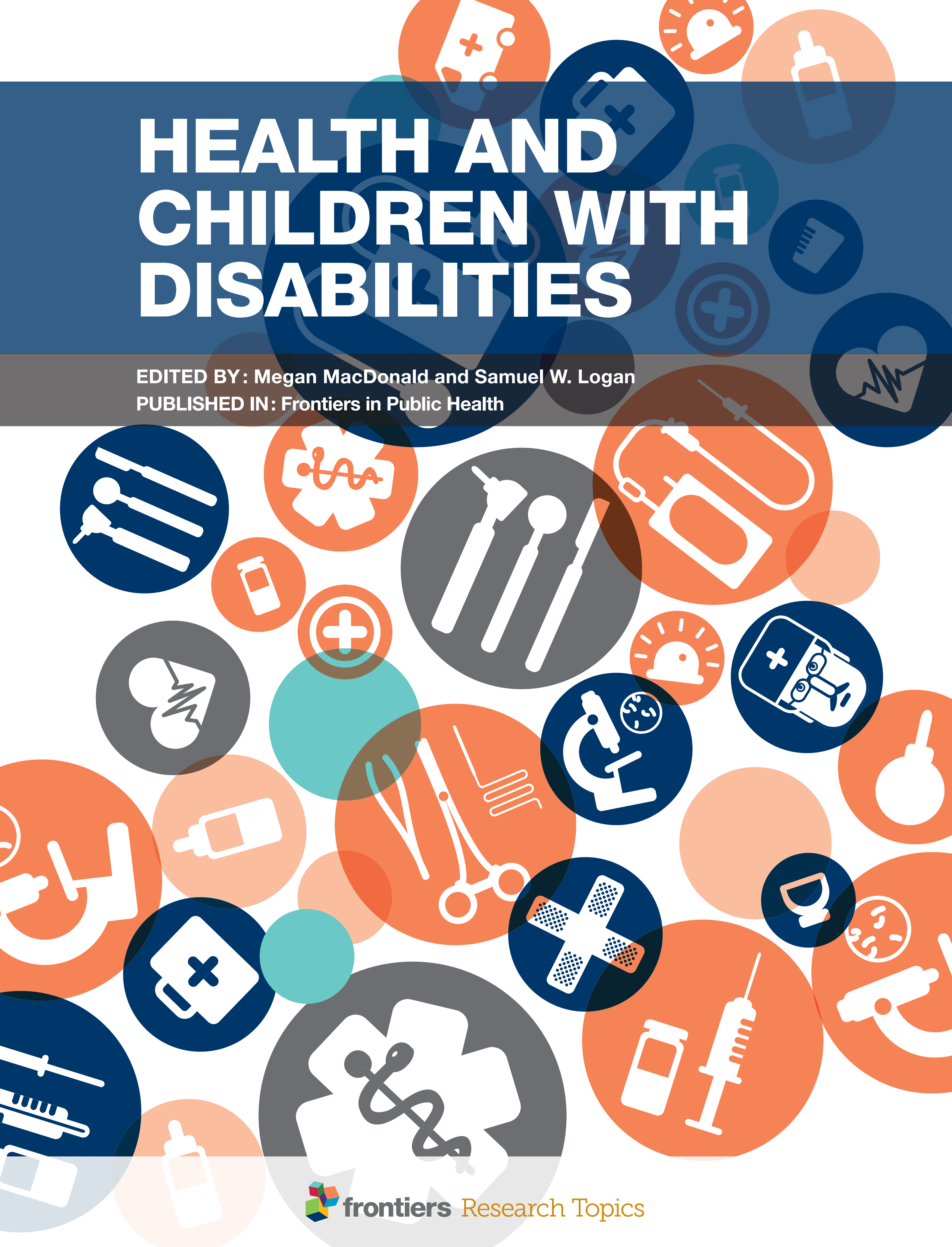

HEALTH AND CHILDREN WITH DISABILITIES

EDITED BY: Megan MacDonald and Samuel W. Logan
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HEALTH AND CHILDREN WITH DISABILITIES

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Articles within this e-book are focused on the health of children with disabilities. Various frameworks have been used to articulate the dynamic interaction of the individual, environment and the task as it relates to child health. A majority of the contributing authors in this special topic are researchers within the field of adapted physical activity. This field embraces a broad perspective of inclusiveness and attitudes of acceptance.

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EDITORIAL
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Editorial: Health and Children with Disabilities

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Keywords: children, disabilities, health, young children, school-aged children

Editorial on the Research Topic

Health and Children with Disabilities

As indicated in the call for papers for the special topic on "Health and Children with Disabilities," known health disparities exist among children with disabilities, including but not limited to motor, social, and communication delays. Addressing these known health disparities and ultimately improving the health and quality of life of children with disabilities is critical for moving toward community inclusiveness throughout educational and public health-related services. Given that child development is dynamic and occurs through the interaction of the individual, environment, and the task, it is important to understand key determinants affecting the health of children with disabilities at an individual and community level.

In this special topic, the editorial team welcomed contributions that employed various study types including single case studies, examination of key determinants of health, intervention, and relevant reviews, all targeted toward better understanding the health of children with disabilities. A majority of the contributing authors in this special topic are researchers within the field of *adapted physical activity*. This field embraces a broad perspective of inclusiveness and attitudes of acceptance. This perspective has been clearly articulated throughout this special topic and is thus an overarching theme throughout this e-book.

Articles within this e-book are focused on the health of children with disabilities and various frameworks have been used to articulate the dynamic interaction of the individual, environment, and the task as it relates to child health. For the purpose of this editorial, an age-related chronological order has been used to describe the content and related manuscripts in this special topic.

YOUNG CHILDREN

The health of young children with disabilities has been addressed within this e-book through various articles. In one study, the the co-occurrence of locomotion and peer interactions (i.e. social mobility) of young children with disabilities was compared to those without and examined across context (classroom, gymnasium, and playground) (Logan et al.). Differences in social mobility were found and how to overcome this gap between peers with and without disabilities was discussed. Allen-Meares et al. reviewed relevant information for early interventionists focused on autism spectrum disorder (ASD). In short, this review targeted key evidenced-based information to share with those at the forefront of working with families who have young children with ASD. In a small randomized control trial of young children in Head Start preschool programs, a motor skill-based intervention positively affected children's motor skill development and self-regulation (Robinson et al.). In these articles, health is addressed holistically to include how children's physical movement impacts aspects of social development for children with disabilities and the critical role of those on the front lines, like early interventionists, in providing up-to-date therapies to young children with disabilities.

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SCHOOL-AGED CHILDREN

The health of school-aged children with disabilities was addressed through related reviews on mental and physical health of children as well as examination of community participation, including how to successfully transition from school into community life through self-empowerment. A review on developmental coordination disorder (DCD) highlighted specific characteristics of the disability, its likeliness to be diagnosed once a child enters school, and other related health issues common among children with DCD, including aspects of mental and physical health (Caçola). The good news is that studies have shown we can teach specific motor behaviors to children with DCD, which may positively impact aspects of health. MacDonald et al. examined the participation patterns of youth with Down syndrome (DS). This study highlighted how different activities had varied reach into the community and discussed how these findings might inform educational and community-based programs for school-aged children with DS. Sullivan studied students transitioning into community life, from high school, and examined how physical activity opportunities alongside peers of similar age empowered these students in their own life, and ultimately empowered students who received Special Education services to actively engage in the community. Taylor conducted a book review of A Teacher's Guide to Adapted Physical Education: Including Students with Disabilities in Sports and Recreation, 4th Edition. This review is relevant for those teaching and providing health-related programs to school-aged students with disabilities and aligns with the broad perspective of inclusiveness and attitudes of acceptance that are central to the field of adapted physical activity/education.

