Effects of Outdoor versus Indoor Exercise Program on Enjoyment, Development and Self-Perception of Motor Competence in Children

Effetti di un programma di esercizio fisico all'aria aperta rispetto al chiuso sul godimento, sviluppo e auto-percezione della competenza motoria nei bambini

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ABSTRACT

This study aimed to investigate the effects of a 6-week outdoor exercise program on children's enjoyment, development and self-perception of motor competence versus indoor. A total of 99 school-age children (6-8 years) were randomly allocated into an outdoor (OG, $n = 49$) or an indoor (IG, $n = 50$) group; the OG performed moderate to vigorous aerobic exercises and team games outdoors and the IG the same intervention program but indoors. At baseline and after the intervention, motor competence (i.e., locomotor skills and object control skills) was assessed through 6 motor tests from the Motorfit battery, and enjoyment and self-perceived motor competence (i.e., locomotor skills and object control skills) were assessed through the Physical Activity Enjoyment Scale – Italian Version (PACES-it) and Pictorial Scale of Perceived Movement Skill Competence (PMSC-2), respectively. After 6 weeks, compared to the IG, the OG showed significant improvements ($p < 0.001$) in: Motorfit tests, i.e. locomotor skills ($d = 0.69$) and object control skills ($d = 1.21$); PACES-it ($d = 0.56$); and PMSC, i.e. locomotor skills ($d = 0.49$) and object control skills ($d = 0.36$). No significant changes were found for the IG ($p > 0.05$). Findings show the positive impact of outdoor exercise programs on school-aged children's enjoyment, development and self-perception of motor competence versus indoor, highlighting the importance of environmental factors and the potential benefits of structured outdoor interventions.

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KEYWORDS
Physical Activity; Locomotor Skills, Object Control Skills, Motivation, Students
Attività Fisica, Abilità Locomotorie, Abilità di Controllo degli Oggetti, Motivazione, Studenti

Citation: Greco, G. et al (2024). Effects of Outdoor versus Indoor Exercise Program on Enjoyment, Development and Self-Perception of Motor Competence in Children. *Formazione & insegnamento, 22*(1S), 146-154. https://doi.org/10.7346/-feis-XXII-01-24_18

Authorship: Conceptualization (G. Greco, L. Poli); Methodology (G. Greco, L. Poli); Software (G. Greco, L. Poli); Validation (G. Greco, L. Poli, S. Cataldi); Formal analysis (L. Poli); Investigation (G. Greco, L. Poli); Resources (S. Cataldi); Data curation (G. Greco, L. Poli); Writing – original draft (G. Greco, L. Poli); Writing – review and editing (G. Greco, L. Poli, S. Cataldi, F. Fischetti); Visualization (L. Poli); Supervision (F. Fischetti). All authors have read and agreed to the published version of the manuscript.

Acknowledgments : The authors received no financial support for the research, authorship, and/or publication of this article.

Conflicts of interest: The Author(s) declare(s) no conflicts of interest.

DOI: https://doi.org/10.7346/-feis-XXII-01-24_18

Submitted: January 28, 2024 • **Accepted**: April 4, 2024 • **Published**: December 2, 2024

Pensa MultiMedia: ISSN 2279-7505 (online)

1. Introduction

The development of motor competence in children and the adoption of an active lifestyle, involving active participation and enjoyment in physical activity (PA), has been linked to numerous physical and mental health benefits (Barnett et al., 2016; Haga, 2008; Janssen & LeBlanc, 2010).

In the context of PA and sports, enjoyment is considered a positive response resulting from participating in PA which reflects feelings of pleasure and fun (Scanlan & Simons, 1992). Furthermore, the experience of fun during PA is associated with greater intrinsic motivation, higher participation in PA, and adoption of active and healthy lifestyles (Dishman et al., 2005; Jaakkola et al., 2017; Vitali et al., 2019; Wallhead & Buckworth, 2004).

