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INVITED REVIEW

Parasports for cerebral palsy: Thinking and 'prescribing' beyond the Paralympics

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Abstract

The landscape of care for individuals with cerebral palsy (CP) has evolved far beyond 'fixing' impairments toward a life course, biopsychosocial approach aimed at enhanced functioning. Parasports remain an underutilized tool to encourage and facilitate physical activity achievement while filling gaps in traditional medical and therapeutic thinking about this new way of delivering services. This narrative review synthesizes evidence spanning multiple sports and gross motor function levels, where parasports demonstrate measurable benefits across all domains of the International Classification of Functioning, Disability and Health. Given the rich array of parasport options, it remains challenging to determine appropriate recommendations across the spectrum of function seen in individuals with CP and related disabilities. We outline sport eligibility based on gross motor function and available adaptations. Rather than viewing parasport as an option for 'athletic' children, evidence supports treating it as an essential element of comprehensive care—uniquely combining therapeutic physical activity benefits with social inclusion, identity development, and community integration.

Cerebral palsy (CP) is the most common cause of motor disability in childhood, affecting posture, movement, and function in diverse and often complex ways.[1] The impact of these challenges frequently extends beyond the body, limiting participation in social, recreational, and community life.[1] As ideas about clinical care have evolved, there has been a growing recognition that a focus on impairment-level interventions does not alone sufficiently address the broader developmental needs, goals, and lived experiences of children with CP. Participation in sport—particularly adaptive or parasport—offers rich opportunities to fill these gaps in our traditional medical and therapeutic models.

Originating in the 1940s as a rehabilitative intervention for patients with spinal cord injury, parasport has become a global movement, encompassing both elite-level competition and inclusive recreational opportunities for individuals across the mobility spectrum.[2] Parasport is formally defined by the International Paralympic Committee (IPC) as 'sport in which individuals with a disability participate and which has classification rules compliant with the IPC Athlete Classification Code'.[2] For children with CP and related motor disabilities, sport participation can provide a mechanism to achieve not only the required 'dose' of physical activity as outlined by Verschuren et al., but also serve as a vessel for broader personal and social benefits.[3] Parasport can serve multiple roles, ranging from structured rehabilitation or targeted physical activity interventions to recreation, social engagement, and competitive sport undertaken for enjoyment or excellence. However, despite this potential and global availability, as demonstrated by the 187 national Paralympic committees, young individuals with CP remain significantly less active than their typically developing peers and are underrepresented in organized physical activity.[2,3]

Abbreviations: GMFM, Gross Motor Function Measure; ICF, International Classification of Functioning, Disability and Health; IPC, International Paralympic Committee.

Barriers to participation in parasport for individuals with CP are multifaceted, with a lack of knowledge of the broad potential of parasports persisting as one of the largest impediments for parents and interested athletes alike.[4] At least one gap to be bridged to facilitate parasport exploration is the need for clinicians to be aware of the benefits, opportunities, and adaptations of parasports.

This narrative review aims to synthesize the available literature on the multifaceted benefits of sport participation for individuals with CP, utilizing the International Classification of Functioning, Disability and Health (ICF) to frame these ideas.[5] Specifically, we organize the evidence and discussion according to the five core ICF components: (1) body functions and structures, (2) activities, (3) participation, (4) environmental factors, and (5) personal factors. Additionally, we utilize both clinical and our own lived experience of multisport participation to present a summary of available sports as well as adaptations, to help clinicians discuss parasport participation with patients and families with CP and related conditions.

Our goal is to provide a practical, evidence-informed resource that helps families, clinicians, and community leaders understand the wide-ranging value of parasports based both on published literature and experiential knowledge. By reframing engagement in sport as an essential part of development rather than as a luxury or afterthought, we hope to promote its broader adoption as a tool for health, inclusion, and lifelong physical activity among children with CP and related disabilities.

What this paper adds

- Parasports are community-based interventions that provide benefits across all domains of the International Classification of Functioning, Disability and Health.
- Parasports can be adapted to suit individuals with cerebral palsy (CP) across all functional levels.
- Parasport participation can be a critical healthcare intervention for individuals with CP.

METHOD

A targeted literature search was conducted in PubMed, using the term 'cerebral palsy' combined with 'parasport' and 'adaptive sport', consistent with prior reviews. To ensure comprehensive coverage, additional searches paired 'cerebral palsy' with each parasport sanctioned or recognized by the IPC in which individuals with CP are eligible to compete (e.g. 'wheelchair basketball', 'powerchair soccer').[6] This was done to facilitate a thorough review given the MeSH for sports with a disability does not comprehensively list individual sports. No date limits were applied. The search was limited to peer-reviewed articles and abstracts published in English. Given the anticipated challenges of isolated keyword-based searches, hand-searching and citation chaining were also employed to ensure a comprehensive review of the available literature.

