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Research Article

Changes in Motor Skills with Short-Term Exercise Interventions in Japanese -9 and -10Year Olds

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Abstract

For a while now, the decline in motor skills among the children of Japan has been viewed as a problem. In particular, the motor skills of routinely inactive children are believed to be strikingly low. The adverse effects of insufficient exercise and inadequate lifestyle habits among children are not limited to the realm of exercise, but also appear in health aspects such as obesity and lifestyle diseases. Therefore, it can be inferred that initiatives to improve motor skills at school will contribute to improving the physical fitness of inactive children or those with low stamina. A short exercise program that can be quickly conducted during recess is especially easy to introduce at Japanese elementary schools, which are not flexible in terms of time. The present study used two different exercise programs (the Agility Ladder Program [ALP] and the Droutability Exercise Program [DEP]) to evaluate short-term changes in children's motor skills scores. Over an eight-week study period, two groups of healthy Japanese children, aged 9 to 10 years (Group 1 [ALP]: 27 participants; Group 2 [DEP]: 19 participants; total: 46 participants) engaged in different exercise programs for only four weeks. The programs were conducted during recess for approximately 10 minutes each time, on an average twice a week, for a total of eight times for both groups. These two programs used different exercises than those usually measured. Scores for repetitive side steps [RSS] and the standing long jump [SLJ] were measured before the programs and each week during the programs. Multiple comparisons were performed on the values, using the t-test, two-factor analysis of variance (ANOVA), and Bonferroni's method. After completion of the study, scores for RSS exhibited significant main effects only for the program period. In both groups, scores improved in the same manner immediately after beginning the programs, but were unstable after the completion. For SLJ scores, significant differences were observed between the groups and program periods. In both groups, significant simple main effects were observed for the program period. Furthermore, SLJ scores temporarily decreased in both groups directly after beginning the programs, after which scores exhibited differing variations and this trend continued after the programs' completion. These results demonstrated that RSS and SLJ scores exhibited different changes and that the appropriate program implementation period for effective short-time and short-term exercise programs is four weeks or longer. In conclusion, short-time programs of about 10 minutes, as used in this research, can effectively improve RSS and SLJ at elementary schools that are not flexible in their curricula or schedules.

Keywords: Motor Skills; Child; Short-Term; Exercise; Change; Program; Short-Time

Introduction

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan has implemented activities designed to improve children's motor skills. However, the results of the 2010 Nationwide Survey on Physical Fitness, Athletic Ability, and Exercise Habits indicated two distinct trends [1]: (1) improvement in physical fitness and athletic ability from involvement in local or school athletic clubs, and thus spending much time in physical activity; (2) declining physical fitness and athletic ability of children who rarely engage in exercise. Amid these conditions, the deterioration of agility (ability to move fast) and standing long jump [SLJ] (ability to jump far) is especially becoming a problem. Therefore, MEXT suggested focusing on improvement of physical fitness among children. Based on this report, schools are introducing initiatives to improve motor skills during recess and physical education classes through short-term programs and programs requiring short time interval, the efficacy of which has been reported.

