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Swimming as a Holistic Therapeutic Intervention for Children with Down syndrome: Perspectives from Parents and Coaches

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Abstract: Children with Down syndrome face multifaceted challenges across physical, emotional, and social domains, necessitating comprehensive and cost-effective early intervention strategies. In Indonesia, access to evidence-based therapeutic services is scarce and fragmented. Water-based activities such as swimming offer a promising therapeutic modality. This qualitative study investigates the impact of a structured swimming program on the holistic development of children with Down syndrome, drawing on the experiences of five mothers and one inclusive swimming coach. Using a phenomenological qualitative design, thematic analysis revealed three core domains of impact: physical development, emotional regulation, and social skills acquisition. The swimming club serves as the sole aquatic therapy facility in the region, extending beyond recreational engagement. Findings indicate that swimming serves as an integrated therapeutic intervention, fostering development across multiple domains in children with Down syndrome. This research supports swimming as an affordable, enjoyable, and sustainable approach to upholding the rights of children with Down syndrome and maximizing their developmental potential. The study aligns with the principles of the Sustainable Development Goals (SDGs) and the Convention on the Rights of Persons with Disabilities, providing empirically grounded evidence for inclusive and adaptive practices.

Keywords: Down syndrome, inclusive swimming program, holistic intervention, psychosocial, inclusive health

1. Introduction

Global development frameworks including the Sustainable Development Goals (SDGs) and the Convention on the Rights of Persons with Disabilities (CRPD) affirm the right of children with disabilities to inclusive health and education [1] [2]. According to data from the Basic Health Research (Riskesdas) conducted by the Ministry of Health of the Republic of Indonesia, the prevalence of Down syndrome in-creased from 0.1% in 2010 to 0.13% in 2013, and further to 0.21% in 2018 [3]

Down syndrome is characterized by common phenotypic manifestations include flattened facial profile, short neck, joint hypermobility, hypotonia, and tongue protrusion. These physical traits are frequently accompanied by congenital heart defects particularly atrioventric-ular septal defects and motor impairments that significantly compromise functional independence in daily activities [4]. Research consistently demonstrates that children with Down syndrome exhibit marked delays in both gross and fine motor development, alongside persistent challenges in verbal and nonverbal communication, which collectively hinder social engagement and interaction [5]. Beyond developmental delays, this population faces an elevated risk of multiple physical comorbidities, including obesity, obstructive sleep apnea, and recurrent respiratory tract infections largely attributable to hypotonia and anatomical anomalies of the upper airway [6] [7]. On the psychosocial front, individuals with Down syndrome often display im-pairments in emotional regulation, cognitive flexibility, and behavioral

adaptability, which negatively impact quality of life and limit opportunities for social inclusion [8].

Given these multifaceted challenges, including developmental delays, motor impairments, and their cascading effects on psychomotor functioning, targeted interventions that enhance developmental outcomes and improve quality of life are critically needed. In this context, the role of professional physiotherapists and the implementation of evidence-based physiotherapy interventions are paramount [9] [10] [11] [12] [13]. Physiotherapy represents a widely utilized and essential therapeutic modality in the management of Down syndrome. Through a systematic, individualized, and needs oriented approach, physiotherapy aims to enhance gross and fine motor skills, optimize postural control, and mitigate the effects of abnormal muscle tone commonly associated with this condition [14]. Various water based exercise protocols, including Aqua Gym and Aqua Jogging, have demonstrated positive effects on multiple physiological and functional domains, such as enhanced peripheral circulation, improved thermoregulation, increased postural stability, improved coordination, and accelerated recovery of injured tissues [15]. Notably, aquatic interventions have been shown to significantly improve the strength of both inspiratory and expiratory musculature, as supported by a growing body of empirical evidence [16] [17] [18] [19] [20].

Engagement in physical activity within aquatic environments has been associated with multifaceted benefits, extending beyond physical health to include enhanced emotional well-being. Emerging research further indicates that adapted sports programs significantly promote motor development in individuals with intellectual disabilities, fostering not only physical competence but also psychological well-being through increased social inclusion and enhanced self-worth [21]. The efficacy of aquatic therapy is largely attributed to the unique physical properties of water namely buoyancy, hydrostatic pressure, and resistance which collectively diminish the effective load on the body while enabling the performance of low impact yet functionally beneficial motor activities [4]. Moreover, water based therapies are consistently reported to be more engaging and intrinsically motivating for children compared to conventional land based exercises. This heightened engagement promotes greater adherence to rehabilitation protocols, reduces anxiety and stress levels, and enhances overall participation in therapeutic activities [22] [23].

