Benefits and Enjoyment of a Swimming Intervention for Youth With Cerebral Palsy: An RCT Study

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Purpose: To investigate enjoyment and specific benefits of a swimming intervention for youth with cerebral palsy (CP). **Methods:** Fourteen youth with CP (aged 7 to 17 years, Gross Motor Function Classification System levels I to III) were randomly assigned to control and swimming groups. Walking ability, swimming skills, fatigue, and pain were assessed at baseline, after a 10-week swimming intervention (2/week, 40-50 minutes) or control period, after a 5-week follow-up and, for the intervention group, after a 20-week follow-up period. The level of enjoyment of each swim-session was assessed. **Results:** Levels of enjoyment were high. Walking and swimming skills improved significantly more in the swimming than in the control group ($P = .043$; $P = .002$, respectively), whereas fatigue and pain did not increase. After 20 weeks, gains in walking and swimming skills were retained ($P = .017$; $P = .016$, respectively). **Conclusion:** We recommend a swimming program for youth with CP to complement a physical therapy program. **(Pediatr Phys Ther 2016;28:162–169)** *Key words: adolescent, ambulation, cerebral palsy, child, female, human, male, pain, physical fatigue, pleasure, randomized control trial, swimming/therapeutic use*

INTRODUCTION

Cerebral palsy (CP) is the most common motor disability in childhood and is associated with lifelong motor impairment.[1] Diverse impairments of body function and structure in addition to activity limitations and participation restrictions have been identified in youth and adults with CP. Of European youth with CP, 70% are able to walk with or without aids,[2] but at lower walking speed than in youth who are typically developing.[3] Reduced walking speed can limit the ability of children and adolescents at Gross Motor Function Classification System (GMFCS) levels II and III to keep up with peers, especially outdoors and in the community.[4] In addition, 45% of adults with CP reported a deterioration of walking skills, with an onset of deterioration between 15 and 34 years of age for 64% of these adults.[5] Secondary problems developing mainly in late childhood include fatigue and pain.[6] Pain has been reported to be present in 60% of 8- to 12-year-old youth with CP[7] and in 74% of 13- to 17-year-old adolescents with CP.[8] Of adults with CP, 30% report substantial perceptions of fatigue, and their reported physical fatigue is significantly higher than in the general population.[9] Adolescents and young adults with CP perceive physical therapy programs during childhood to induce fatigue, pain, and physical distress.[10,11]

Physical activity has been found to contribute significantly to the prevention of chronic pain, fatigue, and deterioration of locomotor skills in adults with CP.[11] Although sustaining a physically active lifestyle is essential for youth with CP to achieve and maintain functional capability,[12] they are considerably less active than their peers who are

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able-bodied.[13] Perceived barriers to engaging in physical activity reported by youth with CP include fatigue, pain during exercise, fear of increased risk of injury, beliefs that learning a motor skill is too time-consuming, and the perception of physical activity and sports as not being fun.[14] A lack of physical activity has been found to be associated with perceived physical fatigue and to contribute to the deterioration of locomotion in adults with CP.[5,9] Because an increase in pain and perceptions of fatigue are associated with a higher chance of inactivity among adults with CP who are able to walk,[15] a vicious cycle of inactivity exists.

Motivation and enjoyment are known to be facilitators for engaging in and for adhering to physical activity.[10,16] Recently, Riner and Sellhorst[12] recommended physical activity and exercise programs for youth with CP be enjoyable, within the child's capabilities, and include only activities with limited risk of falling or injury. Swimming is a community-based exercise that is believed to be fun, not to increase pain during exercise and not to increase the risk for injury in youth with CP,[17-19] but so far no randomized controlled trial has been published to support this. Swimming and other aquatic interventions have been reported to have a positive effect on gait velocity[18,20] and aquatic skills.[17-19] Kelly et al[21] reported that fatigue was not significantly increased after a 12-week community aquatic exercise program. Levels of pain associated with the aquatic intervention have not been reported in any of these studies. Moreover, none of the authors reported the perceived level of enjoyment of the participants regarding the intervention programs.

