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Short-term Intervention Effects of Dual-task Training on Injury and Disability Rates in Young Soccer Players

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Abstract

Background: In soccer performance, coordination training is important and there is a high chance of injury due to improper concentration during a performance, but there is little research on the relationship with injury. The aim of this study was to assess the effect of dual-task training on young soccer players' attention distribution ability, physical function and performance, and occurrence of injury.

Methods: The subjects were 70 soccer players as intervention group and 52 players were as control group (age of all subjects was 15.9 ± 0.8 years, the height was 168.8 ± 5.3 cm, and the body weight was 59.5 ± 6.2 kg). Agility t-test and an original dual-task agility t-test were measured as indicator of attention distribution ability. The history of subjects' injuries was interviewed, and a single-leg triple hop for the distance test and a single-leg standing test with closed eyes were measured as physical function. The dual-task training concluded 5 items and the intervention was performed in approximately 20 minutes one time and six times over 3 weeks at a frequency of twice weekly. The number of people with injuries in each group and each measurement value was compared in each group.

Results: The control group comprised 10 subjects with injuries before intervention and 7 after intervention, whereas the intervention group comprised 12 subjects with injuries before intervention and 3 after intervention. No significant differences were observed in any of the parameters after the intervention in either of the two groups.

Conclusion: Whether this difference was caused by the intervention remains unclear; however, it is possible that the training program in this study was effective for short-term injury prevention. The contents of evaluation and training menu should be reexamined in the future.

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Introduction

Coordination is important in sports performance, and its training should be executed during childhood and adolescence, along with an additional training [1], which not only improves sports performance but also provides physical education.

Nerve cells in the brain involved in intention are finite in number, and attention is mobilized to both tasks in a dual-task environment, whereby interference between tasks occurs (dual-task interference). It has been reported that the performance of each task or of both the tasks could be compromised by the dual-task interference [2]. Paradoxically, it is possible that the ability to pay appropriate attention to each task in a dual-task environment would lead to an improvement in performance, thereby improving the "attention distribution ability."

Coordination training was originally developed in East Germany as a cognitive and information system training method [3]. Various trainings programs to improve attention distribution ability under multiple-task conditions have been developed, and "dual-task training" is one of the widely known methods. There have been numerous studies on dual-task training, which cover the following: development in early childhood [3,4]; transference effect on the skill or technical aspects [5,6]; relevance to brain mechanisms [7,8]; and walking ability of the elderly not to fall, which has been a key topic, especially in Japan and other developed countries where the aging population is increasing [9-11]. Nevertheless, limited scientific verification is available, there are fewer studies targeting adolescents or young adults, and reports focusing on sports injury prevention are virtually nonexistent.

In particular, in sports, there is a high chance of injury due to improper concentration during a performance. Similarly, in soccer competitions, physical function and attention distribution skill is required, and the weather, field conditions, and ally and opponent movements should be considered. Moreover, the players must grasp the required information quickly and act promptly [12]. Some initiatives for coordination training in soccer have been reported [5]; however, most of them are concerned about the technical aspect of

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playing the game and the training ability, and little research is available on the relationship with injury.

We conducted short-term dual-task training in high school soccer players. This study aimed to compare the physical tests conducted before and after the intervention, in order to assess the effect of dual-task training on young soccer players' attention distribution ability, physical function and performance, and occurrence of injury.

Materials and Methods

In this study, a total of three measurements were conducted on 83 male soccer players at T high school in Japan. The subjects were divided into two groups, and there were provided usual training for one group and the dual-task training intervention added for the other one group. These two groups switched each other's training menu at the middle point, and then finally, 70 players with complete data were treated as the intervention group. Of the 13 players, 3 who dropped out were absent during one of the two measures, 10 had some kind of injury before the intervention that prevented them from participating in some measurements. From the first half group, the data of 52 subjects who did not undergo the dual-task training were extracted as the control group. The protocols and group definitions of this research were shown in figure 1. The mean ± standard deviation (SD) age of all subjects was 15.9 ± 0.8 years, the height was 168.8 ± 5.3 cm, and the body weight was 59.5 ± 6.2 kg.

In addition to the agility t-test developed by Sassi [13] (TT), an original dual-task agility t-test (DTT) was conducted as an indicator of attention distribution ability for the subject. The TT was measured as the time taken to run and return to the starting point while touching the cones, which were T shaped, 10 m long, and 10 m wide, placed at each point of the course. In the DTT, the subjects performed the same task by multiplying two numbers in their mind while running the course; single (5-9) and double (13-19) digits were used. The numbers were visually presented behind each of the left and right cone points on the course. The physical therapists interviewed the subjects about the history of their injuries; these were noted if they occurred during the study or within 3 months prior to the study. And the injuries in this study were defined by those the subjects should rest even a day. At the second and third measurements, any injuries that had occurred since the previous measurement were noted.

