the chance to win a race. If you are not good at it, you are only a

tourist on skis.
Our theoretical base comes from describing the phenomenon of bilateral limb deficit. By this phenomenon, we mean the difference in maximal or submaximal force generated by muscles contracted alone or in combination with contralateral muscles. Bilateral limb deficit occurs when the summed unilateral forces are greater than the bilateral force (Kuruganti, 2005).
So far, we have seen unilateral training-based experiments on students, patients, volunteers and collective sports players but we lack practical research in our sport. In experimental group composed of students, Rube and Secher (1988) found almost the same increment in both unilateral and bilateral group. Furthermore, Lee, Kim, Park and Park (2017), were performing experiments on sick subjects where patients after stroke gained more benefits from bilateral training. Secondly, Botton et al. (2016) found that bilateral strength training positively affects strength in bilateral character of movement and unilateral strength training positively affects strength in unilateral character of movement. Skok et al. (2016) came up with the conclusion that unilateral strength training is more effective for collective sports and players should be using this approach.
We see these findings as a stepping stone and if we know the movement structure of any particular sport, we can also set up an effective way of improving the athletes' strength in that movement structure. In addition, it is very interesting that there is also a strength transfer from the trained to untrained limb (Derakhti, Akerlund, 2016; Schlenstedt, 2016; Taniguchi, 1998).
So far, we know that if we train in a unilateral way, we will be better in a unilateral movement structure. However, we still do not know if unilateral strength training approach also improves our performance in specific cross-country skiing double poling bilateral movement structure.
The main benefit of our research will be the direct application of our findings to the cross-country skiing training process. Cross-country skiers will know if unilateral strength training has any value for them and if it will make difference in races eventually.

OBJECTIVE

The objective of our research was to find out if there is a significant effect of unilateral strength training on the cross-country skiing double poling performance.

METHODS

The experiment was conducted from May 15, 2017 to July 10, 2017 for 8 weeks in total. The tests and the entire training process took place in OŠG Banská Bystrica.
Our research sample consisted of 4 male and 4 female probands (Age 17.94 ± 1.04), cross-country skiers, from OŠG Banská Bystrica. These athletes all compete on national and international level and, considering Slovak cross-country skiing possibilities, they also represent an adequate research sample.
After entry test, we divided our sample into two groups which were homogeneous in terms of performance level (Shapiro-Wilk test). Afterwards, we monitored the improvement of each group separately, differences between groups and intraindividual changes.
The experimental group underwent the unilateral strength training program and the control group the bilateral strength training program. The experimental stimulus was directly the unilateral strength training program.
Each training session was built on seven movement patterns based on strength training principles whose author is a well-known strength and fitness coach Michael Boyle. The probands were training in this program 3 times per week. Each session took one hour and fifteen minutes and took place on Monday, Wednesday and Friday.

During the first 4 weeks, we were developing eccentric strength in tempo 4:0:1 (eccentric phase: mid-point: concentric phase), 10 repetitions (first and second week) and 8 repetitions (third and fourth week). We had 4 series for bilateral and 3 series for unilateral group. During the second 4 weeks, we were developing maximal strength in tempo 2:0:1. In the first two weeks of this period, we decreased the number of repetitions to 6, but the number of series stayed the same as in the first four weeks. For the last two weeks of maximal strength development, we did 4 series in unilateral group and 5 series in bilateral group. The number of repetitions was 5 for both groups.
SkiErg from Concept 2 was used as the testing device. It was specifically created and modified for cross-country skiers. We evaluated power in Watts and total distance after 30 second maximum effort test with the data from this trainer. Both variables (Watts and metres) can be seen right on the display after your tests. Of course, both variables could have been affected by the weight of our proband, but the same thing happens in real conditions of cross-country skiing or any other sport.
On the basis of Shapiro-Wilk test, we used a parametric method of statistical significance evaluation. In our case, that parametric alternative was a paired t-test ($p \leq 0,05$) and our results were also supported by a calculation of effect size (Cohen's d). For statistic test calculation, we used Microsoft Excel 2016.

RESULTS

The experimental group increased their average distance on SkiErg by about 9.25 m (48.5 W). The control group made improvement only by 3.75 m (11.75 W) in average. Therefore, the difference between these groups was 6 m (36.75 W).

