Effect of Soccer Games on Gross Motor Development in Preschoolers

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Abstract: This study investigated the effects of playing soccer on the quality of gross motor skills in preschoolers. A 2-group, pretest-posttest design was adopted, comprising both an experimental and a control group. The participants were recruited from 2 public kindergartens located in New Taipei City, Taiwan. The approval of the legal representatives of the 101 preschoolers enrolled in these kindergartens and aged between 4 years and 6 years and 11 months was obtained, and purposive grouping was subsequently conducted. The experimental group comprised 44 participants from the first kindergarten, whereas the control group comprised 43 participants from the second kindergarten. After the recruitment, the experimental group received a soccer program intervention: a 10-week soccer program with two 40-minute sessions per week. Before and after the experiment, the gross motor quality of both groups was measured using the Preschooler Gross Motor Quality Scale, which covers tests for locomotion, object manipulation, and balance. The results of the 10-week intervention showed significantly higher scores for locomotion, object manipulation, balance, and overall gross motor quality in the experimental group than in the control group. This study confirmed that a 10-week soccer program is beneficial for gross motor development in preschoolers. The research results can serve as a reference for gross motor development in preschool education.

Key words: Preschooler, soccer game, gross motor skills.

1. Introduction

Numerous previous studies on gross motor skills in children have mostly focused on schoolchildren, establishing the quantitative relationship between physical motion and motor skills [1-3]. However, previous studies have overlooked gross motor quality in preschoolers. Developing gross motor skills greatly influences child health and fitness. At the preschool stage, children should learn exercise skills that enhance long-term health. When children are unfit at the preschool stage, their motor skill quality, muscle strength, and endurance are affected as well as their activity and attention levels are unfavorable because of

insufficient environmental stimuli and a lack of successful experiences [4]. The fundamental movement skills of 2-7 year-old children are classified as balance, locomotion, and object manipulation skills [5]. Related studies have determined that engaging in additional moderately to highly intense physical activity or undergoing motor skills training significantly enhanced the motor skill performance of preschoolers, particularly regarding locomotion and object manipulation skills [6, 7]. Moreover, physical balance is a prerequisite skill for locomotion and object manipulation [8]. Multiple studies have indicated that structured exercise enhances motor development in preschoolers [9-11].

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Whether motor skills in children are adequately developed until maturation reflects the completeness of

the children's individual brain development. Child motor skills develop at stages that correspond with their ages. Specific milestones at every stage mark different levels of motor maturation. An objective, standardized motor evaluation instrument facilitates determining whether a child's gross motor development corresponds to the motor performance that should be demonstrated at his or her age [12]. According to evaluation standards and test content, current evaluation instruments of child motor skills are divided into quantitative and qualitative models. Quantitative evaluation assesses whether goals were achieved or uses statistical records to determine child motor skills. The results are generally based on a specific performance demonstrated during the evaluation. By contrast, qualitative evaluation is based on a set of criteria established for motor skills and involves observing how children perform motor skills and whether their motor quality levels satisfy predetermined conditions, thereby identifying the developmental level of the child's nerves and motor skills. The results serve as a key early indicator for diagnosing child development disorders [13].

Soccer is a popular sport worldwide as well as an alternative means of exercise for improving the health condition of overweight children [14]. After receiving soccer skills training, children exhibit motor coordination skills that are superior to those of ordinary children and other exercisers [15-17]. Previous studies have shown that playing soccer is a gross motor activity suitable for improving motor development in children. Most previous studies examining the effects of soccer games on motor development have focused on schoolchildren or teenagers. Few studies have investigated playing soccer as an intervention for preschoolers. Therefore, this study aimed to explore the effects of soccer game training on the quality of gross motor skills in preschoolers. The results are expected to serve as a reference for kindergartens promoting future soccer training for preschoolers.