Motor competence is a broad term which includes fundamental movement skill ability, involving locomotor, object control, stability factors (Gabbard, 2012) and motor coordination (Robinson et al., 2015). These are important because sporting activities and games need competence in fundamental motor skills (e.g., running, jumping, catching, throwing) for PA participation (Lubans et al., 2010).

Children with more effective motor competence are more prone to become physically active and fit adolescents (Barnett et al., 2016). This happens because children with better motor competence participate in higher levels of physical activity, and this helps to further develop higher actual and perceived motor competence (Stodden et al., 2008). Along with actual motor competence, self-perceived motor competence, that is an individual's perception of his or her actual abilities, is considered a primary motivational factor underlying voluntary participation in sports and PA (Harter & Pike, 1984). Therefore, understanding the reasons behind the pleasure in practising PA and the comprehension of the individual difference between effective motor competence and perceived motor competence could help researchers, parents, health professionals and educators design the most effective strategies of intervention to promote healthy lifestyles among school-age children.

Nowadays, to the best of our knowledge, few studies have investigated the relationship between the effective development of motor competence and perceived motor competence using objective measures (Barnett, Ridgers, & Salmon, 2015; Estevan et al., 2018; Liong et al., 2015; Pesce et al., 2018), and how the enjoyment may impact on them (Carcamo-Oyarzun et al., 2023; Fu & Burns, 2018). A systematic review of preschool children suggested that PA is a key cross-sectional correlate of motor competence, indicating that such associations at this young age are worth investigating (Iivonen & Sääkslahti, 2014). Studies in older children (10 years old) found childhood motor skill competence was a predictor of subsequent PA (Lopes et al., 2011).

The studies cited previously have investigated the development of motor competence, self-perceived competence and enjoyment through PA in an indoor environment. Our study, however, wanted to investigate these variables in an outdoor environment by comparing them with the indoor one. Research has shown that outdoor playtime is associated with higher levels of PA and is inversely associated with sedentary behaviours. Several studies of preschool children show that children who spend more time outdoors are more active and less sedentary than those who spend less time outdoors (Hinkley et al., 2008; Vanderloo et al., 2013). Outdoor exercise has been found to enhance executive functions dependent on the prefrontal cortex, such as attention, working memory, and inhibitory control (Basso & Suzuki, 2017; Chang et al., 2012). However, parents of young children often prefer indoor activities for their kids due to the support they provide for comfortable daily routines within the family schedule, considerations of safety, and the practicality of managing clothing (Solomon-Moore et al., 2018; Wiseman et al., 2019). Engaging in outdoor play is known to contribute to children's motor competence development by presenting various challenges for them to overcome and the opportunity to acquire new skills (Arja & Donna, 2021; Palmer et al., 2019; Saadu, 2022; Sutapa et al., 2021). However, since further research on this topic is needed, we wanted to study the effects of outdoor versus indoor exercise with our research.

Therefore, this study aimed to investigate the effects of a 6-week outdoor exercise program on children's enjoyment, development and self-perception of motor competence versus indoor. We hypothesized that an outdoor exercise program would improve enjoyment, development and self-perception of motor competence in school-aged children more than the indoor program.

2. Materials and Methods

2.1 Study Design

This study used a randomized controlled study design. A total of 99 school-age children (age range, 6-8 years) were randomly allocated into an outdoor (OG, n = 49; 29 males, 20 females) or an indoor (IG, n = 50; 28 males, 22 females) group; the OG performed moderate to vigorous aerobic exercises and team games outdoors and the IG the same intervention program but indoors.

Participants were paired according to gender and the randomization process was executed using Research Randomizer, a software available on the official website www.randomizer.org, accessed on July 26, 2023. The study was conducted during a summer program of a private primary school from 31 July 2023 to 8 September 2023. Both interventions consisted of a training program for 5 days a week, for 6 weeks, for a total of 30 sessions. Measurements were administered one week before the intervention (baseline) and after at least 72 hours the last training session of the intervention program (post-test).