For the other measurement items, a single-leg triple hop for the distance test (Hamilton et al. [14]) was done on both legs as an evaluation of lower-limb muscle strength and jump performance. A single-leg standing test with closed eyes was done on both legs to assess balance. Each test was performed twice, and the best values were measured.

The subjects were informed about the purpose and details of this study beforehand, and the intervention and evaluation were conducted after their consent. As all the subjects were too young, the consent was obtained from their parents and the soccer club leader. This study was approved in advance by the Takasaki Health and Welfare University Ethics Review Committee (No. 2755). The following tasks were carried out for the dual-task training: (1) a man balances a small ball (turning front → turning back) on one leg in a standing position, (2) a man simultaneously throws two balls and catches both balls, (3) two men throw multiple balls at the same time and catch a ball at the same time, (4) running an obstacle course while holding a ball on a spoon, (5) lifting a soccer ball while doing a word game. The aforementioned trainings were devised after confirming that. they would be moderately difficult for healthy college students. The intervention was performed six times over 3 weeks at a frequency of twice weekly, and four items were selected from five types of training for one intervention and were collectively carried out as a training program of approximately 20 min each. The difficulty was increased at every instance so that the subjects would not find it easier.

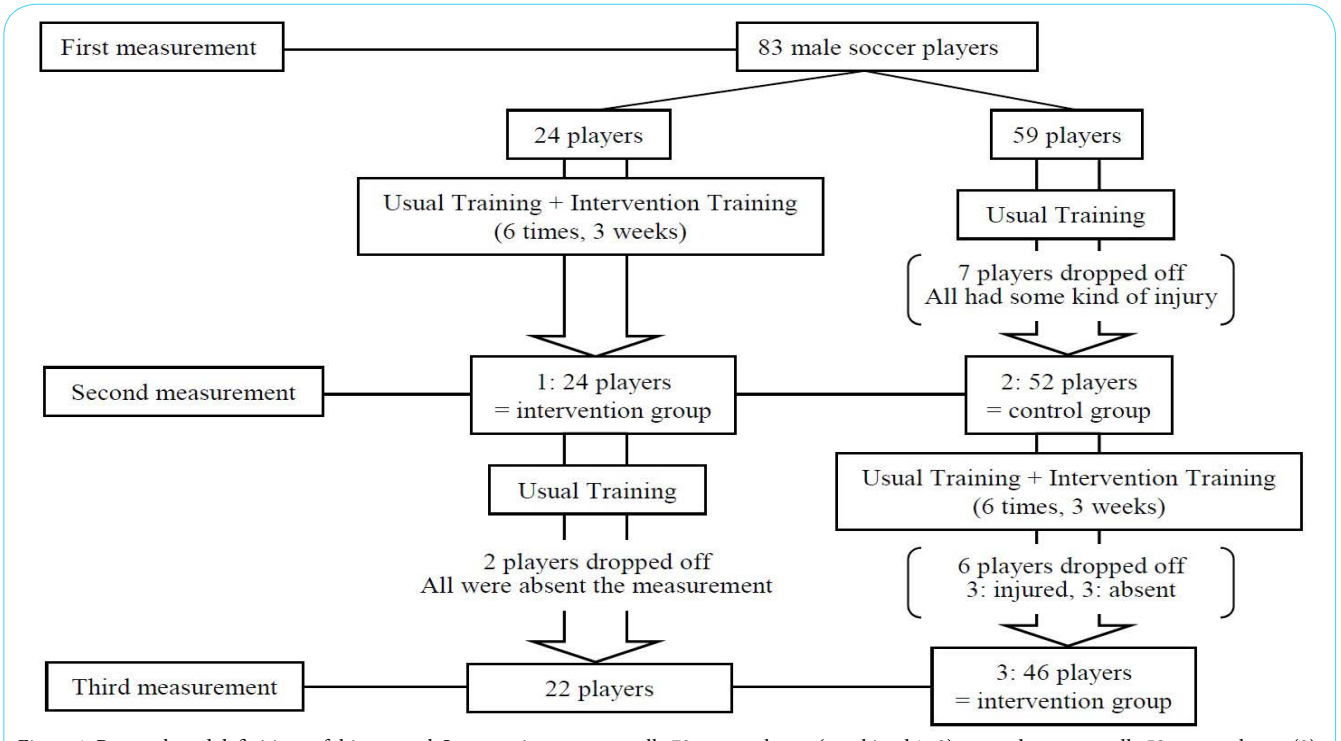

Figure 1. Protocols and definitions of this research Intervention group: totally 70 soccer players (combined 1+3), control group: totally 52 soccer players (2).

The number of people with injuries in each group was visually compared before and after the targeted period and each measurement value was compared using a corresponding Student´s t-test in each group. For statistical analyisis, Excel statistics Statcel, version 3, was used. The level of significance was set at 5%. Effect sizes are given as Hedges'g throughout.

