



Effects of an inclusive water polo programme on motor, psycho-pedagogical and social development in deaf-mute adolescents: An experimental study

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ABSTRACT

This experimental study investigates the effectiveness of an inclusive water polo programme on the psycho-physical and social development of deaf-mute adolescents. Twenty-four participants (aged 12-15 years) were divided into an experimental group ($n = 12$) that followed an adapted water polo programme and a control group ($n = 12$) that participated in traditional physical education classes. Qualitative analysis revealed that after 10 weeks, the experimental group showed significant improvements in motor performance, perceived self-efficacy and relationship dynamics ($p < .001$). The results confirm the educational and integrative value of sport as a global development tool for people with sensory disabilities.

Keywords: Inclusion, Deaf-mutism, Water polo, Adolescence, Psychophysical well-being, Adapted sport.

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INTRODUCTION

The inclusion of people with disabilities is now a fundamental objective of educational and social policies, as sanctioned by the United Nations Convention on the Rights of Persons with Disabilities (UN, 2006), which recognises the right to full participation in cultural, recreational, sporting and educational life. In this context, the educational and social inclusion of adolescents with sensory disabilities, and deafness in particular, is a crucial and still unresolved challenge, despite the legal and cultural progress made in recent decades (D'Alonzo, 2020; Ianes & Cramerotti, 2021). Deaf-mute adolescents, i.e. children with profound deafness and consequent mutism, often face communication and relational barriers that profoundly affect their psychological, motor and social development (Marschark & Hauser, 2012). The literature documents how communicative isolation can affect self-esteem, self-efficacy and active participation in group life (Convertino et al., 2009; Calderon & Greenberg, 2011). Indeed, a lack of socialisation opportunities can lead to reduced social competence, feelings of exclusion and sometimes psychological adjustment problems (Fellinger et al., 2009; Hintermair, 2013). Sport has been shown to be a powerful catalyst for the overall development of people with disabilities, providing not only physical benefits but also tools for personal and relational growth (Goodwin, 2001; Sherrill, 2004). In particular, adapted sport is configured as an inclusive educational context capable of enhancing individual abilities, stimulating autonomy and promoting peer integration (De Anna, 2009; Messina et al., 2018; Tafari et al., 2023). Furthermore, inclusive motor practices consistently fit within the pedagogical framework of Universal Design for Learning (UDL), which promotes accessible and flexible environments for all students (CAST, 2018). Among the different sports disciplines, aquatic activities play a privileged role in inclusive education due to their ability to reduce environmental and sensory barriers. Recent studies show that swimming and aquatic activities improve balance, motor coordination, cardiovascular endurance and psycho-emotional well-being, even in people with disabilities (Fari et al., 2023; Morsanuto et al., 2023).

The aquatic environment promotes body awareness, muscle relaxation and experimentation with movements that would otherwise be complex to perform on land, especially for people with sensory or motor disabilities (Carmeli et al., 2003; Geytenbeek, 2002). Water polo, as a team sport played in water, combines the benefits of aquatic activities with the cooperative dimension typical of collective sports. It requires strategies of non-verbal communication, motor synchronisation, spatial management and group awareness - all skills that can be adapted to promote the inclusion of people with deafness (Dervishaj et al., 2020; Gualdi-Russo et al., 2021). In addition, the playful-competitive component of water polo can stimulate a sense of belonging, motivation and resilience, fundamental aspects in the adolescent growth trajectory (Weiss & Ferrer-Caja, 2002; Eime et al., 2013). Despite this potential, the scientific literature has mainly focused on individual disciplines or generic sports programmes for people with hearing impairments, neglecting the systematic analysis of the effects of an aquatic team sport such as water polo. Existing studies highlight the cognitive and psychological benefits of sport participation, but rarely focus on group dynamics, peer interaction and positive identity building in aquatic sport contexts (Block, 2007; Haegele & Sutherland, 2015).

