ISSN 2689-8268 | Volume 7

American Journal of Surgery and Clinical Case Reports

Research Article Open Access

12 Weeks of Soccer Training Promotes Basic Motor Skill Development in Children with Intellectual Disabilities: A Cross-Sectional Study

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Received: 18 Sep 2023
Accepted: 24 Oct 2023
Published: 30 Oct 2023
J Short Name: AJSCCR

Citation:

Zhang D and Zhen Z. 12 Weeks of Soccer Training Promotes Basic Motor Skill Development in Children with Intellectual Disabilities: A Cross-Sectional Study. Ame J Surg Clin Case Rep. 2023; 7(1): 1-12

Keywords:

Intellectual disability; Tekscan; Practical

1. Abstracts

1.1. Background: Children with intellectual disability (ID) face particular challenges in their cognitive and physical development, and the aim of this study was to investigate whether a 12-week football training programme could promote the development of basic skills in children with ID.

1.2. Method: Seventy children with ID were divided into an intervention group and a control group and their basic motor skills were assessed using the TGMD-2 test, the Tekscan foot pressure measurement system test and the balance beam walking test.

1.3. Results: Gross motor coordination, static balance and dynamic balance improved significantly in the intervention group after the tests ($p<0.05$).

1.4. Conclusions: A 12-week football training programme was effective in promoting the development of basic skills in children with intellectual disability, and these findings have important implications for promoting the overall development of children with intellectual disability and supporting educational and rehabilitation programmes.

2. Introduction

Globally, about 180 million people belong to the group of people with intellectual disabilities, occupying 3% of the global population [1]. Intellectual disability is defined as a disorder in which an individual's IQ is significantly below average and is accompanied by adaptive behavior [2]. In order to address the education of children with intellectual disabilities, special education systems have been established [3]. However, the greater challenge lies in how to take care of this special population in a rational and scientific way in actual teaching [4].

Children with intellectual disabilities often exhibit problems such as uncoordinated movements and lack of stability [5], which stems from their relatively weak large muscle strength [6]. Gradually, it has been recognized that physical activity not only promotes the development of large-muscle movements, but also contributes to a greater degree to the physical and mental development of students with intellectual disabilities by enhancing mental activity, fostering a willingness to engage in active social participation, and enhancing enjoyment of life [7,8].

Fundamental motor skills are a set of non-naturally occurring basic motor learning patterns [9], which not only lay the foundation for advanced specialized motor skills, but also provide a solid foundation for children and adolescents to participate in sports, sports games, and sports competitions [10]. These fundamental motor skills mainly cover displacement, object control, and stabilization skills, all of which fall under the umbrella of gross motor movement [11].

Soccer, on the other hand, is an intense, fascinating and exciting all-round training [12], combining high-intensity interval training, physical training as well as strength training [13]. It represents a flexible and empirically supported concept of soccer, and participation in soccer not only helps to improve the physical condition of the participants [14], but also prevents many diseases in life [15].

Basic motor skills play a key role in the daily life and motor competence of children with intellectual disabilities [16], yet relatively few intervention studies on basic motor skills in children with intellectual disabilities have been conducted. The importance of this study lies not only in scientifically proving that basic motor skills of children with intellectual disabilities can be significantly improved through soccer training, but also in providing practical practical recommendations for the rehabilitation and educational fields.

3. Materials and Methods

3.1. Experimental Subjects

Seventy children with moderate intellectual disabilities aged 9-10 years old were recruited as experimental subjects from special education schools in Shahe City and general elementary schools in the urban area, including 26 students with autism (12 boys and 14 girls), 5 students with Down syndrome (3 boys and 2 girls), 8 students with cerebral palsy (4 boys and 4 girls), and 31 students with developmental delay (16 boys and 15 girls). The inclusion and exclusion criteria of the subjects are shown in Table 1.

The experimental subjects were randomly divided into the intervention group and the control group, with 35 people in each group (Table 2). Before the start of the experiment, all subjects and their guardians were informed of the purpose of the experiment, the content of the experiment, and the requirements of the experiment, as well as signing an informed consent form and completing the Pre-exercise Health Screening Questionnaire (Physical Activity Readiness Questionnaire, PAR-Q) [17]. In the experiment, one child in the control group voluntarily gave up the test and four children in the intervention group voluntarily gave up the test.

Table 1: Inclusion and exclusion criteria for experimental subjects.

Inclusion Criteria	Exclusion Criteria
9-10 years old	Exclusion of students who do not match their actual age.
40≤IQ≤55	Excluding students with too high and too low IQs.
No physical injury.	Excluding students who have not fully recovered their limb function after rehabilitation.
No history of professional soccer training.	Excluding students who participated in other sports training during the experimental period.
Subjects and their guardians were aware of the experiment and voluntarily signed an informed consent form.	Excluding students whose guardians have not signed the informed consent form.