2. Methods

2.1 Design and Participants

This study adopted a 2-group, pretest-posttest design. The research participants were preschoolers recruited from two public kindergartens located in New Taipei City, Taiwan. The inclusion criteria were (a) children aged between 4 years and 6 years and 11 months and (b) those whose legal representative signed a consent form. The participants were subsequently divided into experimental and control groups through purposive grouping. In addition, the exclusion criteria were (1) visual impairment or severe lower limb disorders; (2) osteogenesis imperfecta; or (3) a medical condition such as hypertension, cardiovascular disease, heart disease, epilepsy, or asthma that prevented participation in intense exercise or a medical surgery such as cardiovascular or brain surgeries.

A total of 101 participants were recruited. The experimental group lost seven participants (four participants did not complete the 10-week soccer program, and three participants did not take the posttest). The control group also lost seven participants (four participants were unable to take the pretest, and three participants did not take the posttest). Eighty-seven participants completed both the pretest and the posttest, comprising valid samples; there were 44 valid samples in the experimental group and 43 valid samples in the control group. The experimental group received a 10-week soccer game intervention with two 40-minute sessions per week; each session included a 30-minute soccer game and a 10-minute warmup and cooldown. The control group continued to participate in static classroom activities.

3. Research Instruments

The research instruments adopted in this study were a Preschooler Gross Motor Quality Scale (PGMQS) and a 10-week soccer game intervention.

3.1 Preschooler Gross Motor Quality Scale

This study adopted the Preschooler Gross Motor Quality Scale (PGMQS) and the scale was developed by Sun et al. [13] through a literature review. Gross motor development in preschoolers was evaluated according to three major motor functions: locomotion, object manipulation, and balance. This scale exhibited satisfactory construct validity and internal consistency (Cronbach's $\alpha = 0.87$). The correlation coefficients between the PGMQS and the Peabody Developmental Motor Scales, Second Edition indicated moderate to high positive correlation ($r = 0.61-0.83$, $P < 0.01$) [13]. The correlation coefficients between the PGMQS and the Test of Gross Motor Development, Second Edition showed that the locomotion ($r = 0.82$, $P < 0.01$) and object manipulation ($r = 0.76$, $P < 0.01$) dimensions of the two scales were highly correlated [18]. Therefore, the PGMQS exhibits satisfactory reliability and validity. For preschoolers in the fundamental movement phase, the dimensions evaluated in the PGMQS are complete, and the instructions are easy to understand. It is a standardized evaluation instrument with Taiwanese norms that evaluates the quality of gross motor skills of preschoolers. The PGMQS comprises three subscales. First, locomotion is assessed by eight items (41 points): descending stairs, running, horizontal jumping, hopping, sliding, galloping, leaping, and jumping from side-to-side. Second, object manipulation is assessed by five items (25 points): overhand throwing, catching, kicking, ball bouncing, and striking a standing ball. Third, balance is assessed by 4 items (18 points): single leg standing, tandem standing, walking line forward, and walking line backward. Collectively, the three subscales comprise 17 evaluation items (84 scoring criteria). The researcher administered the test and scored the participants' performance. In the three formal tests administered, a participant received zero points when no motor skill or only a single motor skill was observed to have satisfied the scoring criterion. When performing any motor skills that satisfied the criteria,

the participant received one point. Finally, the scores of the three subscales were summed, with a possible total score of 84 points. The higher the score received by a participant, the more satisfactory is the participant's gross motor performance.

3.2 Design and Implementation of the Soccer Program

The content for the soccer program was designed according to movements covered in a preschool soccer handbook edited by Lin [19] and published by the Chinese Taipei Football Association. All of the soccer activities were conducted under the principle of safety first. Movements designed in the program included footwork drills; dribbling, passing, and shooting a ball; and a soccer game (Appendix A). Two days per week, the soccer coach led the experimental group in a 30-minute soccer game as well as a 10-minute warmup and cooldown. The program was implemented consecutively for 10 weeks in the student activity center (see the Appendix for the soccer game intervention form). Before the intervention, both groups took a PGMQS pretest and provided demographic data such as name, age, height, and weight. After the 10-week intervention, a PGMQS posttest was administered to both groups.