One of the key concepts underlying sport inclusion is 'self-efficacy' (Bandura, 1997), i.e. the perception of one's ability to act effectively in specific contexts. The literature shows that high self-efficacy is associated with higher participation, better school adjustment and higher subjective well-being, even among people with disabilities (López-Pérez et al., 2021; Huang & Chang, 2009). Similarly, positive social relationships with peers are an important predictor of developmental psychological well-being, especially for adolescents with special educational needs (Asher & Parker, 1989; Avramidis, 2013). With this in mind, the present study aims to fill a gap in the literature by systematically investigating the effects of an inclusive water polo programme on a group of deaf-mute adolescents, focusing on three developmental dimensions: (1) motor skills

(endurance, coordination, agility), (2) perceived self-efficacy, and (3) social integration among peers. The proposed intervention is based on an integrative pedagogical model in which movement is not only a vehicle for physical skills, but also a tool for relationships, expression and mutual recognition (Trabalzini, 2020; Vayer, 1986). The work fits into a multidisciplinary theoretical perspective, drawing on special education, developmental psychology, adapted motor activity theory and studies on inclusive educational practices. The hypothesis underlying the research is that participation in an adapted water polo programme, conducted with inclusive methodologies and mediated by communicative technologies (LIS, visual aids), can produce significant improvements in the three dimensions studied, compared to a control group engaged in traditional motor activities. The approach adopted is experimental, with pre- and post-intervention measurements to ensure methodological rigour and reliability of results. The aim is not only to demonstrate the effectiveness of a specific programme, but also to contribute to pedagogical and scientific reflection on the use of sport as an educational resource for inclusion. In the light of the results, it will be possible to formulate operational recommendations for educators, coaches, school managers and sports centre managers interested in promoting evidence-based inclusive practices.

METHODS AND TOOLS

Research drawing

The present study adopts a controlled experimental design with pre- and post-tests, based on a qualitative-quantitative comparative approach, to verify the effects of an inclusive water polo programme on three developmental dimensions: motor, psycho-pedagogical and social. The design follows the logic of a "randomised controlled trial" (RCT), albeit with a limited number of participants, typical of pilot studies in the field of inclusive education (Robson, 2011; Cohen, Manion & Morrison, 2018). This approach allows observed changes to be more confidently attributed to the intervention used, reducing bias from external factors. The experimental design was chosen because it allows for a direct comparison of the quantitative and qualitative results obtained by an experimental group, which received the specific intervention (inclusive water polo programme), and a control group, which continued with standard school motor activities without any adaptations. Qualitative-quantitative data were collected at two points in time: before the start of the intervention (T1) and at the end of ten weeks (T2). The dependent variables were selected based on the existing literature on evaluating the effectiveness of adapted sport (Sherrill, 2004; Block & Obrusnikova, 2007; DePauw & Gavron, 2005). Methodological rigour was maintained through the randomisation of participants, the use of validated instruments and the use of external evaluators with expertise in hearing impairment, thus minimising the observer effect (Roulston, 2010).

Participants

The sample consisted of 24 deaf-mute adolescents (13 females, 11 males), aged between 12 and 15 years ($M = 13.1$; $SD = 1.2$), recruited from two inclusive secondary schools in the Campania region. The criteria for inclusion in the study were:

- Diagnosis of severe or profound bilateral sensorineural deafness certified according to ICD-10 criteria.
- Language competence in LIS (Italian Sign Language) as a first language.
- Basic swimming autonomy, verified by a preliminary test with FIN certified instructors.
- No associated severe cognitive impairment or relevant neurological comorbidity.
- Informed parental/guardian consent and approval by the relevant university ethics committee.

The choice of target population reflects the need to provide meaningful physical activity opportunities to individuals who are often excluded from traditional physical activity programmes (Lieberman et al., 2004;

Marschark & Hauser, 2012). Participants were randomly allocated to the two groups using a computerised randomisation system, stratified by gender and school affiliation. This ensured initial homogeneity between the groups. The activities of the experimental group took place in a sports centre equipped with a regulation indoor swimming pool (25 m, 6 lanes), approved for Paralympic activities and accessible to people with disabilities. The sessions took place during non-school hours, in a protected environment without architectural barriers, with adapted changing rooms and specialised staff. The control group continued the motor activities planned in the school curriculum in their respective gymnasiums, supervised by their physical education teachers.