Other important manuscripts addressed the health of children with disabilities, spanning young childhood into early adulthood. Dillon et al. conducted a systematic review and found that exercise is an evidence-based practice for individuals with ASD. Furthermore, collecting data and successfully measuring physical activity behaviors in children with disabilities can be difficult. Hauck et al. conducted a retrospective study and compared adherence strategies for wearing physical activity monitors in children with ASD. Strategies such as incentives, concealing techniques (e.g., monitors attached to clothing), and providing clear wear instructions can be used in practice to better capture objective physical activity behaviors in children with ASD. To that end, how we define physical activity behavior in children with disabilities differs across studies. Ross et al. examined current conceptual and methodological approaches evaluating physical activity participation of children with disabilities and provided recommendations as the field moves forward.

Finally, in the spirit of inclusiveness and attitudes of acceptance, Rimmer and Vanderbom articulate a *Call to Action*, for health researchers who work on obesity prevention programs. The *Call to Action* proposes collaboration with researchers in disability to adapt existing programs, so that they are inclusive to children with disabilities.

The known health disparities evident between children with and without disabilities are unacceptable. Together, researchers and practitioners can help eliminate this inequity. This special topic sheds light on some of these inequities but more importantly provides recommendations and suggests collaborations moving forward to overcome known health disparities for children with disabilities.

AUTHOR CONTRIBUTIONS

MM and SL worked together on this research topic and jointly reviewed manuscripts to write this editorial for the special topic Health and Children with Disabilities.

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PERSPECTIVE
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A Call to Action: Building a Translational Inclusion Team Science in Physical Activity, Nutrition, and Obesity Management for Children with Disabilities

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The growing evidence base of childhood obesity prevention and treatment programs do not adequately consider how to adapt these programs for children with disabilities. We propose a *Call to Action* for health researchers who conduct studies focused on the general population (i.e., without a disability) to work closely with disability researchers to adapt their programs (e.g., obesity management, increased physical activity, and caregiver training in diet and nutrition) to be relevant to both groups. We refer to this approach as inclusion team science. The hope for this *Call to Action* is that there will be greater synergy between researchers who have high levels of expertise in a specialty area of health (but little or no knowledge of how to adapt their program for children with disabilities) to work more closely with researchers who have a high level of expertise in adapting evidence-based health promotion recommendations and strategies for children with disabilities. Together, these two areas of expertise will lead to inclusive physical activity and nutrition programs for all children.

Keywords: health promotion and disease prevention, community health inclusion, people with disability, evidence-based practice, guideline and program adaptation

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Health-promoting activities have a particularly important value for children with disabilities because of their higher rates of sedentary behavior and greater risk of disability-associated secondary health conditions (1, 2). Increased physical activity can have an enormous impact on reducing secondary conditions and improving the health of children with disabilities (3). Benefits include improvements in gross motor function (4, 5), prevention of deconditioning (6), and increased physical independence (7). These effects are augmented with the presence of good nutrition.

In the current environment, children with disabilities face enormous challenges in acquiring health behaviors (i.e., physical activity and nutrition) critical to weight management and optimization of health. They are much less likely to participate in school and community-based health promotion programs, far more likely to be sedentary, and have a poorer nutritional status (8–11). Functional limitations associated with a physical or cognitive disability can result in a difficult interaction between the child and environment. Inaccessible facilities, lack of transportation to and from indoor and outdoor recreation venues, absence of knowledgeable staff who know how to adapt programs, and a general perception/attitude among providers that children with disabilities need "specialized" vs. integrated services feeds into a culture of isolation and separation (12–14). When these barriers are juxtaposed with the lack of interest, awareness or understanding among service providers regarding how and why they should include children with disabilities in mainstreamed health promotion programs, a vicious cycle is activated that begins with restricted access to physical activity and nutrition education; this leads to a greater number of health problems associated with sedentary behavior and poor diet; and finally, more health problems result in further isolation from peers without disability and a greater vulnerability to early onset health disparities (12, 15–17).

As illustrated in **Figure 1**, health promotion programs for the general population of children and specialized programs for children with disabilities currently tend to be developed and delivered within separate spheres of activity. The left side of the figure shows how this parallel structure may result in inefficient use of resources and inadvertently promote practices and programs that never intersect. While specialized health promotion programs for children with disabilities are quite valuable in situations where a child desires or needs to participate in sports- or disability-specific opportunities (e.g., wheelchair basketball and Special Olympics) to learn and practice specific skills, for example, these programs often have limited availability and frequency (i.e., many are only offered 1 or 2 days per week). There is a pressing need to provide greater amounts of access to mainstreamed physical activity and nutrition programs offered in schools, healthcare facilities, community-based organizations, and outdoor recreation areas. The right side of the figure illustrates the potential benefit of a more *inclusive* framework that supports both children with and without disabilities, but does not negate the need for specialized programs offered to children interested or needing certain services that cannot be provided in mainstreamed settings.

A CALL TO ACTION: BUILDING AN INCLUSION TEAM SCIENCE THAT FOCUSES ON ENVIRONMENTAL AND PROGRAM ADAPTATION VS. REINVENTION

To more effectively prevent and control childhood obesity and optimize health, the Institute of Medicine (18), Centers for Disease Control and Prevention (19), and National Institutes of Health have begun to promote multilevel (e.g., family, organization, and community), multisector (e.g., family, school, health care, community, and policy) approaches that focus on changing, not just individual behavior, but also addressing the broader sociophysical environment in which children live, learn, eat, and play (20). Children with disabilities must be given the opportunity to be included in these initiatives in the same environmental ecosystems that children without disabilities use to engage in positive health behaviors (e.g., outdoor and indoor play, recreation and sport; improved nutritional guidance in homes, schools, and clinics) in order to gain the same health benefits.