Screening and data extraction were conducted by a multidisciplinary team, including two research students and two physicians with expertise in orthopaedics and rehabilitation, two of whom (JH and JE) are Paralympians who each have over a decade of experience in a variety of parasports. Studies were included if the intervention met the IPC definition of parasport, included individuals with CP, and reported outcomes aligned with ICF domains. Studies focused solely on inpatient or physiotherapy-based rehabilitation were excluded, unless explicitly meeting the definition for parasport. In advance we identified areas of ambiguity, including hippotherapy, aquatic therapy, and cycling, where there are parasport equivalents in equestrian, paraswimming, and paracycling respectively. Of note at the time of search strategy generation and searching, the IPC was still the governing body of Para Dance Sport, which has recently transitioned to governance by World Ability Sport. Given that the IPC did and still does recognize it as a parasport we have elected to still include it within this paper.

An additional layer of analysis was conducted to assess sport accessibility and appropriateness across the Gross Motor Function Classification System (GMFCS) levels. Where possible, GMFCS-based recommendations were informed by published data or grey literature. In cases where data were limited, recommendations were based on known sport-specific adaptations. This review therefore aims not only to synthesize existing knowledge but to offer a practical, GMFCS-informed guide for integrating sport into the care and planning for children and young individuals with CP.

RESULTS

Of the 448 articles initially identified through our search, 56 met the inclusion criteria for this review. To ensure interventions within the selected articles constituted parasport per the IPC definition, two of the authors (JH, JE), who both have extensive experience in parasport and medical/therapeutic environments, reviewed the identified studies and ultimately excluded three that did not meet this definition. Given the large volume of studies, a supplemental table is provided with additional details (Table S1), with summary overviews provided here.

Body structure and function

Musculoskeletal system

There is growing evidence that participation in parasport can lead to notable improvements in various aspects

of musculoskeletal function. Improvements in range of motion at the shoulders, hips, and ankles have been seen across various sports, including boccia, indoor climbing, and frame running among others.[7–9] Similarly surf programming increased core strength.[10] Athletes who chose either a swimming or soccer programme for 1 year saw improvements in upper extremity function, mobility, and transfers.[11]

Balance was frequently assessed, as reported in the available literature, with improvements seen quantitatively in equestrian[12] and dance.[13]

Improvements in bone mineral density have emerged as another potential benefit of parasport participation, which is of particular importance for lifelong health in non-ambulatory athletes. Frame running and surfing were both associated with increased densitometry scores.[10,14]

Cardiovascular health

Cardiorespiratory endurance and respiratory function have been reported to improve across a range of programmes, including frame running[9] and surf therapy.[10] Specific physiological indicators such as pulse oxygen as a surrogate for stroke volume have been seen in dancing athletes in GMFCS level V.[15]

Mental health

In their large retrospective study Cribb et al. highlighted the lower rates of anxiety, depression, behavioural disorders, and attention-deficit/hyperactivity disorder symptoms amongst individuals with CP who practise sport compared to young individuals with CP not involved in sport.[16] Similarly, parasoccer and paraswimming were linked with reduced symptoms of attention-deficit/hyperactivity disorder in a group of ambulatory athletes with CP.[10]

Emotional and behavioural benefits also emerged through dance programmes, which decreased internalizing behaviours and increased social competence.[17] Adaptive climbing was found to enhance focus, problem-solving abilities, and confidence across social, emotional, and physical domains.[18] Psychological improvements were also evident in boccia programmes, where emotional intelligence and psychological well-being increased with participation.[19]

Activities and participation

Functional mobility

Parasport interventions have demonstrated consistent improvements in gross motor functional activities across an array of sports, which in the available literature is most frequently quantified by improvements in Gross Motor Function Measure (GMFM) scores either in total or in item subsets. GMFM global scores improved in a 10-week downhill ski programme,[20] equestrian programmes,[12,21] and paracycling.[22] Interestingly, Dutia et al. followed three adolescents with CP functioning in GMFCS level IV over a 46-month performance swimming training programme and found significant improvements in GMFM scores during training; when training was withdrawn there was a significant decline in GMFM, but the scores remained above baseline.[23] This was repeatable over multiple training blocks, which suggests that across the spectrum of mobility and levels of disabilities training has a role in improving gross motor function.[23]