Table 2: Information on body morphology of experimental subjects (n=35).

Control Group				Intervention Group			
Height (m)	Weight (kg)	BMI (kg/m2)	IQ	Height (m)	Weight (kg)	BMI (kg/m2)	IQ
1.40±0.06	36.48±3.72	18.62±1.3	45.93±6.32	1.41±0.06	36.57±3.68	18.46±1.3	45.75±6.28

Note: The difference in body morphology between the experimental and control groups was not significant (p>0.05)

3.2. TGMD-2 test

The TGMD-2 has good reliability and validity in many countries, including China [18,19], and is mainly used in the assessment of children's gross motor movements. The TGMD-2 consists of two parts: one measures body movement skills, including Running, Horizontal jumping, Leaping, Hopping, Galloping, and Sliding. The second measures object manipulation skills, including Dribbling, Kicking, Catching, Striking, Throwing, Underhand Rolling, and Sliding. Sliding. The second part measures object manipulation skills including Dribbling, Kicking, Catching, Striking, Throwing, Underhand Rolling [20]. The gross motor tests were pre-tested 1 week before the start of soccer training and post-tested 1 week after the end of the intervention.

Prior to the formal test, 4 primary subjects independently tested 8 children for inter-subject reliability assessment. Results showed Pearson correlation coefficients between 0.83 and 0.88 for the 12 tasks, indicating statistically significant correlations (P>0.05). Prior to the testing of each task, the principal subject explained and demonstrated the test maneuvers according to the test guidelines. Subjects warmed up before the start of the test, practiced before each test, and video-recorded the testing process. After 14 days of intervention, 16 children were randomly selected for retest reliability analysis, and the retest rate was 24.62%. The Pearson correlation coefficient for the two tests was 0.91, which was statistically significant (P>0.05), indicating that the use of the TGMD-2 in this study had good reliability.

3.3. Static Balance Test

Static balance ability was tested using the Tekscan foot pressure measurement system (Foot Research 6.40 software, USA) [21]. Subjects were tested in three separate programs: standing on both feet with eyes open (FEO), standing on both feet with eyes closed (FEC) and standing on one foot with eyes open (dominant foot)

(SFEO) [22]. The extracted metrics included the envelope area and path length of the center of pressure (COP), and the maximum displacement of the COP in the A-P and M-L directions [23]. The static balance test was performed as a pre-test 1 week before the start of soccer training and as a post-test 1 week after the end of the intervention.

For Tekscan foot pressure measurements, the acquisition frequency was set to 50 Hz and each test lasted for 10 s. Subjects underwent a 10-min warm-up activity before performing the tests. During the test, subjects were asked to stand barefoot in the center of the force plate, with toes facing forward, arms hanging naturally on either side of the torso, and eyes looking straight ahead. In the SFEO test, the primary subject asked the subject to kick a soccer ball placed in front of him and determine his dominant foot by observing which foot he kicked the ball with [24].

3.4. Dynamic Balance Test

The balance beam walking test, commonly used in China, was used to assess the dynamic balance of the subjects [25]. A balance beam (300 cm long, 10 cm wide and 30 cm high) and a stopwatch were used. Each end of the balance beam had a platform (20 cm long, 20 cm wide, and 30 cm high), which served as the start line and finish line, respectively. The dynamic balance test was administered as a pre-test 1 week before the start of soccer training and as a post-test 1 week after the end of the intervention.

Subjects warmed up moderately before the test and then stood on the starting line facing the balance beam with their arms held sideways. When the command "start" was heard, the participant began to walk forward barefoot. The tester used a stopwatch to record the time to start walking and the time to reach the finish line, and the final value was taken as the best result of the two tests. Protectors are arranged during the test to ensure safety, and if the subject falls off the balance beam, the test can be repeated.

3.5. Sports Intervention

The intervention group was trained in soccer at the Sunshine Soccer Club in Shahe City using the single-blind method (Table 3 for the training program and Tables 4, 5, 6 and 7 for the training content) [26] for a period of 12 weeks, with training three times a week for 40 minutes each time. The control group followed the original physical education syllabus for physical education and health courses, other than that the experimental and control groups were given no intervention in other courses and maintained their original habits.

Table 3: Football Training Program.