2.2 Participants

A total of 99 school-aged children (M_{age} = 6.70, SD = ± 0.63, years) were voluntarily recruited to participate in the study from a local private primary school that continues its activities also in summer, without any didact

interruption. All the children came from the same town.

The following inclusion criteria were identified to recruit a convenience sample that could meet the needs of the study: participants had to be able to complete an exercise session and refrain from any physical activity outside the study protocol. Students with orthopaedic conditions that limit their ability to perform exercises were excluded from the study.

To establish the sample size needed for the study, an a priori power analysis (Faul et al., 2007) with an assumed type I error of 0.05 and a type II error rate of 0.10 (90% statistical power) was calculated and revealed that 46 participants in total would be sufficient to observe medium "time x group" interaction effects (f = 0.25). However, to account for possible drop-out, larger samples were recruited.

Before the study began, the intervention program, the purposes of the study, its contents and safety issues in accordance with the Declaration of Helsinki were explained to the children and their parents. Participants' anonymity was guaranteed, and all parents provided written informed consent before the study. The study was approved by the Ethics Committee of Bari University (protocol code 0015637|16 February 2023).

2.3 Procedures

For the OG, the intervention program was carried out in the outdoor soccer field or outdoor schoolyard (covered with a shade cloth) during the hottest hours of the day. For the IG, the same intervention was carried out in the school gym. The outdoor and indoor temperatures were similar. One week before the interventions, a special briefing was held to provide explanations of the exercise program, and participants were taken to the school gym to proceed with anthropometric measurements and performance of standardized gross-motor assessment tests to quantify children's motor competence. The next day, two psychological tests were administered to examine the participants' enjoyment of physical activity and motor competence perception. Participants performed both the pre-test and post-test at the same time of day and under the same experimental conditions. Participants were instructed to wear appropriate sportswear to limit possible variability within the test procedure and were instructed to avoid excessive physical exertion 24 hours before each test session. Students were tested individually, and each task was explained before participants began. Following the pre-test, students were randomly matched to one of two treatment conditions. All test measures and the intervention program were instructed, supervised, and executed by two experienced physical education teachers.

2.4 Measures

2.4.1. Anthropometrics

Students' weight and height were measured with a digital scale and a wall meter. Body mass index (BMI) was calculated using the following formula: subject's weight in kilograms divided by the square of height in meters.

2.4.2. Motorfit Tests

The evaluation included 6 motor tests, which are part of the Motorfit battery (Perrotta et al., 2011); it is based on the individually administered gross-motor development test (TGMD-2) that assesses the gross-motor function of children aged 3 to 10 years (Ulrich, 2002). Gross-motor development mainly involves skills that are used to move the body from one place to another (locomotion) and to move and pick up objects. This test quantifies motor coordination and, specifically, locomotor skill (segmental coordination and rhythmization) and object control skill (Oculo-segmental and spatio-temporal coordination) (Ulrich, 2002).

Participants performed the following tasks:

- Locomotor skills
  - Jumping forward on one foot
  - Lateral galloping
  - Hopping step forward on one foot
- Object control skills
  - Throwing a ball with one hand
  - Catching a ball with hands
  - Hitting a ball with a tennis racket

Under the supervision of two physical education teachers, with previous experience in administering these tests, each test was performed 4 times, and a score of 1 was assigned if the single test was performed correctly; otherwise, a score of 0 was assigned. Thus, the maximum score obtainable for each skill (locomotor or object control) was 12. Due to their simple and time-efficient implementation, these tests are simple and quick to perform. By requiring minimal equipment (i.e., excel file, chalks, cones, tennis balls, volleyballs, tennis rackets), their use is ideal for school context.