Therefore, the purpose of this study was to investigate the effect of a swimming intervention on pain, fatigue, walking ability, and aquatic and swimming skills, in youth with CP with the ability to walk, and the retention of possible gains. Furthermore, the enjoyment of the swimming program was evaluated.

METHODS

The study used a randomized controlled design with single blinding. Youth diagnosed with CP, aged 7 to 17 years, at GMFCS levels I to III were recruited through hospitals, special schools, and private practices. Exclusion criteria were a botulinum toxin A injection or orthopedic surgery during the 6 months before the start of the study. Parents provided full informed consent. Ethical approval was obtained from the university hospital medical ethical committee. Participants were randomly assigned to a control group (no scheduled swimming program) or an intervention (swimming) group. Randomization was blocked by age ($<$12.5 years and $\geq$12.5 years) and by GMFCS levels (I, II, and III).

The 10-week swimming program in the community was offered without financial cost to the participants in the intervention group and consisted of 2 sessions per week (range 40-50 minutes) in a 25-m by 13-m swimming pool (27.5°C). For ethical reasons, the intervention program was also offered without financial cost to the participants in the control group (after the 5-week follow-up tests for this study had taken place). The immediate objective of the program was to improve independence in the water and to learn or improve a swimming stroke. Participants in the intervention group were individually tutored, and some activities were carried out in a group with others present in the pool. A maximum of 4 participants were together in the pool at any time. The main investigator instructed the youth assisted by physiotherapy students. Details of the swimming intervention program can be found in Appendix 1 (Supplemental Digital Content 1, available at http://links.lww.com/PPT/A98). Immediately after each swimming session, the participants rated their perceived level of enjoyment of the swimming session on a 5-point Likert scale using smiley faces and labels ranging from "not at all," "a little," to "very much." All participants in the intervention and control groups continued to receive their usual physical therapy program throughout the study, which was reported to the main investigator and did not differ between groups (Table 1).

A 5-week follow-up period with no scheduled swimming program for either group followed. All participants were evaluated 3 times: before (T_1) and after (T_2) the intervention/control period, and after the 5-week follow-up period (T_3). The swimming group was assessed once more, 20 weeks after the end of the swimming program. The 3 assessors had a BSc in Physiotherapy and Rehabilitation Sciences and were blinded as to group assignment. All assessors were trained in administration of the tests and followed a protocol for administration to ensure consistent instructions. All assessors assessed an equal number of participants of each group to avoid bias.

The main investigator, aware of the group assignment, conducted the measurements in the water. Participants in the control group took part in all tests, including the pool-based measurements. Self-reported current pain intensity and the amount of hurt or pain in the past week were measured using the Faces Pain Scale-Revised and the Visual Analogue Scale, respectively. Both tools are valid and reliable, and the combination of scales is considered the most appropriate for use in clinical trials in children and adolescents.[22] The user-friendly 1-minute fast walk test (1-min WT) measured distance walked at maximum walking speed and is valid and reliable for use in children with CP.[23] Perceptions of fatigue were measured using the Dutch version of the self-report PedsQL multidimensional fatigue scale (PedsQL Fatigue),[24] which is valid and reliable for use in children and adolescents.[25] The Water Orientation Test Alyn 2 (WOTA 2), a 27-item test based on the Halliwick concept,[26] was used to assess the swimmer's level of adjustment and function in the water. The scale is reliable and valid for use in youth with disabilities and consists of a mental adjustment (MA) subscale and a skills, balance control, and movement (SBM) subscale.[27]

Data analyses were performed using SPSS v19 and Microsoft Excel 2010. The α-level was set at 0.05 and all tests were 2-tailed. Demographics and characteristics at baseline were compared between the swimming and

TABLE 1
Descriptive Information at Baseline for the Participants of 2 Groups of Youth With Cerebral Palsy (N = 14)[a]

