

## **I. BACKGROUND**

### **I.a. Evidence-Based Aquatic Therapy Intervention**

The use aquatic therapy interventions for improving the health status of children with Cerebral Palsy (CP) is supported by evidence. Ryan et al. demonstrate how children are more likely to engage in physical activities that are enjoyable and have social interaction.<sup>1</sup> Therefore, the use of a novel and recreational activity, such as aquatic therapy, within a group can help to improve participation and engagement.

Collectively, the parameters of the aquatic therapy programs used in research can point to recommendations for evidence-based interventions. Studies utilized water temperature between 32-36 degrees Celsius, frequencies of 1-2 times per week, durations of 55-60 minutes, inclusion of a warm-up and cool-down, and activities focused on aerobic exercise or functional activities.<sup>2-4</sup> The use of these parameters in literature has been proven to lead to significant outcomes in children with CP.<sup>2-4</sup>

Lai et al. showed significant and large training effects on improving gross motor function and perceptions of physical activity enjoyment in children with CP with these parameters.<sup>2</sup> Additionally, Dorval et al. showed significant increases in self-esteem and functional independence in children with CP following aquatic therapy.<sup>3</sup> Fragala-Pinkham et al. demonstrated significant and maintainable improvements in gross motor function and walking endurance in children with CP with this type of program.<sup>4</sup> Plus, Sterba et al. proved the significant and persisting improvements in the gross motor function of children with cerebral palsy seen following aquatic therapy.<sup>5</sup> Finally, in a systematic review by Roostaei et al., they concluded that aquatic therapy was both feasible and involved minimal adverse effects.<sup>6</sup>

These research studies also utilized parameters that included group activities,<sup>2-4</sup> which helps to enhance participation by addressing interpersonal factors of the Social Ecological Model (SEM).<sup>7-9</sup> This is done by creating an environment where participants are accepted by their peers and feel a motivating social connection.<sup>7-9</sup> These groups can help to enhance “community opportunities to optimize social participation” in a way that improves participation in physical activity.<sup>10</sup>

### **I.b. Evidence-Based Exercise (Aerobic and Anaerobic) Intervention**

The use of exercise interventions, including aerobic and anaerobic, for improving the health status of children with CP is supported by evidence. According to Verschuren et al., children with CP should engage in aerobic exercise at a frequency of three times per week with an intensity of 60% peak heart rate for a duration of 20 minutes.<sup>11</sup> They show how following these activity guidelines leads to better health status in children with CP by improving cardiorespiratory fitness.<sup>11</sup>

Collectively, the parameters of the exercise training programs used in research can point to recommendations for evidence-based interventions. Studies utilized frequencies of 2-4 times per week, durations of 45-90 minutes, aerobic and anaerobic exercises, endurance, interval, and strength training, gradually progressing intensity and duration, and inclusion of warm-up and cool-down.<sup>12-15</sup> The use of these parameters in literature has been proven to lead to significant outcomes in children with CP.<sup>12-15</sup>

Verschuren et al. demonstrated significant training effects for improving physical fitness in children with CP using these parameters.<sup>12</sup> These effects were seen in multiple domains, including aerobic capacity, anaerobic capacity, agility, muscle strength, athletic competence, formal and overall activity participation, physical activity

participation, and skill-based activity participation.<sup>12</sup> Furthermore, Slaman et al. showed significant effects including increased cardiopulmonary fitness, improved body composition, decreased systolic blood pressure, and decreased total cholesterol in children with CP following this type of training program.<sup>13</sup> Additionally, Van den Berg-Emons et al. showed significant effects of decrease in fat mass, increased level of daily physical activity, increased peak aerobic power, and increased isokinetic muscle strength in children with CP following an exercise program.<sup>14</sup> Darrah et al. demonstrated significant increases in muscle strength and positive perceptions of physical appearance in children with CP following a community fitness program.<sup>15</sup> Plus, Unnithan et al. proved significant improvements in aerobic capacity and gross motor function in children with CP following exercise training.<sup>16</sup> Finally, Butler et al. proved significant increases in aerobic fitness in children with CP following cardiorespiratory training.<sup>17</sup>

These research studies utilized parameters that included varying types of activities within the exercise training,<sup>12-15</sup> which helps to enhance participation by addressing individual factors of the Social Ecological Model (SEM).<sup>7-9</sup> Rosenberg et al. demonstrate how “engagement in diverse activities, despite the motor difficulties” enhances perceived confidence.<sup>18</sup> Therefore, the individual factor of perceived confidence can be affected by cultivating participation in diverse activities in a way that improves participation in physical activity.