2.4.3. Psychological tests

Physical Activity Enjoyment Scale – Italian Version (PACES-it). The Physical Activity Enjoyment Scale (PACES) is a questionnaire designed to gauge an individual's enjoyment of physical activity (Carraro et al., 2008; Kendzierski & DeCarlo, 1991). This scale is intended to gauge the enjoyment of children involved in outdoor recreational physical activity. Comprising 16 items, respondents assign scores on a 5-point Likert scale, ranging from 1 (Disagree a lot) to 5 (Agree a lot). Of these items, nine are positive statements (e.g., " It gives me energy"), while seven are negative (e.g., "I feel bored") (Cronbach's alpha, 0.78 to 0.89) (Carraro, 2012). The scale has been slightly modified to make it easily understood by children and to reduce redundancy (Moore et al., 2009; Motl et al., 2001). PACES evaluates diverse facets of enjoyment, encompassing positive emotions, psychological engagement, and overall satisfaction with the activity (Carraro, 2012; Carraro et al., 2008). The internal consistency was highly reliable: = 0.88 (locomotor) and = 0.82 (object control). The score is calculated by adding the 16 items. A higher score reflects higher enjoyment.

Pictorial Scale of Perceived Movement Skill Competence. The Pictorial Scale of Perceived Movement Skill Competence for Young Children (PMSC) was used to assess children's perceptions of their motor competence (Barnett, Ridgers, Zask, et al., 2015; Barnett, Robinson, et al., 2015). It is an instrument asses-

sing 6 locomotor (run, gallop, hop, leap, horizontal jump, and slide) and 6 object control skills (striking a stationary ball, stationary dribble, kick, catch, overhand throw, and underhand roll), based on the Test of Gross Motor Development (TGMD-2) (Ulrich, 2002). Skills for each subscale on the PMSC are ordered so that a cartoon image of a child performing a skill competently is next to an image of a child performing a skill not as competently (Harter & Pike, 1984). Children were required to choose which picture was most like them (i.e., "this child is pretty good at throwing, this child is not that good at throwing, which child is like you?") and within the chosen picture were asked to further indicate their perceived competence. Options for the 'good' picture included: "really good at …" (score of four) or "pretty good at …" (score of three); and for the "poor" picture included: "sort of good at …" (score of two) or "not that good at …" (score of one). This resulted in four possible levels of competence for each skill (a four-point Likert scale (range 1–4)). Scores for each skill were summed into locomotor and object control subscales (with a possible range of scores for each subscale of 6–24). The internal consistency was reliable for the locomotor skills (= 0.78) and highly reliable for the object control skills (α = 0.82). A higher score reflects higher perceived competence.

2.5 Exercise Intervention Program

The exercise intervention program was administered in the morning hours from Monday to Friday, from 9.00 a.m. to 12 p.m. For the OG, in the early morning hours (9.00 a.m. – 10 a.m.) were performed activities in the soccer field, while in the hottest hours were organized games performed in the courtyard covered with shade cloth (11.15 a.m. – 12.00 p.m.). From 10.00 a.m. to 11.15 a.m. children took a break led by the teachers. For the IG, the same activities were all performed indoors in the school gym.

The exercise intervention program was composed of two diverse group physical activities of varied targets: a first part of exercise design to improve body perception, basic motor skills and coordination, and a second part of team games. The exercise program was standardized with a typical plan beginning with a warm-up session (10 minutes) followed by a moderate-to-vigorous aerobic exercise session (40 minutes), focused on recreation addressed towards the improvement of body perception, basic motor skills, and coordination. The intervention follows with a cool-down (10 minutes) and muscular relaxation. Lastly, a games session (45 minutes) was proposed to the child. Specifically, participants were exposed to a final part of competitive games to engage them in a new way to increase motivation and self-efficacy through the pleasure of being active, acceptance of defeat and full awareness of one's ability. Overall, the exercise program was designed to be enjoyable and appealing by allowing participants to use their favourite music during exercise sessions and experiencing a team mentality. *Table 1* shows the five weekly exercise programs used.