	Swimming Group (n = 7)	Control Group (n = 7)	Statistics	*P*
Demographics				
sex, male/female	5/2	3/4	Fisher test	.592
Age at enrollment, y/mo	8/7 (3/4)	11/8 (3/5)	$U = 19.0$	.535
Age categories				
7-12.5 y	5	5	$U = 24.5$	1.00
12.5-17 y	2	2		
Mobility level				
GMFCS I	1	2	$U = 24.0$	1.00
GMFCS II	6	4		
GMFCS III	0	1		
Manual ability level				
MACS I	1	1	$U = 24.5$	1.00
MACS II	4	4		
MACS III	2	2		
CP subtype[b]				
Unilateral spasticity	2	3		
Bilateral spasticity	4	2		
Dyskinetic	0	2		
Nonclassifiable	1	0		
Gestational age, wks	33 (12)	39 (3)	$U = 14.5$	.220
Anthropometrics				
Height, m	1.29 (0.3)	1.51 (0.3)	$U = 18.5$	.478
Weight, kg	26 (13.0)	35 (16.5)	$U = 15.0$	.245
Related medical history				
ASD	2	1		
Speech difficulties	0	2		
Visual impairment	5	4		
Hearing difficulties	0	0		
Seizure disorder	2	2		
Education				
Special needs education	7	5	Fisher test	.462
Mainstream education	0	2		
Swimming experience	6	7	Fisher test	1.00
Orthotic devices	7	6	Fisher test	1.00
Physical therapy, min/wk	90 (60)	100 (45)	$U = 24.0$	.992

Abbreviations: ASD: autism spectrum disorder; GMFCS: Gross Motor Function Classification System; MACS: Manual Ability Classification System.
[a]Values are medians (interquartile range) for the continuous variables and are frequencies for ordinal and categorical variables.
[b]Cerebral palsy subtypes according to the surveillance of CP in Europe.

control groups using Mann-Whitney *U* tests for the ordinal (eg, GMFCS and Manual Ability Classification Scale) and continuous (eg, age and anthropometrics) descriptive measures and Fisher exact tests for the categorical descriptive measures (swimming experience (yes/no), use of orthotic devices (yes/no). The baseline values of the outcome variables were compared between groups using a Mann-Whitney *U* test or an unpaired *t* test. Changes over the 10-week (T_1 to T_2) and 15-week periods (T_1 to T_3) were compared between groups using Mann-Whitney *U* tests for the pain intensity scores, PedsQL Fatigue scores and the WOTA 2 scores, and unpaired *t* tests for the 1-min WT scores. Changes over time ($T_1 - T_2 - T_3$) within each group were analyzed using a Friedman 2-way analysis of variance (ANOVA) by ranks for pain intensity, the PedsQL Fatigue, and the WOTA 2. Where significant results were found by the Friedman 2-way ANOVA, post-hoc tests corrected for multiple comparisons were used to test the differences between baseline (T_1) and posttest (T_2) and between baseline (T_1) and follow-up test (T_3). Changes over time within each group for the 1-min WT were analyzed using a repeated-measures ANOVA (simple contrasts, first). Bonferroni correction for multiple testing was applied. The differences between the baseline values and the 20-week follow-up scores of the swimming group were evaluated using Wilcoxon matched-pairs signed rank tests and paired *t* tests.

RESULTS

The participant flow diagram is shown in Figure 1. The number of possible candidates assessed for eligibility is unknown, as some therapists and institutions did not reveal the number of eligible participants because of privacy