Research related to the implementation period of such a program and the time necessary for improving motor skills was carried out by Nguyen, Obeid, and Timmons [2], who conducted a weeklong session with children ages 3–5 in which the short-term power output, heart rate response to a treadmill test, and 25-m dash completion times for healthy preschoolers were measured. They report that power output and 25-m dash completion times are reliable ways to measure fitness. Also, Baquet, Guinhouya, Dupont, Nourry, and Berthoin [3] analyzed the effects of a short-term interval training program conducted over a period of seven weeks and for a short time interval of 30 minutes per session on a group of children ages 8–11, who were divided into an experimental group and a control group. The results showed that the experimental group had a significantly greater improved SLJ and 20-meter shuttle run when compared to the control group. Kamijo, Pontifex, O'Leary, Scudder, Wu, Castelli and Hillman [4] divided children ages 7–9 into an experimental group and a control group then tested the effects of implementing a physical activity program that was conducted after school for a 150-day period. From the results, they report that physical activity training improves the working memory in the brains of prepubescent children and that routine physical activity which results in improved cardiopulmonary function helps shapes the cognitive development of children prior to puberty. As for research into the testing used to evaluate motor skills, Babin, Katić, Ropac and Bonacin [5] divided seven-year-olds into an experimental group, which underwent a special exercise program, and a control group, which underwent a standardized exercise program. The researchers then measured the children twice over the course of a nine-month period using a series of 12 different motor tests including repetitive side steps [RSS], bench balancing, ball throwing, and standing long jump. They report that when compared with the control group, the experimental group exhibited a considerable change. Furthermore, results indicated that the short-term and short-time program improved SLJ, running ability, such as the shuttle run, and RSS. These findings evaluate comparisons with experimental and control groups, along with testing reliable ways to measure fitness. However, these studies performed tests only pre- and post-intervention.

If it is possible to understand the progress in motor skills every week, from the program initiation, then we can possibly understand aspects, such as when the program's effects manifest, the length of time required for effectiveness, whether methods for improving different motor skills are the same, the extent of time interval for which motor skills can be maintained after the program, and when motor skills start to deteriorate after the program. In short, understanding how motor skills changes over time would be beneficial in developing effective exercise programs.

This study includes reports from MEXT on concerns over deterioration of motor skills and conducts research targeting Japanese children aged 9–10 years. The age range is same as in the research conducted by Baquet et al. [3] and Kamijo et al. [4], focusing on RSS, and on SLJ investigated by Babin et al. [5] and Baquet et al. [3]. The programs used in this research were conducted by Miyaguchi, Demura, Kaba, and Uzawa, [6], who reported correlations in running ability and motor skills improvements and by Yasumitsu and Nogawa [7] who reported on agility. These two short-term programs have different movements and have been conducted over approximately a month. Programs that can be conducted over a short time, such as recess, and a short-term of approximately a month have been introduced with ease into Japanese elementary schools that have no flexibility in curriculum and scheduling. These two different programs test both running ability and agility, but they do not test effects on ability to jump far. The ability to jump far - something which MEXT views as a problem - is important because it is also related to leg muscle strength. If these programs are effective in improving ability to jump far, it is possible to improve that, in addition to agility and running ability, thus enabling a highly effective program. The progress of RSS and SLJ test scores was evaluated using these two short-time and short-term programs.

This research considered standard that motor-skills tests advocated by MEXT are conducted at elementary schools all over Japan, along with RSS being performed as an ability to move fast test and SLJ being implemented as an ability to jump far test. This research uses the measured score of the RSS amount as an indicator of ability to move fast and the measured score of the SLJ distance as an indicator of ability to jump far.

Therefore, the present study focused on the RSS and SLJ of Japanese children aged 9–10 years, and implemented two types of short-time exercise programs to test short-term changes in

children's motor skills:

Hypothesis 1: Test scores for RSS and SLJ exhibit identical changes.

Hypothesis 2: Test scores for RSS and SLJ will both be maintained for only four weeks after the program ends.