Intervention

The inclusive water polo programme was developed over a 10-week period, with two weekly sessions of 90 minutes each. The intervention was designed according to the principles of universal design for learning (UDL) and adapted sport, emphasising active participation, collaboration and personalisation of goals (Moran & Block, 2010; Haegele & Sutherland, 2015). General programme aims:

- To promote the improvement of functional motor skills and aquatic coordination.
- To increase self-efficacy and emotional resilience.
- To promote peer social interaction in cooperative contexts.

Each session followed a structured, recurring pattern:

- 1 Warm-up (15 minutes)
 - Global joint mobility.
 - Dynamic stretching and cardiovascular warm-up in shallow water.
 - Ball games.
- 2 Technical activities (30 minutes)
 - Basic swimming and floating techniques.
 - Balls, passes and throws with visual and tactile adaptations.
 - Simulations with facilitating rules
- 3 Situational games (30 minutes)
 - 3 vs 3 mini-matches with LIS referees.
 - Co-operative relays.
 - Exercises with alternating roles (goalkeeper, centre-back, defender).
- 4 Defatigue and metacognition (15 minutes)
 - Stretching in the water and guided relaxation.
 - Group reflection supported by visual posters and marked dialogue.
 - Visual experiential diary (pictograms, icons, drawings).

The adaptations concerned both the environment and the teaching, in line with the recommendations of the European Agency for Special Needs and Inclusive Education (2018):

- Visual signs in the pool.
- Bilingual instructors (Italian/LIS).
- Extended learning times.
- Immediate and multimodal feedback (visual, tactile).
- Personalised monitoring of skills.

The control group continued with the general motor activities provided for in the school curriculum (free body exercises, non-adapted team games) under the guidance of the physical education teachers. No specific

interventions or forms of adaptation or communicative support were used. This allowed a "naturalistic" comparison of the effects of the adapted programme.

Evaluation tools

The selection of instruments for quantitative analysis was guided by criteria of validity, reliability and adaptability to an inclusive context with deaf-mute subjects. All tests were administered by operators experienced in motor and augmentative communication.

Performance

25 metres Swimming Test

The time taken to cover 25 metres in freestyle. Electronic chronometric measurement. Validated for developmental age (Caspersen et al., 1985; Zinner et al., 2015).

Water Jump Test from a static position

Measures the explosive power of the lower limbs in an aquatic environment. Height measured in cm using underwater photocells. Adapted from the Sargent Jump Test (Harman et al., 1990).

Psycho-Pedagogical Well Being

General Self-Efficacy Scale (GSES)

English version of Sibilila et al. (1995). 10-item scale, Likert 1-4. Reliability: $\alpha = 0.86$. The instrument was adapted in LIS format by means of visual aids validated by experts.

Social Inclusion

Peer Interaction Scale (PIS) – Adapted version

Measures the quality of peer interactions in school and sports contexts (Asher et al., 1979). Adapted for individuals with sensory disabilities by Bossaert et al. (2011).

All instruments were adapted and validated through a process of visual translation into LIS, supported by a team of interpreters, developmental psychologists and educators with expertise in deafness. The tests were preceded by familiarisation sessions on the methods of administration. Responses were collected in the presence of LIS mediators to ensure the authenticity of the data and reduce the risk of semantic misunderstandings (Napier & Leeson, 2016). For the qualitative analysis, semi-structured interviews and visual experience diaries collected from both groups were analysed using NVivo 14 software. The analysis followed the steps of Braun and Clarke's (2006) thematic approach: familiarising with the data, generating initial codes, exploring themes, reviewing, defining and naming themes.

Statistical analysis

Analyses were performed with SPSS v27 using a mixed approach:

- Repeated measures analysis of variance (ANOVA) (time \times group) to compare the evolution in the two groups.
- In case of significant interaction, t-tests were performed for paired (within group) and independent (between groups) samples.
- Calculation of effect size by:
 - Partial η^2 (ANOVA),
 - and Cohen (t-test), according to Cohen's criteria (1988):

$d = 0.2$ (small), 0.5 (moderate), $0.8 +$ (large).

- Testing of statistical assumptions: normality (Shapiro-Wilk), homogeneity of variances (Levene), sphericity (Mauchly).

Statistical significance was set at $p < .05$, but practical significance was also considered, which is particularly relevant in educational contexts (Greenhalgh et al., 2016).