One way to disentangle the separate research agendas in health promotion between children with and without disability is to encourage adaptation of successful, evidence-based programs established for children without disability (often referred to as translation research). The Guidelines International Network defines guideline adaptation as "*the systematic approach to the endorsement and/or modification of a guideline(s) produced in one cultural and organizational setting for application in a different context. Adaptation may be used as an alternative to de novo guideline development, e.g., for customizing (an) existing guideline(s) to suit the local context*." (21) There are several benefits to guideline or program adaptation (22–24): (1) reduces duplication of effort while maintaining the validity of evidence-based recommendations, (2) encourages a participative approach involving

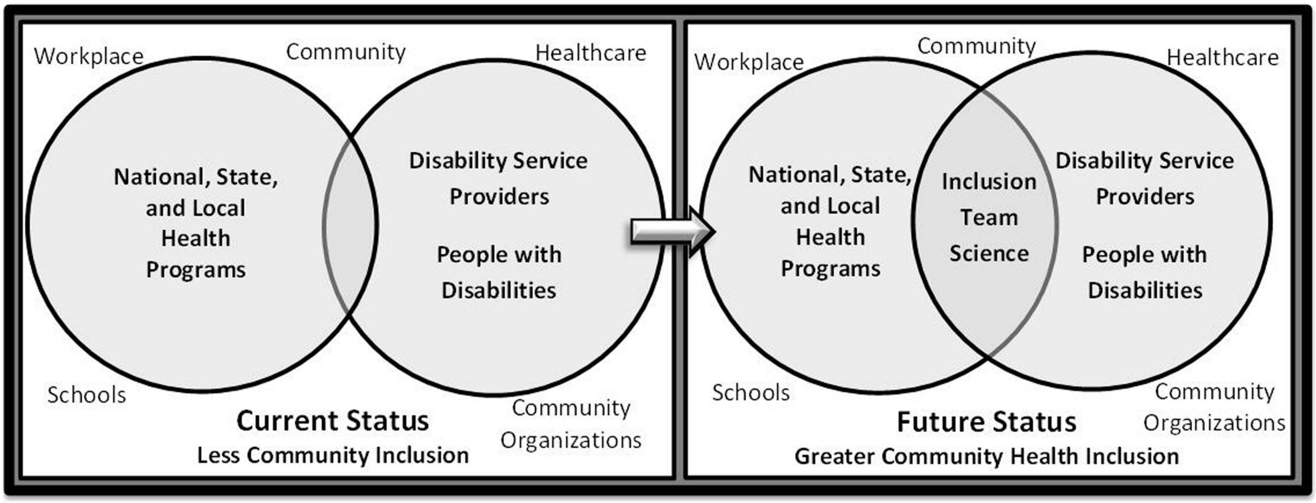

FIGURE 1 | **Current and Future Status of Community Health Inclusion**.

key stakeholders in order to foster local ownership of recommendations and promote utilization, (3) ensures consideration of (regional and local) contextual factors to improve uptake by targeted users, and (4) improves guideline/program quality by increasing knowledge and commitment to evidence-based principles using reliable methods to ensure quality and validity of adapted guidelines/programs and promotes explicitness and transparency in documenting recommendations.

A recent methodology has been developed that allows researchers and programmers to adapt evidence-based guidelines and programs in physical activity and nutrition for adults and children with disabilities (25). The tool/method is referred to as the GRAIDs Framework, which stands for *G*uidelines, *R*ecommendations, *A*daptations *I*ncluding *D*isability. The GRAIDs Framework is a systematic process for obtaining collaborative information from a coalition of experts in the field as well as individuals with disabilities and their families. The GRAIDs Framework has, thus, far been used to adapt CDC's evidence-based obesity prevention strategies (19) to be inclusive of children and adults with disabilities. Utilization of the GRAIDS framework has the potential to provide children with disabilities and their caregivers with timely and suitable guideline/program adaptations for physical activity and nutrition that will afford them the ability to actively participate in inclusive programs with their non-disabled peers.

ADAPTATION EXAMPLE: THE BRIEF MOTIVATIONAL INTERVIEWING PROJECT (BMI^2)

The BMI^2 (Brief Motivational Interviewing to reduce BMI) study tested the impact of motivational interviewing (MI) delivered by primary care providers and registered dietitians (RD) on pediatric obesity in a non-disabled population (26). The target group was parents of overweight children of ages 2–8 years. Forty-two practices from the American Academy of Pediatrics, Pediatric Research in Office Settings Network were randomly assigned to one of the three groups. Group 1 (usual care) measured BMI percentile at baseline, 1-year, and 2-year follow-up. Group 2 (provider only) delivered 4 MI counseling sessions to parents of the participating child over 2 years. Group 3 (Provider + RD) delivered 4 provider MI sessions plus 6 MI sessions from a RD. The primary outcome was child BMI percentile at 2-year follow-up. At 2-year follow-up, the adjusted BMI percentile was 90.3, 88.1, and 87.1 for Group 1, 2, and 3, respectively. The Group 3 mean was significantly ($p = 0.02$) lower than Group 1. Mean changes from baseline in BMI percentile were 1.8, 3.8, and 4.9 across Groups 1, 2, and 3. MI delivered by providers and RDs (Group 3) resulted in statistically significant reductions in BMI percentile.

Adapting the BMI^2 Program for Children with Disabilities

The GRAID Framework was used to develop an inclusive version of BMI^2 and is comprised of several inclusion recommendations and adaptations that relate to providing education and training to program staff who are not knowledgeable in working with families who have a child with a disability and who may have varying levels of physical and cognitive function. A brief example of a GRAID developed for the BMI^2 program can be found in **Table 1**. Each guideline/program applied to the GRAID Framework has a menu of inclusion recommendations and adaptations that allow the provider to select the ones that are relevant to their local context and need. Adaptations can be tested in an iterative nature and, when found effective, can be cataloged for future use with other families who have similar needs. A unique feature of the adapted guidelines/programs are the *inclusion elements*, print and video resources that are linked to each adaptation and offered through the National Center on Health, Physical Activity, and Disability (www.nchpad.org). The inclusion elements are examples of successful applications of the adaptations in real life settings.

BUILDING AN INCLUSION TEAM SCIENCE TO AVOID "REINVENTING THE WHEEL"

Concern over the rapidly increasing incidence and prevalence of health disparities among people with disabilities (27) has produced intense interest among federal agencies in identifying evidence-based strategies and practices to prevent or reduce these

TABLE 1 | An example of GRAID inclusion recommendations and adaptations for an evidence-based weight management program (BMI^2) (26).

Guideline: healthcare providers should include children with disabilities in health promotion programs	
(1) Inclusion recommendation	Healthcare facilities should educate healthcare professionals about disability, obesity, and health
(a) Adaptation	Offer a training session about disability and the problems related to obesity, how to prevent and treat obesity, and where to find data on the topic
(2) Inclusion recommendation	Healthcare facilities should train healthcare professionals about strategies to increase physical activity for children with disabilities
(a) Adaptation	Educate doctors and RDs about setting appropriate physical activity goals for children with disabilities (e.g., importance of self-discovery, decision making and choice, and independence)
(3) Inclusion recommendation	Healthcare facilities should train healthcare professionals about policies supporting the participation of children with disabilities in all aspects of their community
(4) Inclusion recommendation	Health promotion programs should develop and disseminate educational materials inclusive of children with disabilities representing diverse ethnic and racial backgrounds
(a) Adaptation	Incorporate inclusive images of children with disabilities and terminology representing diverse ethnic and racial backgrounds in physical activity and healthy nutrition educational materials
(b) Adaptation	Provide physical activity and nutrition educational materials in accessible, linguistically appropriate formats (e.g., larger font, web-accessible, in the preferred language)

disparities. Ideally, the "evidence base" from which such guidelines or strategies would be derived would consist of rigorously conducted empirical studies with appropriate representation of all target populations in the data. Unfortunately, there are few areas of disability health or rehabilitation research in which the sample size and scientific rigor of studies compares favorably with that typically found in large scale general population studies.