Method

Participants

This research was requested by the Board of Education and the elementary school's principal. A total of 62 Japanese fourth-grade students were initially recruited for the study. Children aged 9–10 years, attending a public elementary school in Tokyo (Grade 4 [N = 62 children; Mean age = 9.21 years, SD = 0.41]) were divided into Group 1 (girls: 15; boys: 16) and Group 2 (girls: 15; boys: 16). Both Group 1 and Group 2 had identical numbers of boys and identical numbers of girls. This school is located in the heart of Tokyo school district, where the number of schoolchildren and the playground space is very limited. The fourth-grade students in this school were very inactive, with the lowest fitness level in this school district. Even though the Board of Education and the school principal had tried various programs to improve these children's activity levels, not much was achieved. Thus, the researchers were asked to administer this program specifically for these students. There are two fourth-grade classes in this elementary school. Each class is independent of the other, and they do not interact during class sessions and even during lunch break or recess.
Their mean height and body weight were standard, at 133.8 cm, 30.0 kg for girls (national average: 133.5 cm, 30.0 kg) and 134.1 cm, 29.8 kg for boys (national average: 133.5 cm, 30.5 kg). As far as exclusion criteria, nonattendance did occur due to factors such as illness, poor physical health, and school transfers during the study; only the data for participants who participated in all nine measurement sessions and all eight program sessions was used. For this reason, the number of boys in Group 1 decreased by 4, leaving it with a final total of 27 participants (girls: 15; boys: 12), while 6 girls and 6 boys were dropped from Group 2 resulting in a total of 19 participants (girls: 9; boys: 10). Between both the groups, the data for a total of 46 participants was used. Before implementing this study, meetings were held with the Board of Education and the elementary school principal about the safety measures and the research schedule for children. The principal obtained written consent from the parents/guardians of the children to participate in the study. The Ethics Committee of the School of Health and Sports Science, Juntendo University, approved this study.

Procedure

The eight-week study from May to July, 2011, was determined by considering the elementary school curriculum and class schedules. There was a request from the Board of Education and the elementary school's principal to conduct the programs for the two groups during this research. The view that everyone should be equal in Japanese elementary schools has become strong recently, so it is difficult to administer a program for one group and not the other. Therefore, the program was administered to both groups over the same term. Gabel, Obeid, Nguyen, Proudfoot, and Timmons [8] investigated muscle power, speed, and physical activity progress over a 15-month period for children aged 3–5 years; they were concerned with muscle power and speed, both also concerns of MEXT. They reported that muscle power and speed improved in children who engage in much physical activity. However, these programs compared children's motor skills only before and after the program, rather than documenting changes across different time periods within the program. Participants in the two groups engaged in two different short-time programs, the agility ladder program [ALP] and the droutability exercise program [DEP] (Droutability is derived from the "Draw out ability" coordination exercise program devised by Yasumitsu), for four weeks. Post-intervention, RSS and SLJ scores were measured weekly for another four weeks after the exercise program ended, and changes in scores over the entire two months were compared. These were the outcome measures used across the duration of the program. The exercise programs were conducted on an average of twice a week and eight times for both groups. The exercise programs used the 20-min recess period (10:25–10:45 a.m.), and each instruction period lasted for approximately 10 min.

The study began on May, with Group 1 engaging in the ALP and Group 2 engaging in the DEP. Before the initiation of the programs on May and each subsequent week until the study completion date of July, RSS and SLJ scores were measured nine times over the eight weeks, and motor skills measurement values were tested. A t-test was used to examine the RSS and SLJ scores measured before the initiation of the programs on May, to determine whether the two groups' distribution was identical. Results were t (44) = .96, ns for RSS and t (44) = .46, ns for SLJ, indicating identical distribution; no significant differences were noted.

Design of the Intervention Program

For the Group 1 ALP, researchers used the same program as reported by Miyaguchi et al. [6]. This program correlates with running ability and motor skills improvement. Two approximately 4 m ladders with nine squares (41 × 41 cm) were placed parallel (Figure. 1). This activity involved choosing two activities during study period—quick run, lateral run, open and closed jump, and two-leg zigzag step. The instructor chose two of the four. For each activity, participants were instructed to place their legs clearly in the area between the ladder's

rungs (squares) and not step on the ladder while moving their bodies as quickly as possible. For the quick run, participants ran over the ladder as fast as they could. For the lateral run, participants were instructed to stand inside a square, face the ladder's right or left side, and run sideways over the ladder. For the open and closed jump, participants repeatedly jumped into each square along the ladder, advancing one square at a time while alternately opening and closing both legs. For the two-leg zigzag step involves the child stepping with both feet simultaneously in left and right directions. The right foot is outside the square, and the left foot is inside the square when stepping to the front-right diagonally; the left foot is outside the square, and the right foot is inside the square when stepping to the front-left diagonally. The child moves one square forward at a time while doing this movement. The 27 participants in Group 1 were further divided into Group A (n = 14) and Group B (n = 13). One ladder was used by Group A, while the other was used by Group B. First, the instructor gave the participants a demonstration and then blew a whistle for the children to begin the activity.

