The Use of Polyamide Slaklines in Evaluating the Moving Speed in the Dynamic Balance and the Effort Capacity During the Education through Adventure Programs

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Our study's goal was to underline the differences between the girls' and the boys' representative in terms of age, in what concerns the moving speed and the effort perception during the dynamic balance when walking on the slackline throughout the activities specific for the Development through Education and Adventure (DEA). The results have shown the fact that the boys have a better speed movement on the slackline rather than the girls, allowing us to conclude that the boys' dynamic balance is superior to the girls' balance on both studied age categories. Perceiving the physical effort through heart rate is different according to age category when walking on the slackline for the groups of the study.

Keywords: moving speed, dynamic balance, heart rate

The equipment made of plastic, used today for sports activities and recreational ones have diversified in terms of shape, quality, reliability, endurance, toughness, elasticity, etc. [1-3]. The sports equipment made of plastic have a major contribution when speaking about improving the motor and humanly functional potential and facilitates the ways and the opportunities of physical exercises practice in different environments, according to the type of recreational or sports activities [4,5]. Nowadays, sports equipment are largely used during the physio- and kinetotherapy process by adapting their usage to the patients' needs [6-9].

The Education through Adventure (EA) is a form of nonformal education which has positive effects at a motor, psychological and behavioral level by placing the participant in a natural, unfamiliar environment, during different activities or experiences which have a certain degree of controlled risk. This type of education benefits from the innovation of the technology concerning the sports equipment made of plastic and from nanotechnology, with diverse designs adapted to the subjects' particularities and the goals of the outdoor recreational activities. Educating the speed of movement in the dynamic balance conditions can lead to educating other components of the fitness process found in a interrelation and an inter-condition state [10-14]. Recent studies show the beneficial aspects of the balance exercises on the slackline regarding the fitness components and physical skills development.

The slackline kit has a polyamide strap of 15 or 25 m length and a 5 m width with buckles made of 100% steel; a tension system, a set containing 2 protections for the trees 100% polyester, with a 120cm x 15cm dimension; a backup system for assuring the tension system and a backpack for transport [15]. The exercises on the slackline consist of moving on the extended strap, anchored between two trees or two special poles, trying to maintain and educate the dynamic balance without having any counterpoint, the balance being made using the hands. The polyamide used for creating the strap is a plastic product obtained by poly-condensation or polymerization and it used to make the synthetic fibers [16], which assures its strength, its rigidity and its flexibility when anchoring and retightening and under the human weight impact. Exercising on the slackline will determine tensions with different values according to the type of activity. Studies have shown that the tension on the slackline depends on the length of the strap, the human weight of the subject, the launching angle from the middle of the strap in the

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balance position and it is calculated as the following [15,17]: Tension (kN) = Weight (W) x The Length of the Strap (L)/ 400 * descending angle (F) . The slackline is systematized according to the task as the following:

Rodeo straps between 100 and 200 kgf (1 - 2 kN), low tension between 200 and 800 kgf (2 - 8 kN), medium tension 800+ kgf (8+ kN).

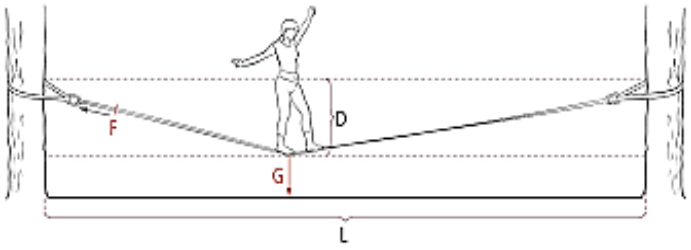

Fig. 1. Tension on the slackline in a stable balance [17]

Approaching the physical activities from an interdisciplinary perspective fits with the new scientific trends which have major effects on the motor, psychological, functional components and also on the materials and the sports equipment [18-21].

In this context, our study had two major objectives: the first objective tried to underline the differences between the girls' and the boys' representatives on age category concerning the speed of movement in the dynamic balance conditions on the slackline during the activities specific for the Development and Education through Adventure (DEA) programs; the second objective followed the evaluation of the impact after using the slacklines reflected on the functional capacity evaluation of the subjects involved in the study during the test of moving on the slackline during the DEA programs.

Experimental part

Materials, methods and procedure

The research was conducted using 218 subjects from Galati county, divided into two representatives: the first included 114 students from Vth to VIth grades, 50 boys (43.85%) and 64 girls (56.15%), which took part in the DEA1 Program; the second representative engaged 114 sudents from VIIth and VIIIth grades, with 44 boys (43,05%) and 60 girls (56,95%), which took part in the DEA2 Program.