1	Aerobic exercise: • Running in straight line forwards/backwards • Walking in a straight line puts the heel of a foot with a tip on the other foot. • Walking on the toes/heels • Walking crossing the legs. • Game of "hard-soft" • Jumping rope • Spinning a sponge ball tied to a rope. • Children, in a circle, jump when the ball arrives near their feet. • Children run in straight lines, when they hear a whistle will be a jump, when they hear two whistles will walk. • Running in any direction without colliding with classmates • Children are seated side by side with the legs stretched out, they pass the pall with the feet; when the ball will arrive to the last child, he takes the ball and runs to positions itself as first. • Game oh hoops Team game: Catch and throw balls
2	Aerobic exercise: • Hopping on a foot • Hopping right and left on two feet. • Lateral galloping • Galloping in straight line forward • Sliding a ball in straight line, guiding it with a stick • Game of "near-far" • Children are in line side by side. There are circles place to 10 meters (in a small number of ½ compared to children); at the start all children try to occupy a circle. On each round remove one or two circles • Sack race • Children are in single line and pass the ball to the classmate who is behind, the last of the raw sneak up between the legs of the classmates. • In couple, make a dribble with the hands and after the bounce one child takes the ball of his mate. Team game: Freeze/Tag Zone
3	Aerobic exercise: • Hopscotch • Children walk four-legged a predeterminate route trying to not drop the sandbag that they have on the back. • Game of "inside-outside" • In couple, children try to take three balls on the air, by touching them with any part of their body. • Game of bowling. Children first kick the ball and then roll it with the hands. • Mirroring mate's movements • Mirroring animals' movements • Charades

	• Jumping in and out of the circle • Slalom run with and without ball. • Exercise for rolling • Throwing and catching exercise Team game: Stay focused in rhythm.
4	Aerobic exercise: • Hopping on a foot • Hopping right and left on two feet. • Lateral galloping • Galloping in straight line forward • Game of "heavy-light" • One child takes a ball under one foot and keep the balance, at the signal kick the ball towards an established goal. • Slalom run with and without ball. • Crosswalk (tie at the opposite wrist and ankle ribbons of two different colours) • Basket with fee • Trails of dexterity and agility Team game: Up, Down, Stop, Go
5	Aerobic exercise: • Goal shooting with obstacles • Slalom run with and without ball. • Obstacle race (to overcome above and below) • Game of "slow-fast" • Crosswalk and cross running • Tic-tac-toe • Cops and robbers • Children are in single line; the first child starts to slalom between the mates and then all the others. • Children are in circle and have in their hands a stick. They are divided into two teams; the first child has a cup on his stick. At the signal the first child passes the cup to the mate at his side Team game: flag football

Table 1. Weekly exercise intervention program.

2.6 Statistical analysis

Statistical analyses were conducted using the JASP software v. 0.17.2.1 (JASP Team, 2023). Data were presented as group mean (M) values and standard deviations (SD). An independent sample *t*-test was applied to detect any group differences at baseline, and then a two-way ANOVA (experimental/control group) x time (pre/post-intervention) with repeated measures was performed to analyse the effect of the intervention on all examined variables. Subsequently, when "group × time" interactions showed significance, Tukey's post-hoc test was conducted to identify significant comparisons within groups. Changes (Δ) were calculated as post-test value – baseline value. Partial eta squared (η^2_p) was used to estimate the magnitude of the difference within each group and defined as follows: small: $\eta^2_p < 0.06$, moderate: $0.06 \leq \eta^2_p < 0.14$, large: $\eta^2_p \geq 0.14$. In addition, Cohen's *d* was calculated for the post hoc tests. The criteria to interpret the magnitude of Cohen's *d* were as follows: small ($d = 0.20–0.49$), moderate ($d = 0.50–0.79$) and large ($d \geq 0.80$) effect size (J. Cohen, 1992). To assess the internal consistency of the psychological tests, Cronbach's alpha was used; scores from 0.70 to 0.79 were considered reliable, from 0.80 to 0.90 as highly reliable, and >0.90 as very highly reliable (L. Cohen et al., 2013). The statistical significance was set a priori at $p < 0.05$.