### **I.c. Interventions within the Context of the Social Ecological Model**

One way to increase participation in exercise in children with CP is to address the individual and interpersonal levels of the SEM through identifying and alleviating barriers.<sup>1,7,8</sup> One barrier includes a lack of the perceived health benefit of physical

activity.<sup>1,7,8</sup> Therefore, ensuring that education regarding the exercise program is a priority of the programming will improve participation. Another barrier includes activities not creating accommodations for the physical characteristics of children with CP.<sup>8</sup> Therefore, ensuring that the program is targeted to this patient population in a way that creates modifications and addresses the specific activity related needs of the children will eliminate this barrier. An additional barrier includes fear of not being accepted by peers.<sup>8</sup> Therefore, fostering an environment of community within a group of children who can relate to each other will alleviate this barrier. Finally, additional barriers cited in literature include lack of opportunities, lack of awareness of possibilities, lack of access to transportation, lack of time, financial restrictions, and time of training being inconvenient.<sup>8,9</sup> All of these barriers can be addressed in this program by its presence as an after-school, transportation provided, subsidized program that is advertised within schools and around the community.

Following examples found in research, the SEM can also be used to increase the success and sustainability of this community program by engaging partners that span sectors and cross multiple levels in society.<sup>19</sup> Additionally, it can enact focus groups that will help to tailor program decisions to the target population in order to eliminate individual and interpersonal barriers while enhancing buy-in from participants.<sup>19</sup>

#### **I.d. Evidence-Based Outcome Measures**

The use of outcome measures is important in order to evaluate patient status and measure progress over time following intervention. Multiple outcome measures have been utilized in the study of physical activity and gross motor function in children with CP. The Gross Motor Function Measure (GMFM),<sup>2,4,5,12,16</sup> 10-meter Shuttle Run Test

(SRT),<sup>4,12</sup> and 6-Minute Walk Test (6MWT)<sup>4,12,17</sup> have all been extensively utilized within research studies to assess the performance of children with CP following intervention. They have also been proven in literature to be effective tools for the measurement of function in children with CP.<sup>20-22</sup> Besios et al. found the GMFM to have a very high reliability score.<sup>20</sup> They concluded that it is a reliable measure for assessing functional ability and mobility in children with CP.<sup>20</sup> Therefore, increased score on the GMFM is related to increased gross motor function in children with CP.<sup>20</sup> Verschuren et al. demonstrated how the SRT could be used to assess aerobic fitness in children with CP.<sup>21</sup> They showed how this test provides a reflection of “overall capacity of the cardiovascular, respiratory, and muscular systems.”<sup>21</sup> Additionally, they were able to establish reference curves for children with CP that improve the ability to use the SRT as an objective measure for this population.<sup>21</sup> Therefore, improved score on the SRT is related to improved capacity of cardiovascular, respiratory, and muscular systems in children with CP. Nsenga Leunkeu et al. found the 6MWT to be a reproducible and valid measure of cardiorespiratory response in children with CP.<sup>22</sup> They show how this measure offers a more feasible alternative to cycle-ergometer tests that still accurately assesses the aerobic fitness levels of children with CP.<sup>22</sup> Therefore, improved scores on the 6MWT is related to improved aerobic fitness in children with CP. These functional outcome measures that demonstrate the health status of children with CP can be used as assessments to measure progress over time following intervention. With the goal of improving health status, the children participating in intervention will then be able to enjoy decreased risk of overweight and obesity, decreased risk of secondary complications, improved fitness levels, and improved quality of life.<sup>23-25</sup>

## **II. PROGRAM GOALS**

### **II.a Improving Health Status of Participants**

The overall goal of this community-based program, called “C Me Move with CP,” is to improve the health status of children with Cerebral Palsy through education and evidence-based interventions offered in an accessible way to the community. The program aims to improve the physical fitness of participants, provide opportunities for social and engaging physical activity, and introduce healthy habits. Through education and intervention for improving overall health and wellness, these participants will leave the program with improved health status, as well as the tools to continue on in a lifelong commitment to healthy lifestyles. The following goals are the aim for the program to achieve following 12 weeks of children’s participation in the program.

