



OPEN Effect of cognitive-behavioral therapy-based physical play intervention on empathic ability of children with intellectual disabilities

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Purpose The purpose of this study was to investigate the potential of cognitive-behavioral therapy-based sports game intervention in enhancing empathy abilities among children with intellectual developmental disorder. **Methods** Thirty-one children aged 7–8, diagnosed with intellectual developmental disorder and attending mainstream schools, were enlisted for this study. They were randomly allocated to either the experimental group (n = 17) or the control group (n = 19). Both groups participated in regular physical activities of similar frequency and consistency throughout the study duration. Additionally, the experimental group underwent an 18-week cognitive-behavioral therapy-based sports game intervention. The Griffith Empathy Measure (GEM) questionnaire was administered to comprehensively evaluate the impact of the intervention program on the participants' empathy abilities. **Results** No statistically significant discrepancies were observed in the total scores and factor scores of the GEM pre-test between the experimental and control groups (GEM pre-test: $p = 0.974 > 0.05$). However, following the intervention, the experimental group exhibited notably higher total scores and factor scores in the GEM post-test compared to their pre-test scores, and these scores were significantly higher than those of the control group post-test scores. **Conclusion** Cognitive-behavioral therapy-based sports game intervention can effectively promote the development of empathy abilities in children with intellectual developmental disorder.

Keywords Sports game intervention, Empathy abilities, Children with intellectual developmental disorder, Cognitive-behavioral therapy

Intellectual disability, also known as intellectual developmental disorder (IDD), is characterized by deficits in cognitive functioning and adaptive behaviour¹. Adaptive behavior impairment is one of the defining parameters of intellectual disability (ID) and represents a hierarchical multidimensional construct that includes practical, conceptual, and social skills, as well as physical and vocational competences^{2,3}. The development and differentiation of adaptive functioning are crucially dependent on the first three factors (practical, conceptual, and social skills)⁴. Compared to typical children, children with IDD have a higher probability of experiencing typical health and psychological deficits, such as attention, memory, and executive function disorders, as well as social difficulties⁵. Among these, social difficulties are more pronounced in inclusive settings and can lead to children being on the periphery of learning and social life for an extended period⁶. The reason for this is twofold. First of all, there is a decrease in intellectual capacity, causing children to struggle with expressing and articulating their thoughts clearly, which often leads to misunderstandings. Secondly, there is an impaired emotional adaptation, resulting in children being unable to effectively navigate various situations. This often leads them to isolate themselves and avoid social interactions as a coping mechanism⁷. Consequently, most intellectually disabled children face difficulties in socializing and achieving self-fulfillment. Many studies have shown that inclusive education creates an equal learning environment, providing more opportunities for children with intellectual and special needs to develop their social, emotional, and behavioral skills^{8,9}. In inclusive education, the positive attitude of typical children towards accepting children with special needs is a crucial factor for their successful integration into the learning environment^{10,11}. Despite the positive outcomes

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brought about by changes in education policies, there still exist numerous obstacles in reality. For instance, some teachers, peers, parents, or leaders continue to discriminate against this group and are unwilling to accept such children in the educational process¹². Therefore, in order to improve the current situation of children with IDD in inclusive education environments, it is not only necessary to establish a fair and inclusive social environment but also to actively adopt various methods and approaches to help this group enhance their cognitive abilities and adaptive functioning.

Empathy has a multidimensional structure, consisting of cognitive empathy and emotional empathy. Cognitive empathy refers to the ability to infer others' emotional states and understand their feelings and emotions. Emotional empathy refers to the ability to indirectly experience and share the emotions of others^{13,15}. Empathy is an important social emotional skill, and the improvement of empathy levels can stimulate the development of prosocial behaviour and enable appropriate responses to others' emotions. Compared to typical children, children with IDD face obstacles in understanding and expressing empathy and its various components^{16,17}. As a result, many children with IDD struggle to form and maintain interpersonal relationships, leading to a lack of intimate and meaningful social connections¹⁸. Although there are differences in empathy among children with different symptoms¹⁹, it still affects their social development. Studies have demonstrated that empathy can be enhanced through training²⁰. Empathy training within a school setting can be classified into different categories, including experiential training (where instructors facilitate "experiences" such as games and role-playing), didactic (based on lectures), skill training (involving lectures, demonstrations, and practice), and mixed methods²¹. Many of these methods are similar to those used in behavior skills training, involving modeling, instruction, rehearsal, and feedback.

Cognitive Behavioral Therapy (CBT) is widely used as an effective psychological treatment approach in clinical settings²². In early research, there has been some controversy regarding the effectiveness of CBT for individuals with IDD. The main reason for this is that individuals with IDD may have cognitive impairments that make it difficult for them to engage in cognitive-based psychotherapy²³. However, recent studies have found that CBT can be effective in treating psychological issues in adults with IDD^{24,25}. Additionally, CBT may also have therapeutic potential for children with IDD, as some of them have the ability to recognize thoughts, feelings, and behaviours, and can establish connections between them, which are fundamental elements of CBT. Therefore, before conducting CBT with children with IDD, various cognitive, executive, and communication factors need to be considered in order to maximize treatment effectiveness⁵. For example, for children with IDD who have poor attention, CBT therapy can incorporate methods that capture their interest, such as colorful pictures, computer animations, and task-oriented games^{26–28}. For children with IDD who have executive function impairments, they may exhibit poor response inhibition and impulsive behaviours, including interrupting the therapist. This can be managed by redirecting attention and establishing treatment rules, such as not interrupting when the other person is speaking. The rules should be clear and concise, accompanied by visual reminders of appropriate behaviour²⁹. Although CBT has therapeutic potential for addressing psychological issues in children with IDD, there is limited research on CBT specifically targeting empathy in children. However, CBT interventions do incorporate techniques necessary for empathy training, such as role-playing and game tasks. Thus, it is feasible to combine CBT with empathy training for children with IDD who have the ability to recognize thoughts, feelings, and behaviours.