3. Results

Participant characteristics and anthropometric data measured at baseline are shown in *Table 2*.

	Outdoor group (n=49)		Indoor Group (n=50)			
	Mean	**SD**	**Mean**	**SD**	***t***	***p***
Age (years)	6.65	0.66	6.74	0.60	0.68	0.49
Body height (cm)	120.26	10.44	124.98	8.79	2.29	0.02
Body weight (kg)	24.86	4.66	25.63	14.51	0.35	0.72
BMI (kg/m^2)	17.43	3.91	16.37	9.51	0.72	0.47

Table 2. Characteristics of the study participants. Notes. Data are expressed as mean ± standard deviation (SD); BMI= body mass index.

All participants received the assigned treatment conditions and completed the interventions without dropouts; no injuries or health problems were observed. Changes after 6-week exercise intervention programs are shown in *Table 3*.

	Outdoor Group (n = 49)			Indoor Group (n = 50)		
	Baseline	Post-test	Δ	Baseline	Post-test	Δ
Motorfit tests (score)						
Locomotor skills	8.94 (1.25)	10.00 (1.24) †*	+1.06 (0.02)	8.62 (1.85)	8.78 (1.73)	+0.16 (0.09)
Object control skills	8.29 (1.02)	9.78 (1.24) †*	+1.49 (0.10)	9.32 (1.28)	9.40 (1.35)	+0.08 (0.06)
Psychological tests (score)						
PACES-it	62.18 (10.04)	66.59 (7.64) †*	+4.41 (0.93)	68.10 (6.99)	66.66 (6.64)	-1.44 (0.31)
PMSC (Locomotor skills)	15.30 (4.41)	17.20 (4.29) †*	+1.90 (0.15)	15.58 (4.72)	16.36 (3.43)	+0.78 (0.46)
PMSC (Object control skills)	15.35 (4.32)	17.14 (4.34) †*	+1.80 (0.07)	14.60 (5.48)	14.76 (5.54)	+0.16 (0.11)

Table 3. Changes after 6-week exercise intervention programs. Notes: values are presented as mean (±SD); Δ: pre- to post-training changes; †significant "group x time" interaction: a significant effect of the intervention ($p < 0.01$). *Significantly different from pre-test ($p < 0.001$). PACES-it: Physical Activity Enjoyment Scale – Italian Version; PMSC: Pictorial Scale of Perceived Movement Skill Competence.

3.1 Motorfit Tests

A two-way repeated measures ANOVA found a significant "time x group" interaction for the motor fit tests: locomotor skills ($F_{1,97} = 46.940$, $p < 0.001$, $\eta^2_p = 0.33$, large effect size) and object control skills ($F_{1,97} = 70.240$, $p < 0.001$, $\eta^2_p = 0.42$, large effect size). Post hoc analysis revealed that the OG made a significant increase from pre- to post-test in the Motorfit tests: locomotor skills ($t = -11.35$, $p < 0.001$, $d = 0.69$, moderate effect size) and object control skills ($t = -12.46$, $p < 0.001$, $d = 1.21$, large effect size). No significant changes were found for the IG ($p > 0.05$) after intervention.