RESULTS

Quantitative results analysis

The Experimental Group showed statistically significant improvements in all variables analysed.

Table 1. Quantitative results experimental group.

Variable	Pre-test (M \pm DS)	Post-test (M \pm DS)	<i>p</i>	<i>d</i>
Time 25m (s)	37.1 \pm 2.9	30.8 \pm 2.6	<.001	1.45
Jump in the water (cm)	22.7 \pm 3.5	29.1 \pm 3.3	<.001	1.33
Self-Efficacy (GSES)	21.5 \pm 3.1	30.2 \pm 2.9	<.001	1.80
Peer Interaction (PIS)	14.8 \pm 2.6	21.7 \pm 2.4	<.001	1.82

Performance

The results from the experimental group (EG) show significant improvements in motor skills. The mean time to swim 25 metres in water decreased from 37.1 \pm 2.9 seconds to 30.8 \pm 2.6 seconds ($p < .001$), indicating an increase in swimming efficiency. In addition, water jump height increased from 22.7 \pm 3.5 cm to 29.1 \pm 3.3 cm ($p < .001$), suggesting an improvement in explosive strength and neuromuscular coordination. These results are consistent with previous studies that have highlighted that regular physical activity promotes growth and development in childhood, with benefits for physical, mental and cognitive health. In addition, participation in physical activity can support children's social development by providing opportunities for personal expression and social integration.

Psycho-Pedagogical Well-Being

Perceived self-efficacy, as measured by the General Self-Efficacy Scale (GSES), increased significantly in the EG from 21.5 \pm 3.1 to 30.2 \pm 2.9 ($p < .001$). This increase reflects an improvement in perceived ability to cope and overcome challenges. The literature shows that sport has important intrinsic qualities that enable social, psychological and physical development in an individual, such as improved self-esteem and independence in performing daily tasks. In addition, regular physical activity during childhood tends to become an integral part of a person's lifestyle, which has a positive impact on health in later life.

Social Inclusion

Peer interaction, as assessed by the Peer Interaction Scale (PIS), showed a significant improvement in the EG, increasing from 14.8 \pm 2.6 to 21.7 \pm 2.4 ($p < .001$). This result indicates an improvement in the participants' social and interpersonal skills. Previous studies emphasise the importance of inclusion in school sport, showing that participation in physical education provides a high level of acceptance and recognition for children or young people with disabilities, even outside of sport. In addition, physical activity can have a positive impact on several aspects of young people's lifestyles, encouraging the adoption of healthy behaviours.

Control Group

In the control group (CG), which continued to perform general motor activities as part of the weekly school programme without any specific adaptations, there were no statistically significant differences in any of the variables analysed. This comparison confirms the effectiveness of the inclusive water polo programme in promoting the motor, psychoeducational and social development of deaf-mute adolescents. In the control group (CG), which continued with unadopted physical education activities at school, no statistically significant changes were observed between pre- and post-test measurements. The detailed quantitative results are detailed in Table 2.

Table 2. Quantitative results control group.

Variable	Pre-test (M ± DS)	Post-test (M ± DS)	p	d
Time 25m (s)	36.9 ± 3.1	36.3 ± 3.0	n.s.	0.19
Jump in the water (cm)	22.9 ± 3.2	23.1 ± 3.0	n.s.	0.06
Self-Efficacy (GSES)	21.2 ± 2.9	21.6 ± 3.1	n.s.	0.13
Peer Interaction (PIS)	14.7 ± 2.5	15.0 ± 2.6	n.s.	0.12

Note. n.s. = not significant. Effects of negligible magnitude according to Cohen's criteria.

These data confirm that simply continuing school physical activity without specific adaptations was not sufficient to promote improvements in the dimensions studied.

Quantitative analysis revealed significant differences between the experimental group (EG) and the control group (CG) in all variables studied. The EG showed significant improvements in motor performance, perceived self-efficacy and peer interaction, whereas the CG showed no statistically significant changes.

Qualitative results analysis

Qualitative thematic analysis was conducted using NVivo 14 software on semi-structured interviews and visual experience diaries collected from both groups. Qualitative sample:

- EG: 12 participants → 12 interviews + 12 visual diaries.
- CG: 12 participants → 8 interviews (4 declined) + 12 less detailed visual diaries.