Weeks	Warm-up Activity (15min)	Football Skills and Fitness Training (9 min)	Games and competitions (8min)	Football Shooting Exercise(5min)	Relaxation Activities (3min)
Week 1	FIFA11+Kids	T9+T7	G8+P3	Kick to two goals (3:3-6:6)	Relaxation Activities
Week 2	FIFA11+Kids	FF1+T2	P3	Kick to two goals (3:3-6:6)	Relaxation Activities
Week 3	FIFA11+Kids	FE2+FE4+FE7+FE10+T9	G2+P8	Kick to two goals (3:3-6:6)	Relaxation Activities
Week 4	FIFA11+Kids	FE2+FE4+FE7+FE10+T10	G4+P6	Kick to two goals (3:3-6:6)	Relaxation Activities
eek 5	FIFA11+Kids	FF1+T5	G7+P12	Kick to two goals (3:3-6:6)	Relaxation Activities
Week 6	FIFA11+Kids	FE1+FE4+FE8+FE11+T11	P9	Kick to two goals (3:3-6:6)	Relaxation Activities
Week 7	FIFA11+Kids	FF2+T12	P7	Kick to two goals (3:3-6:6)	Relaxation Activities
Week 8	FIFA11+Kids	FE2+FE4+FE8+FE10+G5	P9	Kick to two goals (3:3-6:6)	Relaxation Activities
Week 9	FIFA11+Kids	FF2+T4	G8+P15	Kick to two goals (3:3-6:6)	Relaxation Activities
Week 10	FIFA11+Kids	FE2+FE4+FE8+FE10+T10	G5+P11	Kick to two goals (3:3-6:6)	Relaxation Activities
Week 11	FIFA11+Kids	FF1+T8	G6+P22	Kick to two goals (3:3-6:6)	Relaxation Activities
Week 12	FIFA11+Kids	FE1+FE4+FE8+FE11+G2	P18	Kick to two goals (3:3-6:6)	Relaxation Activities

Table 4: Technical training content for football.

Project	Purpose	Introduce
T2-Play soccer	Equips players with the ability to control the length and direction of a soccer ball run.	The drill involves hitting a partner's ball. Kick the ball in pairs, 1 soccer ball each. 1 player starts by kicking the ball in any direction. The other player then tries to hit his partner's ball, with both players taking turns. Hitting their partner's ball counts as 1 point, and then a new round of training begins. Players take turns to start. Tally the scores, but time it so that everyone finishes the drill in the same amount of time.
T4-Shooting	Develop students' ability to shoot vigorously and accurately.	One goalkeeper. The remaining players are divided into two groups. One group stands near one of the goal posts. The other group stands at the right distance in front of the goal. The distance depends on the skill of the players and the size of the goal. The ball is kicked from the first player in the goal post group to the first player in the row of players in front of the goal. This person then shoots the ball. It is possible to stop the ball before shooting, but this should be avoided as much as possible, and then kick directly at the goal. The player who passed the ball at the goalposts runs to the back of the goal line. Another player picks up the ball and walks to the back of the goal post queue. Remember to train both legs.
T5-Control the ball/ catch the ball 1	Develop the student's ability to control the soccer ball when catching.	Kick the ball in pairs, one ball per pair of players. Players stand 3-5 meters apart. Give the ball (kick or throw) to a partner who “tames” the soccer ball. (Use the inside of the foot, the outside of the foot, the thigh)
T7-Control the ball/ Passing Out 1	Develop students' ability to control the soccer ball when passing.	6-8 players stand in 2 rows facing each other, 6-8m apart. the first player passes the ball to the first player opposite, who controls the ball and then passes it to the next player opposite, and so on. After completing the pass, run to the back of the other row.
T8-Control the ball/ Passing Out 2	Develop students' ability to control the ball when they catch it and can pass it.	Form an equilateral triangle or square. The number of players should be at least one more than the cones. Players spread out towards the cones, with the cones about 1m apart from the players. Start at a cone with two players standing. Pass the ball to a player near the cone who controls it and then passes it to the player at the next cone. After completing the pass, run after the ball to the next cone. Remember to practice in a clockwise and counterclockwise direction.
T9-Dribbling	Develop the student's ability to dribbling.	Carry the ball to each other in the training area. Stop the ball in different ways (sole of the foot, inside of the foot, outside of the foot, knee, hip, chest) when signaled by the coordinator/coach, depending on the player's ability. Carry the ball under different conditions (right foot only, left foot only, alternating right and left foot, outside of foot, inside of foot, etc.).
T10-Simon Says	Develop students' ability to carry the ball, look up and change direction.	Pair training. Two people with a ball. One player follows the other, who tries to get away from the follower by changing direction and speed. after 1min swap roles.
T11-Turning with the ball	Develop students' ability to turn and change direction with the ball.	3 players stand on a line 10m apart. kick off from one end. The center player walks towards the soccer ball and receives it along the ground. After receiving the ball, he turns and passes it to the player on the opposite side. The center player then moves forward to meet the ball. Then receives the ball along the ground again, turns and passes it to the player on the opposite side. The center player lasts 30-60s.
T12-Turning and shooting with the ball	Equip players with the ability to turn and shoot with the ball.	Set up a 5×5m square with 4 cones at the right distance from the goal. Place the last cone 6-10m from the square. Players stand in a line with the ball behind the last cone and one player in the square without the ball. The first person in the queue passes the ball to the player in the square who attempts to turn with the ball and kicks it towards the goal before it leaves the square. The passer enters the square and prepares to pick up the ball from the next player in the queue. The shooter picks up the ball and walks to the back of the queue.