3.2 Psychological Tests

Statistical analysis showed significant "time x group" interaction for PACES-it ($F_{1,97} = 42.229$, $p < 0.001$, $\eta^2_p = 0.30$, large effect size), and PMSC: locomotor skills ($F_{1,97} = 6.90$, $p < 0.01$, $\eta^2_p = 0.07$, moderate effect size) and object control skills ($F_{1,97} = 48.420$, $p < 0.001$, $\eta^2_p = 0.33$, large effect size). Post hoc analysis revealed that the OG made a significant increase from pre- to post-test in the PACES-it ($t = -6.89$, $p < 0.001$, $d = 0.56$, moderate effect size), and PMSC: locomotor skills ($t = -6.27$, $p < 0.001$, $d = 0.49$, small effect size) and object control skills ($t = -10.75$, $p < 0.001$, $d = 0.36$, small effect size). No significant changes were found for the IG ($p > 0.05$) after 6 weeks.

4. Discussion

Our study aimed to investigate the effects of a 6-week outdoor exercise program on children's enjoyment, development and perception of motor competence versus indoor. We hypothesized that an outdoor exercise program would improve enjoyment, development and self-perception of motor competence in school-aged children more than the in-door program. The results obtained in the OG showed significant improvement in gross motor skills (locomotor and object control), as well as in the children's perception of their motor competence. Similarly, there was a marked significant increase in enjoyment score in the OG, compared with the IG group, fully confirming our hypothesis.

According to the competence motivation theory (Harter, 1978), enjoyment, along with perceived competence, are significant contributors to PA participation and continuous engagement in sports activities (Fu & Burns, 2018; Reeve & Weiss, 2006). We found that the different setting of the same exercise protocol is a variable that can change the enjoyment perception of the activity practiced. The OG showed a significant increase in the PACES score, highlighting the importance of an out-door setting in the perception of enjoyment in school-aged children. The impact of outdoor activities on children's enjoyment is multifaceted, influencing physical, psychological, and social aspects. Outdoor exercise has been associated with various psychological benefits, impacting mood, stress levels, and cognitive function in school-aged children (Cataldi et al., 2021; Mnich et al., 2019). Different studies showed that exposure to natural environments during outdoor activities has been linked to reduced stress and anxiety, positively influencing cognitive performance, and potentially contributing to a more enjoyable and satisfying experience for children engaging in physical activities (Faria et al., 2022; Vella-Brodrick & Gilowska, 2022). According to (Kemple et al., 2016), the novelty and dynamic nature of outdoor environments stimulate greater interest and engagement among children compared to traditional indoor settings. This increased engagement is closely linked to heightened enjoyment, as children perceive outdoor activities as more enjoyable and exciting. Exposure to natural elements, such as sunlight and green spaces, has been associated with positive mood and increased feelings of well-being; moreover, sunlight is a natural source of vitamin D, which has been linked to improved mood, further enhancing the overall enjoyment of outdoor physical activities (Pretty et al., 2005). Differently, the IG reported a reduction trend in PA enjoyment at the end of the intervention. This reduction trend is in contrast with a previous study (Schneider & Cooper, 2011) where indoor activities increased PA enjoyment, in low baseline PA enjoyment and no significant change was observed in high baseline PA enjoyment. This may be due to their sample differing from ours, i.e., consisting only of adolescent girls, and, at least in part, to the summer season during which, de-spite the climate-controlled indoor setting, performing indoor exercise may be perceived as more tedious and limiting compared to the winter period.

Our findings align with other studies that have demonstrated the positive impact of exercise on motor skills in children (Holfelder & Schott, 2014; Robinson

et al., 2015; Xin et al., 2020). The relationship between PA and motor competence can be attributed to various physiological and psychological mechanisms. Engaging in regular exercise promotes the development of neuromuscular coordination and balance, crucial components of motor competence (Fisher et al., 2005). Moreover, PA has been shown to enhance cognitive functions such as attention and memory, which are closely linked to motor skill acquisition (Tomporowski et al., 2011). Programs that incorporate a variety of activities, including aerobic exercises, strength training, and coordination drills, are particularly effective (Fischetti & Greco, 2017; Stodden et al., 2008). Importantly, our findings underscore the role of structured outdoor exercise pro-grams in maximizing the benefits of motor competence. While the IG does not reach statistical significance, it shows an increasing trend, suggesting that the improvement of motor skills in an indoor setting may take longer compared to an outdoor setting, which would seem to speed up the learning process.