Beyond GMFM scores, improvements in wheelchair skills have been noted among wheelchair basketball players who outperformed wheelchair-using non-athletes in wheelchair skills tests.[24] Other task-specific outcomes include improved sit-to-stand ability after participation in indoor climbing,[8] and enhanced functional independence across domains such as mobility, locomotion, communication, cognition, and psychosocial adjustment, as observed in a randomized control trial of wheelchair dance involving children in GMFCS levels II to V.[25]

Sport performance

Parasport participation improves sport-specific performance. For example, children with CP in GMFCS levels IV/V starting a frame running programme had significant improvements in ability to use the running frame at the end of 12 weeks of training.[14] Similar sport-specific improvements were seen in paracycling,[22] swimming,[23] climbing,[8] and boccia.[7] This cumulative evidence underscores the importance of allowing individuals with CP opportunity to try, perhaps fail at times, and subsequently learn and get better.

Environmental and personal factors

Engagement in sports such as frame running and soccer has led to increased happiness, self-confidence, belonging, and reduced isolation.[26,27] Wheelchair tennis programming was found to enhance young people's mobility, self-esteem, social networks, and family support.[28] Benefits for caregivers have also been reported: for example, long-term hippotherapy was associated with improved caregiver quality of life.[21]

Quantitative psychological scores in adaptive climbing interestingly showed no change despite consistent qualitative self-reports of improvements in confidence, attaining a sense of athletic identity, and improved inclusion amongst peers. These inconsistencies highlight the need for mixed-method approaches[8,18] to capture impacts potentially not typically assessed or easily quantified.

Among adolescents, frame running not only improved function but also served as a platform for community support and integration.[29] Participants in cycling and team sports expressed a stronger social identity and motivation to pursue long-term goals.[30] These findings illustrate the broad influence of parasport as both an activity in itself and

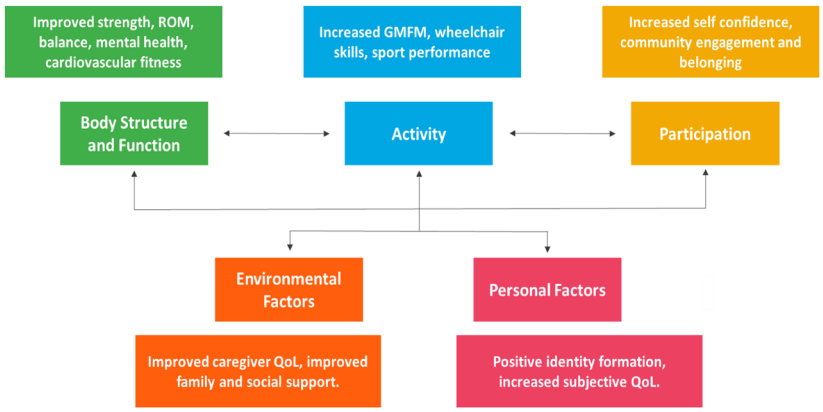

FIGURE 1 The International Classification of Functioning, Disability and Health domains and the associated changes associated with parasport participation. Abbreviations: GMFM, Gross Motor Function Measure; QoL, quality of life; ROM, range of motion.

a context that supports social participation, identity development, and inclusion as illustrated in Figure 1.

Sport-specific adaptations and recommendations

Prescribing or recommending parasport for individuals with CP and related motor disabilities can be challenging. Not only does it require knowledge about available sport opportunities but it also requires some understanding about eligibility and availability of adaptations within each sport. Much of the parasport classification system has traditionally been based on spinal cord injury or amputation, adding additional complexity for understanding where someone with differing function 'fits'. Although the requirements for equipment and classification can be quite rigid at an elite level, most recreational and community-based parasport specific programmes have experience with and are willing to adapt to suit the individual needs of each athlete.

This review focuses not only on competitive opportunities but also recreational-level participation that prioritize health benefits, skill development, and community engagement. Table 1, generated from our lived experience and grey literature review, outlines parasport opportunities suitable for individuals with CP (and related disabilities) based on GMFCS levels, and available adaptations that may facilitate participation. Indeed, one of the challenges is the lack of access; however, many parasports can be integrated into existing able-bodied clubs, thereby decreasing the barrier for individuals with CP living outside of major centres or in under-resourced areas. One such example is track and field/athletics, where athletes with CP (in GMFCS levels I–V) can train and compete alongside their non-disabled peers both in the school system and in local clubs. Sports that can be integrated are flagged in Table 1. Of note, these clubs may have less experience with disability adaptation but can be connected with regional or national sport organizations to facilitate adaptations.