Federal agencies have recently recognized this deficit and increasingly have funding opportunities that call for coordinated teams of investigators with diverse skills and knowledge to conduct studies of complex social problems with multiple causes and etiologies who can work toward a common health goal. In the case of disability, the ideal environment would be to target an area of health (e.g., physical inactivity or obesity) that would involve two studies: the primary study would be directed at the larger target population, which in the case of the BMI^2 study involved children and their families, and the adjunct study would address a subgroup of children with disabilities. What this would allow for is the interaction of experts in obesity research blending with experts in disability who can connect these two areas of science.

Toward that end, the hallmark of team science is collaboration to address a scientific challenge that leverages the strengths and expertise of professionals trained in different fields. This allows for such problems to be examined from multiple perspectives, ultimately giving rise to comprehensive and integrative solutions and minimizing duplication of effort and reinventing the wheel.

Inasmuch as researchers are accustomed to working within their respective areas of expertise, consideration must be given to the organization, composition, and dynamics of the team. Scientific leadership must ensure that all perspectives are equitably included in the design and conduct of the study and that the structure and organization of the team facilitates meaningful involvement of all parties. This is especially important for teams that engage multiple stakeholders, including community members, service providers, and policymakers. Each perspective contributes to the team's ability to achieve a common health goal and to foster the translation of study findings to practice and policy.

CONCLUSION

Public health programs and professionals who work in schools, fitness and recreation centers, and healthcare facilities must recognize the low rates of physical activity participation and poor nutrition among people with disabilities and begin to develop effective and cohesive strategies to address this problem. While most of the financial resources in public health have been directed at prevention of disease, injury, and disability, there is growing recognition among public policy experts that prevention of secondary conditions is an equally important issue among people with disabilities. Health promotion activities, especially increased participation in physical activity and improved nutrition, can have an enormous positive impact on reducing secondary conditions and improving health in children with disabilities.

While there will always be a need for specialized research and programs targeting specific subgroups (i.e., children with physical/cognitive disability), a model that begins with inclusion team science can serve as the foundation for building a framework that uses the successful elements of adaptation (i.e., GRAIDs) for promoting inclusion in existing and new programs.

Implementing new evidence-based research findings that are in the early stages of development could take years, or perhaps decades, to reach application in clinical or community practice (28). Use of the GRAIDs Framework in future research and programmatic efforts provides a unique opportunity to test their utility in mainstreamed health promotion programs and build a database of practice-based evidence. Successful adaptations can then be cataloged and scaled to other communities, with the intention to keep children with disabilities and their family members an integral part of an inclusive, supportive community.

AUTHOR CONTRIBUTIONS

JR conceived the topic and focus of this article. Both JR and KV contributed to the writing and content.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Empowering Students in Transition

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The purpose of this study was to (a) identify potential benefits for students with disabilities taking part in a physical activity program with same-age typical peers on a Midwest university campus and (b) to determine if the program impacted the students with disabilities empowerment. Empowerment theory was used to determine how transition students' attitudes change over the course of the semester while participating in a workout buddy program with same-age college peers. The program was structured to provide a sense of empowerment to students to make their own decisions and learn for themselves so they do not feel a lack of power in their lives. This study implemented elements of a quantitative design but a majority utilized a qualitative design based on the assumptions of the Interpretivist paradigm. The quantitative design elements focused on the analysis of two questionnaires: Sports Questionnaire and the Perceived Control Scale Questionnaire. The analysis of the focus group data revealed the following themes as positive effects of the intervention: positive effect on empowerment, how happy the program made the students, what benefits the students gained from the program, the student's familiarity with university students, and the environment, and, lastly, the students ability to ask for assistance when need. Findings from the study determined that the empowerment of the students with disabilities was impacted while participating in the program. In general, the findings of gaining empowerment were similar to previous studies in that students with disabilities are able to gain empowerment from participation in fitness and recreation programs. The researcher noted during focus groups that some of the Best of Both Worlds (BOBW) students were not confident in starting conversations with their university peers. Although the BOBW students felt a sense of losing empowerment with this specific instance, there was an overall positive impact on the BOBW students' empowerment. By giving the students the opportunity to participate and socialize with peers of their own age at a college setting, they were able to gain a sense of empowerment in their own life.

Keywords: transition program, fitness, peer modeling, collaborative learning, empowerment theory

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INTRODUCTION

The Passage of Public Law 94–142, and all subsequent reauthorizations of the Individuals with Disabilities Education Act (IDEA), has resulted in increased opportunities for individuals with disabilities in schools and recreation settings (1). Prior to this law, students with identified disabilities were often denied an education, cognitive age was used to deny instruction, testing was discriminatory and an emphasis was placed on the disability label versus the needs of the individual (2). The Americans with Disabilities Act has lead to increased opportunities for individuals with disabilities in schools and recreation settings (1).

The Best of Both Worlds (BOBWs) Program is a comprehensive collaborative transition program for students, aged 19–21, who have identified disabilities. The program provides instruction in work skills, community participation skills, independent living skills, and self-advocacy skills. BOBW students have completed credits required for high school graduation in the state and are accessing post-secondary training alongside their typical same-aged peers on a university campus. BOBW's students were selected for program participation by their Individualized Education Program (IEP) team, based on additional skills needed to live, work, and advocate for themselves as adults in the community. The program has been in place since the beginning of fall semester, 2011, focusing on socialization, gaining independence as well as a fitness/recreation component. Within the program, there are 1.5 intervention specialists and 4 job coaches on site. BOBW students are accompanied by job coaches, during all work, community, and fitness/recreation activities, to help answer any questions that arise while they are offsite. This support makes for an easier transition toward independence for the students.

The BOBW program has a very rich and multifaceted partnership with a small Midwest university whereby same-age college peers are partnered with and work alongside the BOBW students as they develop a healthy, active adult life, through a peer buddy workout program, community service, and social opportunities. The program provides the BOBW students with encouragement to become more independent by offering safe recreation and leisure skills, teaches safe equipment utilization, and a workout facility and opportunity to exercise with same-aged peers. The university students, who serve as peer buddies, also model daily social skills that are acceptable to society, as well as health factors related to using a workout facility for recreation and leisure in adult life (e.g, using a swipe card to access the facility, wiping down machines after usage, etc.). Additionally, a Certified Adapted Physical Educator (C.A.P.E.) professor works within the program, matching buddies, offering feedback for program enhancement, and teaching the "buddies" how to teach self-advocacy skills to the BOBW students. Self-advocacy is one of the largest curriculum areas in the transition program life skills curriculum. Students with disabilities need training to understand self-advocacy, how it applies to them, and how to use it in their daily lives.

The purpose of this study was to explore how participation in a cardiovascular exercise, weight training, and recreation program impacted the empowerment of students with disabilities when they participated in the program with an assigned university "buddy." More specifically, the research set out to determine how the participants' attitudes and empowerment changed while participating in BOBWs Workout Buddy Program. Studies have shown that there is a positive correlation between physical activity and empowerment for students with disabilities (3, 4). In a past study, the biggest barrier found was that fitness and recreation facilities were unfriendly environments (5). There is limited knowledge about empowerment theory in a college campus fitness program and with a transition program. This research intended to determine how the participants' attitudes and empowerment changed while participating in BOBWs Workout Buddy Program, as additional research was needed in this area. This research is significant because it addresses the importance of empowerment in students with disabilities. An important supplemental purpose was to identify and break down the barriers those adults with disabilities face with daily participation in fitness and recreation.