### **II.b SMART Program Goals**

1. Within 12 weeks, participants will improve their The Gross Motor Function Measure (GMFM)<sup>2,4,5,12,16</sup> scores by 0.8 according to the minimally clinically important difference<sup>26</sup> to improve motor function in order to independently participate in activities of daily living.

2. Within 12 weeks, participants will improve their 10-meter Shuttle Run Test (SRT)<sup>4,12</sup> scores by 2 percentiles on the Verschuren et al. 10-meter Shuttle Run Test reference centile curves for people with Cerebral Palsy<sup>21</sup> to improve aerobic capacity in order to participate in play with peers on the playground.

3. Within 12 weeks, participants will improve their 6-Minute Walk Test (6MWT)<sup>4,12,17</sup> scores by 34.4 meters according to the minimally clinically important

difference<sup>27</sup> to improve endurance in order to efficiently transfer between classes in school.

4. Within 12 weeks, participants will demonstrate compliance with home activities of completing educational booklet pages on 4 out 5 days to improve self-efficacy in health and wellness learning in order to participate in independent self-management of healthy lifestyles and fitness.

### **III. METHODS**

#### **III.a. Who**

Participants: This program will be offered to children with Cerebral Palsy who are ages 7-18 years old. The program will accept participants at a 3:1 ratio of participants to program facilitator volunteers in order to maintain quality and safety at all times. The program will be advertised through local schools and community activity centers in order to recruit participants. Additionally, the program will create relationships with health care providers in the community who may potentially make referrals to the program for their patients. Enrollment in the program will be on a first come, first serve basis until the program reaches capacity. Children will be required to have medical clearance from their doctors to safely participate in the program. Capacity of the program will be determined by number of volunteers available, based on ratios described below. Multiple session times will be added if space becomes a limiting factor to participation.

Personnel: This program will be led by at least 5 trained and licensed Physical Therapists who volunteer their time on rotating schedules so that at least 1 Physical Therapist is present for the programming to lead to group at all times. If participant numbers exceed 21 participants, then 2 Physical Therapists will be present at each

session. Additional trained program facilitator volunteers will be utilized to help lead the groups at a 3:1 ratio of participants to trained volunteers. This will ensure that quality and safety are maintained at all times during the program. These volunteers will be trained in leading exercises and assisting during the programming before their first session. Groups will be separated by functional level and age. This sense of community and socialization allows the program to address the SEM barrier of fear of not being accepted by peers.<sup>8</sup> Children who require more assistance or modification will be paired with a 1 on 1 volunteer assistant. All entry assessments of incoming children, follow-up assessments throughout program participation, and exit assessments at completion of the program will be performed by licensed and trained Physical Therapists. All Physical Therapists and trained program facilitator volunteers will be recruited from the local community to volunteer their time to the program. Word of mouth and email flyers will be used to recruit Physical Therapy volunteers. Word of mouth, email flyers, flyers posted on local college campus, and flyers posted in community locations will be used to recruit program facilitator volunteers.

**III.b. What**

This program will consist of a daily after-school program consisting of two interventions performed throughout the course of the week. These evidence-based interventions include aquatic therapy intervention and exercise (aerobic and anaerobic) intervention. Each intervention will be completed on alternating days of the week so that Exercise sessions are every Monday, Wednesday, and Friday while Aquatic sessions are every Tuesday, Thursday. Participants will also be given educational booklets with home activities that are to be completed at home and brought back the next day for



discussion during warm-up activities. This commitment to education will address the SEM barrier of a lack of the perceived health benefit of physical activity.<sup>1,7,8</sup> The evidence-based interventions will be comprised of parameters found in the chart below. Each session will follow either the aquatic therapy intervention track or exercise (aerobic and anaerobic) intervention track, based on the day of the session. Aquatic sessions will take place in a therapeutic pool at temperature of 34 degrees Celsius. All Exercise session activities will be modified to performance level of the individual. This will help to address the SEM barrier of activities not creating accommodations for the physical characteristics of children with CP.<sup>8</sup> Gym equipment including weights, step boards, kick boards, and other equipment will be provided by the UNC Wellness Center.<sup>28</sup> Activities will be varied from session to session in order to improve interest and engagement by creating diversity and variety in the participants experiences.