For health care providers and families new to the Paralympic movement, it is essential to understand that specialized sports equipment, particularly sports wheelchairs used in activities such as wheelchair basketball, can differ substantially from daily-use mobility equipment, meaning that daily wheelchair use is not a prerequisite for participation in wheelchair sports. Sports wheelchairs and other specialized equipment are considered sport-specific apparatus. They are typically available for rental or loan through recreational and club-level programmes, thereby decreasing the barrier of equipment acquisition to initial participation. In discussions with patients and families, it is important to emphasize the multifaceted benefits of parasport participation as described above, highlighting that it is more than just a sport, and is worthy of consistent participation (in the same ways as we have traditionally talked about therapy and 'stretching'). When we collaborate with patients and families, and have an understanding of our local (para)sport ecosystem, we can reduce participation barriers.

DISCUSSION

There is growing recognition—reflected in a rapidly expanding body of research—of the broad and meaningful benefits of parasport participation for individuals with CP and mobility disabilities more broadly. These benefits have been shown to span all domains of the ICF, demonstrating improvements not only in physical health but also in functional mobility, social inclusion, and emotional well-being. While the positive impacts of physical activity are well established, parasport uniquely combines this known 'therapeutic' value of physical activity with a mechanism to achieve these aims consistently through fun, goal-oriented, community-based activities. Parasport can serve as a powerful, family-centred approach to developing physical literacy, often creating inclusive environments where siblings play together on equal footing and parents become actively involved as coaches, volunteers, fans, and advocates within sport organizations. Parasport offers

TABLE 1 Subset of sporting options for individuals with CP, alongside the gross motor function required to participate at a recreational level and various adaptations to enable participation.

Sport	GMFCS level eligible	Adaptations and variations
Wheelchair basketball and wheelchair rugby	I–IV	Athletes with unilateral CP - One arm drive (e.g. single-arm Orion chair from Melrose Kiwi Concept Chairs) - 'Cross' pushing using one arm to cross over to the contralateral wheel to push (e.g. Gustavo Villafañe of Argentina) - Arm orthoses to facilitate pushing (e.g. Yukinobu Ike's custom sport specific orthoses) - Glove variation to improve grip on the wheel and the ball Lower extremity hypertonia - Seating adaptations and strapping (e.g. M2 ratchet straps for hips, knees, feet) - Ball holders to prevent the ball from sliding off a lap when pushing
Athletics/track and field[a]	I–V	- Wheelchair racing (GMFCS levels II–IV) - Seated throws using discus, shot put, javelin, or club throw (GMFCS levels II–V) - Frame running +/– extensive truncal/upper extremity support (GMFCS levels II–V) - Ambulatory throws, running, and jumping (GMFCS levels I–II)
Boccia[a]	III–V	- Ramps for players who cannot throw effectively (BC3 classification) - Ball trays to keep balls within an athlete's reach - Non-slip mats - Removing footplates or push rims to increase stability
Swimming[a]	I–V	- Recreational: flotation devices (including lower body wetsuit, pull buoys strapped to legs, etc.) - Elite: one-hand start/touch, stroke variations (e.g. one-arm butterfly), starting assistant, or in water starts
Fencing[a]	I–IV	- Seated (static) or standing - Strapping a hand to the weapon
Archery[a]	I–IV	- Standing or seated - Release aids including thumb triggers and mouth tabs for those with arm or hand impairment - Bow stands - Bow variations (e.g. recurve or compound bows)
CP football/soccer ('7 a side')	I–III	- Can use frames/walkers, orthoses, or crutches - Cleats not required
Powerchair football/ hockey	III–V	- Variety of joysticks - Lower chairs with frame extensions - Add-ons for wheelchairs to control the ball
Surfing[a]	I–V	- Range of positions on board including prone, seated, kneeling, standing, or fully supported - Adapted wetsuits with zippers for all four limbs
Dance[a]	I–V	- With or without wheelchair, either power or manual chair - Can be done alone, partnered, or in a group
Cycling[a]	I-IV	- Handcycle - Adapted mountain bike (e.g. Bowhead Reach) - Wheelchair add-on handcycle (e.g. Batec Hybrid 2) - Tricycle (adult sizes commercially available) - Adapted handlebars and foot pedals/strapping/orthoses
Equestrian[a]	I–V	- Supported seating, adapted reins, hands on guidance - Powered lifts to assist with getting on/off horse (e.g. LifeLyfts Post Mounted Equestrian Seat Lift)
Boat sports (canoe, kayak, rowing)[a]	I–IV	- Outriggers to increase stability - Adaptive seating including backrests - Grip aid (e.g. 'Active Hands kayak hand adaptation' or 'Active Hands wrist adaptation') - Double kayak for additional power/support - Specialized docking systems (e.g. 'BoardSafe Docks')
Powerlifting[a]	I–IV	- Seated or ambulatory - Gripping aids - Wide benches and strapping systems - Scaling/adapting the lifts/movement - Pneumatic resistance systems to reduce the need to manually adjust weights
Sailing[a]	I–V	- Stable boats - Adapted seating - Adapted control systems - Stability bars to provide grab points - Power assisted winches