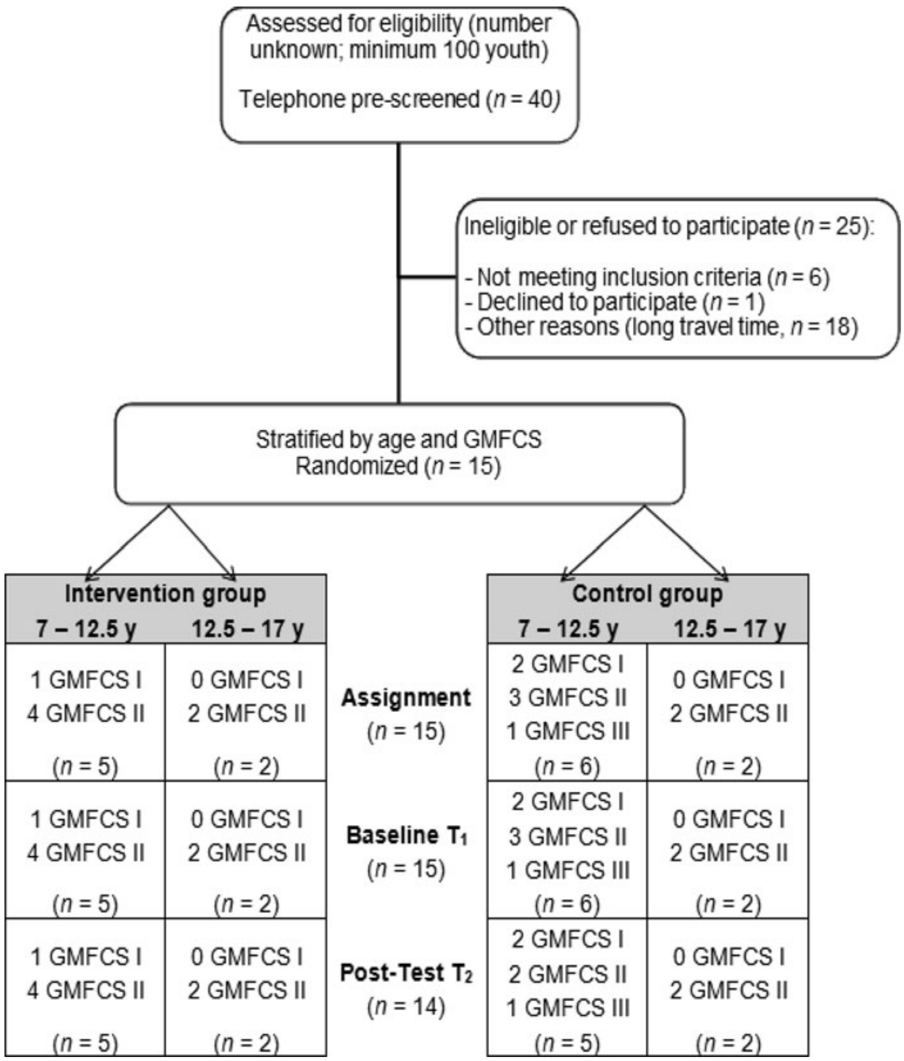

Fig. 1. Diagram illustrating the flow of participants and group assignment, including the number for each level of the Gross Motor Function Classification System (GMFCS), within each age category. One child in the control group dropped out at T_2 due to a persistent viral infection.

regulations. Of the 40 individuals who responded to the recruitment efforts, 15 were randomized and completed the baseline testing, and 14 (7 control and 7 intervention) completed the study and were included in the data analysis. One participant of the control group dropped out because of a persistent viral infection. The majority of participants were classified in GMFCS level II (n = 10) and the 7- to 12.5-year (n = 10) category.

The 2 groups were not significantly different at baseline in demographics, characteristics, and physical ability (Table 1); however, participants in the control group were slightly older, heavier, and taller than participants in the intervention group. Both groups were comparable at baseline for the outcome measurements.

Adherence and Enjoyment

All participants of the intervention group completed 16 to 20 swimming sessions (median adherence 100%). All individuals but 1 rated their levels of enjoyment with a median maximum score (5), indicating that the swimming sessions were enjoyed "very much." One child reported a score of 3, indicating that the sessions were enjoyed "a little bit." No adverse events related to the study procedures were reported.

Walking Ability

One adolescent of the control group was unable to perform the 1-min WT at posttest (T_2) because of a knee injury unrelated to the study. The walking distance at maximum walking speed of the swimming group improved over time ($T_1 - T_2 - T_3$), but not to a level of significance (Table 2). Over the 10-week swimming intervention (T_1 to T_2), the improvement in walking distance at maximum walking speed of the swimming group was significantly different from the change in the control group (Table 3). No significant differences were observed between groups for their changes over the 15-week period (T_1 to T_3) that included a 5-week follow-up period. However, walking distance in the swimming group increased by 18.9 m compared with a 4.9-m increase in the control group. After