There is a correlation between physical activity and empathy. Research has illustrated that children and adolescents who engage in sports exhibit higher levels of empathy compared to those who do not participate in any physical activity^{30–32}. Kwon (2018) conducted a study involving teenagers who were involved in school basketball, dance, badminton, yoga, and soccer clubs. The study found that the intensity of sports had no impact on the empathy skills of students, but the frequency of participation in sports was positively correlated with empathy skills³³. Sood (2017) examined players in different positions in men's basketball and found no differences in empathy among point guards, shooting guards, power forwards, small forwards, and centers. This suggests that different energy-consuming activities and various types of sports can have a positive impact on empathy. It is more important to engage in physical activity itself than the specific way it is done.

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Therefore, combining CBT with exercise intervention integrates treatment education, cognitive restructuring, and exposure into the exercise intervention program, making it more targeted. Sports games are chosen as one of the best ways for children and adolescents with IDD to participate in physical activities due to their status as a product of physical cognitive potential^{34,35}. Physical potential encompasses physical health, while cognitive potential encompasses intelligence, which is a multidimensional domain that consists of reasoning, planning, decision-making, rapid learning, and learning from experience³⁶. Sports play a vital role in boosting the self-confidence of individuals with IDD and facilitate interaction and collaboration with individuals of different illness. Consequently, the research aims to investigate the impact of sports game interventions based on Cognitive Behavioral Therapy (CBT) on the empathy abilities of children with Intellectual Developmental Disorder (IDD) in inclusive education at the elementary school level (with intellectual abilities above the borderline, IQ > 70).

Materials and methods

Participants

The sample size required for the experiment was calculated using G-power 3.1.9.7 (Dusseldorf, Germany). Since this is a two-factor repeated measures ANOVA with time (2) \times group (2), we selected Repeated measures, within-between interaction (ANOVA) with a statistical power (1-B) set to 0.80 and a significance level (alpha) of 0.05. Based on a statistical power of 0.80, the effect size for the medium interaction effect of time \times group was set to ES (Effect size) = 0.30, resulting in a total sample size of 28 participants, with at least 14 participants in each group. Given that the study focused on children with IDD, and considering a potential 20% loss in sample size, the sample size was further increased during recruitment, resulting in a total of 36 participants. Recruitment of 40 typically developing IDD children, aged 8–9 years, attending regular mainstream schools, as research subjects, with the following selection criteria: (1) Participants recruited must meet the criteria for mild intellectual disabilities outlined in the Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition), with an IQ of 70 or above; (2) Ages between 8 and 9 years old; (3) All recruited participants undergo the Peabody Picture Vocabulary Test (PPVT) and the Brockport Physical Fitness Test (BPFT) to ensure adequate language comprehension and motor skills; (4) Normal or corrected-to-normal vision; (5) Participants voluntarily participate, and parental informed consent is required, with research approved by the school's ethics committee (approval number: ECMUC2023013CO), all methods were performed in accordance with the relevant guidelines and regulations which the 1964 Declaration of Helsinki conducted. The trial was prospectively registered at <http://www.chictr.org.cn/> as ChiCTR2400085468 and on 07/06/2024 Registration was completed. Exclusion criteria: (1) Children with motor impairments; (2) Children who do not cooperate with interventions; (3) Children whose guardians do not consent.

The participant screening process is shown in Fig. 1. To begin with, the 40 recruited children with IDD attending regular classes underwent PPTV and BPFT tests, resulting in the exclusion of 4 children who did not meet the criteria. One child's PPTV test result differed significantly from those of the other children. Additionally, three children underwent the BPFT test; one was unable to complete basic running and jumping movements due to leg issues, while the other two were unable to concentrate and complete all the tests, leading them to withdraw from the testing activities midway. Subsequently, group selection is based on age factors using stratified cluster randomization, the experimental group ($N=18$) and the control group ($N=18$). Finally, after removing data from dropouts and invalid data, a total of 31 participants actively participated in the intervention (experimental group $N=14$ and control group $N=17$).

Scales

- 1) Peabody Picture Vocabulary Test (PPTV) used the revised PPTV-R by Sang and Miao (1990), which is more suitable for assessing the language abilities of Chinese children. The test consists of 120 picture boards, with each board containing four pictures. Participants are required to select the picture that best matches the given verbal prompt. The final score is automatically calculated upon completion of the test.
- 2) Peabody Picture Vocabulary Test (PPTV) used the revised PPTV-R by Sang and Miao (1990), which is more suitable for assessing the language abilities of Chinese children. The test consists of 120 picture boards, with each board containing four pictures. Participants are required to select the picture that best matches the given verbal prompt. The final score is automatically calculated upon completion of the test.
- 3) Griffith Empathy Measure (GEM) is a tool adapted by Dadds et al. (2008) from the "Bryant Empathy Index Scale" (Child and Adolescent Version). The questionnaire is composed of 23 items, including two basic dimensions: cognitive empathy and affective empathy. The former has 6 items, while the latter has 9 items. Some questions have been adjusted based on the research objectives. The Likert 9-point scale was used to mark the responses, where -4 represents strongly disagree and 4 represents strongly agree. The main focus of this version of the questionnaire is to assess the empathy skills of children with special needs. It has passed reliability tests (Cronbach's alpha coefficient exceeds 0.8) and validity tests (test-retest reliability also exceeds 0.8). Additionally, the RMSEA = 0.07, CFI = 0.91, TLI = 0.88, indicating good structural validity of the entire questionnaire, making it suitable for this study (for detailed content, please refer to the appendix).