Figure 1. Agility ladder program (ALP).

For the Group 2 DEP, researchers used the same program on agility used by Yasumitsu and Nogawa [7], with cross plates (24 × 24 cm) and numbered disks (diameter: 15 cm), on which numbers 1–9 were written in different colors (Figure. 2). Ten cross plates and six sets of numbered disks (total: 54) were randomly placed over half of a gymnasium floor (15 × 15 m). When the intervention activity began, students ran to a cross-plate of their choice and stepped back and forth over the cross-plate as quickly as possible without touching the plate. Next, the students were instructed to reach a disk with a specific color or number. For example, if the color was "red," the students moved to the nearest red disk, touched it with a foot, and then quickly returned to their original cross-plate to resume the stepping action. During the 30 s of the program, the students continuously moved around in all directions in search of a disk with the designated colors or numbers and repeated the activity in response to the instructions. The students were asked to move as swiftly as possible while avoiding collision with their classmates. The students participated in three sets of the 30-s intervention activity. The 19 participants in Group 2 were further divided into Group A (n = 10) and Group B (n = 9). A 1-min. set (play: 30 s; rest: 30 s) was conducted with Group A playing, while Group B rested, and vice versa. Three sets were conducted each time, with Groups A and B alternately playing and resting for 30 s.

Figure 2. Droutability exercise program (DEP).

Measurements

In Japan, the new MEXT physical fitness guidelines for children aged 6–11 years are generally used to test their motor skills. The introduction of this new physical abilities test, based on a 1999 survey of exercise performance and physical ability, represents an overhaul of the previous tests and was formulated to be more suitable to present populations. It is based on such elements as physical changes in the population, developments in sports medicine and science, and the progress of the aging population [1]. The items implemented for 6- to 11-year-old male and female children include the following: grip, upper-body raise, seated hamstring stretch, repetitive side steps, 20-m shuttle run (back and forth endurance running), 50-m run, standing long jump, and softball throw. Accordingly, agility was measured by the RSS test, and ability to jump far was measured by the SLJ. These tests are also included in the California Physical Performance Test [9], which comprises the following six items: standing long jump, one-minute sit-ups with elevated legs, side steps, decline pushup, pull-ups, and 6-minute run/walk. For the RSS, a centerline was drawn along the floor, and 100 cm from it, a parallel line was drawn on either side of the centerline, forming two areas in which to perform repetitive side steps (Figure. 3) and the standing long jump (Figure. 4). For the RSS, participants were instructed to stand astride the centerline and, when they heard the

whistle, to sidestep over or onto the line to the right without jumping. They then returned to the centerline and sidestepped over or onto the line to the left. This exercise was repeated for 20 seconds, with 1 point awarded when they passed over each line (4 points by stepping right, center, left, center). They were instructed to perform as many steps as possible in 20 s. In accordance with the MEXT guidelines, participants formed pairs, and 4–7 participants were measured at each site so that 8–14 participants were measured simultaneously. Participants counted each other's scores, measuring each other twice each time. For the SLJ, two instructors and assistants stood at each line and called each participant in order, before conducting measurements twice for every participant. Participants placed their feet slightly apart, lined up their toes with the front edge of the start line, and jumped forward with both feet at the same time. A straight line was measured from the center of both feet before jumping (front edge of the start line) to the spot where, upon landing, the participant's body (e.g., foot, hand, or bottom) touched the floor closest to the start line. Measurements were approximated to the nearest centimeter. The researchers recorded the results on score sheets, in accordance with MEXT guidelines. These two tests (RSS and SLJ) were measured prior to the exercise programs and each subsequent week, for nine total measurements. Both Groups 1 and 2 underwent both tests on the same day. The highest scores of the two measured for each child were recorded.