TABLE 2

Results of the 1-Minute Fast Walk Test, the Visual Analogue Scale, the Faces Pain Scale Revised, the PedsQL™ Multidimensional Fatigue Scale, and the Water Orientation Tests Alyn 2 (Total Score, Mental Adjustment Score and Skills, Balance Control, and Movement Score) at Baseline (T_1), Posttest (T_2), and After 5 Weeks of Follow-Up (T_3) for the Swimming Group and the Control Group[a]

Outcome Measurement		*n*	Baseline (T_1)	Posttest (T_2)	5-wk Follow-Up (T_3)	Statistical Analysis[b]	*P*
1-min WT, m	Exp	7	69.1 (14.1)	80.7 (17.4)	88.0 (15.6)	$F(2,12) = 3.788$; MSE = 167.11	.053
	Ctrl	6	78.1 (20.2)	70.5 (32.1)	83.0 (29.7)	$F(2, 10) = 3.348$; MSE = 119.56	.077
VAS (0-100 mm)	Exp	6	6.5 (25.8)	12.0 (51.8)	13.5 (21.0)	$\chi^2(2) = 0.333$	.898
	Ctrl	7	18.0 (44)	28.0 (32)	6.0 (28.5)	$\chi^2(2) = 1.778$	.451
FPS-R (0-10)	Exp	6	1 (2)	0 (0)	0 (1.5)	$\chi^2(2) = 1.077$	.741
	Ctrl	7	0 (3)	2 (10)	0 (3)	$\chi^2(2) = 2.364$	.389
PedsQL Fatigue, %[c]	Exp	5	76.4 (20.8)	73.6 (12.5)	83.3 (22.2)	$\chi^2(2) = 0.316$	.907
	Ctrl	7	94.4 (16.0)	91.7 (3.5)	88.9 (27.1)	$\chi^2(2) = 6.077$[d]	.042
WOTA 2 total, %	Exp	7	40.0 (5.6)	74.7 (16.9)	74.7 (18.3)	$\chi^2(2) = 13.000$[e]	<.001
	Ctrl	7	52.0 (23.5)	65.4 (31.9)	60.5 (36.3)	$\chi^2(2) = 4.571$	.112
WOTA MA, %	Exp	7	60.6 (6.6)	87.2 (3.1)	90.9 (9.6)	$\chi^2(2) = 13.040$[e]	.001
	Ctrl	7	66.7 (25.1)	63.6 (35.2)	59.0 (43.8)	$\chi^2(2) = 0.240$	.932
WOTA SBM, %	Exp	7	21.4 (7.1)	64.3 (33.3)	61.9 (33.3)	$\chi^2(2) = 11.385$[e]	.001
	Ctrl	7	35.7 (25.0)	66.7 (40.5)	61.9 (46.4)	$\chi^2(2) = 7.684$[d]	.019

Ctrl, control group; Exp, experimental group; FPS-R, Faces Pain Scale-Revised; MA, mental adjustment score; 1-min WT, 1-minute fast walk test; PedsQL Fatigue, PedsQL multidimensional fatigue scale; SBM, skills, balance control, and movement score; VAS, Visual Analogue Scale; WOTA 2, Water Orientation Test Alyn 2.

[a]Values are medians (interquartile range) for all scales except for the 1-min WT (means and standard deviations are presented).

[b] Changes over time were analyzed using a repeated-measures ANOVA for the 1-min WT and a Friedman 2-way ANOVA for the other scales.

[c]An increase in the PedsQL Fatigue represents a decrease in fatigue.

[d]$P < .05$.

[e]$P < .01$.

TABLE 3

Comparison of the Changes Between the Swimming and Control Groups Over the 10-Week and 15-Week Periods for the 1-Minute Fast Walk Test and the Water Orientation Test Alyn 2