Experimental design

Used a 2 (experimental group, control group) \times 2 (pre-intervention, post-intervention) factorial mixed design, with group as the between-subjects factor and time as the within-subjects factor, the study examines the development of prosocial behaviour and empathy abilities in children with IDD in inclusive classrooms. The independent variable is the CBT sports game intervention program, and the dependent variable is the development of prosocial behaviour and empathy abilities. The experiment contains three parts: (1) pre-intervention testing of prosocial behaviour and empathy levels in children with IDD in inclusive classrooms, (2) a 18-week CBT group game intervention, and (3) post-intervention testing of prosocial behaviour and empathy abilities in children with IDD in inclusive classrooms.

Due to the differences in educational stages among the participants, in order to control experimental variables, it was ensured that there were no significant differences in verbal intelligence, physical fitness, and empathy between the experimental group and the control group children. In addition, both groups of children were provided with regular physical activities of the same frequency and homogeneity. The intervention for the experimental group children was conducted in a dance studio within the school, which the participants were more familiar with. Each intervention session included one main instructor and two or three assistant personnel. The main instructor was responsible for maintaining the pace of the activities, while the assistant personnel helped the children overcome any confusion and quickly adapt to the content of the activities. The intervention lasted for 18 weeks, with four sessions per week, each lasting 50 min³⁸.

CONSORT-2010 Flow Diagram

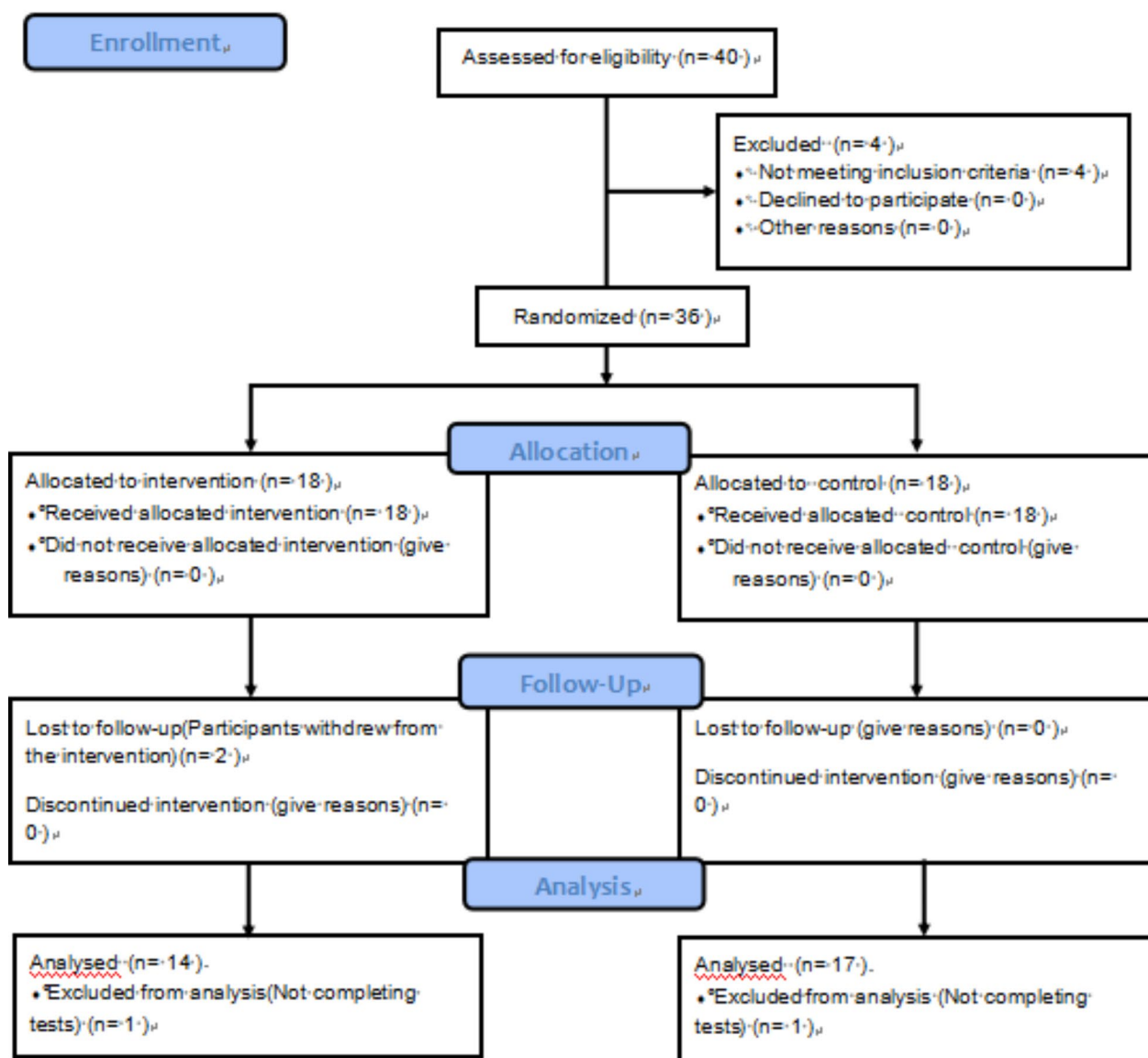


Fig. 1. Flowchart of experimental subject screening process.

Procedures

Intervention

The intervention program is divided into two main modules: basic training and developmental training. Basic training focuses on emotion recognition and involves low-difficulty sports game interventions. Developmental training, on the other hand, primarily focuses on social training such as “pro-social” skills and includes interventions using sports games of low-medium to medium difficulty.