4. Data Analysis

An independent samples *t* test was administered to test the homogeneity of the pretest of the experimental and control groups, as well as to compare the pretest results of the quality of various gross motor skills. Subsequently, a paired samples *t* test was adopted to compare the gross motor quality of the experimental and control groups before and after the soccer intervention. Finally, the pretest results and the ages of the two groups' participants were set as covariates in performing an analysis of covariance (ANCOVA) on posttest differences between the two groups.

5. Ethical Considerations

Before this research was conducted, it was reviewed

and approved by the Institutional Review Board of Science Ethics of Taipei City Hospital (Case number: TCHIRB-1031002). The participants and their legal representatives were informed of the research objectives, methods, and process, as well as of the study's restrictions and benefits. In addition, the author obtained the consent from the legal representatives of the participants. During the research process, the participants and their legal representatives could withdraw their consent and withdraw from the study at any time without a reason. To protect individual privacy, records that could be used to identify the participants and their private data were handled as confidential information during the study. All of the research data were used only for academic purposes.

6. Results

6.1 Personal Background

A total of 87 participants completed the research process. The valid samples of the experimental group comprised 44 preschoolers: 25 boys and 19 girls. Their average age was 62.80 ± 6.18 months, average height was 109.02 ± 5.21 cm, and average weight was 17.94 ± 2.57 kg. By comparison, the valid samples of the control group comprised 43 preschoolers: 27 boys and 16 girls. Their average age was 63.53 ± 6.88 months, average height was 108.88 ± 5.97 cm, and average weight was 19.90 ± 2.57 kg.

6.2 Differences Between the PGMQS Pretest and Posttest

The study results comprised the total scores of the three subscales of the PGMQS scale (Table 1). In the

pretest, no significant difference was observed in the gross motor quality of the two groups. After the 10-week soccer intervention, a comparison of the pretest and posttest results showed significant differences in locomotion ($P < 0.001$), object manipulation ($P < 0.001$), balance ($P < 0.01$), and overall gross motor quality ($P < 0.01$) in both the experimental (Fig. 1) and control groups (Fig. 2). In general, an increase in the ages of the preschoolers reflects mature physical motor development.

Therefore, the pretests scores and ages of the participants in both groups were set as covariates in an ANCOVA, which investigated whether the posttest results of gross motor quality differed between the two groups. After the effects of the pretest scores and age were excluded, the analysis determined whether the gross motor performance of the preschoolers was affected by participation in the 10-week soccer program (Table 2). Furthermore, after the effects of age and the pretest scores were excluded, the difference in the posttest scores for locomotion between the experimental and control groups achieved significance ($F = 102.17$; and $P < 0.001$), with the mean score (38.23) of the experimental group (after adjusted) being significantly higher than that (34.12) of the control group. The difference in the posttest scores for object manipulation between the experimental and control groups achieved significance ($F = 69.89$; and $P < 0.001$), with the mean score (21.77) of the experimental group (after correction) being significantly higher than that (18.61) of the control group. In addition, the difference in the posttest scores for balance between the experimental and control

Table 1 Summary of the between-group independent *t* test.

Items	Experimental group (<i>n</i> = 44)	Control group (<i>n</i> = 43)	95% CI		<i>t</i> -value
	Mean $\pm$ SD	Mean $\pm$ SD	Lower limit	Upper limit	
Locomotion	32.66 $\pm$ 4.64	31.74 $\pm$ 4.98	-1.14	2.97	0.89
Object manipulation	18.20 $\pm$ 3.71	16.84 $\pm$ 4.71	-0.437	3.17	1.51
Balance	13.89 $\pm$ 3.16	14.74 $\pm$ 2.49	-2.07	0.356	-1.41
Overall score ^a	64.75 $\pm$ 9.43	63.33 $\pm$ 8.90	-2.49	5.33	0.72

Values are presented as means $\pm$ SD. ^aOverall score of preschoolers in gross motor quality.