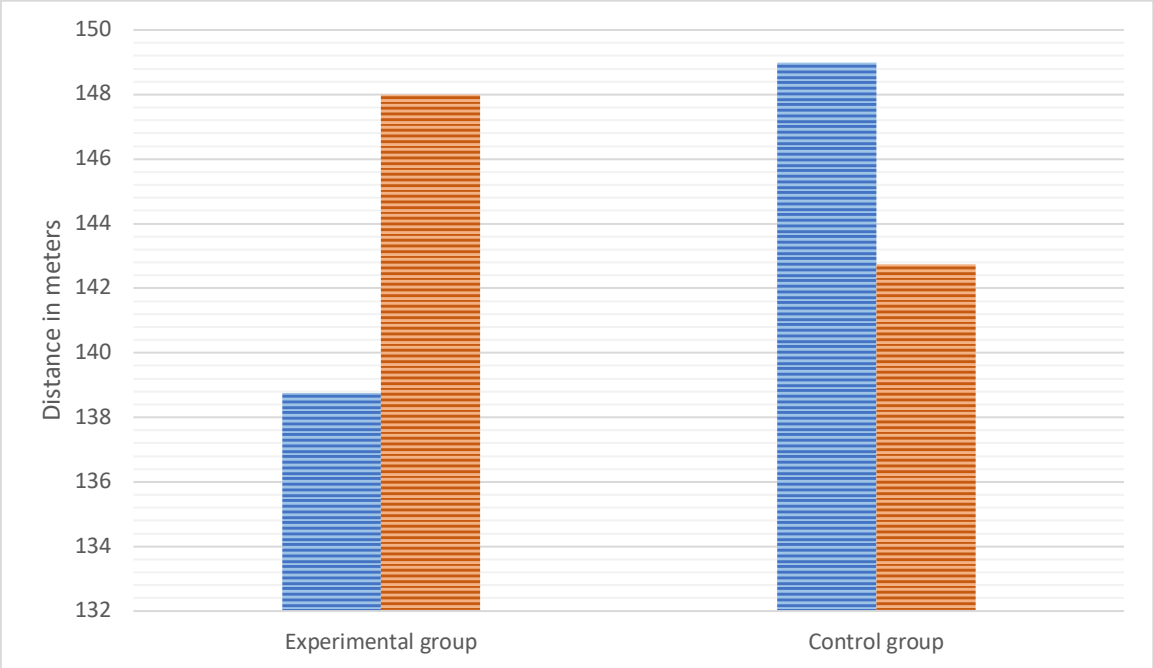

Fig. 1: Average completed distance on SKIERG for both groups.

To put it in statistics, the value of statistical significance (p) was 0.724 between the final tests of both groups.
Additionally, there is no evidence about statistically significant improvements in each group separately, either. For the experimental group (p) was 0.11 and for control group 0.19.

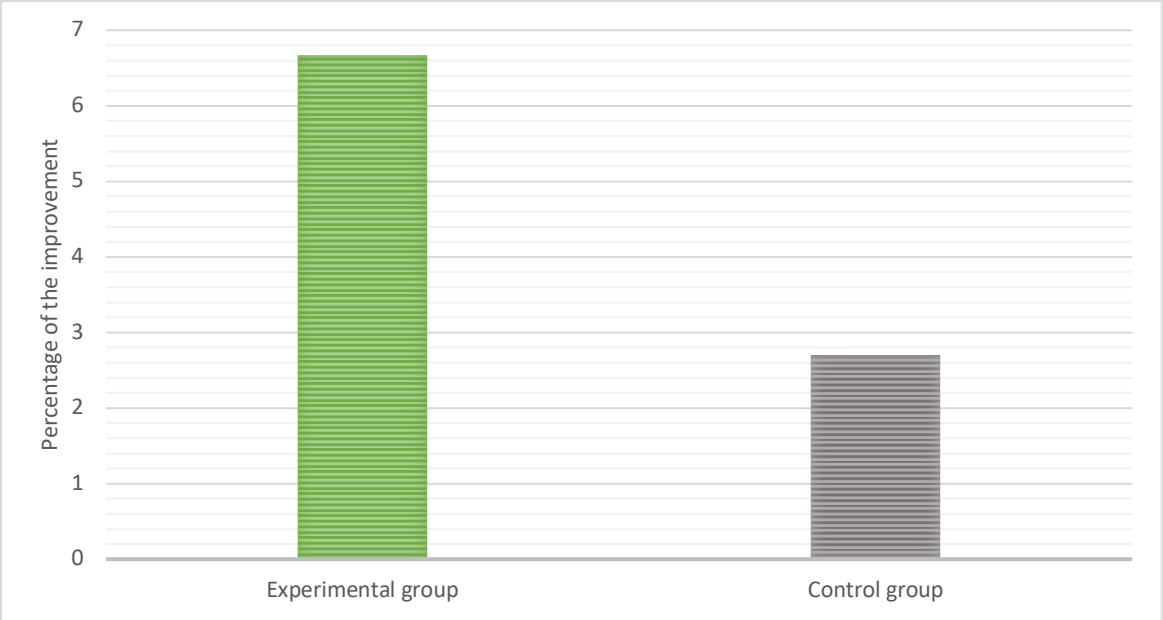

Fig. 2: Percentage of total distance improvement of both groups

The experimental group increased its performance by about 6.66%, which translated to almost 6 meters' improvement in the total completed distance.