Despite growing empirical support for aquatic interventions among children with Down syndrome in high income countries, evidence from low and middle income settings, particularly in Southeast Asia, remains scarce. In Indonesia, inclusive aquatic therapy programs are virtually nonexistent outside major urban centers, and community based rehabilitation services tailored to children with intellectual disabilities are fragmented, underfunded, and often inaccessible [24] [25]. This study represents the first qualitative documentation of caregiver and practitioner perspectives within Indonesia's only known inclusive swimming programs for children with Down syndrome, situated in Padang, West Sumatra. By foregrounding experiential insights from this unique community based therapeutic setting, this study addresses a critical contextual gap in the global literature on disability inclusive health interventions. Consequently, the present study aims to examine swimming was perceived by participants as facilitating holistic developmental progress across physical development, emotional regulation, and social development of children with Down syndrome, drawing perspectives from both parents and coaches. The findings offer empirically grounded, context sensitive evidence to inform the design and replication of affordable, sustainable, and rights based aquatic rehabilitation models in resource constrained areas.

2. Materials and Methods

2.1. Design

This study employed a qualitative phenomenological research design to explore the lived experiences of mothers of children with Down syndrome who actively participate in swimming programs, as well as the perspectives of coaches who train children with special needs, including those with Down syndrome. The phenomenological approach was selected because it facilitates a deep, nuanced understanding of the subjective meanings individuals ascribe to their personal experiences [26] [27]. This methodological choice aligns closely with the study's objective: to uncover how regular participation in swimming influences family dynamics, child development, and caregiver well-being, as perceived and articulated by the participants themselves.

2.2. Procedure

Data were collected through semi-structured, open-ended interviews designed to allow participants to articulate their lived experiences in their own words, while ensuring systematic coverage of key thematic domains relevant to the study's objectives [28]. The interview guide was developed based on a comprehensive review of the existing literature on aquatic therapy and Down syndrome, with questions tailored to elicit rich, context specific narratives. All interviews were conducted online via video conferencing in July 2025 by the first author, in the Indonesian language. A total of six individual interview sessions were carried out one with each participant (five mothers and one swimming coach) and with each session lasting approximately 25 to 30 minutes. All interviews were audio-recorded with the participants' informed consent.

Interview questions for mothers focused on their motivations for enrolling their children in inclusive swimming programs, perceived benefits and challenges, observed changes in their children's physical, emotional, and social development, and their own psychosocial experiences as caregivers. The coach was asked about training strategies, observed developmental outcomes in children with Down syndrome, collaboration with families, and systemic barriers to inclusion in aquatic settings. Thematic saturation defined as the point at which no new codes, categories, or insights emerged from successive interviews [29], was achieved by the fifth interview (with the fifth parent). The sixth interview with the coach was conducted to provide complementary professional insight, consistent with the study's dual perspective design, and yielded primarily corroborative rather than novel information.

2.3. Participants

This study employed purposive sampling, a non-probability sampling technique used to select participants who possess specific characteristics relevant to the research objectives [30]. Sampling continued iteratively until theoretical saturation was achieved, defined as the point at which no new themes, insights, or information emerged from additional data [29]. This ensured that the collected data were in-depth, thematically rich, and directly responsive to the research questions. The main requirements for participants in this study included: (1) Parents of children diagnosed with Down syndrome who actively participate in structured swimming programs; (2) Coaches with professional experience in training children with Down syndrome or other developmental disabilities.

The final sample comprised five mothers of children diagnosed with Down syndrome, all of whom regularly participated in structured swimming sessions conducted three times per week. The sample also included one coach with extensive professional experience in inclusive aquatic training, specifically with children with developmental disabilities. All participants were recruited from Profi Swimming Club, an inclusive

swimming facility in Padang, West Sumatra, Indonesia, that provides adaptive swimming programs tailored for children with developmental and intellectual disabilities. Verbal informed consent was secured from all participants after a comprehensive explanation of the study; written consent was omitted due to low literacy and community preferences for oral agreement. The protocol received ethical approval from Universitas Negeri Padang.