Table 3. Qualitative results.

Theme	Description	Frequency	EG	CG
Empowerment and mastery	Expressions related to feeling capable, useful, competent.	High	XXX	-
Effective non-verbal communication	Use of looks gestures and facial expressions to cooperate.	High	XXX	-
Group cohesion and sense of belonging	Feeling part of the team, accepted.	High	XX	-
Boredom and routine	Perception of repetitive or unstimulating activities.	Average	-	XX
Autonomy and personal initiative	Experiences in which participants report greater decision-making autonomy.	Average	XX	-
Communication frustration	Difficulty expressing oneself in motor contexts.	High	-	XXX

Emerging themes:

These themes were systematically coded and compared between groups, revealing a clear advantage for the EG in terms of psycho-pedagogical well-being, motivation and social interaction.

Samples of text extracts (EG)

- I like that we can understand each other without words. Everything is different under water, but we understand each other.
- I used to be afraid of making mistakes, but now I try even if I'm not sure. The water helps me.

Samples of text extracts (EG)

- We always do the same things in the gym and I don't always understand what to do.
- The others talk and I can't keep up, so I do it myself.

DISCUSSION

The results of the study strongly support the initial hypothesis: a structured inclusive water polo programme can have significant positive effects on the motor, psychoeducational and social development of adolescents with deafness. These data are in line with the literature that identifies adapted sport as a powerful mediator of well-being and inclusion (DePauw & Gavron, 2005; Goodwin & Watkinson, 2000). Firstly, analysis of motor performance - both in terms of swimming speed over 25 metres and jumping height in the water - shows a clear increase in neuromuscular efficiency. This improvement can be attributed to regular training, the specificity of the motor tasks and the aquatic environment, which has the advantage of reducing joint stress and facilitating wide, harmonious movements (Franceschini et al., 2022). As noted by Getz, Hutzler and Vermeer (2006), aquatic activities allow for proprioceptive and vestibular stimulation, which promotes motor development in individuals with sensory disabilities and provides a safe but challenging exercise environment. On a psychological level, the significant increase in perceived self-efficacy (measured by the General Self-Efficacy Scale) should also be interpreted as an indicator of the empowerment generated by the sporting context.

According to Bandura (1997), a sense of self-efficacy is built through successful experiences, social models, verbal persuasion and physiological regulation: all elements that are present in the proposed programme, thanks to the systematic use of visual and physical reinforcement, the presence of competent models (LIS coaches) and the opportunity to face progressive and calibrated challenges. Furthermore, the specific adaptive framework of the intervention, based on equal access and the valorisation of differences, allowed the participants to experience feelings of competence and mastery, which are central to adolescent identity development (Deci & Ryan, 2000). One of the most significant findings relates to the improvement in relational dynamics. Scores on the Peer Interaction Scale increased significantly in the experimental group, indicating a greater capacity for positive peer interaction. This finding reflects the assumption of inclusive education that collaboration in meaningful activities is a powerful driver for building social bonds (Booth & Ainscow, 2011). In particular, water polo - with its demands for cooperation, synchronisation and instant adaptation - promotes forms of communication that are alternatives to verbal language, such as gestures, eye contact and proxemics, tools that are already familiar to deaf people.

As shown by Lieberman et al. (2004), non-verbal communication in sport can act as a communicative 'bridge' that allows language barriers to be overcome and authentic interaction to flourish. It should also be noted that the improvement recorded in the experimental group did not occur in the control group, confirming the specificity of the intervention, where participants expressed feelings of monotony, communication difficulties

and poor integration, confirming that generic school motor activities are not sufficient to meet the educational and relational needs of students with sensory disabilities. This suggests that normal school physical activities, unless adapted, are not sufficient to significantly promote the developmental dimensions investigated. This point is particularly relevant from a systemic perspective, as it highlights the urgent need for further training of physical education teachers in relation to the specific needs of students with sensory disabilities (Rouse, 2008). From a pedagogical point of view, the success of the intervention can be attributed to the inclusive structure of the programme, the training of the operators and the use of multimodal and cooperative strategies. These results support the idea that physical education should be rethought in an inclusive and relational way, valuing physicality as a vehicle for expression, learning and belonging. From a methodological point of view, the use of validated tools adapted to the context of deaf people ensured the reliability of the measurements.