10 Minute Warm-Up	
<u>Aquatic Therapy Intervention</u>	<u>Exercise (Aerobic and Anaerobic) Intervention</u>
10 minutes of kicking activities (kicking with a kickboard, assisted swimming of laps)	10 minutes of aerobic exercise (running, jump roping, dancing, kickboxing, soccer)
10 minutes of balancing activities (balancing on one foot, hopping, catching)	10 minutes of anaerobic exercise (weight training: individuals should increase weight over time as progression of intensity of exercise)

10 minutes of strengthening activities (squatting, jumping, jumping jacks)	10 minutes of aerobic exercise (running, jump roping, dancing, kickboxing, soccer)
10 minutes of stepping activities (marching in place, stepping to a rhythm, stepping up and down stairs)	10 minutes of anaerobic exercise (step-ups, squats, push-ups, sit-ups)
10 Minute Cool Down and Stretching	

**III.c. When**

This program will occur from 3:45-4:45pm on Monday-Friday. This after-school time slot addresses the SEM barrier of time of training being inconvenient.<sup>8,9</sup> An example of the schedule can be found in the chart below. Exceptions will be made for holidays and other conflicts. Programming will be offered on 5 days a week for 60-minute sessions throughout the year. Participants will be encouraged to commit to 4 days a week of sessions for at least 12 weeks. At the end of an individual’s course of 12 weeks, they will be offered the opportunity to continue for another course of 12 weeks if there is available room. However, if there is a wait list for participation, participants will be moved to the bottom of the current wait list to enroll in a second course of 12 weeks of sessions.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	4:45-5:45pm	4:45-5:45pm	4:45-5:45pm	4:45-5:45pm	4:45-5:45pm	
	Exercise Session	Aquatic Session	Exercise Session	Aquatic Session	Exercise Session	

**III.d. Where**

This program will be held in the facilities of the UNC Wellness Center at Meadowmont.<sup>28</sup> The aquatic therapy intervention sessions will be held in the pool facilities within a reserved space. The exercise (aerobic and anaerobic) intervention sessions will be held in a reserved group fitness room. Through this community partnership, participants will have access to the pool area and a designated group fitness room during program hours. Additionally, they will receive a discounted rate for membership and access to the facilities beyond program hours. All costs of participating in the program will be subsidized by community partnerships sponsors in order to alleviate financial burden. This will address the SEM barriers of lack of opportunity and financial restrictions.<sup>8,9</sup>

**III.e. How**

Enrollment: Participants will be recruited through advertisements throughout schools, community activity spaces, physical therapy offices, and gyms. Additionally, patients will be recruited from referrals from health care practitioners. Program enrollment will be on a rolling basis so that participants can begin the program at any point throughout the year. Participant guardians will fill out a form online, or fill out a form in person during session hours, to enroll their children as participants. Enrollment also requires medical clearance from a doctor. Every participant must complete an entrance assessment prior to beginning the program. During this assessment, they will be evaluated on formal outcome measures including The Gross Motor Function Measure (GMFM),<sup>2,4,5,12,16</sup> 10-meter Shuttle Run Test (SRT),<sup>4,12</sup> and 6-Minute Walk Test

(6MWT).<sup>4,12,17</sup> Height and weight will also be recorded during the assessment.

Equipment needed for the assessments will be brought by the Physical Therapist performing the evaluation if it is not available at the UNC Wellness Center. Equipment needed will include a stop watch, measuring wheel, chair, cones, scale, tape measure, and assessment booklets. The same assessment will be completed at follow-up points occurring at 4-week intervals. The success of the interventions will be based on minimally clinically important difference values and reference centile curves for people with Cerebral Palsy. A final assessment with the same measures will be completed upon completion of a 12-week course of the program. Participants and their families will be given information from their assessments for their personal health and fitness tracking.