Table 5: Contents of football fitness training.

Project	Introduce
FF1-Soccer Fitness Route 1	1. Take the ball around the cone in a zigzag pattern.
	2. Do 10 arm extensions.
	3. Jump diagonally forward in a straight line. Land on both legs and jump 4 times to each side (8 times total).
	4. Standing on your right leg, lift your left leg and let the ball pass under your left leg while keeping your balance. Then stand on your left leg and practice the above movements. Practice twice with each leg.
	5. Move from one cone to the other in a stride.
	6. Sit down with the ball between your knees. Hold the ball between your knees for 10 s. Relax for 10 s and repeat the exercise.
	7. Carry the ball. Bring the ball forward over 3 cones, turn around; bring it backward over 2 cones, turn around; bring it forward over 3 cones, turn around; bring it backward over 2 cones, and so on.
	8. Do 10 sit-ups.
	9. Throw the ball through the cones. Run to first cone without holding ball. Step diagonally backward to the next cone. Then run forward and step diagonally backward from the cone you are at, and so on.
	10. do 6 deep squats. Squat down as deep as possible in a slow, controlled manner.
	11. Kick the ball across between two cones. Run towards the ball as fast as you can and kick it into the goal.
	12. Do 10 back stretches.
FF2-Soccer Fitness Route 2	1. zigzag with the ball around the cone.
	2. do 6 lunge reps on each leg (12 reps total). See Fitness Exercise for lunge exercise instructions.
	3. Jump back and forth on one foot, diagonally across the line. Jump each leg to the side 3 times (12 times total).
	4. Stand with your legs apart. Pass the ball in a figure eight. Do this four times in each direction.
	5. Move from one cone to the other in a backward stride.
	6. Lie down and place the ball between your feet. Slowly lift the ball off the ground. Lift the ball eight times.
	7. Throw the ball over the cones. Then snake through the cones as fast as you can.
	8. Do 10 high leg lifts. Rest briefly, then repeat the exercise.
	9. Carry the ball forward through one cone - then diagonally back to the side - turn and carry to the next cone - turn and carry the ball diagonally back.
	10. Stand on one leg. Throw the ball into the air and catch it. Exercise a total of 3 times. Work on maintaining balance at the same time. Then switch to the other leg and perform the same exercise.
	11. Kick the ball across between two cones. Run as fast as you can towards the ball and kick it into the goal.
	12. Lie on your back and do 10 pelvic lifts.

FE1-Lunge	Hold the ball with both hands in front of your chest; stand with your feet together and your back straight. Take a big step forward with one leg, keeping the other foot in the same position but on tiptoes. Make sure you are well balanced and have a straight back. The toe of the front leg should be pointing forward, with the knee above the foot, but not over the toe. Use your front leg to push yourself back to the starting position. Repeat the exercise with the other leg. This can be done with a partner. After each lunge, toss the ball to a partner who will perform the exercise. Remember to train both legs.
FE2-Squat	Hold the ball with both hands in front of your chest. Stand with your legs slightly apart (shoulder-width apart), toes pointing slightly outward. Move your hips back and bend your knees slightly while keeping your back straight. You can lean forward slightly, but keep your back at the same angle as your shins. Visualize yourself sitting in a chair. Keep your knees above your feet. Squat down as far as you can while keeping your heels on the ground. Then slowly press your back back to the starting position.
FE4-Stretching the arms	Lie prone, hands on the floor shoulder-width apart; stand on your toes or kneel on the floor. Bend your arms and slowly lower your body toward the ground, raising your body just before your chest is about to touch the ground. Tuck in your stomach and tighten your abdominal muscles during the exercise.
FE7-Bow body	Lie on your back, soles or heels on the floor; lift your buttocks and tighten your glutes and hamstrings. Arms are held against the body or out to the side. Slowly raise and lower the hips during the exercise, or hold the hips high for 20-45s.
FE8-Legs to soccer ball	Sit on the ground, legs bent; hold the soccer ball with both thighs/knees and squeeze the ball; hold this position for 10 s. Repeat the exercise 2-4 times.
FE10-Sit ups	Lie on your back with your legs bent towards your partner at a proper distance. One of you holds the ball to your chest and slowly lowers your torso downward. When the back touches the ground, raise the torso again and throw the ball toward the partner, who does the same exercise.
FE11-Back stretch	Lie prone, keep your body straight; hold the ball with both hands in front of your head, tighten your back muscles, try to raise your torso as high as you can, and then throw the ball to your partner.

Table 6: Game content.

