SHOULD INJURY PREVENTION STRATEGIES BE INTRODUCED INTO PHYSICAL EDUCATION LESSONS AT SCHOOL?

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ABSTRACT

Asymmetries in muscle strength exceeding 15% between the two lower-limbs are considered potential causative factors of injury. The objective of the study was to determine the percentages of strength asymmetry between the lower-limbs of school children and investigate whether values >15% correlated with performance in speed drills. The sample was composed of N=138 students (72 M and 66 F, 12.0±1.1 yrs; 52.4±11.1 Kg, 159±0.08 cm) attending the first 3 years of an Italian middle school. Lower-limb strength asymmetries were assessed using the tests: One-Leg Hop (OLH), One-Leg Triple Hop (OLTH) and Side Hop (SH); running speed was assessed using the tests: 10 and 20m sprint, 10x5m Shuttle Sprint and 4.115m Side Steps and Forward (4.115m SSF). To test for correlations between lower-limb asymmetries and running speed performance, Pearson's correlations were calculated. Statistical significance was considered for $p<0.05$. Performances in the OLTH test revealed that an astonishing 65% of male school children present levels of asymmetry >15%. Pearson's correlations revealed that values of asymmetry >15% in the OLH and OLTH tests positively correlate with performance in the shuttle test ($r=0.452$, $N=23$; $p<0.05$) and 4.115m SSF test (performed on the right leg; $r=0.706$, $N=25$; $p<0.01$). Thus, running drills requiring lateral movements and changes in direction are affected by imbalances in lower-limb muscle strength in children and adolescents. Compensation strategies aimed at diminishing the percentage of strength asymmetry should be introduced into physical education lessons within schools in order to reduce the risk for injury.

Key words: Strength asymmetry, Injury Prevention, School, Children

INTRODUCTION

Children and adolescents spend of time of day at school[1]. Sinclair and Xiang [2] maintain that, after the home, school is the where most injuries occur, because children are exposed to a number of situations that have the potential to present risks: the classroom, the playground and in the school gym during hours of physical education. Kelm et al.[3] show that 5% of students suffer injuries during the performance of sporting activities at school every year; Sosnowska & Kostka[4] as well as Benamghar et al.[5] report that the percentage of injuries reported in schools occurring as the result of sporting accidents is between 33% and 41% for all age, and that the percentage of injuries increases in relation to age, standing at 34% for 12 year olds and reaching 60% for 15 year olds[6]. The degree of seriousness of an injury and incomplete recovery affect when a child is able to return to practicing sporting activities at school, and this is to the disadvantage of the child on both the short-, medium- and long-term[7]. Functional asymmetries in muscle strength, determined by strength deficits between the two limbs, exceeding 15% between the two lower- are considered potential causative factors of injury[8,9]

Objectives: The objective of the present study was to determine the percentages of strength asymmetry between the lower-limbs of school children and investigate whether values >15% correlate with performance in speed drills.

Materials and methods: The sample was composed of N=138 students (72 M and 66 F, 12.0±1.1 yrs; 52.4±11.1 Kg, 159±0.08 cm) attending the first 3 years of an Italian middle school. Lower-limb strength asymmetries were assessed using the following tests: One-Leg Hop (OLH), One-Leg Triple Hop (OLTH)[8] and Side Hop (SH)[10]. Before performing the tests, the dominant lower-limb was established by asking each student to kick a ball[11]. As indicated in the literature[8], the tests which assessed each leg individually started with the dominant limb. Performance in speed drills was assessed using the following tests: the 10 and 20m Sprint test[12,13], the 10x5m Shuttle Sprint test [14] and the 4.115m Side Steps and Forward test (4.115m SSF)[15].

To calculate the percentage of strength asymmetry between the dominant (D) and the non dominant (ND) leg, the following formula was applied: 1-(ND*100/D)[16]. To investigate whether the percentage of asymmetry measured in the hop tests was correlated with performances in the tests of running speed (10 and 20m sprint tests), the 10x5m Shuttle Sprint test and the 4.115m SSF test, Pearson's correlations were calculated, subdividing the data according to values of asymmetry that were either less or greater than 15%. Values of asymmetry greater than 15% are considered to be significant [8,9] and, therefore, possible causative factors of injury; while values less than 15% were considered by the same Authors as acceptable levels of asymmetry in lower-limb strength. Statistical significance was considered for $p<0.05$.