Transportation: Free transportation on a program van will be offered from local schools to the Wellness Center every weekday. This will allow the program to address the SEM barriers including lack of opportunities, lack of access to transportation, lack of time, financial restrictions, and time of training being inconvenient.<sup>8,9</sup>

#### **IV. PROGRAM EVALUATION**

##### **IV.a. Evaluation Methods**

Committee: It is important to evaluate the success of a community-based program in order to ensure quality and efficacy of the program. This program will enact a committee to perform a program evaluation using the CDC framework for program evaluation.<sup>29</sup> This committee will consider stakeholders, anticipated health outcomes, necessary program resources including community partners, whether or not they feel it is a worthwhile referral, and opportunities for change in order to make the program

better. The program will be as transparent and comprehensive as possible regarding anticipated health outcomes, aims, and goals in order to facilitate the evaluation process. This committee will also complete a survey where they include suggestions for how to improve the program, areas where they would like to request further information to be considered in the future, and any other recommendations to enhance the quality and effectiveness of the program.

Outcome measures: In order to provide data for the evaluation of the program, information regarding participant assessments on outcome measures used in the program will be published in order to show the progression of participants over time. Evaluation of progress towards program goals will also be assessed and presented as information for the evaluation of the program. Participants will be re-assessed every 4 weeks throughout their time in the program. The initial data from the first cohort of individuals will be evaluated after this first 4-week re-assessment. Furthermore, data will be continually re-assessed at subsequent 4-week intervals. This data will be helpful in proving the effectiveness of the interventions in relation to desired health outcomes.<sup>29</sup>

Surveys: Participant and participant family surveys will be used to measure the quality of the program as well as satisfaction. These surveys will be used to collect data about what to change to improve the program, what to add to strengthen the program, what can be done better in the future, and what to continue doing in the program that has been successful so far over time. Surveys will include questions related to satisfaction with the program, ease of transportation, convenience of schedule, efficiency of time used by volunteers, perceptions of safety provided by volunteers, enjoyment of activities, financial burden posed by the program, opinions on stewardship

of program resources, quality of life as a result of the program, perception of social opportunities provided by the program, and willingness to recommend the program to others. After 8 weeks of the program, the first surveys will be disseminated to participants and their families. This feedback will be used to help improve the program after only 8 weeks of programming. Furthermore, surveys will be collected at subsequent 8-week intervals.

Continual evaluation: It is important that evaluation methods continue throughout the duration of the program. This helps to ensure continuation of quality, commitment to excellence, and reception of feedback. In addition to considering feedback from consistent assessments and quality surveys, the program board of directors will also meet every 6 months to re-evaluate program goals, missions, and aims. This will help to ensure that the program is staying true to its objectives as well as providing the opportunity for the program to evolve over time. Ultimately, the program will be committed to continual evaluation in order to optimize the degree of impact and benefits it can provide to the health and wellness of children with Cerebral Palsy.

## **V. CONCLUSION**

A community-based program focused on the health and wellness of children with Cerebral Palsy is pertinent in order to address the well-being, fitness, and quality of life of these children. Targeting health behaviors and addressing SEM level barriers will help to tackle the issue of decreased physical activity and resulting overweight and obesity in children with Cerebral Palsy.<sup>30-36</sup> Furthermore, increasing physical activity status in this patient population would help to address not only their fitness levels and overweight or obesity, but also the associated secondary problems and health risks.<sup>30-36</sup>

Not only will this program offer evidence-based interventions to increase the aerobic fitness and endurance of these children, it will also provide education and instill healthy habits. Ultimately, this program serves an important role in instilling lifelong commitments to healthy lifestyles. Allowing children with Cerebral Palsy inclusive opportunities to engage in fun, social experiences of physical activity will provide experiences that can benefit their lives forever. Therefore, it is imperative for “C Me Move with CP” to begin programming as soon as possible for the benefit of children with Cerebral Palsy. Thank you!

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