Empowerment Theory focuses on the process of increasing personal power, meaning self-confidence, and self-determination, in order to enable individuals, families, and communities to improve their situation (3, 6). According to Depauw and Doll-Tepper (7), historically, teachers made uninformed choices about children with special educational needs that in effect disempowered them. By not allowing students to make their own choices and decisions teachers ignore the importance of children's lived experiences of their own difficulties. The teachers' limited understanding of the child's needs, essentially restricted successful inclusion (7). Adults with disabilities typically feel a lack of power in their lives, which could impede their sense of making their own decisions or necessary changes in their own lives (3, 6, 8). Empowerment theory takes the environment into account, as well as promotes positive behaviors and participation that involve individuals to improve their overall quality of life (9).

By allowing children with special educational needs to take on challenges, and encourage them to participate, children will succeed. As such, the consultation and empowerment of children with special educational needs with regard to their education is of great importance. It allows the child a chance to accept and cope with their disability, as well as providing fundamental information to adults regarding the child's experiences (10) (p. 174).

This may help them later on in life so they can make their own decisions, which is necessary in life (3, 11). However, previous research found that BOBW buddies sometimes felt uncomfortable being around adults with disabilities (12). Similarly, Griffin et al. (13) noted "concerns for students that were not as willing to participate with students with disabilities included that they might not know how to act around the students with disabilities, which in turn would make them feel uncomfortable" (13) (p. 235).

While participating with a fitness program, adults with disabilities start to learn how to work their way around the restrictions they face (5). Providing adults with disabilities the opportunity of participation and involvement, BOBW program provides them a sense of empowerment to make their own decisions and learn to become independent. Through participation with fitness and recreation programs, adults with disabilities learn to overcome self-imposed perceptions of their capabilities as well as how to turn their limitations into abilities (14). People who perceive themselves as competent, capable, and self-determining will be able to face and deal with life's challenges (9).

According to the Centers for Disease Control and Prevention, adults need at least 150 min of moderate-intensity aerobic activity every week and muscle-strengthening activities on two or more days a week (15). Exercise has been shown to have a strong correlation between participation in an exercise program and positive changes in behavior for adults with disabilities (16–18). Findings from studies suggest that participation in exercise programs can alter behaviors, such as intellectual functioning, stereotypic behavior, work performance, and self-concept (16–18). Gabler-Halle et al. (16) suggested that students with disabilities should be provided with encouragement to choose activities that they find enjoyable. This helps in their comfort level toward being at the gym with others around them. The students should carry out activities voluntarily so they are enjoying themselves rather than being forced to participate (16).

Adults with disabilities may feel a lack of power in their lives, which later on in life could impede their sense of making their own decisions or necessary changes. While participating in a fitness program, adults with disabilities start to learn how to work their way around the restrictions they face. Block et al. (9) found that providing adults with disabilities the opportunity to participate, they were provided a sense of empowerment to make their own decisions and learn to become independent. Coates and Vickerman (14) found that students with disabilities felt that physical activity helped them relieve stress and made them feel happiness, and gave them mostly positive feedback. However, negative feedback was directly related to negative attitudes from their peers or surroundings (14).

BARRIERS TO PARTICIPATION IN FITNESS AND RECREATION

There are many barriers that adults with disabilities face with daily participation in fitness and recreation. These barriers consist of health, social, and familiarity with environment barriers. The BOBW Program has been constructed with the intention of eliminating these barriers.

Familiarity with Environment Barriers

Best of Both Worlds students in particular faced the barrier of coming to a campus full of students with whom they are unfamiliar. They also faced a barrier of working out in an environment in which they were originally unfamiliar. The university students were able to observe the BOBW students utilize the campus as a *typical college student*, as well as how much this meant to the BOBW students. With the university students *approval*, BOBW students were provided the empowerment to become an individual and feel comfortable with coming to campus and being around other students.

During their workout, there were many college students working out as well, which could have been intimidating at times for the BOBW students. With the BOBW program, buddies eased the students into the workouts and tried to increase socialization with other college students as well. The greatest emotional and psychological barriers adults with disabilities face when wanting to use fitness and recreation facilities were unfriendly environments (5, 13).

Social Barriers

Individuals with disabilities often witness negative attitudes and behavior from students without disabilities or the facility staff (13). Other concerns include not having anyone to assist individuals with disabilities, when needed, and lack of support from friends and family to access and participate in fitness programs. Outsiders negative attitudes toward individuals with disabilities could potentially make the students feel uncomfortable and unwilling to come back (19). These negative attitudes can have a huge effect on the students and could potentially make the students feel uncomfortable and unwilling to come back (19).

Adults with disabilities may feel a lack of power in their lives, which later on in life could impede their sense of making their own decisions or necessary changes. While participating in a fitness program, adults with disabilities start to learn how to work their way around the restrictions they face. Through participation with fitness and recreation programs, adults with disabilities learn to overcome self-imposed perceptions of their capabilities as well as how to turn their limitations into abilities. People who perceive themselves as competent, capable, and self-determining will be able to face and deal with life's challenges (9).

Griffin et al. (13) found that college students indicated positive attitudes toward students with disabilities but they also expressed concerns that they might not know how to act around the students with disabilities, which in turn would make the students with disabilities feel uncomfortable. This study also showed that females were more willing to participate and interact with students with disabilities than were males (13). Previous BOBW program research noted that freshman buddies entering the program felt reluctant to work with students with disabilities due to minimal previous experience (12). However, as the buddies attended more sessions with the students, they began to feel more comfortable, which made the environment more welcoming. Once the buddies eliminated the barrier of being uncomfortable, they were able to begin building a relationship with the students. In the long run, it helped the students because they began to feel more comfortable speaking up for themselves. Students with disabilities have been found to be more willing to listen to someone their own age rather than their job coach who was much older (19). They also liked to have age appropriate conversations and, therefore, providing buddies who are around the same age gives them the opportunity.

Health Barriers

There are many health issues that our society faces today. Such issues include: disability; obesity; access to facilities; and equipment, etc. Students with disabilities tend to have lower fitness levels due to the lack of participation in physical activities; therefore, progressions and modifications to physical activities are needed (20). Obesity is a serious problem that citizens in the United States face on a daily basis. Green and Reese (21) found that providing individuals with disabilities the opportunity to become empowered and be able to feel comfortable around others at the gym provides them with opportunities to obtain a healthy lifestyle (21).

Barriers Accompanied by Supports

Having committed buddies to help guide and encourage students to participation in physical activity makes for a better environment. Block et al. (9) found that trying to eliminate barriers associated with disabilities and physical exercise help motivate and increase physical exercise in the students. Research has shown that if the buddies are around the same age as the students with disabilities, the program may be more successful to help keep the student engaged and motivated (9) Previous BOBW program research noted that the BOBW students like to have age appropriate conversations and providing buddies that are around the same age provides that opportunity (12).

METHODS

This study implemented a mixed method design based on the assumptions of the Interpretivist paradigm. This study involved the students of BOBWs students and university buddies over a 3-month period. There was a constant setting at the recreation facility on the university campus. Two questionnaires were implemented: Sports Questionnaire (14) and the Perceived Control Scale Questionnaire (22). The Sports Questionnaire and the Perceived Control Scale questionnaire were used once toward the start of the program and once toward the end. Targeted questions from the initial implementation of each of the surveys added to the demographic data for the BOBW students. The scores of the questionnaires were calculated by questionnaire category and the data were illustrated in a pie chart or box plot as applicable.