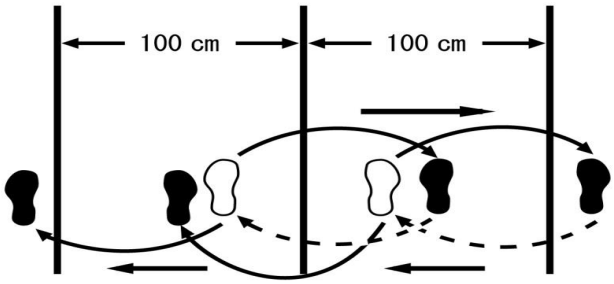

Figure 3. Movement direction and pattern of repetitive side steps (RSS).
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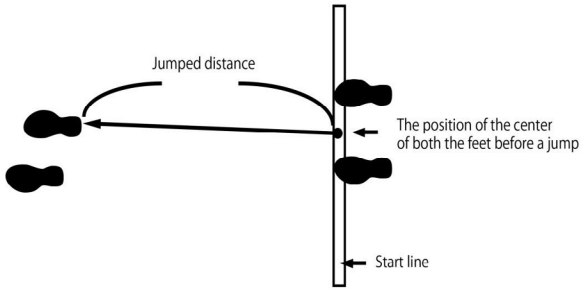

Figure 4. Starting position and measuring method of the standing long jump (SLJ).
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Data Analysis

Using the statistical analysis software, IBM SPSS Statistics 21, the RSS and SLJ were measured each week, with multiple comparisons performed on the values, using the t-test, two-factor analysis of variance (ANOVA), and Bonferroni's method. Significance was set at $p < .05$.

Results

Two-factor ANOVA of RSS scores indicated no significant differences between groups and program period ($F(8,352) = 1.78$, $p < .08$, $\eta 2 = 0.04$). A significant main effect was observed only for the program period ($F(8,352) = 22.00$, $p < .01$, $\eta 2 = 0.33$), indicating that the scores differed significantly across the nine measurement periods. Multiple comparisons indicated the highest value in post-intervention week two, followed by post-intervention week four. Cronbach's alpha for RSS was .950. These results indicate that in both groups, RSS scores rose in the same manner directly after the programs' beginning, but scores were unstable after the program's completion (Table 1).

Table 1. Changes in score (points) for RSS with short-time exercise programs.

Measurement	Group 1 ALP		Group 2 DEP	
week	M	SD	M	SD
Pre	36.00	2.84	35.00	4.26
1	37.22	3.67	38.85	5.38
2	38.26	3.61	39.00	4.22
3	39.52	4.52	40.11	4.82
4	39.56	4.62	**41.95**	4.66
Post 1	40.37	5.16	40.74	4.58
2	**41.15**	5.23	**41.37**	5.16
3	39.85	4.80	39.42	7.23
4	**41.56**	5.93	**40.79**	4.21

Note: ALP = agility ladder program; DEP = droutability exercise program.

Because the results of multiple comparisons with two-way ANOVA and Bonferroni's method for SLJ scores indicated significant differences for groups and program period, simple main effects of each factor were investigated ($F(8,352) = 2.70$, $p < .01$, $\eta 2 = 0.06$). Both groups exhibited significant simple main effects for the program period ($F(8,352) = 10.85$, $p < .01$, $\eta 2 = 0.20$). Moreover, significant simple main effects were found for both groups in post-intervention weeks three and four. Multiple comparison testing found that the highest value was exhibited in post-intervention week two, followed by post-interven-

tion week one. For Group 2, the highest value was exhibited in post-intervention week four, followed by post-intervention week two. When the groups were compared, the Group 2 SLJ scores were significantly higher in post-intervention weeks three and four. Cronbach's alpha for SLJ was .947. These results indicated that for both groups, SLJ scores dropped temporarily, immediately after the program began, but subsequently exhibited different changes. Results also suggested that scores changed differently in the groups post-intervention (Table 2). These results indicated that scores for RSS and SLJ exhibited different changes over time in the two groups.