According to the meta-communicative theory in play, children often exhibit implicit actions or expressions during the game. If the other party can receive and understand this information in a timely manner and respond accordingly, the activity can proceed smoothly. However, in the group of IDD children who attend regular classes, they lack this cognitive ability. For example, they may have difficulty recognizing and understanding their peers' information or may provide incorrect responses, which creates many obstacles for them to integrate into collective life. Lana et al. (2010) found a positive correlation between facial expression recognition ability and cognitive empathy³⁷. Heward et al. (2007) discovered a close relationship between different facial expressions displayed by individuals when witnessing others facing difficulties (such as fear and calmness) and their subsequent prosocial behaviour³⁹. Participants who were able to recognize fearful expressions exhibited more prosocial behaviour in later experiments⁴⁰. Heward et al. (2007) also suggested that the recognition of fearful facial expressions may trigger participants' emphatic responses, which in turn lead to the generation of prosocial behaviour. Therefore, correctly identifying one's own or others' expressions and emotions is a crucial step and the first part of the cognitive-behavioral model. According to the theory of children's motor skill development, the design of movements should follow a sequence from simple to difficult, with single and simple exercises laying the foundation for more complex actions in the future.

Based on the development objectives, create a clear theme and choose appropriate social stories that align with the theme. Each activity was introduced with a social story, followed by sports games. The design and movements of the sports games were centered around the theme. Develop intervention plans in a logical sequence that correspond to each step, making them more feasible. The specific details of the plan are outlined in Table 1.

Inspired by the cognitive-behavioral model, the implementation path of the sports game intervention program is set as "warm-up", theme guidance, exploration experience, and summary reflection in four stages, as shown in Fig. 2.

- (1) Warm-up: this part is aimed at "awakening", helping participants open up their minds and bodies, and prepare for the start of the activity.
- (2) Theme guidance: this part is aimed at "cognitive construction" using social stories to help participants experience different emotions, accumulate various emotional experiences, continuously introduce new cognitive concepts, gradually enhance participants' cognitive levels, and cultivate their empathy. The core content of this part lies in the "theme" of the activity, indicating the social emotions and values covered in the theme

Modules	Stages	Developing target	Sports game content
Basic training 1–3 weeks	Emotion and Facial Expression Recognition	Understanding basic facial expressions and emotions such as happiness, sadness, anger, and fear, and being able to imitate them.	(1) Theme Names: - Guessing Peer Expressions - Relay of Peer Expressions (2) Low difficulty sports game actions: - Rhythmic Stepping - Rhythm Clapping - Directional Jumping - Switching Feet Jumping
	Self-Emotion Recognition	Initiating the expression of one's own feelings and emotions.	
	Recognition of Others' Emotions	Identifying the emotions of the protagonist in social stories.	
Development training 4–18 weeks	Compliance with Norms	Adhering to social norms and encouraging others to follow the rules.	(1) Theme Names: - Command Game (Listening, Counter, Passing Commands) - Civilized Little Guardians - Queue Formation Command Game - Imitating Traffic Police Game (2) Medium-low difficulty sports game movements: - Multi-directional Rhythmic Steps (Parallel, Open-Close, Lunge, etc.) - Crawling in Different Directions (Kneeling, Push-up, and Supine Crawling) - Throwing, Hitting, and Rolling Balls
	Relationality	Developing helpful, cooperative, and inclusive behaviours towards others.	(1) Theme Names: - Fighting the Evil Wolf Together - Relay Race - Crawling Competition - Hoop Jumping, Ring Tossing, Ball Throwing, and Jump Rope Competition - Strength Competition (2) Medium-low difficulty sports game actions: - Forward Rolls - Compound Rolling in Multiple Axes
	Altruism	Cultivating altruistic behaviour, proactive sharing behaviour, and empathetic comforting behaviour.	(1) Theme names: - Hugs of Love (hugging teachers and peers according to specific numbers) - Holding Hands and Crossing the River (2) Medium difficulty sports game actions: - Continuous hoop diving, hoop jumping; two or more people coordinating throwing and rolling balls back and forth
	Trait	Cultivating qualities such as honesty, trustworthiness, optimism, and self-confidence.	(1) Theme names: - Respecting the elderly and loving the young role play - I am a Guide Dog (blindfolded obstacle course) (2) Medium difficulty sports game movements: - Running and jumping, crawling (using equipment such as hoops, footprints, yoga bricks to disrupt the order, two-person cooperation) - Two or more people coordinating rhythmic gymnastics with light equipment (coordinating throwing and rolling hoop balls)

Table 1. Sports game intervention scheme based on cognitive-behavioral model.

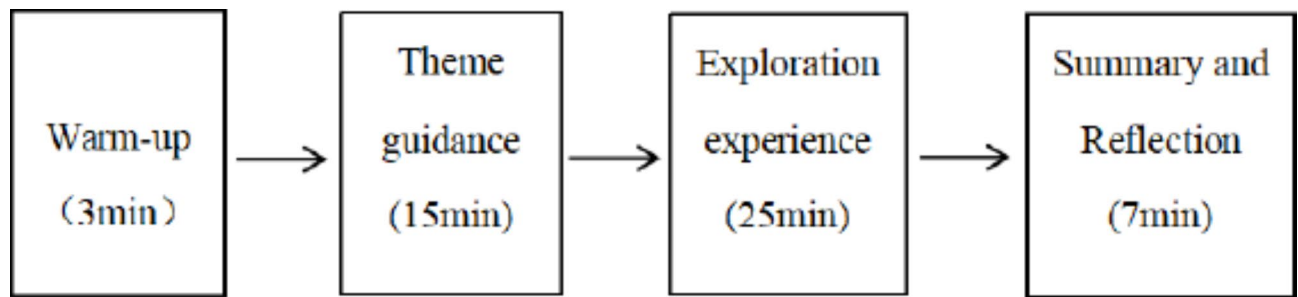


Fig. 2. Implementation process of sports game intervention program.

story, laying the groundwork for subsequent exploratory experiences, and serving as a bridge between the warm-up section and the exploratory experience.