Subject Selection and Gaining Access to the Site

The researcher has worked with the program since its inception in 2011. The BOBW student participants were selected due to the researcher's previous experience, which led her to contemplate if participation in the BOBW workout Buddy program impacted the empowerment of the BOBW students. The fall 2015 was an ideal year for implementation of this study because 10 new students were starting the BOBW program. Students and buddies attended the typical routine of working out for an hour session, twice a week in the university campus fitness center. University students served as workout buddies and mentors to motivate, interact, and exercise weekly with students enrolled in the BOBWs Program. The BOBW program students had individualized workout programs created by the public school adapted physical educator, which were designed to include the Cybex and cardiovascular machines available in the fitness center on the university campus. The BOBW students and buddies serving as college buddies worked out for 1–1.5 hours twice weekly. Other opportunities were available to socialize on campus, such as use of recreation facilities, athletic contests, lunch, theater productions, and other campus programs with their workout buddies.

Participant Demographics

As illustrated in **Table 1**, the participants were the students enrolled in the BOBW Program who submitted a signed consent form. Although there were 17 students enrolled in the program, only 8 students completed the Consent for Participation in Social and Behavioral Research form and participated in the study. As noted in **Table 2**, the participants consisted of three males and five females. The mean age of the participants was 19.5 years of age.

TABLE 1 | BOBW student population.

Gender	Male	Female
All BOBW students (*N* = 17)	9	8
Students in study (*N* = 8)	3	5

TABLE 2 | BOBW student population by gender and assigned number.

Assigned number	Male	Female	Year in program
Student 2		X	1st
Student 3	X		1st
Student 7	X		1st
Student 8		X	2nd
Student 12		X	1st
Student 13		X	1st
Student 14		X	2nd
Student 16	X		2nd

Questionnaire Selection

For this research study, two questionnaires were used: the Perceived Leisure Control questionnaire (22) and the Sports questionnaire (14) that was subdivided into two questionnaires containing sports interests and participation section as well as an *About Me* section. The surveys were reviewed by a panel of experts comprised the following: two Adapted Physical Educators, one Adapted Physical Education Professor, and two public school Intervention Specialists who were familiar with the BOBW program and students. The expert panel reviewed the surveys to determine content validity, appropriateness for the population, and appropriateness of the scale. The expert panel determined that the surveys contained the appropriate content that was intended to be measured, and it was determined that they survey had content validity. The Expert Panel also evaluated the instruments relative to presence of construct of interest and determined that construct was addressed in the instrument.

The Perceived Control Scale questionnaire was composed of 17 questions about the BOBW students and how they felt about participation in sports/activities. This questionnaire helped the researcher to better understand where the BOBW students stood on their opinion of their own empowerment. The answers were based on a five-point Likert scale as follows: 1-Stongly agree; 2-Agree; 3-neutrual; 4-Disagree; and 5-Strongly disagree. This questionnaire was used as a pre/post-questionnaire to determine any differences in empowerment.

The Sports Questionnaire (14) was used to acquire specific information about the types of physical activities in which the students participate. At the end of the Sports questionnaire, an "About Me" section was provided to get insight on how the students felt about their sport ability and how they felt around their peers while performing recreation activities. This questionnaire helped to better understand the types of activities with which the students would like to be involved. The first part of the survey consisted of five questions asking the students what sports they have participated in before and with which sports they would like to participate. Under each of the five questions, there were 20 sports/activities to place a mark next indicating that they are choosing this sport/activity. There was also a blank space where the BOBW students were able to enter another sport/activity that was not listed. The *About Me* section of the survey consisted of nine questions. These questions asked the BOBW students about their feelings toward the program and their own performance throughout the program. The answer options to the questions were as followed: Yes, with a smiley face; Not sure, with a straight face; No, with a frown face. This questionnaire was used as a pre/post-questionnaire to witness any differences in empowerment.

The Perceived Leisure Control and Sports questionnaires were administered twice to each participant, once at the beginning of the fall program and a second time toward the end of the fall program; before the focus groups were conducted. The purpose of the redelivery of each questionnaire was to determine if the BOBW students' empowerment had changed from the beginning of the program to the end of the program. The surveys were taken by paper and pencil. An Intervention Specialist or trained job coach were in the same room to provide support to the BOBW students, in accordance with the student's Individualized Education Plans.

Procedures

This study obtained approval from universities' institutional Review Board (IRB) and was carried out in accordance with the recommendations of the board. Additionally, written consent to conduct the study was obtained from city school system and written consent for participation in the study from study participants or their legal guardians was obtained in advance in accordance with the Declaration of Helsinki. Informational letters were sent to the parents/guardians of the BOBWs students, who were not their own guardians to explain the study and surveys that their children would be completing. Participants (or their legal guardians) who were willing to participate in the study were asked to sign the consent form. If participants, or their legal guardians, did not want to participate in the surveys or focus groups, they were dismissed from the study without any penalty.

Trustworthiness of Data

Trustworthiness was a strategy used in this study to assure credibility of the data. Four strategies were used throughout this research project: member checking, identifying negative cases, peer debriefing, and triangulation of data (23, 24). The researcher attempted to establish credibility by becoming familiar with the setting and participants prior to the start of the study. Peer debriefing sessions were completed with the researcher's advisor. Data sources were triangulated and negative cases were sought.

Data triangulation was a method used to ensure consistency in data by collecting data through multiple methods. Patton (25) stated "studies that use only one method [of data collection] are more vulnerable to errors linked to that particular method … than are studies that use multiple methods in which different types of data provide cross-data validity checks" (25) (p. 1192). For this reason, four different types of data collection occurred in this study. Specifically, triangulation occurred in this study by collecting three different participants questionnaires and the focus group transcripts. Triangulation of sources is checking for consistency of data from the same source and methodology.

At each stage of data collection, peer debriefing and analysis of negative cases took place. Peer debriefing involved the researcher meeting with her advisor to discuss initial data findings and themes found in data review to ensure that similar conclusions were made about the data. The data were also assessed for negative cases. Negative case analysis was used to broaden an already established theory, display an exception to a theory or phenomenon, or completely change a theoretical framework (25). Negative cases also show how a specific group, environment, dynamic, or instance does not fit a pre-established pattern or theory of interaction already prevalent in literature. The data collected were assessed for negative cases to see the themes that emerged that were not previously described in the literature or did not follow common themes found in previous research (25).

Focus Groups

Focus groups were used as a form of interviewing with the intention of providing another layer of data or perspective on the research problem (26). Focus groups were conducted to help determine whether or not student's empowerment had changed throughout the BOBW program. Four separate focus groups were conducted based on the BOBW student's availability. All focus groups were conducted in a classroom located in the BOBW program building. The focus groups were convenience scheduled in accordance with the researchers schedule and the BOBW student's schedules.

QUESTIONNAIRE RESULTS

The first result section pertains to the questionnaires. The second result section includes the focus group data to support the question of this study.