Table 2. Changes in score (cm) for SLJ with short-time exercise programs.

Measurement	Group 1 ALP		Group 2 DEP	
week	M	SD	M	SD
Pre	140.33	13.11	138.37	15.60
1	133.33	13.76	137.26	13.57
2	135.67	13.15	137.21	12.26
3	141.70	15.75	143.95	14.86
4	141.63	14.29	145.79	12.41
Post 1	**143.07**	14.32	147.79	13.94
2	**146.41**	13.63	**148.11**	18.89
3	136.74	12.38	**147.63***	19.14
4	139.26	11.99	**148.84***	13.99

Note: The Group 2 SLJ scores were significantly higher in post-intervention weeks three and four. ALP = agility ladder program; DEP = droutability exercise program

*p < .05 .

Hypothesis 1, "Test scores for RSS and SLJ exhibit identical changes." was not supported. Hypothesis 2, "Test scores for RSS and SLJ will both be maintained for only four weeks after the program ends" was not supported.

Discussion

Many previous studies offering proposals to improve motor skills in children outline the content of an exercise program and its effects expressed as the difference between outcome measures taken before and after the program. Zahner, Puder, Roth, Schmid, Guldimann, Pühse, Knöpfli, Braun-Fahrländer, Marti, and Kriemler [10] examined the results of physical activity program intervention in a school's physical education class over a 6-month period, dividing children aged 6–13 years into experimental and control groups. The results showed that the experimental group had a significantly improved 20-meter shuttle run when compared with the control group. Nettlefold, Mckay, Warburton, McGuire, Bredin, and Naylor [11] measured the amount of physical activity of children ages 8–11years during recess and physical education classes. They reported that the amount of physical activity is high in boys, but low in girls and further argued that intervening in exercise programs is necessary. These reports indicated that the introduction of exercise programs during physical education class or recess increases physical activity. This leads to improvement of motor skills, that is, interventions are thus necessary. However, time interval required for improvement in motor skills after intervention has not been determined. Recently, in particular, short-time programs and programs conducted over short periods of approximately one month have attracted attention because of their perceived convenience [12]. Miyaguchi et al. [6] conducted the ALP over one month, with children aged 4–5 years and tested the correlation between the ALP and running ability. The results showed correlation between the short-term ALP and running ability, as well as motor skills improvement. In research on short-term programs, Yasumitsu and Nogawa [7] executed the DEP for approximately 10 minutes per session, during recess over the research period of 26 days, dividing children aged 7–8 years into experimental and control groups. They tested the effects of short-time programs on the improvement of test scores in RSS used as an indicator of agility. The results showed that the experimental group had significantly improved test scores when compared to the control group. Many of these studies have conducted investigations before and after an exercise program, but have not examined changes in motor skills during the program. The present study clarified that for both RSS and SLJ, motor skills test scores of children who engaged in the programs exhibited different changes over time, but improved significantly. A report by Yasumitsu and Nogawa [7] compared an experimental group that engaged in an exercise program and a control group that engaged in individual activities such as soccer and tag; they found that motor skills test scores improved more in the experimental group. This also suggested that providing instruction for such programs, for instance, during recess, could effectively improve children's motor skills. We know that motor-skill interventions effectively improve children's fundamental movement skills [13]. Kamijo et al. [4] also reported that implementing exercise programs led to improved fitness and overall health.