Fig. 1 The paired-t test on the experimental group ($n = 44$).

Values are presented as means $\pm$ SD. $\square$ pretest, $\blacksquare$ posttest; *Significant differences between pretest and posttest in the experimental group; *** $P < 0.001$

Fig. 2 The paired-t test on the control group ($n = 43$).

Values are presented as means $\pm$ SD. $\square$ pretest, $\blacksquare$ posttest; *Significant differences between pretest and posttest in the control group; ** $P < 0.01$; *** $P < 0.001$

Table 2 ANCOVA results of both groups on the gross motor quality posttest, and adjusted mean and standard error.

Items	Experimental group ($n = 44$)	Control group ($n = 43$)	F-value
	Mean $\pm$ SE	Mean $\pm$ SE	
Locomotion ¹	38.23 $\pm$ 0.29	34.12 $\pm$ 0.29	102.17***
Object manipulation ²	21.77 $\pm$ 0.27	18.61 $\pm$ 0.27	69.89***
Balance ³	16.53 $\pm$ 0.19	15.22 $\pm$ 0.19	24.00***
Overall score ⁴	76.53 $\pm$ 0.55	67.86 $\pm$ 0.56	122.66***

Values are presented as means $\pm$ SE. SE: standard error.

Covariates in the model: ¹pretest locomotion and age; ²pretest object manipulation and age; ³pretest balance and age; ⁴pretest overall score and age. *Significant differences between experimental group and control group; *** $P < 0.001$

groups achieved significance ($F = 24.00$; and $P < 0.001$), with the mean score (16.53) of the experimental group (after correction) being significantly higher than that (15.22) of the control group. Finally, the difference in the posttest scores for overall gross motor quality between the experimental and control groups achieved significance ($F = 122.66$; and $P < 0.001$), with the mean score (76.53) of the experimental group (after correction) being significantly higher than that (67.86) of the control group. In summary, the analytical results showed that the 10-week soccer intervention effectively enhanced the locomotion, object manipulation, and balance scores of the experimental group as well as their overall gross motor quality score.

7. Discussion

In the present study, all subscales of gross motor skills, including locomotion, object manipulation, and balance scores, in the experimental group have significant differences between the pretest and posttest. This phenomenon was also observed in the control group. Previous studies have also found that gross motor skills improves as 3-6 year-old preschoolers grew older and matured in mental as well as physical domains [13]. In other words, a significant age effect on gross motor skills during childhood was observed.

On locomotion, the posttest score on locomotion of the experimental group was significantly higher than that of the control group, after controlling the pretest scores and age of the two groups. This showed that a structured 10-week soccer program intervention with two 40-minute sessions per week significantly enhanced the preschoolers' locomotion. These results correspond with those of most previous studies [14, 20, 21].

Erceg et al. [20] conducted a 9-month soccer training for 7-8 year-old boys and determined that soccer training enhanced motor flexibility. The preschool soccer program designed in the present study emphasized enhancing flexibility in lower limb movements and the ability of object manipulation. Our

results showed that the posttest score on object manipulation of the experimental group was significantly higher than that of the control group, after controlling the pretest scores and age.

In addition, the results of the present study showed that a structured 10-week soccer intervention significantly enhanced the preschoolers' balance. Several studies have found that playing soccer enhances balance [14, 21]. Sun et al. [13] have found that the dynamic and overall balance of 3-6-year-old preschoolers improved as they grew older, with performance differences becoming increasingly clear over time. There is also a similar result in the present study. After controlling the pretest scores and age, the posttest score on balance of the experimental group was significantly higher than that of the control group.

Hardy et al. [9] proposed that structured exercise designed by teachers facilitated enhancing child motor skills. Moreover, Rocha et al. [17] indicated that playing soccer enhanced the motor skills of preschoolers. Kakebeeke et al. [22] also inferred that the older the preschoolers were, the more likely they could complete basic motor tasks. The results of our study correspond with those of these studies. In the present study, the posttest score on overall gross motor quality of the experimental group was significantly higher than that of the control group, after controlling the pretest scores and age.