- (3) Exploration experience: This is the core part of the sports game intervention, where the emotional cognition and experiences proposed in the previous section are implemented into specific activities. Children engage in independent exploration and experience various types of sports games, continuously practicing and strengthening their empathy skills.
- (4) Summary and Reflection: The purpose of this is “feedback and adjustment”, guiding participants to actively express their thoughts and experiences, using this as a basis to expand and extend the learned skills into real life.

Taking “Peer Emotion Relay” as an example: (a) Warm-up: Use multimedia to display images of various expressions, allowing children to gain a preliminary understanding of different emotions. (b) Theme Guidance: Watch short scenario stories featuring different themes, such as happiness and anger, to immerse children in the experience and express their feelings, thereby cultivating their empathy skills. (c) Exploration Experience: Divide the children into four groups. Each group selects one child to express their current feelings through facial expressions (without informing others). The other children must imitate the expression while completing simple physical activities. This continues until the last child guesses what the first child’s emotion was after completing the activity. (d) Summary and Reflection: Encourage children to actively express their thoughts and experiences after completing the physical activities.

Statistics

All data were analyzed for normality and homogeneity of variance using SPSS 20.0. One-way ANOVA was used to compare the inter-group differences of all indicators at baseline. When baseline homogeneity was confirmed, two-way repeated measures ANOVA (group \times time) was employed to compare the effects of different types of exercise on the empathy abilities of children with IDD. Mauchly’s sphericity test was used to assess the homogeneity of variances. When the results did not meet the sphericity assumption, the Greenhouse-Geisser method was applied for correction, and LSD was utilized for post-hoc testing. A partial eta squared (η^2) was computed to check the differences between groups, where 0.01 to 0.059 was determined as a small effect, 0.06 to 0.137 as a medium effect, and > 0.138 as a large effect.

Results

Homogeneity testing and analysis of experimental and control groups before the experiment

Before the experiment, a one-way analysis of variance was conducted on the PPTV, BPFT, and empathy test results of participants in the experimental and control groups. The results showed that there were no significant differences in PPTV ($p = 0.839 > 0.05$), BPFT ($p > 0.05$), and empathy ($p = 0.974 > 0.05$) between the two groups, indicating that the levels of verbal intelligence, physical fitness, and empathy of participants with intellectual disabilities in the experimental and control groups were homogeneous before the experimental intervention, as shown in Table 2.

Results and analysis of the impact of sports game intervention based on the cognitive-behavioral model on children’s empathy competency

As shown in Tables 3 and 4, using repeated measures ANOVA to analyze the separate and interaction effects of group and time factors on empathy competency, the results show: In terms of empathy competency, cognitive empathy ($F = 13.407, P = 0.067 > 0.05, \eta^2 = 0.316$), emotional empathy ($F = 5.247, P = 0.059 > 0.05, \eta^2 = 0.153$), and overall empathy competency ($F = 14.236, P = 0.173 > 0.05, \eta^2 = 0.329$) did not show significant main effects over time, indicating that there was no significant time trend in empathy competency of children with IDD attending mainstream classes; cognitive empathy ($F = 9.51, P = 0.004 < 0.01, \eta^2 = 0.247$), emotional empathy ($F = 9.79, P = 0.03 < 0.05, \eta^2 = 0.252$), and overall empathy competency ($F = 15.987, P = 0.02 < 0.05, \eta^2 = 0.355$) showed significant differences in the main effects of group, indicating significant differences in empathy competency between the experimental and control group children; cognitive empathy ($F = 12.937, P = 0.001 < 0.01, \eta^2 = 0.308$), emotional empathy ($F = 8.36, P = 0.031 < 0.05, \eta^2 = 0.224$), and overall empathy competency ($F = 17.636, P = 0.02 < 0.05, \eta^2 = 0.378$) showed significant differences in the interaction effects of

Measurement index		Experimental group(<i>n</i> = 14) M ± sd	Control group(<i>n</i> = 17) M ± sd	<i>P</i>
Age	-	7.00 ± 0.63	7.05 ± 0.85	0.839
Ppvt	-	74.79 ± 1.19	75.15 ± 1.09	0.609
Bpft	BMI	16.01 ± 3.51	17.60 ± 3.31	0.178
	30 sit-ups (reps)	14.63 ± 3.44	12.79 ± 3.57	0.133
	Back lift (cm)	26.25 ± 2.46	25.58 ± 6.20	0.548
	Dumbbell lift (reps)	24.25 ± 4.52	27.05 ± 6.86	0.067
	Sit and reach (cm)	8.95 ± 6.87	10.25 ± 5.82	0.687
	10 m shuttle run (m)	77.19 ± 10.64	78.68 ± 47.19	0.348
Empathy	Cognitive Empathy	33.92 ± 4.94	33.22 ± 4.17	0.067
	Emotional Empathy	31.30 ± 4.608	32.00 ± 4.65	0.059
	Total Empathy Score	65.23 ± 8.47	65.22 ± 5.38	0.173

Table 2. Homogeneity testing results in the experimental group and control group. Note: * in the table indicates $P < 0.05$; ** indicates $P < 0.01$; PPTV: Peabody Picture Vocabulary Test; BPFT: The Brockport Physical Fitness Test; BMIbody mass index.

Categories	Pre-experiment		Post-experiment	
	Experimental group	Control group	Experimental group	Control group
Cognitive empathy	33.92 ± 4.94	33.22 ± 4.17	39.15 ± 2.85	32.18 ± 4.18
Emotional empathy	31.30 ± 4.608	32.00 ± 4.65	38.54 ± 1.94	32.28 ± 4.28
Empathy	65.23 ± 8.47	65.22 ± 5.38	77.69 ± 3.95	64.56 ± 6.48

Table 3. Descriptive statistics of empathy competency before and after the experiment (M ± SD).