Sports Questionnaire *About Me* Section

The data from implementation of the pre and post *About Me* section of the Sports questionnaire were illustrated in the pie charts for questions 1–9. Pie charts were used to show proportional data and the percentage represented by Yes, Maybe, and No responses to the *About Me* section of the Sports Questionnaire. A separate pie chart was created for each question within the *About Me* section of the Sports Questionnaire.

Question number one asked if the students enjoyed the BOBW program. Question number two asked if the buddies for the BOBW program helped enough during the workout. This pie chart compares the answers from pre- to post-questionnaires showing that they were answered the exact same way for both question one and two. All students reported that they enjoyed the program from the beginning of the semester to the end, making the BOBW program a positive aspect in their life.

Question number three asked if the students believe they were good at sports during the BOBW program (see **Figure 1**). During the pre-questionnaire, six out of the seven students believed that they were good at sports during the BOBW program, but one student felt she was not. During the post-questionnaire, five out of the seven students believed they were still good at sports during the BOBW program, while two of the students were not really sure if they were or not. The researcher noted a small sense of empowerment on Student 13 who was a first year student in the BOBW program. She reported that she did not believe she was good at sports during the pre-questionnaire, but reported that she was not sure for the post-questionnaire. Student 12 showed a negative impact from the beginning of the semester to the end when asked if she believed she was good at sports. She reported that she was good at sports during the pre-questionnaire but was not sure during the post-questionnaire.

Question number four asked if the students felt that the buddies/peers think that they were good at sports (See

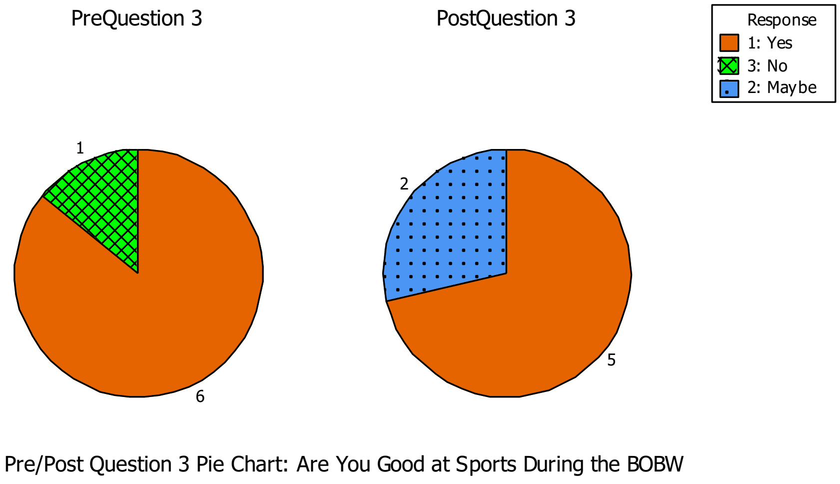

FIGURE 1 | **Question number three asked if the students believe they were good at sports during the BOBW program**.

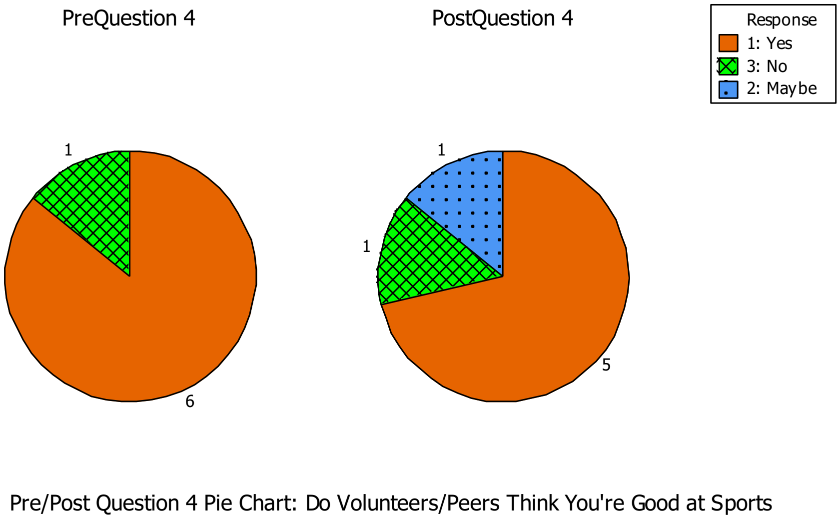

FIGURE 2 | **Question number four asked if the students felt that the buddies/peers think that they were good at sports**.

Figure 2). During the pre-questionnaire, six out of the seven students agreed that their buddies/peers thought they were good at sports, while one student did not. During the post-questionnaire, five out of seven students agreed that the buddies/peers thought that he/she was good at sports. However, one student was unsure and the other student disagreed that the buddies/peers thought she was good at sports. During the pre-questionnaire, Student 2 reported that she did not think her buddies/peers think she is good at sports. But during the post-questionnaire, she reported that she was unsure if her buddies/peers thought she was good at sports. This was a small instance of empowerment shown in the program. Student 13 had a negative impact from this question. During Student 13's pre-questionnaire, she reported that her buddies/peers thought she was good at sports. However, in the post-questionnaire, she reported that her buddies/peers did not think she was good at sports. This was an instance of negative impact on empowerment for Student 13. She may have believed her buddies/peers thought she was good at sports until she actually played sports around them during the program. This could be the reason for her loss of empowerment.

Question number five asked if the students felt that other students in their class thought they were good at sports (see **Figure 3**). During the pre-questionnaire, four out of the seven students thought that their classmates thought they were good at sports, while the other three students were not sure. During the post-questionnaire, four out of the seven students indicated that their classmates thought they were good at sports, while two students did not and one other student was unsure. Student 16 had a small positive impact due to this question. He reported that

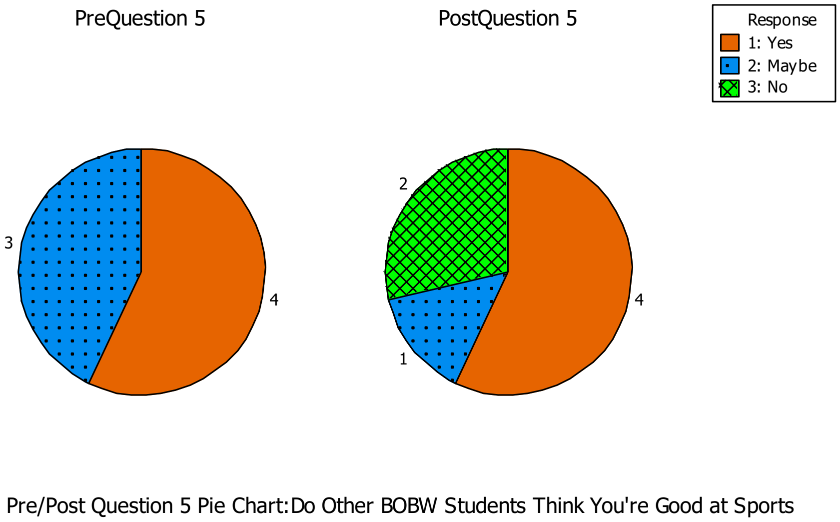

FIGURE 3 | **Question number five asked if the students felt that other students in their class thought they were good at sports**.

he was unsure if others in his class thought he was good at sports during the pre-questionnaire. But during the post-questionnaire, he reported that he thought others in his class thought he was good at sports. He may have been unsure at the beginning of the program, but was reassured by his classmates throughout the semester. Students 2 and 13 seemed to have a negative impact on empowerment from pre- to post-questionnaire. This instance could be because these students had never been in a program, such as the BOBW, so they were not sure how other students in their class felt toward them until after the semester had ended.