Results

The control group comprised 10 subjects with injuries before the whole period and 7 after the period, whereas the intervention group comprised 12 subjects with injuries before intervention period and 3 after the period. No significant differences were observed in any of the parameters after the whole period in either of the two groups. Moreover, no difference was observed in the DTT targeted parameter of attention distribution ability (intervention group: TT 10.81 ± 0.57 s → 10.79 ± 0.53 s, DTT 11.48 ± 1.00 s → 11.69 ± 0.93 s). The results of the measurement are shown in Table 1.

Discussion

The number of injured subjects decreased in the intervention group compared with that of the control group. Whether this difference was caused by the intervention remains unclear; however, it is possible that the training program in this study was effective for short-term injury prevention. It has been reported that working memory training in a similar 1-2 month period might be beneficial for maintaining and improving the cognitive functioning in old age [15]. Additionally, some reports have shown the possibility of working memory performance being improved throughout the life span [16], and one report revealed the trainability of cognitive ability for athletes compared to nonathletes [17]. Whether this is equivalent for young people or athletes is doubtful and it needs to be discussed in the future. Furthermore, it has been reported by Gil et al. [19] that young volleyball players should dedicate at least 4 h weekly for their training to achieve a significant improvement in cognition. It would also be necessary for each sport to reorganize the training program as an effective intervention, taking into account the content, intensity, frequency, and the effect of continuing such training from a long-term perspective. In addition, in this study, physical function and performance did not change. Since, not only physical function and performance but also many environmental factors and other factors are concerned with regard to injuries, it is necessary to consider these factors as well.

In this study, DTT was measured as an indicator of attention distribution ability, but no change was observed. One of the factors for this could be the deviation between the content of evaluation and that of interventions. It was reported that an adequate cognitive task was required for enhance attention distribution ability [2], and it was also shown that under a balance task with a cognitive task, postural control appeared to take priority over cognitive processing [6]. Since the intervention in this study consisted of a lot of balance tasks, it could not be adequate for a cognitive task in this study.

Additionally, the DTT could not be a suitable assessment as the attention distribution ability in this study. A calculation task was used as the cognitive task in this study, which was moderately difficult for college students before the measurement, and it was possibly too difficult for some of the subjects. The test should be developed to have reasonable reliability and validity in both single- and dual- task methods, and it needed to show that the dual-task method might be an appropriate way to assess coordination in the targeted subjects. As a cognitive evaluation set, numerous methods of evaluation have been reported, mainly for walking function, in studies targeting the elderly [19]; however, there have been some evaluation methods reported in young subjects with posttraumatic brain injury [20]. Although there have been several reports on balance function and the evaluation method in the static motion [21], there have been almost no evaluation methods specialized for athletes and sports movements. Notably, a reexamination of an appropriate evaluation method needs to be discussed in the future.

Control group (n = 52)		Before		After		Analysis results		
		Ave	(SD)	Ave	(SD)	p -value	ES	95% CI
Agility t-test		11.12	(0.62)	10.81	(0.51)	0.336	-0.535	-0.92 to -0.14
Dual-task agility t-test		11.90	(1.02)	11.59	(1.00)	0.620	-0.306	-0.69 to 0.08
Single leg triple hop for distance	Rt	558.3	(53.3)	585.3	(53.0)	0.775	0.504	0.11 to 0.89
	Lt	558.4	(42.6)	588.9	(55.1)	0.334	0.615	0.22 to 1.01
Single-leg standing time with eye closed	Rt	23.3	(18.8)	23.8	(20.5)	0.445	0.022	-0.36 to 0.41
	Lt	29.6	(19.8)	28.0	(23.0)	0.357	-0.077	-0.46 to 0.31
Intervention group (n = 70)		Before		After		Analysis results		
		Ave	(SD)	Ave	(SD)	p -value	ES	95% CI
Agility t-test		10.81	(0.57)	10.79	(0.53)	0.853	-0.031	-0.36 to 0.30
Dual-task agility t-test		11.48	(1.00)	11.69	(0.93)	0.182	0.225	-0.11 to 0.56
Single leg triple hop for distance	Rt	598.3	(57.5)	588.3	(66.8)	0.342	-0.160	-0.49 to 0.17
	Lt	599.4	(53.0)	593.7	(59.7)	0.552	-0.100	-0.43 to 0.23
Single-leg standing time with eye closed	Rt	26.1	(20.4)	28.4	(20.7)	0.505	-0.112	-0.22 to 0.44
	Lt	31.8	(22.8)	32.8	(19.7)	0.764	0.505	- 0.28 to 0.38

Table 1: The results of measurements.

Rt: right, Lt: left, Ave: average, SD: standard deviation, ES: effect size (Hedges' g), CI: confidence interval

Competing Interests

The authors declare that they have no competing interests regarding the publication of this article.

Author Contributions

All authors made substantial contributions to the conception and design, acquisition of data. Keisuke Hamada and Kazumasa Nakagawa were mainly took charge of analysis and interpretation of data and Yuko Takahashi and Kazumasa Nakagawa were mainly involved in drafting the manuscript or revising it critically on important intellectual contents. Each author has participated sufficiently in the work to take public responsibility for appropriate portions of the contents.

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