Project	Purpose	Introduce
G2-Shipwreck game	Carry the ball under pressure.	The player with the ball must carry the ball around the tackler without losing possession. When in a certain area, you are safe. However, there can only be one player on each piece at any given time. If a player carries the ball to a given area, anyone already there must leave.
G4-3 consecutive games	Exercise students' on-court observation skills and cooperation	Place 3 x 3 cones at 2m intervals, 10-20m from the chalk line. If there is no chalk line on the pitch, set up two cones as a goal line. 3-4 players from each of the 2 teams stand behind the goal line. The first 3 players from each team hold undershirts. On a given signal, the first 2 players from each team rush to one of the cones, place their undershirts on the cone, fold back, and touch the next player, who places his undershirt on an unvested cone. When all undershirts are in place, the next player running toward the undershirts must move one vest. Once an undershirt has been moved, it must be placed somewhere.
G5-Bear Hug Catching Game	Cooperation and carrying the ball under pressure.	2-3 ball carriers wear undershirts. Everyone has a soccer ball (including the snapper) and players must carry the ball around the field. The snapper must try to touch the other players. If they are touched by the snapper, they become the snapper and must put on their undershirts; players are safe when they are in each other's arms.
G6-Mud Puddle Game	Work together and carry the ball under pressure.	2-3 ball grabbers wear undershirts. Everyone has a soccer ball (including the snappers) and players must carry the ball around the field. Grabbers must try to touch other players. If you are touched by the ball grabber, you need to pick up your ball and stand with your legs apart. Another player can kick the ball through the crotch of the above mentioned person to save a person "stuck in the mud". After a given amount of time has elapsed, the ball grabber is replaced.
G7-Safety Ball Game	Exercise students' observation and cooperation skills on the court.	2-3 ball grabbers wear undershirts. This is a normal game of catch, but is only safe when the ball is obtained. Players must cooperate with each other to pass the ball to the person who is almost caught.

G8-Hand Holding Game	Cooperation.	2-3 ball grabbers wear undershirts. One of the ball grabbers tries to catch the other players. When caught, you hold the ball grabber's hand and work together. Form a long line of grabbers in this manner. When a long line contains 4 players, divide into 2×2 players.

Table 7: Contents of football matches.

Project	Purpose	Introduce
P3-Name and pass game	Work on student communication skills.	Mark an appropriate court with 4 cones; all players move around the court; half the players carry the ball. The player with the ball tries to make eye contact with the player without the ball. The player with the ball then yells out the receiver's name and passes the ball to the other player. Make full communication between players.
P6-Relegation or Promotion Match	Develop students' ability to carry the ball.	Mark out a number of small pitches (6 x 10m) so that they are next to each other. At one end is the "Champions League", then various national series, ranked from highest to lowest. 1 v 1 matches are played on each pitch. The ball must be carried across the goal line to score. Players must touch the ball at least once on the pitch and again after it crosses the goal line. If you win, you advance to the next series. A loss relegates you to the next level. In case of a tie, the player who scores the last goal is the winner. If the game results in a 0-0 tie, the winner is determined by rock-paper-scissors.
P7-Kickoff contest to 4 goals	Work on student observation skills on the field and communication skills during the game.	4-6 players per team; 2 teams per pitch. Mark out a proper pitch of more width than length with 4 cones and place 2 goals at each goal line so that they are slightly away from the touchline; goals can be scored at either end.
P8-Goal Zone Contest	Cooperation, communication and understanding of the game.	A large field is marked out with a goal area 5 meters deep at each end and two teams (5-8 players each) play against each other to guard their own goal area. To score a goal, one team must pass the ball to a teammate in the goal area who controls the ball. Only the strikers are allowed to stay in the goal area, but not for more than 5-10s at a time (the appropriate time limit is set according to the level of the players).
P9-2-over-1 passing contest	Cooperation, communication and technical skills.	Two teams play each other. At each end of the goal line, a player acts as a "rebound wall". This player must pass the ball back to the team that previously passed it. This "wall" may move along the entire goal line. To score a goal, a team must pass the ball to the "wall" and then receive the ball back from that player. Depending on the level of the player, the "wall" may be allowed to touch the ball a certain number of times.
P11-Fruit Salad Competition	Shooting, Challenging and Competition.	1 player provides the name of a fruit (same for both teams), provides a different fruit name to the second player, and so on. The coordinator/coach names one or more fruits. The ball is then kicked into the area in front of the goal. The "fruit" whose name is called runs onto the field and controls the ball. The first team to get the ball is the offense and they must try to score. The other team is the defense and they must prevent the offense from scoring. The game ends when the defender takes control of the ball or kicks it away. When the signal is received, a new game begins. If the coordinator/coach says "fruit salad", all players run the track.
P12-Two-Person Match	Cooperation and communication	Mark out a proper pitch with a goal at each end. Play a normal soccer game, but with teammates holding hands in pairs.
P15-Interval game	High intensity, high speed matches.	Mark out a pitch with large goals, 20-25 m apart. place a goalkeeper in each goal. There are two teams in total, but each team sends only 2-3 players to the pitch to play. The rest wait behind their respective goals. The scoring team holds the ball again. The game is then restarted by that team's goalie. The game lasts 45-90s, after which new players from each team replace them on the field. The person not currently playing helps retrieve the ball and places it in the goal so that the goalkeeper can restart play immediately. It is advisable to have no more than 3 groups of players per team. Otherwise the waiting time becomes too long. It is good to organize the game by presenting teams with significantly different skills, because you can match the skills of the players who are on the field for the game.