Although previous studies have mostly explored differences in child motor skills produced by conventional physical education programs and unstructured games and daily activities [2, 23, 24], few studies have used soccer interventions to investigate gross motor development in preschoolers. The present study adopted a 10-week soccer program as an intervention strategy and indicated that the intervention enhanced gross motor development in preschoolers. In addition, Šalaj et al. [25] demonstrated that soccer can be an effective component of courses that facilitate developing basic motor abilities in preschoolers. Therefore, the results of the present study can serve as a

reference for designing future courses in preschool education.

8. Study Limitations

In this study, the experimental group participated in a structured 10-week soccer program intervention, whereas the control group continued static classroom activities. However, the authors could not control whether the preschoolers of the control and experimental groups participated in other related activities during their leisure time that might have affected their performance during the research process.

9. Conclusion

Soccer is a convenient and economical sport that can be played alone or in groups. This study confirmed that implementing a structured soccer intervention involving two 40-minute sessions per week significantly enhanced preschoolers' locomotion, object manipulation, balance, and overall gross motor quality.

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Appendix A Schedule for the 10-Week Soccer Program Intervention.

Week	Weekdays	Content	Time (minutes)
1	Wednesday and Friday	1. Soccer familiarization and warmup: Running and squatting, z-shaped lateral run, and backward run	5
		2. Soccer drills: Penalty kicks, ball control using the inside of the foot, back-to-back passing, and back-to-back tackling	30
		3. Cooldown and sharing activities: Straight-line walking and sharing daily reflections	5
1. Soccer warmup: Z-shaped lateral run, backward run, arm-swinging running jump, and backward jog		5	
2. Soccer drill: Dribbling (straight-line, s-shaped, and circle)		30	
3. Cooldown and sharing activities: Straight-line walking and sharing daily reflections		5	
1. Soccer warmup: Backward jogging, running in place with hands on hips, and clapping hands overhead with lateral jumping movements		5	
2. Soccer drills: Running with a ball, dribbling along a line, and dribbling and shooting		30	
3. Cooldown and sharing activities: Straight-line walking and sharing daily reflections		5	
1. Soccer warmup: Clapping hands overhead with lateral jumping movements, lateral movement with cross-steps, and running with turns		5	
2. Soccer drills: Shooting, running passes, and triangular passes		30	
3. Cooldown and sharing activities: Straight-line walking and sharing daily reflections		5	
1. Soccer warmup: Running with turns and knee-lifting jumps		5	
2. Soccer drills: Straight-line dribbling, shooting, and a game entailing kicking accuracy		30	
3. Cooldown and sharing activities: Straight-line walking and sharing daily reflections		5	
6	Wednesday and Friday	1. Soccer warmup: Knee-lifting jumps and penguin walk	5
		2. Soccer drills: Straight-line dribbling, shooting, and close-range shooting	30
		3. Cooldown and sharing activities: Straight-line walking and sharing daily reflections	5
1. Soccer warmup: Penguin walk		5	
2. Soccer drills: Straight-line dribbling, long shots, and the toss and stop		30	
3. Cooldown and sharing activities: Straight-line walking and sharing daily reflections		5	
1. Soccer warmup: Running with turns and clapping hands overhead with lateral jumping movements		5	
2. Soccer drills: Dribbling along a line, blocking tackles, and body checks		30	
3. Cooldown and sharing activities: Straight-line walking and sharing daily reflections		5	
1. Soccer warmup: Running and squatting and stooping jump		5	
2. Soccer drills: Passing in pairs, spot passes, and long shots		30	
3. Cooldown and sharing activities: Straight-line walking and sharing daily reflections		5	
1. Soccer warmup: Z-shaped lateral backward run, and knee-lifting jumps		5	
2. Soccer drills: Futsal game		30	
3. Cooldown and sharing activities: Straight-line walking and sharing daily reflections		5	