Outcome Measurement	Swimming Group Mean (SD)	Control Group Mean (SD)	Statistical Analysis[a] *t* (Confidence Interval)		*P*
1-min WT, m					
Baseline—posttest[b]	11.6 (18.2)	− 8.3 (11.8)	2.289 (0.77 to 39.04)[d]		.043
Baseline—follow-up[c]	18.9 (23.1)	4.9 (17.5)	1.280 (−9.83 to 37.83)		.225
	Median (Interquartile Range)		*U*	*z*	
WOTA 2 total score (%)					
Baseline—posttest[b]	33.3 (8.7)	6.2 (9.3)	2.0[e]	− 2.878	.002
Baseline—follow-up[c]	34.6 (9.3)	3.7 (9.1)	2.5[e]	− 2.814	.003
WOTA 2 MA (%)					
Baseline—posttest[b]	24.2 (4.6)	0.0 (9.2)	0.0[e]	− 3.148	.001
Baseline—follow-up[c]	30.3 (3.3)	− 2.6 (13.3)	1.0[e]	− 3.006	.001
WOTA 2 SBM (%)					
Baseline—posttest[b]	35.7 (17.9)	16.7 (21.4)	8.5[d]	− 2.056	.042
Baseline—follow-up[c]	38.1 (15.5)	4.8 (20.2)	6.0[d]	− 2.380	.016

1-min WT, 1-minute fast walk test; SD, standard deviation; MA, mental adjustment subscore; SBM, skills, balance control, and movement subscore; WOTA 2, Water Orientation Test Alyn 2.

[a]Differences between groups were analyzed using unpaired *t* tests for the 1-min WT and using Mann-Whitney *U* tests for the WOTA 2.

[b]Values represent the absolute changes between the baseline score and the posttest score.

[c]Values represent the absolute changes between the baseline score and the score after 5 weeks of follow-up.

[d]$P < .05$.

[e]$P < .01$.

the 20-week follow-up period, the 1-min WT scores of the swimming group were significantly higher than at baseline, with a mean improvement of 14.6 m (Table 4).

Pain

One participant's pain intensity data (swimming group) were removed from the analysis because of inability to comprehend the pain intensity scales, as judged by the assessor in consultation with the participant's parents and school teacher. Baseline values of both the Visual Analogue Scale and the Faces Pain Scale-Revised were low (Table 2). Variability for the pain intensity scores within each group and between the 2 measurement scales was high. Changes over time were not significantly different between groups, and no significant change over time within either group

TABLE 4

Results of the 1-Minute Fast Walk Test, the Visual Analogue Scale, the Faces Pain Scale Revised, the PedsQL™ Multidimensional Fatigue Scale, and the Water Orientation Tests Alyn 2 (Total Score, Mental Adjustment Score, and Skills, Balance Control, and Movement Score) at Baseline and 20 Weeks After the End of the Program for the Swimming Group[a]

Outcome Measurement	n	Baseline	20-wk Follow-Up	Statistical Analysis[b]	P
1-min WT, m	7	69.1 (14.1)	83.7 (7.7)	$t(6) = 3.251^{d}$; CI [3.6-25.54]	.017
VAS (0-100 mm)	6	6.5 (25.8)	16.0 (41.8)	$Z = -1.095$	.375
FPS-R (0-10)	6	1 (2)	1 (3.5)	$Z = -0.813$	.750
PedsQL Fatigue, %[c]	5	76.4 (20.8)	90.3 (8.3)	$Z = -2.023$	.064
WOTA total, %	7	40.0 (5.6)	80.3 (24.9)	$Z = -2.366^{d}$	.016
WOTA MA, %	7	60.6 (6.6)	87.9 (12.1)	$Z = -2.371^{d}$	.016
WOTA SBM, %	7	21.4 (7.1)	69.1 (41.7)	$Z = -2.366^{d}$	.016

CI, confidence interval; FPS-R, Faces Pain Scale-Revised; 1-min WT, 1-minute fast walk test; MA, mental adjustment subscore; PedsQL Fatigue, PedsQL multidimensional fatigue scale; SBM, skills, balance control, and movement subscore; VAS, Visual Analogue Scale; WOTA 2, Water Orientation Test Alyn 2.

[a]Values are medians (interquartile range) for all scales except for the 1-min WT (means and standard deviations, and confidence intervals are presented).

[b]The differences between the baseline values and the 20-week follow-up scores of the swimming group were evaluated using a paired t test for the 1-min WT and Wilcoxon matched-pairs signed rank tests for the other scales.

[c]An increase in the PedsQL Fatigue represents a decrease in fatigue.