Table 1. Demographic Characteristics of Adult Participants

No	Role	Age	Gender
P1	Mother of Child C1	58	Female
P2	Mother of Child C2	46	Female
P3	Mother of Child C3	53	Female
P4	Mother of Child C4	55	Female
P5	Mother of Child C5	57	Female
P6	Swimming Club Coach	35	Male

Table 2. Demographic Characteristics of Children with Down syndrome

No	Duration In Programs (Years)	Age	Gender	Initial Functional Profiles
C1	8	23	Female	Physical: No heart or lung problems, but not physically active Emotional: Tends to be quiet and passive when angry; does not express emotions openly Social: Socializes at school, but rarely interacts outside of close friends
C2	3	8	Female	Physical: Physically quite healthy, but can't swim at all Emotional: Often bursts into tears when he doesn't get what he wants; has difficulty delaying his desires. Social: Not yet fluent in speaking, very limited vocabulary; doesn't have any close friends outside of the family.
C3	4	17	Male	Physical: Mild obesity; weak muscles; large belly; doesn't dare enter a deep pool. Emotional: Easily angered and frustrated; tends to withdraw when upset; was traumatized by fear due to a negative experience with a coach in his early days. Social: Initially very dependent on his parents' presence; reluctant to interact if he feels uncomfortable.
C4	5	16	Male	Physical: Very weak physically; frequently ill (fever, cough); difficulty breathing; slurred speech. Emotional: Very impulsive, if he wants something, it must be done immediately; easily frustrated if delayed. Social: Already good at helping and socializing, but verbal communication is limited.
C5	9	21	Male	Physical: Frequently ill with fever and cough; low immune system; difficulty breathing when coughing; thin and weak body. Emotional: Very easily angered, can hit the table or run out when angry; has difficulty accepting rejection. Social: Enjoys playing in water since childhood, but is not used to interacting in structured groups.

2.4. Data Analysis

The analysis in this study uses thematic analysis to identify, analyze, and report patterns (themes) in the data, following the six-step approach outlined by Braun and Clarke's (2022) : (1) familiarization with the data, (2) initial coding, (3) theme development, (4) theme review, (5) theme definition and naming, and (6) report writing [31]. All transcripts were initially coded by the first author, who systematically generated descriptive and interpretive codes through line by line reading. To enhance analytical credibility and reduce interpretive bias, the preliminary codebook and emerging themes were shared with the second author an experienced qualitative researcher for independent review and critical feedback during structured supervision sessions. Any discrepancies in code interpretation or theme boundaries were discussed iteratively until full consensus was reached. This collaborative validation process aligns with established strategies for ensuring trustworthiness in qualitative research conducted by small teams [32]. Final themes were further refined through repeated comparison with the original data to ensure they remained grounded in participants' lived experiences.

3. Results

One of the most salient findings in this study was that parents and the coach perceived participation in the inclusive swimming programs as facilitating holistic developmental progress across physical, emotional, and social domains in children with Down syndrome, an outcome they attributed directly to the rarity of such inclusive services in the Padang area. The local context played a central role, as expressed by P1:

"There is only one swimming club here that accepts children with Down syndrome."

This was further emphasized by participant P3, who said that when his child left the club and then decided to rejoin, she told her child:

"I will register you again, but on the condition that no one gets upset and scared and suddenly wants to leave again because there are no other clubs that will accept children with Down syndrome."

This limitation makes the swimming club established by P6 not just a place for training, but the only physical, emotional, and social therapy space available for children with Down syndrome in West Sumatra. Without this club, the information conveyed by parents and observed by coaches would most likely not have been possible. The most striking change is seen in the significant contrast between the "before" and "after" swimming conditions. Based on in depth interviews with five parents and one swimming coach in Padang, it was found that inclusive swimming programs have a holistic impact on children with Down syndrome in three main domains: (1) Physical Development, (2) Emotion Regulation and (3) Social Development. These results are clearly evident in the various stories shared by the participants and show the diverse changes that have occurred since the children became involved in the inclusive swimming programs in Padang.

3.1 Physical Development

Parents reported significant changes in their children's physical condition after participating in regular swimming training, ranging from increased muscle mass and body strength. As stated by P3:

"His body has become thicker, firmer, and more muscular. When we touch him, his flesh feels solid."

Then there was a noticeable increase in endurance, marked by a decrease in the frequency of illness. P5 stated:

“My child used to often have fevers and coughs... now he never has fevers anymore.”

The next thing was an improvement in respiratory function, especially in the ability to regulate breathing during physical activity and when sick. This was conveyed by P1:

“Now, thank God, he is much healthier... he used to have difficulty regulating his breathing, but now he is good at regulating his breathing.”

Then P6 reinforced this finding by emphasizing that swimming intensively trains the respiratory system:

"Swimming 20 meters back and forth is hard... it trains your breathing. These children get sick less often."

Regular swimming training has a significant positive effect on children's physical condition, including increased muscle mass, body strength, endurance, and respiratory capacity, as well as a reduction in the frequency of illness.