Implementing the DEA1 Program (Vth-VIth grades) took place between 20th and 25th of April 2019, implementing the DEA2 Program (VIIth-VIIIth grades) took place between 30th of April and 5th of May 2019, in the Aventura Durau Park. At the end of the specific activities from the DEA programs, tests were conducted on the experimental representatives.

Slackline- walking on the strap (adapted activity) the activity implied mowing forward on straps fixed on trees, with the 5cm width, situated at a 0.7-1m distance from the ground in order to form a horizontal line with 5cm and 25m lengths. The participants had the possibility of using a 2.5 cm strap, situated between 1,7-2m in regard to the main strap, adopting different positions of the arms- laterally stretched, up and forward.

The DEA1 Program participants, Vth-VIth grades had to walk 55m on the slackline including two lengths of slackline; of 15m and of 25m (3 games). The tension used on the slacklines had a medium level of approximately 100-200 kgf (1-2 kN). The DEA2 Program participants, VIIth-VIIIth grades had to walk 70m on the slackline, including 3 lengths of slacklines of 15m and 25m (4games).

All the participants, after finishing one length, had to come on the ground, go around the tree and climb again on the slackline, being used by an advised person. The two programs, DEA1 and DEA2 are different from the point of view the track difficulty and the exercises applied to the age particularities. With the help of POLAR M200, worn by each subject that took part to the study, the time of completing each track was measured and also the minimum and the maximum heart rate was taken for each participant; the device was selected on the Other Outdoor feature.

Statistical analysis

The results of the research were processed in SPSS 24, calculating the statistic indicators: arithmetic mean (X), standard deviation (SD), Min – minimum value, Max – maximum value, CV – coefficient of variability, t – Student test, Pearson correlation (r), F - Levene's test of equality of variances**.** The significant stage considered relevant for the study was $p < .05$.

Results and discussions

The statistical analysis of the data, on the Vth-VIth grades representative show that all the test values were statistically significant for p<.05, and the variability coefficient shows a good homogeneity when evaluating the movement on the slackline and a very good homogeneity for the functional parameters , the values being registered between 0-10% (Table 1.) For all the tests, the boys registered superior values comparing with the girls. The r value indicates insignificant correlations between the speed of movement and the functional parameters.

Table 1

STATISTICAL DESCRIPTIVE OF RESULT FOR 55 M WALKING ON SLACKLINE - VTH-VITH GRADES

Parameters	Group	X	SD	Min	Max	CV	t	p
Speed of movement (min)	B	3.00	.57	2.15	4.32	19%	36.79	.000
	G	3.20	.43	2.32	4.11	13.43%	59.36	.000
HR min (pulse/min.)	B	87.16	6.05	70.00	98.00	6.9%	101.72	.000
	G	86.89	6.59	78.00	99.00	7.58%	105.36	.000
HR max (pulse/min.)	B	127.72	4.92	118.00	139.00	3.85%	183.25	.000
	G	125.89	5.16	113.00	137.00	4.09%	194.89	.000
HR med (pulse/min.)	B	109.48	6.26	97.00	121.00	5.71%	123.59	.000
	G	108.9	5.87	98.00	121.00	5.39%	148.33	.000

X – average; SD – standard deviation; Min – minimum, Max- maximum; CV – coefficient of variability, t- value of Student test, df- degree of freedom, p – level of probability, B – group of boys ; G – group of girls, HR max – heart rate maximum, HR min – heart rate minimum, HR med – heart rate medium.

According to table2, the results for the VIIth-VIIIth grades representative show that the boys have a speed of movement of 1.20 min faster than the girls. Taken into consideration the functional parameters, the girls have registered higher heart rates comparing with the boys, the effort being perceived by the girls as being more challenging. The homogeneity of the representative had a medium degree when speaking about the speed of movement on the slackline and very good at the functional parameters. All the values of the study for this representative were significant from a statistic point of view. The r values show insignificant correlations between the speed of movement and the functional parameters.

Table 2

STATISTICAL DESCRIPTIVE OF RESULT FOR 70 M WALKING ON SLACKLINE - VIITH-VIIITH GRADES

Parameters	Group	X	SD	Min	Max	CV	t	p
Speed of movement (min)	B	14.06	2.24	9.54	18.09	15.93%	41.54	.000
	G	14.86	2.69	10.40	21.46	18,1%	42.66	.000
HR min (puls/min.)	B	76.45	6.30	64.00	90.00	8.24%	80.39	.000
	G	81.86	7.74	62.00	93.00	9,45%	81.92	.000
HR max (puls/min.)	B	121.45	4.06	112.00	130.00	3,34%	198.13	.000
	G	126.26	8.73	116.00	161.00	6.91%	111.97	.000
HR med (puls/min.)	B	99.36	4.18	90.00	107.00	4.2%	157.38	.000
	G	104.26	5.90	93.00	119.00	5.65%	136.82	.000

X – average; SD – standard deviation; Min – minimum, Max- maximum; CV – coefficient of variability, t- value of Student test, df- degree of freedom, p – level of probability, B – group of boys ; G – group of girls, HR max – heart rate maximum, HR min – heart rate minimum, HR med – heart rate medium.