P18-Shooting to 4 holes competition	Develop students' court judgment and work on turnaround techniques.	Marks out a course with 4 holes at the corners of the course. The holes consist of 4 cones, one of which also serves as a marker for the corner of the course. There are 2 teams playing each other on the court. To score, a player must pass the ball to a teammate in the hole. When one team scores, the opposing team holds the ball. The number of players in a hole must never exceed 1 and the time spent in the hole must not exceed 5s at a time.

3.6. Statistical Analysis

The experimental data were statistically analyzed using SPSS26.0 statistical software. The data were subjected to variance chi-square test, within-group data were compared using one-way repeated-measures ANOVA, and between-group data were compared using independent samples one-sample t-test. All test indicators were expressed in the form of mean ± standard deviation, and the difference was statistically significant by the probability of concordance P<0.05.

4. Results

As shown in Table 8, the difference between the mean values of the pre-test scores of each of the TGMD-2 scales in the intervention and control groups was not significant (P>0.05). The difference between the mean values of the posttest scores of running, one-legged hopping, side-scooting, ball slapping, and rolling and the mean values of the posttest scores of locomotors, manipulative, and gross motor movements in the control group compared with the pre-tests was significant (P<0.05). The difference between the mean posttest scores of all items in the intervention group compared to the pre-test was significant (p<0.05). The difference between the mean values of the posttest scores of all items in the intervention group compared to the posttest of the control group was significant (P<0.05).

Table 9 shows that the difference between the results of the static balance program pre-test between the intervention and control groups was not significant (P>0.05). The differences in COP area and length at FEO posttest, COP area, length and distance in the A-P direction at FEC test, and COP length and distance in the M-L direction at SFEO test in the control group were significant (P<0.05) when compared to the pretest. The difference between the posttest results of all static balance items in the intervention group compared to the pretest was significant (P<0.05). The difference between the posttest results of all static balance items in the intervention group compared to the posttest of the control group was significant (P<0.05).

We can see from Table 10 that the difference between the results of the dynamic balance pre-test in the intervention and control groups is not significant (P>0.05). The difference between the dynamic balance posttest results of the control group compared to the pretest is significant (P<0.05). The difference between the results of dynamic equilibrium post-test in the intervention group compared to the pre-test was significant (P<0.05). The difference between the results of dynamic equilibrium posttest in the intervention group compared to the posttest in the control group was significant (P<0.05).

Table 8: Gross motor test results before and after intervention.

Test Action	Test Content	Group	Pretest	Posttest	Δ	*F*	*P*	η^2
Mobility Actions	Running	CG (n=34)	5.13±1.09	5.45±1.16	0.32	4.5	0.04	0.06
		IG (n=31)	5.12±1.11	6.89±1.21*	1.77	87.52	0	0.59
	Horizontal Jumping	CG (n=34)	3.46±1.05	3.73±1.08	0.27	3.83	0.05	0.05
		IG (n=31)	3.47±1.02	5.09±1.09*	1.62	118.51	0	0.66
	Leaping	CG (n=34)	1.63±0.76	2.12±0.95	0.49	26.12	0	0.28
		IG (n=31)	1.65±0.83	4.57±1.02*	2.92	567.82	0	0.9
	Hopping	CG (n=34)	3.59±1.03	4.04±1.04	0.45	7.29	0.08	0.03
		IG (n=31)	3.57±1.03	4.86±1.08*	1.29	57.95	0	0.49
	Galloping	CG (n=34)	4.45±1.02	4.66±1.06	0.21	2.99	0.06	0.04
		IG (n=31)	4.48±1.02	5.73±1.09*	1.25	115.99	0	0.66
	Sliding	CG (n=34)	3.83±1.07	4.16±1.06	0.33	6.49	0.01	0.09
		IG (n=31)	3.85±1.04	5.86±1.09*	2.01	166.88	0	0.74
	Locomotor Score	CG (n=34)	22.09±6.06	23.91±6.15	1.82	12.1	0	0.15
		IG (n=31)	22.14±6.09	31.40±6.18*	9.26	168.42	0	0.74