Previous studies suggest that engaging in regular structured exercise programs con-tributes significantly to the development and enhancement of motor skills in school-aged children (Lubans et al., 2010). This is particularly crucial during the formative years when fundamental motor skills are being acquired and refined. As children participate in various physical activities, they not only enhance their proficiency in these fundamental motor skills but also develop a sense of mastery and confidence in their motor abilities. This aligns with the notion that increased exposure to diverse motor tasks positively influences self-perceived motor competence (Stodden et al., 2008). Studies have shown that improvements in overall physical fitness resulting from regular exercise are associated with positive self-perceptions of physical abilities (Lubans et al., 2010). The development of strength, endurance, and general fitness contributes to a child's perception of competence in different motor activities. This interplay between physical fitness and self-perceived motor competence under-scores the multifaceted benefits of exercise for school-aged children. In addition to motor skill development, exercise has been linked to positive psychological outcomes, including increased self-esteem and reduced anxiety (Robinson & Goodway, 2009). These psychological benefits may create a favourable environment for the enhancement of self-perceived motor competence. Self-perception of motor competence and enjoyment are significant contributors to participation in PA and continued engagement in sports activities (Reeve & Weiss, 2006). Children who have high levels of perceived motor competence are more likely to develop and demonstrate physical skills, such as gross motor skills and participation in PA (Fu & Burns, 2018). The results of our work show that an exercise protocol practised in an outdoor setting can significantly improve self-perception of motor competence, in contrast to the same intervention protocol practised in an indoor environment.

Few studies have related enjoyment, development and self-perception of motor competence (Burton et al., 2023). Researchers have explored factors affecting PA, gross motor skills, and some constructs of motivation (i.e. perceived motor competence and enjoyment) in children (Gao et al., 2013; Goodway & Rudisill, 1997). Although perceived competence has shown some evidence as a mediator between motor competence and PA participation, the evidence with other motivational constructs, such as enjoyment and perceived motor competence, has been weaker and less explored. Researchers have examined the link between PA enjoyment and PA participation in youth, however, there is a lack of work linking enjoyment with gross motor skills (Fu & Burns, 2018). Our results support previous work findings that underscore perceived motor competence as a fundamental motivational construct in gross motor skills development (Barnett et al., 2011; Robinson & Goodway, 2009).

Conceptually supporting the idea of a bi-directional relationship between actual and perceived motor competence (Fu & Burns, 2018). We also found that high levels of enjoyment were associated with higher scores in gross motor skills and self-perception of these skills.

To the best of our knowledge, this is the first randomized controlled study investigating the effects of an outdoor exercise program on primary school children's enjoyment, development and self-perception of motor skills, with objective measures. The novelty of our work lies in the investigation of the possible relationship between these three variables, along with the investigation of the effects induced by an outdoor training setting, which have not yet been studied in depth.

However, some limitations must be considered. First, the short duration of the intervention may have hindered the statistically significant improvement in actual and perceived motor skills in the IG. Second, the summer season during which the intervention was carried out may have affected the perceived PA enjoyment and, consequently, the positive relationship between enjoyment, actual and self-perceived motor competence. Finally, the selected sample (southern Italian children aged 6 to 8 years) may limit the generalization of the results of the present study to children of other school levels or different places of origin.

5. Conclusions

Findings show the positive impact of outdoor exercise programs on school-aged children's enjoyment, development and self-perception of motor competence, highlighting the importance of environmental factors and the potential benefits of structured outdoor interventions. Differently from indoor exercise programs, in outdoor settings, children's actual and perceived motor competence are significantly associated, showing a positive relationship with PA enjoyment, a motivational construct fundamental in this prime time for intervention on children's motor skills. Future research should explore extended intervention periods on diverse populations and seasons to further support and generalize these findings.

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