[d]$P < .05$.

was reported (Table 2). Between-subject variability for the change in pain intensity between the measurement occasions was high.

Perceptions of Fatigue

Two participants' data on the PedsQL Fatigue (swimming group) were removed from the analysis because of inability to comprehend the questionnaire, as judged by the assessor in consultation with the participants' parents and school teachers. The PedsQL Fatigue scores of the swimming group did not change significantly over time, whereas the PedsQL Fatigue scores of the control group did change significantly over time (Table 2); post-hoc tests revealed a significant increase in fatigue between baseline (T_1) and follow-up (T_3) in the control group. The changes over the 10- and 15-week periods did not differ between the swimming and control groups ($U = 16.0$, $Z = -0.245$, $P = .874$; $U = 9.0$, $Z = -1.390$, $P = .199$, respectively). Although not reaching significance, after 20-week follow-up, the PedsQL Fatigue scores of the swimming group were higher than at baseline (representing a decrease in fatigue), with a median improvement of 4% (Table 4).

Swimming Skills

The total score, the MA subscore, and the SBM subscore of the WOTA 2 changed significantly over time in the swimming intervention group (Table 2). The results of the post-hoc tests in this group revealed significant improvements from baseline (T_1) to postintervention (T_2) and from baseline to the end of the 5-week follow-up period (T_3) for all scores. In contrast, the control group showed no significant change in the total score or the MA subscore over the test period. The SBM subscore of the control group changed significantly over time, and post-hoc tests revealed a significant improvement from baseline (T_1) to posttest (T_2) (16.7% absolute increase). It should be noted, however, that in the swimming group all WOTA 2 scores increased significantly more than in the control group for both the 10- and 15-week periods (Table 3). After the 20-week follow-up period, the swimming group's total score and both subscores of the WOTA 2 remained significantly higher than the baseline values (Table 4).

DISCUSSION

The aim of this study was to investigate the effect of a swimming intervention on pain intensity, perceptions of fatigue, walking ability and aquatic and swimming skills, in youth with CP with the ability to walk (with or without handheld mobility devices), and the retention of possible gains. There is a paucity of studies in the literature investigating the influence of swimming programs on the various impairments and activity limitations encountered by youth with CP. Among youth with CP, 1 barrier to engaging in physical activity is the perception that physical activity and sports are not fun.[14] Therefore, the perceived level of enjoyment of the swimming intervention was also assessed.

All youth in the swimming intervention group had a high adherence to the swimming program and reported high levels of enjoyment. Swimming skills improved after the 10-week program and walking ability showed a trend toward improvement, without adverse effects on pain intensity and fatigue. These gains in the swimming intervention group were retained 20 weeks after the end of the program.

Walking Ability

The findings show that 1 of the indicators of walking ability, walking distance at maximum walking speed, increased in the swimming intervention group after the

10-week swimming program. The change in walking distance over the 10-week swimming program was significantly different from the change over this period in the control group. Twenty weeks after the completion of the swimming program, a significant increase from baseline was retained in the swimming intervention group. Maximum walking speed has not been reported in any other study on aquatics in youth with CP. Changes larger than 5.1 m were deemed clinically relevant[23]; such clinically relevant changes were found for 3 participants after the swimming intervention and for 5 participants 20 weeks after completing the swimming intervention. As walking with restrictions limits the ability of youth to keep up with peers in the community,[4] the improvement in walking speed can facilitate participation in the community.

Fatigue and Pain

Self-reported feelings of fatigue did not increase in the swimming intervention group after the 10-week swimming intervention, which is in agreement with the findings of Kelly et al,[21] who indicated no changes in fatigue after a 12-week aquatic exercise program in a sample of five 9- to 11 year-old children with CP. In the present study, fatigue increased significantly in the control group over the 15-week period (T_1 to T_3). Important to note are the high baseline levels of the sample in the present study (sample median of 89.9%), which indicates that feelings of fatigue occurred rarely in the month before baseline. These high scores imply that the youth of the present sample did not feel fatigued frequently. Variability in pain intensity change scores within each group and between the 2 measurement scales was high. The changes over time for self-reported pain intensity did not differ significantly between groups. These findings are in contrast to regular physical therapy programs that have been reported to cause pain and physical distress.[10] Pain and fatigue are perceived by youth with CP to increase because of exercise and consequently are barriers to engaging in physical activity.[14] In addition, increases in pain and fatigue have been reported to be associated with a higher chance of inactivity in adults with CP.[15] Therefore, the finding that the engagement in the physical activity program in the present study did not increase levels of pain or fatigue is pertinent. Notably, the relatively cold water in the community swimming pool apparently did not affect pain or fatigue.