Operational Actions	Dribbling	CG (n=34)	2.23±0.91	2.59±1.02	0.36	8.2	0.01	0.11
		IG (n=31)	2.21±0.89	4.54±1.08*	2.33	320.82	0	0.84
	Kicking	CG (n=34)	4.93±1.02	5.42±1.13	0.49	6.77	0.08	0.03
		IG (n=31)	4.95±1.05	6.20±1.18*	1.25	64.15	0	0.52
	Catching	CG (n=34)	2.18±0.63	2.37±0.75	0.19	3.82	0.05	0.05
		IG (n=31)	2.19±0.61	3.53±0.99*	1.34	145.49	0	0.71
	Striking	CG (n=34)	4.12±1.04	4.76±1.08	0.64	9.64	0.06	0.04
		IG (n=31)	4.11±1.06	5.85±1.11*	1.74	122.18	0	0.67
	Throwing	CG (n=34)	3.89±1.08	4.10±1.12	0.21	2.98	0.09	0.04
		IG (n=31)	3.87±1.08	5.33±1.17*	1.46	123.84	0	0.67
	Underhand Rolling	CG (n=34)	3.65±1.03	3.98±1.03	0.33	5.51	0.02	0.08
		IG (n=31)	3.64±1.02	4.57±1.06*	0.93	38.32	0	0.39
	Manipulative Score	CG (n=34)	21.01±6.04	22.52±6.09	1.51	7.45	0.01	0.1
		IG (n=31)	20.98±6.06	30.03±6.17*	9.05	152.54	0	0.72
Scores of GM		CG (n=34)	CG (n=34)	49.20±10.51	6.1	40.24	0	0.38
		IG (n=31)	IG (n=31)	61.43±11.46*	18.31	278.02	0	0.82

GM: gross motor; CG: Control Group; IG: Intervention Group. *: P<0.05. The difference between the intervention group posttest and the experimental group posttest was significant.

Table 9: Static balance test results before and after intervention.

Test Action	Test Content	Group	Pretest	Posttest	Δ	F	P	η2
FEO	Area (cm2)	CG (n=34)	4.91±1.23	4.34±0.96	-0.57	18.21	0	0.22
		IG (n=31)	4.87±1.36*	3.45±0.80	-1.42	106.14	0	0.64
	Length (cm)	CG (n=34)	106.62±32.61	91.48±29.36	-15.14	16.21	0	0.2
		IG (n=31)	107.05±32.62*	69.21±17.41	-37.84	129.72	0	0.68
	A-P (cm)	CG (n=34)	3.16±1.20	2.85±1.24	-0.31	7.94	0.07	0.03
		IG (n=31)	3.18±1.35*	2.69±0.74	-0.49	13.6	0	0.18
	M-L (cm)	CG (n=34)	4.15±1.19	3.81±1.23	-0.34	8.52	0.06	0.02
		IG (n=31)	4.14±1.23*	3.57±1.17	-0.57	13.97	0	0.19
FEC	Area (cm2)	CG (n=34)	5.14±0.98	4.58±1.16	-0.56	19.77	0	0.23
		IG (n=31)	5.12±0.97*	3.67±0.62	-1.45	199.86	0	0.77
	Length (cm)	CG (n=34)	115.37±34.83	99.71±24.01	-15.66	18.61	0	0.22
		IG (n=31)	116.75±33.81*	77.63±17.60	-39.12	130.5	0	0.69
	A-P (cm)	CG (n=34)	4.22±0.99	3.94±0.57	-0.28	8.53	0	0.15
		IG (n=31)	4.28±1.17*	3.57±0.60	-0.71	37.25	0	0.38
	M-L (cm)	CG (n=34)	5.42±2.02	4.93±2.35	-0.49	3.47	0.07	0.05
		IG (n=31)	5.39±2.03*	4.15±1.04	-1.24	34.95	0	0.37
SFEO	Area (cm2)	CG (n=34)	20.79±4.36	18.68±4.84	-2.11	14.25	0	0.18
		IG (n=31)	20.55±5.00*	15.31±3.15	-5.24	98.38	0	0.62
	Length (cm)	CG (n=34)	125.56±40.40	115.33±44.01	-10.23	3.99	0.05	0.06
		IG (n=31)	127.85±38.18*	102.19±30.23	-25.66	34.42	0	0.36
	A-P (cm)	CG (n=34)	9.21±2.44	8.58±2.63	-0.63	3.17	0.08	0.04
		IG (n=31)	9.27±2.77*	8.13±1.73	-1.14	15.29	0	0.2
	M-L (cm)	CG (n=34)	9.17±2.02	8.41±2.35	-0.76	8.29	0.01	0.11
		IG (n=31)	9.19±2.38*	7.22±1.43	-1.97	62.82	0	0.51

FEO: both feet with eyes open; FEC: both feet with eyes closed; SFEO: a single foot with eyes open; A-P: anterior-posterior; M-L: medial-lateral. CG: Control Group; IG: Intervention Group. *: P<0.05. The difference between the intervention group posttest and the experimental group posttest was significant.