The present study used two types of short-time exercise programs and tested short-term changes over time in children's motor skills test scores. Results indicated that for RSS, scores improved in both groups in the program's first week and continued to improve until the fourth week. However, after the programs, changes were observed in both groups' scores, and the improvements were not maintained consistently for the next four weeks. For SLJ, Group 1 scores decreased greatly after beginning the program, but in the third week, recovered to nearly the same level as pre-intervention. Scores then improved until post-intervention week two, but subsequently decreased. Group 2 scores presented an interesting result, level-

ing off until the program's second week, and then continuously improving from post-intervention weeks three to four. These results indicated that short-time exercise programs affected children's motor skills immediately after beginning the program and that motor skills test scores for RSS and SLJ exhibited different changes over time, since RSS scores improved; however, SLJ scores decreased in the second week of post-intervention. In the results, SLJ scores were observed to decline or else stay the same during the first two weeks that the ALP and DEP programs (whose goal is to improve SLJ) were implemented, but these scores showed improvement starting in the third week, implying that SLJ can be improved by carrying out the programs for at least four weeks. Although neither program used in this study to increase agility and running ability actually included movements similar to SLJ, the results suggested that they are effective in improving the ability to jump far.

Previous studies of changes in children's motor skills over time include that by Pišot, Šimunič, Šarabon, Jelovčan, and Plevnik [14], who determined and analyzed the presence of selected fundamental motor patterns in 107 healthy Slovenian children aged 4–6 years. Beginning at age 4, the children were longitudinally monitored throughout three test sessions in 2009, 2010, and 2011. Ikeda and Aoyagi [15] investigated kindergarten children, conducting measurements and analyzing results twice each year, at 6-month intervals, from 2006 to 2007. Kasuga, Nakano, and Murase [16] conducted measurements intermittently over three years on participants from their junior to senior year of kindergarten (aged 4–6 years). Krasilshchikov and Kerian [17] conducted a 12-week intervention study with 10-year-old children; they measured physical fitness before the study, in the study's sixth week, and in the last week. If the short-term weekly changes in motor skills such as those tested in this study can be made clear together with the characteristics of yearly and monthly changes in children's motor skills provided by prior research, it will be possible to organize an effective time frame and content for the program that match the specifics of motor skill improvement, and the efficient study of a large number of exercises and physical movements becomes possible. In addition, designing both short-term and long-term programs becomes simple. Motor skills show improvement during the period of time that the programs are being implemented, as was made apparent by this study as well as past research. However, the decline or instability in motor skills during the four weeks that the programs were not being conducted in this study further implies that continual exercise programs for children are essential, as are a large number of different types of movement and the amount of activity.

However, there are major limitations. Of the many programs proposed for improving children's motor skills, researchers tested only the ALP and the DEP. Furthermore, the sample size was small, and only children aged 9–10 years were targeted. The control group could not be set and was requested by the Board of Education and the elementary school's principal. The study period was only eight weeks because researchers had to adjust it to meet the busy schedule of elementary schools; the exercise programs were actually conducted for only four weeks. Muscle and neural factors could not be tested. There were also only two measurement items—RSS and SLJ—indicating that other motor skills factors require testing.

Conclusion

According to this research, RSS results for the ALP indicated high scores in post-intervention weeks two and four; for the DEP, the highest scores were observed in the program's fourth week. Furthermore, SLJ results for the ALP indicated that the highest scores came in post-intervention week two; for the DEP, post-intervention week one scores were the highest, and hardly any change was subsequently observed until post-intervention week four. These results demonstrated that RSS and SLJ scores exhibited different changes and that the appropriate program implementation period for effective short-time and short-term exercise programs is four weeks or longer. In turn, this suggested that for the two short programs conducted in this study, lengths of four to six weeks might be useful for improving motor skills. In conclusion, short-time programs of about 10 minutes used in this research can effectively improve RSS and SLJ in elementary schools that are not flexible in their curricula or schedules.

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