RESULTS

From the results of the asymmetry formula applied to the OLH, OLTH and SH tests, it emerges that 64.96% of males present values >15% (indicated as a possible causative factor of injury) in the OLTH test.

In relation to the OLH test (table 1), Pearson's correlations for values of asymmetry less than 15% show a negative correlation with performance in the 4.115-m Side Steps and Forward test for the left leg ($r=-0,193$, $N=115$; $p<0.05$), while values of asymmetry greater than 15% are correlated with performance in the 10x5m Shuttle Sprint Test ($r=0,452$, $N=23$; $p<0.05$).

In relation to the OLTH test (table 2), Pearson's correlations for values of asymmetry less than 15% are correlated with performance in the 4.115m Side Steps and Forward test for the right leg ($r=0,706$, $N=25$; $p<0.01$).

Finally, in relation to the SH test, no significant correlations emerge between values of asymmetry greater or less than 15% and performance in any of the other tests.

Table 1 Pearson's correlations for OLH performance and values of asymmetry less and greater than15%

Variable	1	2	3	4	5	6	7
1	1	0.038	-0.099	-0.165	-0.164	-0.193(*)	-0.108
2	0.038	1	0.358	0.330	0.169	0.179	0.452
3	-0.099	0.358	1	0.898	0.324	0.224	0.291
4	-0.165	0.330	0.898	1	0.287	0.236	0.194
5	-0.164	0.169	0.324	0.287	1	0.729	0.310
6	-0.193	0.179	0.224	0.236	0.729	1	-0.092
7	-0.108	0.452(*)	0.291	0.194	0.310	-0.092	1

1=OLH % asymmetry <15%; 2=10x5m Shuttle Sprint Test; 3=10 m sprint; 4=20 m sprint; 5=4.115m SSF right leg; 6=4.115m SSF left leg; 7=OLH % asymmetry >15%; *=p<0.05;

Table 2 Pearson's correlations for OLTH performance and values of asymmetry less and greater than 15%

Variable	1	2	3	4	5	6	7
1	1	0.123	-0.001	0.129	-0.094	-0.211	0.089
2	-0.179	0.126	0.070	0.133	-0.026	0.161	0.069
3	-0.074	0.214	0.016	0.017	0.011	0.172	0.109
4	-0.064	0.146	-0.063	-0.050	-0.008	0.112	0.067
5	-0.056	0.138	-0.114	-0.048	-0.037	0.093	0.013
6	-0.017	0.130	0.231	0.239	0.186	0.245	0.018
7	0.089	0.288	0.305	0.275	0.706(**)	0.283	1

1=OLTH % asymmetry <15%; 2=10x5m Shuttle Sprint Test; 3=10 m sprint; 4=20 m sprint; 5=4.115m SSF right leg; 6=4.115m SSF left leg; 7=OLTH % asymmetry >15% **=p<0.01

DISCUSSION AND CONCLUSIONS

The prime objective of the study was to investigate the presence of strength asymmetries in the lower-limbs and to determine the percentage of such asymmetries. From the results of the asymmetry formula applied to the triple hop test, we can see that the proportion of male students with asymmetries > 15% is 64.96%, while the statistic for the female students remains relatively limited at 12.42%.

These results are not in line with those of other studies present in the literature, which show greater percentages of asymmetry in females due to the considerable physical and physiological differences between males and females[17, 18] and in the use of stored elastic energy[19]. As regards the results of the influence of the percentage of asymmetry on performances that involve the speed capacity, the correlations suggest that performances in the 4.115-m 4.115m SSF test and the Shuttle Sprint test (involving changes in direction), both of which require the execution of lateral movements, are negatively affected (in both sexes) by imbalances in muscle strength between the lower limbs. In the case of the 10x5m Shuttle Sprint test, this result can be interpreted considering the fact that performing a change in direction requires the subject to make a lateral jump in order to invert the running direction.

The characteristics of the musculoskeletal apparatus of children and adolescents call for the need for teachers/coaches responsible for sport, both scholastic and extra-scholastic, to place greater importance on injury management. Indeed, the anatomical, physiological and neuromuscular characteristics of school children and the age-dependent development of certain motor capacities necessitate the development of effective prevention strategies. Compensation strategies aimed at diminishing the percentage of strength asymmetry should be introduced into physical education lessons within schools in order to reduce the risk for injury.

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