3.2 Emotional Regulation

Participation in swimming is also associated with an improvement in children's ability to manage their emotions. This can be seen in children who become more patient and able to delay their desires. P4 said:

“In the past, if he wanted something, he had to have it right away, but now he can be more patient... wait a moment.”

Furthermore, there has also been a drastic reduction in emotional outbursts. P5 describes the change in his child's behavior:

“He used to get angry and hit the table... now it's very different, he understands how to control his emotions.”

Then it is seen that the child begins to show empathy and takes on the role of mood regulator. P3 said that her child now even mediates when his parents argue:

“He tells me to be more patient, take a breath, and not get emotional... he acts as a mediator.”

P6 acknowledged that although the children's moods are still fluctuating, the consistent swimming environment helps them learn to express their emotions verbally:

“Usually, parenting also has an influence... but in the pool, they learn to recognize and express their feelings. Because when we're in the pool, I also encourage them to talk.”

Consistent participation in swimming training not only affects physical condition, but also contributes greatly to the progress of children's emotional regulation. Through habits, discipline, and social interaction in the pool area, children are taught to be more patient, reduce hasty emotional reactions, and begin to build empathy and the ability to resolve conflicts. The role of the coach in providing opportunities to talk about feelings also reinforces this process.

3.3 Social Development

Swimming also creates an inclusive space that expands children's social capacity to interact, be accepted, and develop socially in a supportive environment. Ultimately, because they are accustomed to interacting in their safe space, children have increased social initiative. P5 reported:

“I used to be quiet... now I want to help, for example by sweeping the mosque or helping with youth group activities.”

Another thing is that verbal communication has become clearer and more active. As stated by P2:

“He used to be quiet and couldn't speak, it was difficult, unclear... now he has more vocabulary, more friends, is good at talking, and can interact.”

There are also changes in independence and increased awareness of routines. P2 said:

“He already knows the schedule... when it's time, he's right on time at the pool, puts his water bottle and swimming gear away himself. After he's done, he tidies up.”

P6 also emphasized significant social changes:
"He used to be very indifferent, busy with his own world. Now he initiates conversations, greets people, kisses hands... just like a normal person."

These findings indicate that swimming is not merely a physical intervention but also functions as holistic therapy that simultaneously supports the physical development, emotional regulation, and social skills of children with Down syndrome within a rare inclusive context.

4. Discussion

Rather than simply replicating reports of “increased muscle strength,” our findings contextualize these improvements within the specific pathophysiology of Down syndrome. Parents and coaches consistently report significant improvements in muscle strength, physical endurance, and respiratory function in children with Down syndrome after regular swimming participation, which is consistent with experimental studies showing that hydrodynamic resistance during swimming increases neuromuscular activation and reduces functional limitations associated with hypotonia in adolescents with trisomy 21 [33] [34] [35]. Notably, participants emphasized respiratory regulation during daily activities a critical adaptation given the high prevalence of obstructive sleep apnea and recurrent respiratory infections in this population [6].This echoes [36], who documented that structured aquatic programs significantly improve inspiratory muscle strength and reduce respiratory morbidity. Thus, swimming may function not just as exercise, but as non-pharmacological respiratory therapy, especially vital in settings like Padang where access to pulmonologists or physiotherapists is limited.

The reported emotional changes including increased patience, improved self-control, non destructive emotional expression, and enhanced empathy during family conflicts, highlight the potential of swimming as a tool for fostering emotional regulation development. The rhythmic, full body movements required in swimming combined with the hydrodynamic pressure of water flowing around the limbs and trunk may generate a gentle somatosensory input akin to tactile massage. This, together with the thermal stability of the aquatic environment, likely contributes to parasympathetic activation, reducing physiological arousal and promoting mental relaxation [37]. Such conditions

align with participants' reports of decreased emotional outbursts and increased capacity for calm self expression (e.g., P5: "now he understands how to control his emotions"). In this light, the pool functions not only as a motor training space but also as a sen-sorimotor regulator that supports emotional regulation particularly valuable for children with Down syndrome, who often experience heightened sensory reactivity and autonomic dysregulation [8] [38], supports social engagement and emotional co-regulation. In this context, the pool becomes more than a physical space, it is a physiologically safe environment that reduces defensive autonomic states (e.g., fight-or-flight or freeze responses), thereby enabling children to express emotions verbally rather than through outbursts. This may explain why the coach observed that children "learn to recognize and express their feelings" more readily in the water, a finding consistent with emerging evidence on aquatic therapy and autonomic regulation in neurodevelopmental conditions [35] [39]