The comparing analysis from table 3 shows that for the Vth-VIth grades representative, significant differences have been registered only for the speed of walking on the slackline of Xd .201, SDd.094 in favour of the boys' group. The functional parameters have not registered significant statistic differences for this age representative.

The representative for the VIIth -VIIIth grades has registered significant statistic differences at the speed of movement on the slackline and significant statistic differences at all the functional parameters in favor for the girls' group comparing with the boys' group (Table 3).

Table 3
STATISTICAL ANALYSIS OF INDEPENDENT SAMPLES TEST OF PARAMETERS OF STUDY

Class	Parameters	Levene's Test		t-test EM				
		F	p	t	df	p	Xd	SDd
Class V-	Speed of movement (min.)	6.33	.013	-2.12	112	.036	-.20	.09
	HR min (pulse/min.)	1.37	.244	.22	112	.823	.26	1.20
	HR max (pulse/min.)	.26	.610	1.91	112	.058	1.82	.95
	HR med (pulse/min.)	1.31	.254	.50	112	.616	.57	1.14
Class VII-VIII	Speed of movement (min.)	2.63	.108	-1.61	102	.110	-.80	.49
	HR min (pulse/min.)	.86	.354	-3.80	102	.000	-5.41	1.42
	HR max (pulse/min.)	4.31	.040	-3.39	102	.001	-4.81	1.41
	HR med (pulse/min.)	5.04	.027	-4.70	102	.000	-4.90	1.04

F-test of equality of variances, t- value of Student test, df- degree of freedom, p – level of probability,
Xd - average of difference, SDd - standard deviation of difference, Levene's Test EV - Levene's Test for Equality of Variances,
t-test EM - t-test for Equality of Means

The results of our study fill in the results of previous studies which evidence the fact that using the slacklines can contribute at the education of the dynamic balance and has important influence on the effort ability. For the Vth-VIth grades, the results of the study can underline significant differences between boys and girls , favoring the boys in what concerns the speed of movement in the dynamic balance on the slackline.

On the other hand, the perception of the effort by the participant did not show significant differences in terms of heart rate values variation between boys and girls. We consider that this phenomenon is due to the desire to succeed and to the challenge and, perceiving the danger and other physical and functional exciting factors were controlled by the subjects. As a result of the process that implies growing and motor and somatic development, the results for the VIIth-VIIIth grades show that between boys and girls , significant differences can be seen only at the functional parameters whereas , at the speed of movement on the slackline, both boys and girls registered comparably equal results.

We consider that the dynamic balance level for the two groups of boys and girls were comparably equal , but the effort felt during walking on the slackline was bigger for the girls probably because of the neuron-psychic stress.

Numerous studies that speak about slackline usage proved the efficiency of training on the slackline in terms of educating the static and dynamic balance that try to keep track of the following: the investigation of neuronal and muscular correlation of learning a balance task [22-24], the improvement of posture in sport [25-28], the improvement of psycho-motor ability and of several sports skills in case of balance conditions [29-31].

A series of studies followed the effects of using slackline exercises for patients included in a physiotherapy process and a functional rehabilitation for improving the balance, the motor control and the posture for physical fitness [32-34]. Using interdisciplinary knowledge from the plastic science, together with physics, medicine, physical education and sport information, facilitates the creation of performing equipment, adapted to the participants' motor and somatic particularities in order to optimize health and the human motor potential [35-37].

Conclusions

Analyzing the speed of movement on the slackline, both groups of boys from both ages registered higher values than the girls' groups, concluding that the boys are faster than the girls. Although from a statistic point of view, significant values were registered only when the boys from the VIIth-VIIIth grades walked on the slackline comparing with the girls of the same age.

In terms of effort capacity, the girls perceive the effort through heart rate variations higher than of the boys' from the Vth-VIth grades. Our study have shown insignificant statistic differences between boys and girls from the VIIth-VIIIth grades regarding the effort perception through heart rate variations.

The study's results underline the fact that the boys have a higher dynamic balance compared with the girls from the Vth-VIth grades (age 10-12) and equal for the VIIth-VIIIth grades (age 13 -15) when walking on the slackline.

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