Table 10: Dynamic balance test results before and after intervention.

Test Content	Group	Pretest	Posttest	Δ	*F*	*P*	η^2
Balance Beam (s)	CG (n=34)	16.39±2.31	14.95±1.58	-1.44	10.16	0	0.14
	IG (n=31)	16.52±2.27	12.84±1.45*	-3.68	58.82	0	0.5

CG: Control Group; IG: Intervention Group. *: P<0.05. The difference between the intervention group posttest and the experimental group posttest was significant.

5. Discussion

This study assessed the gross motor skills of children with intellectual disabilities by using the TGMD-2 test instrument and confirmed that a 12-week soccer training program achieved significant results in enhancing their gross motor skills, further supporting the idea that physical activity positively affects children's motor skills and coordination [27,28]. This study provides useful guidance for the rehabilitation training and development of children with intellectual disabilities and highlights the important role of physical activity in the development of gross motor skills in children with intellectual disabilities.

Due to their unique physiological and neurodevelopmental conditions [29], children with intellectual disabilities can have positive adaptive changes to physical exercise, and although they may face some motor deficits [30], due to the plasticity of their neurological and muscular systems [31], they can gradually improve their motor abilities through appropriate training [32]. And soccer, as a whole-body sport, can promote the development of muscle coordination, balance and motor skills in children with intellectual disabilities in several ways [33].

The research team conducted a detailed assessment of the static balance of children with intellectual disabilities and examined the effects of 12 weeks of soccer training on their static balance. The study found that children with intellectual disabilities who underwent soccer training made significant improvements in several measures of static balance at post-test. This finding provides strong support for a deeper understanding of the positive role of motor interventions in the development of children with intellectual disabilities [34].

We conducted a comprehensive assessment of the dynamic balance of children with intellectual disabilities through the balance beam walking test. The results showed that the difference between the dynamic balance post-test results of the control group and the pre-test was significant ($p<0.05$). This suggests that even in the absence of external intervention, children with intellectual disabilities show improvement in their dynamic balance ability over time. However, more encouragingly, the dynamic balance post-test results of the intervention group also showed a significant difference ($P<0.05$) when compared to the post-test results of the control group. This implies that the 12-week soccer training had a more positive impact on the dynamic balance of the children with intellectual disabilities. This result further validates the effectiveness of soccer training in enhancing dynamic balance in children with intellectual disabilities [35].

In conclusion, soccer training has been shown to be of significant value in improving muscle strength, coordination and motor skills in children with intellectual disabilities [36,37]. This training covers a wide range of gross motor movements such as running, jumping and rolling [38], thus effectively contributing to the overall physical development of children with intellectual disabilities. Through these varied activities, children with intellectual disabilities can acquire better muscle coordination [39], improve neurological adaptations [40], and enhance coordination between different body parts [41]. This has a positive impact on their athletic performance and movement control in daily life [42].

Of particular note, soccer, as a whole-body sport, is important for the development of balance [43]. In soccer training, children with intellectual disabilities are required to maintain stability while running, changing direction and controlling the ball [44]. This requirement helps to improve their balance and enables them to maintain physical stability in a rapidly changing environment [45]. Through a 12-week soccer training program, children with intellectual disabilities can make significant progress in their balance skills.

This study emphasizes the importance of soccer training in improving the basic motor skills of children with intellectual disabilities. However, we must also recognize that the sample size of this study was relatively small and the intervention period was only 12 weeks, so larger and longer studies are needed to validate its long-term effects [46], in order to provide more comprehensive support for the rehabilitation and development of children with intellectual disabilities. In addition, considering that different types of intellectual disabilities may have different impacts on training effects [47,48], we need to pay more attention to individualization and differentiation when designing intervention programs for children with intellectual disabilities [49]. We look forward to more in-depth studies in the future in order to reveal more comprehensively the multiple benefits of physical education and sport in the development of children with intellectual disabilities, so as to provide more comprehensive support for their growth and social integration.

6. Conclusions

A 12-week soccer training program promotes the development of basic skills in children with intellectual disabilities. Soccer training has significant value in improving muscle strength, coordina-

tion and motor skills in children with intellectual disabilities. Soccer, as a whole-body sport, has positive effects in developing gross motor skills and balance in children with intellectual disabilities

7. Funding

This study was funded by the National Social Science Foundation of China (BLA150063), The Discipline Crossing Fund Project of Beijing Normal University (BNUXKJC2012), The National Social Science Fund of China(21BTY023).

8. Acknowledgments

We would like to thank the National Social Science Foundation Programme, the Interdisciplinary Foundation Programme of Beijing Normal University and the Shahe Sunshine Football Club for their support of this study.

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