Interaction	Categories	F	<i>P</i>	η_p^2
Time	Cognitive empathy	13.407	0.067	0.316
	Emotional empathy	5.247	0.059	0.153
	Empathy	14.236	0.173	0.329
Group	Cognitive empathy	9.51	0.004**	0.247
	Emotional empathy	9.79	0.03*	0.252
	Empathy	15.987	0.02*	0.355
Time*Group	Cognitive empathy	12.937	0.001**	0.308
	Emotional empathy	8.36	0.031*	0.224
	Empathy	17.636	0.02*	0.378

Table 4. ANOVA of the impact of sports game intervention based on the cognitive-behavioral model on empathy competency. Note: * in the table indicates $P < 0.05$; ** indicates $P < 0.01$.

time × group, indicating significant differences in empathy levels between the experimental and control groups before and after sports game intervention based on the cognitive-behavioral model.

In order to further verify the effectiveness of sports game intervention based on the cognitive-behavioral model in developing empathy in children with IDD, a simple effect analysis of the interaction between time and group was conducted, and the results are shown in Figs. 3 and 4.

Before the experiment, there were no significant differences in empathy between the experimental group and the control group, including cognitive empathy ($F = 0.047$, $P = 0.83 > 0.05$, $\eta_p^2 = 0.002$), emotional empathy ($F = 0.068$, $P = 0.079 > 0.05$, $\eta_p^2 = 0.043$), and total empathy score ($F = 0.048$, $P = 0.076 > 0.05$, $\eta_p^2 = 0.037$).

After the experiment, there were significant differences in empathy between the experimental group and the control group, including cognitive empathy ($F = 19.393$, $P = 0.011 < 0.05$, $\eta_p^2 = 0.495$), emotional empathy ($F = 17.002$, $P = 0.037 < 0.05$, $\eta_p^2 = 0.474$), and total empathy score ($F = 36.538$, $P = 0.003 < 0.05$, $\eta_p^2 = 0.608$). This indicates that sports game intervention based on the cognitive-behavioral model has a significant promoting effect on empathy in children with IDD.

Discussion

Comparison results of changes in GEM scores of two groups of participants before and after the intervention show that the empathy-promoting effect of sports game intervention based on CBT on children with IDD is

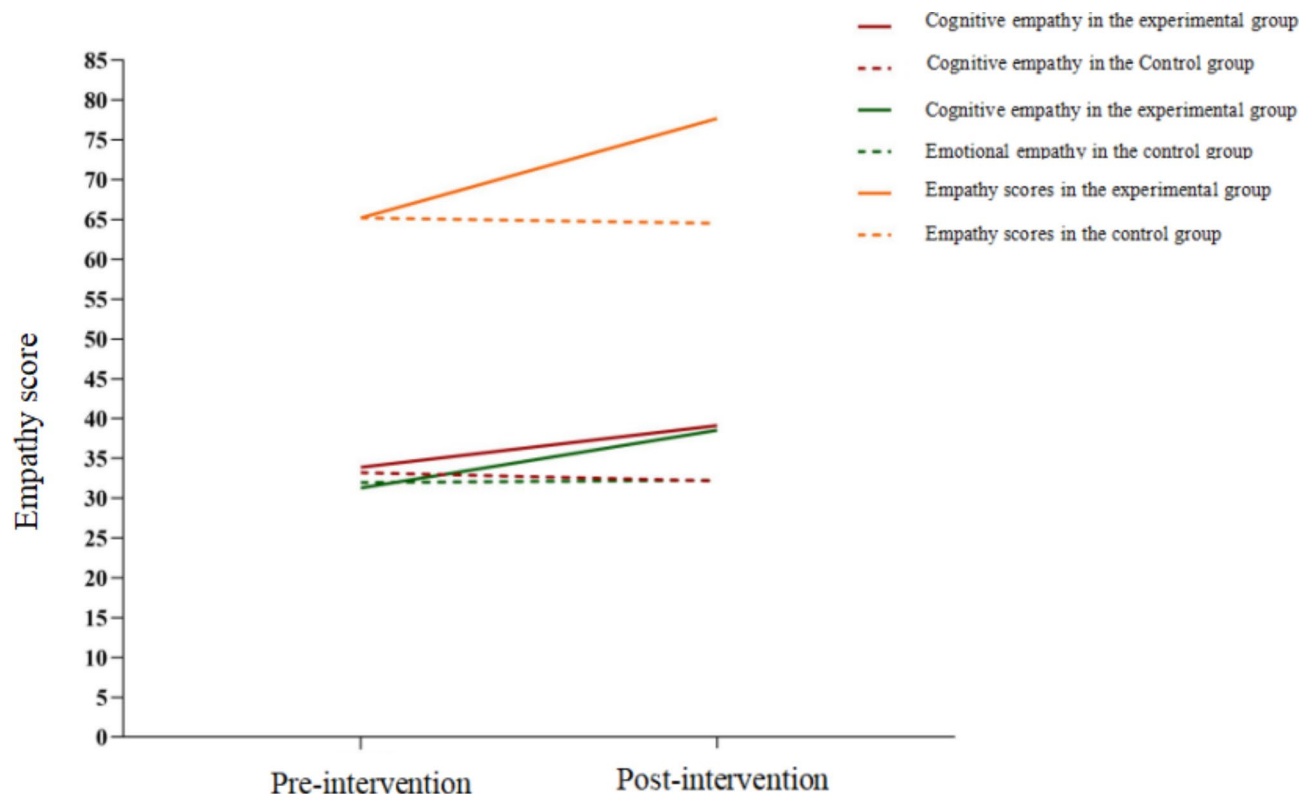


Fig. 3. Changes in empathy scores before and after interventions in different groups.

significant. Among them, the promotion effect of cognitive empathy on children is more significant than that of emotional empathy, and the reasons for this are analyze as follows.