Swimming Skills

Swimming skills improved significantly more in the swimming intervention group over the 10-week swimming program than in the control group, and the changes were retained with significance after a 20-week follow-up period. During this follow-up period, 4 of the 7 participants in the swimming group swam during their school time, or recreationally with family. Swimming skills improved by more than the minimal detectable change (14.2%)[27] in 6 of the 7 participants in the swimming intervention group. The improvement in swimming skills after the swimming intervention supports previous research.[17-19] However, in those studies no control group had performed the aquatic tests nor was a follow-up period longer than 3 weeks included.[17-19] The strong retention found in the present study implies that the swimming skills were learned and consolidated during the 10-week intervention. This contrasts with the perception that learning a motor skill is too time-consuming for youth with CP[14] and is important with regard to the retention of swimming skills that enable the participants to engage in a greater variety of physical activities performed in the water.

Enjoyment and Adherence

All participants in the swimming intervention group but 1 reported enjoying the swimming sessions "very much" (maximum score of 5). By participating in the swimming program, the youth experienced that sport and exercise programs, in this case swimming, can be fun. Therefore, a swimming program such as that offered in this study has the ability to eliminate 1 of the barriers to engaging in physical activity.[14] Because enjoyment and motivation are important facilitators for engaging in physical activity, adhering to therapy, and sustaining a physically active lifestyle,[10,12,16] the findings of the present study are important. The suggested positive relationship between enjoyment and adherence is supported by the high attendance rates (median 100%) found in the present study. Furthermore, none of the participants dropped out during the intervention, implying that the motivation to complete the swimming program was high.

Limitations

Only 14 participants completed the study and some participants were not capable of completing the pain intensity scales and the PedsQL Fatigue questionnaire, which negatively affected the power of the statistical analysis and increased the possibility of type II errors. For practical reasons, the assessor of the WOTA 2 was not blinded to group assignment. However, the WOTA 2 test was evaluated according to the objective criteria as explained in the manual.[27] Another limitation of the study is the lack of reliability and validity studies of the use of the pain and fatigue measures in youth with CP; however, the measures are psychometrically sound for use in children.[22,25] The data of those showing difficulties with completing the pain measures and the PedsQL were excluded. The motor performance measures (WOTA 2 and 1-min WT) have been tested for validity and reliability in youth with CP[23,27]; however, the cognitive ability of the children was not specified in these studies. Because of the nature of the measure, we did not experience any difficulties with the instructions regarding the motor tasks. Another limitation of the study is the use of convenience sampling, which might have contributed to the high enjoyment levels in this sample.

Nevertheless, the present study showed that the commonly perceived barriers to physical activity participation[14] were nonexistent in the case of the swimming program, because in addition to high enjoyment during the program, levels of fatigue or pain did not increase due to the swimming program, and swimming skills improved and were retained. These factors are important with regard to sustaining a physically active lifestyle.[12] In addition, while participating in this physically active swimming program, motor proficiency on land and in the water improved. A swimming intervention is therefore a recommended physical activity for youth with CP who are ambulatory to combat the vicious cycle of inactivity and improve mobility both in and out of the water.

CONCLUSION

Specialists, physical therapists, and parents should become aware of the benefits of a swimming program for youth with CP who are ambulant, to complement a rehabilitation program. Physical activity and sport programs should be promoted to youth with CP with trial and introductory sessions provided in community-based settings in collaboration with physical therapists, as a lack of information sustains the perception that physical activity and sport programs are not enjoyable and increase pain and fatigue. Finally, it is highly recommended to assess the perceived level of enjoyment in any intervention program, because enjoyment is closely related to adherence.

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