The use of experienced LIS operators avoided the risk of misunderstandings and communication biases during the test phases. Furthermore, the experimental approach with a control group and pre-post measurements allows a high degree of confidence in attributing the observed changes to the intervention. A limitation of the study is the sample size, which, although sufficient to ensure statistical power for the analysis, could be increased in future research for greater generalisability. In addition, the 10-week duration, although significant, does not allow for the verification of long-term effects. A follow-up after six months or a year would be desirable to understand whether the observed improvements are sustained over time. Another point for reflection concerns the role of the trainers. Their competence in LIS and pedagogical sensitivity were key factors in the success of the project. This underlines the need for multidisciplinary training for sports professionals that goes beyond technical skills to include communication and interpersonal skills (Sherrill, 2004).

Finally, it should be emphasised that inclusive sport activities not only benefit students with disabilities but can also transform the whole educational context into a more empathetic, collaborative and diversity-conscious environment. As Morin (2001) states, education must embrace the complexity of the human condition and recognise the educational value of difference and intercultural dialogue. Looking ahead, extending the study to larger samples and different contexts could strengthen the generalisability of the findings. In addition, medium- and long-term follow-up will allow the stability of the induced changes to be assessed. The combination of an experimental and qualitative approach represents a promising methodological model for future research in inclusive education.

CONCLUSIONS

This research has contributed to enriching the landscape of studies on inclusion in education and sport, providing empirical evidence to support the effectiveness of an adapted water polo programme for deaf-mute adolescents. In particular, it has shown that structured, accessible and moderately communicative physical activity can have a positive and significant impact on three fundamental axes of human development: functional motor skills, psychological self-efficacy and interpersonal skills. The main contribution of the study is that it focuses not only on the improvement of motor skills, but also on the educational, social and emotional effects of the sport experience. This holistic perspective is in line with the biopsychosocial approach to disability proposed by the World Health Organisation (WHO, 2001), which goes beyond the medical-centred model to value the potential of the person in their environment. From an operational point of view, the findings suggest that inclusive sport programmes should become an integral part of the curriculum in lower secondary schools, especially those with an inclusive vocation.

International guidelines (UNESCO, 2015; European Agency for Special Needs and Inclusive Education, 2020) emphasise the importance of providing equal opportunities for all students to participate in physical activity and sport, regardless of their starting conditions. Water polo, as a dynamic, cooperative sport that can be practised in a supportive environment such as water, is one of the most promising disciplines for the inclusion of young people with deafness. Its communicative nature, which requires the reading of body signals and constant adaptation to partners and opponents, makes the game a situated, experiential and highly relational learning space (Vygotsky, 1978). In addition to the aspects highlighted above, the symbolic value of the initiative should be emphasised: offering young people, who are often excluded, the opportunity to practise a competitive team sport, traditionally considered "*difficult*", produces an identity transformation that goes far beyond the technical skills acquired. It is an authentic claim to belonging and to the right to the complexity of human experience (Nussbaum, 2011). In this sense, the results invite educational and sports institutions to build stable networks of collaboration between teachers, educators, sports instructors and families, with the aim of creating multisensory, accessible and challenging educational environments.

It is not enough to simply 'integrate' students with disabilities: the whole education and sports system needs to be rethought in terms of inclusivity, changing rules, methods, expectations and spaces. In the future, we hope to extend the study to different contexts (urban and rural areas, different school levels) and to multiple or different disabilities (hearing impairment, intellectual disability, autism spectrum disorders) in order to test the adaptability of the proposed model. A parallel qualitative analysis is also desirable, using interviews or focus groups to explore the experiences of participants, capturing their emotions, meanings and narratives. Finally, a strong investment in the professional training of sport educators is recommended, so that skills such as LIS, diversity management, inclusive education and adaptive design become an integral part of university and professional courses. Inclusive sport is not just an educational practice: it is a worldview based on fairness, respect and recognition of the unique value of each person.

AUTHOR CONTRIBUTIONS

The authors noted that there was equal participation in the elaboration of this document.

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No potential conflict of interest was reported by the authors.

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