The research results indicate that sports games based on CBT enhance children's empathy levels. This study suggests that empathy in IDD children can be improved through training, which aligns with some conclusions in the literature^{41,42} Secer and Alabay (2011) found that empathy training for 5–6-year-old children living in social service institutions and child protection agencies positively impacted their social skills and reduced problematic behavior among them. In Kahraman (2007), the positive development of children's empathy skills was attributed to empathy training. These studies, along with current research, demonstrate that children's empathy skills can be developed through training. Özbal and Gönen (2023) investigated the empathy and prosocial behavior (helping and sharing) development of children who underwent empathy training. The results showed that the training program improved the empathy and prosocial behavior of children in the experimental group. Although different methods were employed in these studies, it can be proven that children's empathy can be enhanced through positive training, indicating the plasticity of children's empathy. Of course, the effectiveness of different training methods varies, and this study demonstrated the enhancement of cognitive empathy in IDD children through sports games based on CBT, as opposed to emotional empathy.

From a neurobiological perspective, the theory of internal imitation of others' behaviours by observers has been supported by brain mechanism studies. Functional magnetic resonance imaging now proves the existence of neural relay mechanisms, indicating that individuals with empathy imitate the unconscious behaviours of others, such as postures, gestures, and facial expressions, more than those without empathy⁴³. Participants unconsciously imitate the actions and facial expressions of others through brain mechanisms, primarily reflecting the actions of others by stimulating the same motor and sensory areas in the observer's brain as those being observed. This mirroring ability has been demonstrated at the level of individual muscle fibers. For example, if a person's hand muscles are pricked with a needle, the same motor and sensory areas in the observer's brain will be activated⁴⁴. Studies also indicate that when patients imitate or simply observe emotional facial expressions, similar brain region networks are activated in the observer. In this network, there is activity in simple observation of emotional faces, with greater activity when imitating emotions⁴⁵. In addition to the internal representations displayed on others' faces, shared neural circuits have also been shown to be used for tone, touch, disgust, and pain. Researchers conclude from these studies that observers' sensitivity to others' feelings is reduced. This is achieved through a neural action representation mechanism, which typically regulates the emotional content of the observer and triggers empathic responses. These differences in neural processes may be the reasons for individual differences in empathy⁴⁶. Due to the cognitive impairments present in children with IDD, the study ensured that all participants had an IQ greater than 70 during the selection process, indicating a certain level of cognitive ability. This was done to support the smooth implementation of sports game interventions framed within cognitive-behavioral therapy (CBT) and to ensure that cognitive training,