Research findings on increased verbal communication, social initiative, empathy, and independence suggest that swimming pools function as communities of practice, which aligns with research [40] that suggests that swimming pool environments function as communities of practice, where children with Down syndrome gradually internalize social norms through repeated and meaningful participation. Unlike isolated therapeutic environments, swimming pools bring together peers, both disabled and non-disabled, in shared activities that require cooperation, taking turns, and mutual support. As participants explained, children began to "remind others when they were late" or "help sweep the mosque," reflecting not only imitation but also legitimate peripheral participation [40] through which newcomers move toward full membership in the social world. This aligns with findings that inclusive physical activity environments can serve as informal apprenticeships in social competence [41]. Furthermore, the transfer of skills learned in the pool to everyday life, such as independently preparing swimming gear or helping with household chores, reflects findings [42], which reported that aquatic interventions promote the development of body awareness and functional independence. In a context where special schools (SLB) are hours away and regular schools often refuse enrollment [25] [43], swimming clubs become the only socially inclusive arena that takes its role far beyond mere recreation.

Extending this logic to clinical practice, physiotherapists are encouraged to incorporate these insights into clinical assessments, not only evaluating physical capacity in isolation, but also considering motivational readiness and adherence to therapeutic routines as interdependent determinants of rehabilitation success [44].In resource-limited settings like Padang, where formal physiotherapy is scarce, the affective and behavioral engagement fostered through inclusive swimming may in fact be the primary driver of functional gains. Thus, clinicians and policy-makers alike should recognize that therapeutic efficacy is not confined to clinical techniques alone, but is deeply embedded in the social and emotional context of the intervention. This underscores an urgent need to replicate this model in other underserved regions and to integrate community-based aquatic programs into national early intervention frameworks, as recommended by [43] [45]. Moreover, coach training should incorporate foundational knowledge of Down syndrome's developmental trajectory [8], ensuring that physical activity is coupled with psychosocial scaffolding.

This study's small, homogenous sample (n = 6) precludes statistical generalizability. The findings reflect subjective, context-bound experiences of families in one Indonesian city. However, thematic saturation was achieved, and the narratives show strong alignment with international literature on aquatic therapy. As [32] note, the transferability of qualitative findings depends not on representativeness, but on "thick description" and theoretical resonance both of which are present here. Overall, the results confirm that swimming functions not merely as a recreational pursuit but as a holistic

therapeutic intervention capable of simultaneously influencing physical, emotional, and social development in children with Down syndrome an approach that is fully aligned with the principles of comprehensive, inclusive child development in rehabilitation and education. Future mixed-methods or longitudinal studies could test whether these perceived benefits translate into measurable developmental milestones.

5. Conclusions

This qualitative study provides compelling, contextually grounded evidence that structured swimming programs can function as a holistic therapeutic intervention for children with Down syndrome, particularly in underserved regions like Padang, Indonesia, where access to formal rehabilitation services is extremely limited. The consistent reports of improvements across physical development, emotional regulation, and social development from both parents and the coach suggest meaningful developmental benefits, though findings must be interpreted with caution due to the small sample size and phenomenological design, which preclude statistical generalization. Notably, the inclusive swimming club at the heart of this study is the only therapeutic space of its kind in West Sumatra, serving not only as a site for motor skill development but also as a vital source of psychosocial support for families. Despite its limitations, the depth and convergence of participant narratives alongside alignment with international literature enhance the transferability of these findings to similar low resource, community driven contexts. Several methodological constraints warrant careful consideration. First, social desirability bias may have shaped participants' accounts, especially given that the coach (P6) is also the founder of the club; parents, recognizing his indispensable role in sustaining this rare service, might have emphasized positive outcomes to express gratitude or avoid criticism. Second, the single site design restricts the diversity of experiences captured, as findings reflect the realities of one specific program in Padang and may not generalize to settings with different cultural norms, resource levels, or program structures. Third, the study relies solely on self reported data, without objective corroboration from tools such as pulmonary function tests, standardized emotional regulation scales, or behavioral observation checklists leaving room for recall or attribution bias.

Nevertheless, this model holds significant promise for replication. Its low cost, reliance on existing public infrastructure (e.g., municipal swimming pools), and community-based delivery make it a scalable and sustainable option for remote or underfunded areas. We recommend that local governments, inclusive schools, and rehabilitation networks collaborate to establish similar programs, supported by mandatory coach training on Down syndrome characteristics and adaptive pedagogical strategies ideally integrated into national certification curricula. When implemented inclusively, consistently, and with appropriate scaffolding, swimming offers more than physical exercise; it becomes an accessible, enjoyable, and rights affirming pathway to holistic development, fully aligned with the principles of the Sustainable Development Goals and the Convention on the Rights of Persons with Disabilities.

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