(Continues)

TABLE 1 (Continued)

Sport	GMFCS level eligible	Adaptations and variations
Climbing[a]	I–V	- Seat systems +/− ratchet style belays where participant can entirely or partially be hoisted by the belayer - Adaptive grips
Table tennis and badminton[a]	I–IV	- Ambulatory or wheelchair categories - Gripping aid to hold the racquet (e.g. 'Active Hands angled aid)' - Badminton: narrow courts to reduce need for lateral movement
Wheelchair tennis[a]	I–IV	- One arm drive chair (as described above) or power wheelchair for those with upper extremity impairment - Gripping aid/strapping systems to hold the racquet (e.g. 'Active Hands angled aid'/'general-purpose gripping aid', or hockey tape) - Ball bounce counts (typically two bounces in wheelchair tennis; can adapt at a recreational level for more)
Alpine skiing[a]	I–V	- Outriggers for stability - Various walker style supports (e.g. 'Enabling Technology Slider') - Harness support for standing skiers - Sit-ski with varying levels of support/tethering (can be mono-ski or bi-ski depending on stability needs) - 'Tetraski' which is a joystick-controlled sit-ski
Snowboard[a]	I–II	- Outriggers for stability - Can use variety of orthotics to facilitate stability
Para ice hockey	I–V	- One arm 'J' stroke for propelling - Anti-tip devices (e.g. Unique Inventions antitip device) - Push bar/handle to assist those who are unable to independently propel themselves (e.g. Unique Inventions push handles) - Varying degrees of back support and straps (e.g. Unique Inventions high back, leg supports, knee supports)
Wheelchair curling[a]	I–IV	- Power or manual wheelchair - Modification of delivery stick including gripping aids - No sweeping required is needed
Nordic skiing	I–III	- Standing or seated, with a variety of seating and strapping options (e.g. kneeling vs seated) - 1 or 2 poles

Abbreviations: CP, cerebral palsy; GMFCS, Gross Motor Function Classification System.

[a]Sports that can be integrated into existing able-bodied programmes within schools or communities.

a means of supporting physical and mental development in ways that may augment our traditional ways of doing things, for athletes across the mobility spectrum. It is worth noting that in most professional sports there is an explicit recognition of tiers of ability, designed to accommodate the large numbers of individuals wishing to be involved in those various sports. Parasports for individuals with alternate means of functioning are simply another expression of these realities.

Current research on parasport in individuals with CP is limited by methodological and conceptual gaps. Many studies are small in scale and short in duration, which restricts the ability to capture meaningful or long-term outcomes. Few high-quality randomized controlled trials exist within this research space. The focus is predominantly on children and those with 'milder' impairments, limiting applicability across the broader CP population, including adults and those with higher support needs.

Research tends to favour therapy-oriented interventions (e.g. 'aquatic therapy') over sports that may be less traditionally thought of as 'therapeutic', like wheelchair basketball, leading to an incomplete understanding of the benefits across various sporting opportunities. Key outcomes such as long-term functional status, employment, and overall well-being remain underexplored. Comparisons between athletes and non-athletes with CP across the lifespan are also rare, leaving significant gaps in our understanding of the broader impact of sport participation, highlighting the need for more comprehensive, inclusive, and longitudinal research in this field.

When working with children with any childhood-onset disability and their families, we must consider both their short- and long-term future. Parasport participation can, for some athletes, extend beyond recreational-level participation and evolve into elite training opportunities. With this, a world of possibility opens—travel, schooling (e.g. National Collegiate Athletic Association wheelchair basketball in the US), funding, and for some the pride of representing their country on the world stage. This is true for individuals who are functioning in GMFCS level I (e.g. Canadian discus thrower Renee Foessel) or those with higher degrees of mobility impairment (GMFCS levels IV/V) like boccia star David Smith, who was crowned British Champion at age 14. Parasport participation must not be seen as an 'extra' activity only for 'sporty' kids, but as a vital tool to support and augment current clinical care with the aim of lifelong health, social inclusion, and opportunity for individuals with CP.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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SUPPORTING INFORMATION

The following additional material may be found online:
Table S1. Summarized results of the literature review by sport.

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