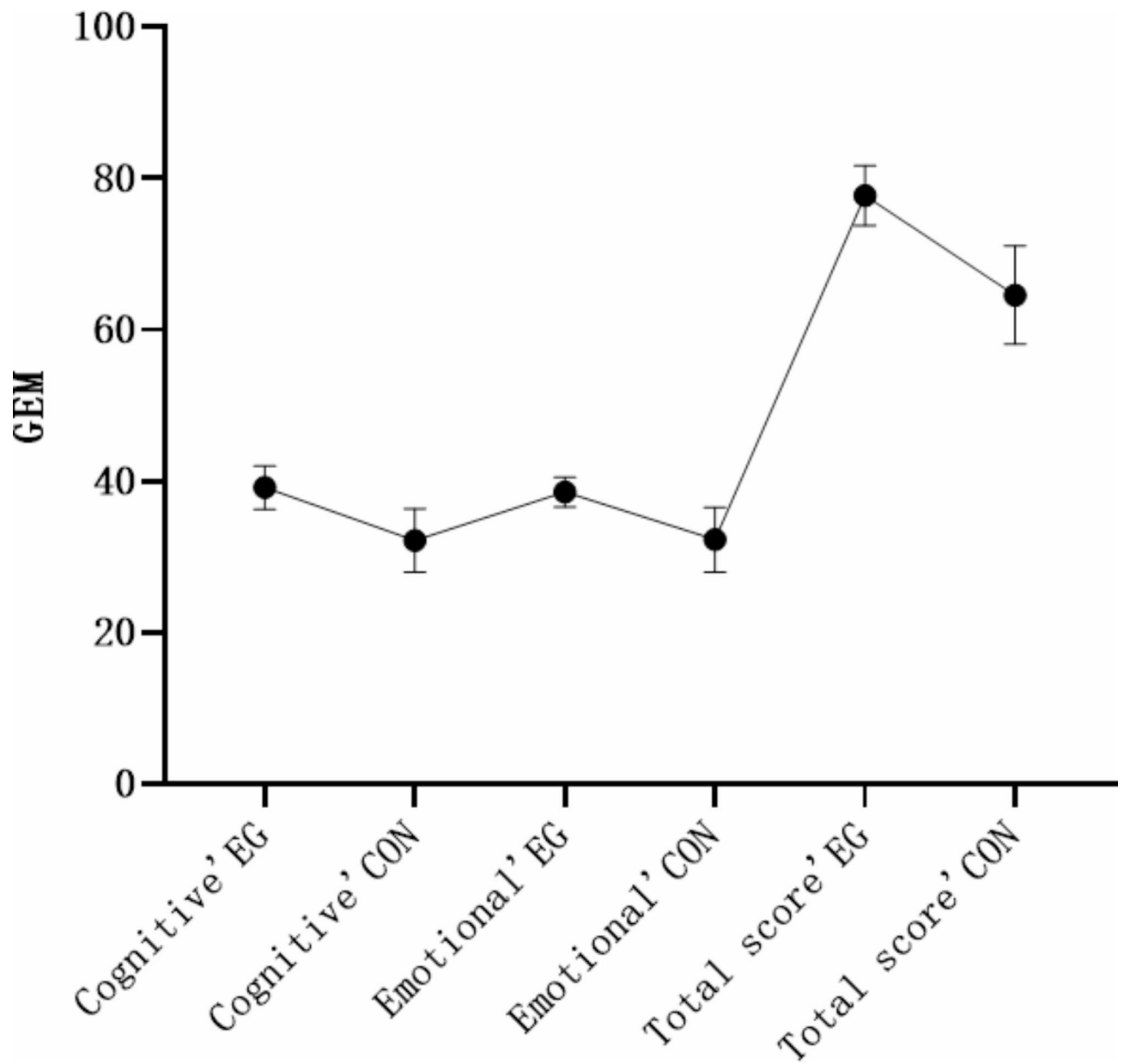


Fig. 4. Comparison of GEM scores between 2 groups after intervention. Note: EG: Experimental group; CON: Control group.

combined with CBT, was integrated throughout the activities. The foundational training component focuses on basic cognitive training for the children, helping them recognize their own emotions and the emotions of others. In the developmental training, there is a greater emphasis on using social stories with clear prosocial themes and creating sports game activities around these themes to continually reinforce higher-level cognitive awareness in children. This approach has a more significant promoting effect on children's cognitive empathy. Research indicates that empathy helps individuals connect with others; therefore, individuals often feel the strongest empathetic responses toward those who resemble them in appearance or behavior, those who have experienced similar suffering, or those who share common goals⁴⁷. For children with inherent cognitive impairments, the cognitive training within CBT-based sports game interventions cannot change the existing cognitive deficits. Instead, the aim of this research is to guide and reinforce how children can focus on their own feelings and those of others in certain situations, how to respond appropriately, and to develop their empathetic abilities. This will enable children to react appropriately in similar situations in the future.

From the perspective of the mechanisms of emotional empathy and cognitive empathy, Emotional empathy is a resonance of one's emotions, the ability to empathize with the emotional state of others⁴⁸. Cognitive empathy, on the other hand, involves recognizing the emotions of others and understanding their viewpoints. Research by Decety(2002) suggests that empathy begins with the automatic perception of emotions, but its ultimate manifestation requires top-down cognitive factors to regulate emotional empathy⁴⁹. Since children

with Intellectual and Developmental Disabilities (IDD) often have cognitive deficits, participants in studies are typically selected with an IQ above 70, indicating a certain level of cognitive ability necessary to support interventions primarily based on Cognitive Behavioral Therapy (CBT), such as sports games interventions, which can proceed smoothly with cognitive training integrated throughout the activities. The foundational training focuses on basic cognitive exercises for children, such as activities themed around “My Mood Diary”, aiding children in identifying both their own and others’ emotions. In developmental training, the emphasis shifts to reinforcing children’s higher-order cognitive awareness through social stories with clear prosocial themes and sports games activities designed around these themes, resulting in a more pronounced promotion of cognitive empathy in children. This aligns with the research of Kalliopuska and Tiitinen (1991), who found that activities involving storytelling and role-playing were more effective than those involving music and drawing in enhancing children’s empathy skills^{50,51}. Empathy helps individuals connect with others, so individuals often exhibit the greatest empathic responses towards those who resemble them in appearance or behavior, those who have experienced similar suffering, or those with shared goals. For IDD children with congenital cognitive deficits, cognitive training in sports game interventions based on CBT cannot alter the existing cognitive deficits but aims to guide and reinforce how children focus on both self and others’ feelings in certain situations, how to respond appropriately to others, enabling children to quickly respond suitably in similar situations in the future. Additionally, children’s empathic abilities are closely related to their prosocial behaviors, with empathy positively predicting behaviors such as helping, altruism, and cooperation.

In summary, the promotion of empathy in IDD children through sports games based on CBT also indirectly validates the intervention’s role in promoting prosocial behavior in IDD children. Thank you for your valuable suggestions. Based on your feedback, I have added a discussion of the study’s limitations and prospects for future research in the article.

Conclusion

The conclusion of this study is that sports game interventions based on CBT can effectively promote the development of empathy in children with IDD. Although the results indicate the effectiveness of the intervention for IDD children, the study also has some shortcomings: (1) Although the sample size calculated using G-power supports the results of this research, these findings only provide or supplement reference cases for the development of empathy skills in children with IDD in inclusive classrooms. The limited sample size is insufficient to support the conclusion of “suitability for large-scale implementation”; (2) The short duration of the study lacked longitudinal tracking and long-term efficacy evaluation. In future research, (1) it will be important to further expand the sample size and incorporate a longitudinal tracking experimental design to observe long-term effects; (2) promoting collaboration between families and schools is essential. The subjects of this study are children with IDD in inclusive schools, who have more opportunities to interact with typically developing peers compared to children in special education schools. However, prior observations indicate that group discrimination still exists. Therefore, effective integration into groups is an urgent reality for them. This research also aims to help these children genuinely integrate into collective life through a series of guided interventions, while improving the phenomenon of group discrimination. We need the joint efforts of families, schools, and society.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics statement

The Institutional Ethical Committee of the Minzu University of China approved all procedures and protocols (No. 2022-06-02-K01). Written informed consent has been obtained from the patient(s) to publish this paper. The patients/participants provided their written informed consent to participate in this study.

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Author contributions

GTD was responsible for conducting a literature review, conducting experiments, collecting data, and writing the manuscript. YW and HSH were responsible for the research concept and providing instructive guidance. HYC and TL were responsible for teaching management.

Declarations

Conflict of interest

The authors declare that they have no conflict of interest.

Additional information

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