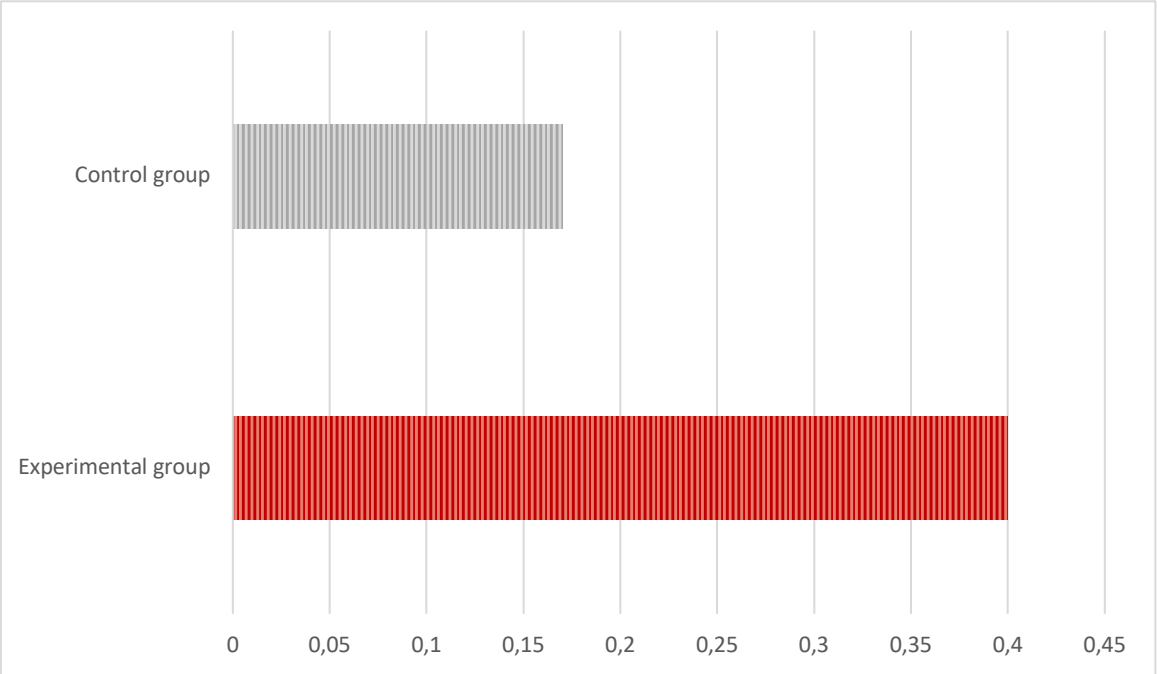

Fig. 3: Effect size (Cohen's d)

Due to small statistical significance, we calculated the effect size of the experimental group improvement (r = 0.4), which can be interpreted as a medium effect of experimental stimulus.

DISCUSSION

Before our experiment, we knew that if we train in a unilateral way, we will be better in a

unilateral movement structure. On the other hand, we did not know if unilateral strength training approach will also improve our performance in the specific cross-country skiing double poling technique.
On average, the difference of completed distance between the experimental and the control group amounted to almost 6 m. You can see almost identical starting point for both groups but a totally different final result. Statistical significance (p) was 0.724. Since it is more than 0.05, we can state that we have not registered significant changes in the athletes' performance level. We credit this fact to the low number of probands and not to the quality of the experimental stimulus.
Despite the fact that our results were not statistically significant, the experimental group increased its performance by about 6.66% (9.25 m) and we registered a medium effect size ($p = 0.11$, $r = 0.4$) of the experimental group's improvement. This is definitely significant in real conditions where the gap on the finish line between a winner and a loser in cross-country skiing can often be only a few centimetres.
We can now proclaim that the experimental group made a significantly greater improvement in terms of total distance and power than the control group. Despite the fact that we cannot confirm statistically significant changes between groups but only for each group separately, we can state that our results are significant in real world of racing and that the unilateral strength training approach also improved the performance in a specific movement structure.

CONCLUSION

Unilateral strength training approach has a greater effect on performance enhancement for our specific purpose than bilateral strength training approach.
Even though we have improved our athletes' performance and we are making conclusions for real world conditions, we also have to consider possible deviations which could have been caused by our testing device. We cannot be sure if the distance recorded on our trainer is the same as it could be on snow. What we can confirm and prove is the power improvement on the same trainer of both groups at the beginning and at the end of our experiment.
That brings us back to the start when we asked ourselves if it would be more efficient for cross-country skiers to do unilateral strength training compared to bilateral. According to our results, it seems that unilateral strength training might create better transfer to double poling cross-country skiing technique than bilateral strength training.

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