Question number six asked if the students took part in any sport outside of the BOBW program (See **Figure 4**). During the pre-questionnaire, four out of the seven students indicated that they took part in another sport, while two students were unsure and one student did not. During the post-questionnaire, four out of the seven students again answered yes, while one student was unsure and two students said they were not apart of a sport outside of the BOBW program.

Question seven asked if the students thought it was easy to get to sport programs near where they live (See **Figure 5**). During the pre-questionnaire, five out of the seven students answered yes, while the other two students were unsure. During the post-questionnaire, five out of the seven students answered yes once again, while one student answered unsure and the other answered no.

Question number eight asked if the students got any help to play sports outside the BOBW program (See **Figure 6**). During the pre–questionnaire, three out of the seven students answered yes, while the remaining four students answered no. During the post-questionnaire, three out of the seven students answered yes, while one student was unsure and the remaining three students answered no.

Question number nine asked if the students thought they needed more help to play sport outside the BOBW program (see **Figure 7**). During the pre-questionnaire, three out of the seven students said yes, while one student was unsure and the remaining three students said no. During the post-questionnaire, two out of the seven students indicated that they needed help to play sports outside the BOBW program, while the remaining five students indicated no. Students 13 and 14 reported a positive impact on empowerment. During the pre-questionnaire, student 13 stated she was unsure if she needed help outside the BOBW program. But during the post-questionnaire, she stated she did not think she needed more help to play sports outside the BOBW program. Student 14 showed the same instance of positive impact on empowerment. However, Student 14 reported yes during the pre-questionnaire and no during the post-questionnaire. This instance showed a positive impact from the BOBW program to become more independent while at other sports and on the student's lives.

Perceived Leisure Control Questionnaire

The data from the Perceived Leisure Control Questionnaire were illustrated in Box plots with the intention of visually representing the data. Box plots are useful for identifying outliers as well as for comparing data distributions. The confidence level was set at 80% due to the small size of the population with the intention of illustrating the degree of dispersion of data, as well as the outliers between the pre- and post-implementation. The null hypothesis (H0) concluded that all pre- and post-questions were answered the same. The alternative hypothesis concluded that pre- and post-questions differ.

No data dispersion was found pertaining to questions 1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, and 14. The pre/post-questionnaire boxplots for questions 4, 9, 15, 16, and 17, created with an 80% confidence interval, the H0 was rejected as all answers for pre- and post-questionnaire questions were answered the same. As noted in **Figures 8–10**, the boxplot show the confidence interval with a blue line margin, with the mean marked as an x on the boxplot at an 80% confidence level and the position of the Ho value at 0.

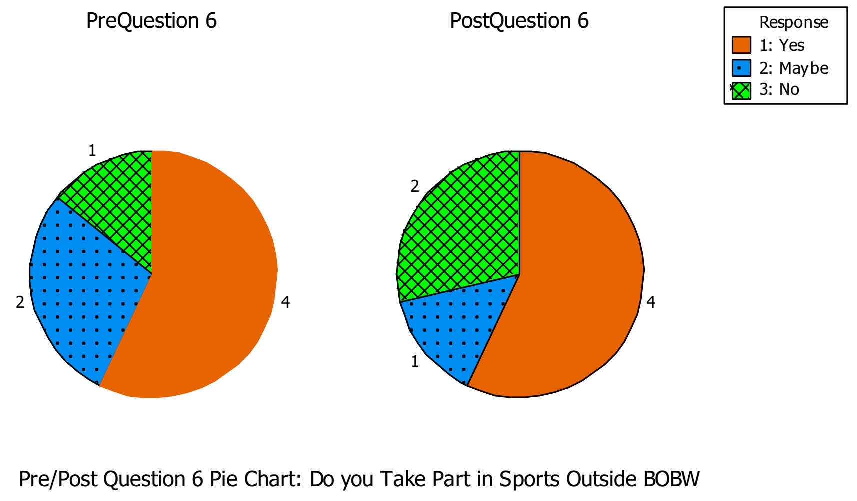

FIGURE 4 | **Question number six asked if the students took part in any sport outside of the BOBW program.**

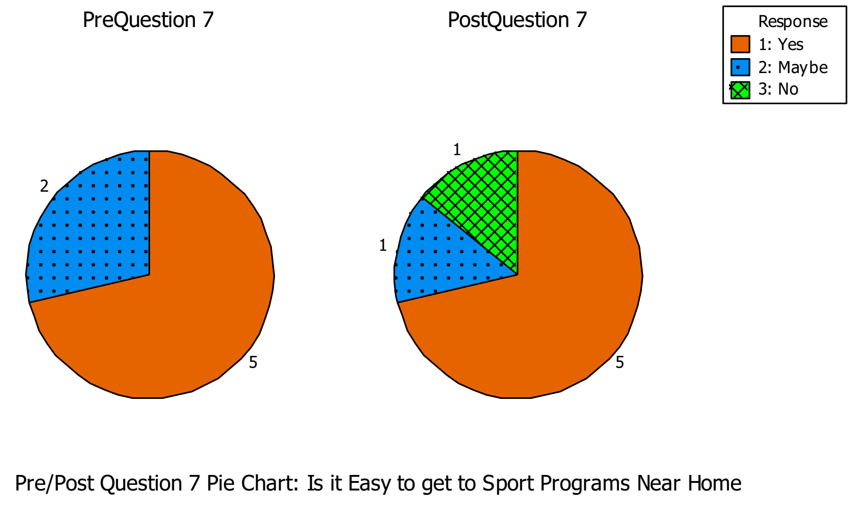

FIGURE 5 | **Question number seven asked if the students thought it was easy to get to sport programs near where they live.**

Since the Ho fell outside of the confidence interval on questions 4, 9, 15, 16, and 17; therefore, the hypothesis was rejected.

Question number four asked the students if someone started an argument with me, I could make him or her stop (See **Figure 8**). This question showed no impact on four out of the eight students, while the other four students had a negative impact from the beginning of the semester to the end of a semester. Student 8 showed an instance of negative impact and loss of empowerment from this question. This finding was interesting because the student is a second year in the program. Originally, she reported she strongly agreed that she could make someone stop if they started an argument with her. During the post-questionnaire, Student 8 reported that she disagreed with that statement.

Question number nine asked the students if he/she could make good things happen when he/she did recreation activities (See **Figure 9**). This question showed no impact on four out of the eight students, while the other four students seemed to have a negative impact. Question number 15 asked the students if he/she could do things during recreation activities that would make other people like them more (See **Figure 10**). This question showed no impact on six out of the eight students, while the other two students seemed to have a negative impact from the beginning of the semester to the end of the semester. Student 16 showed a negative impact from this question reporting that he agreed with the statement made in question fifteen. However, during the post questionnaire, he reported that he strongly disagreed with the statement made in question fifteen.

Question number 16 asked the students if he/she could make recreation activities fun for everyone (See **Figure 11**). This question showed no impact on six out of the eight students, while

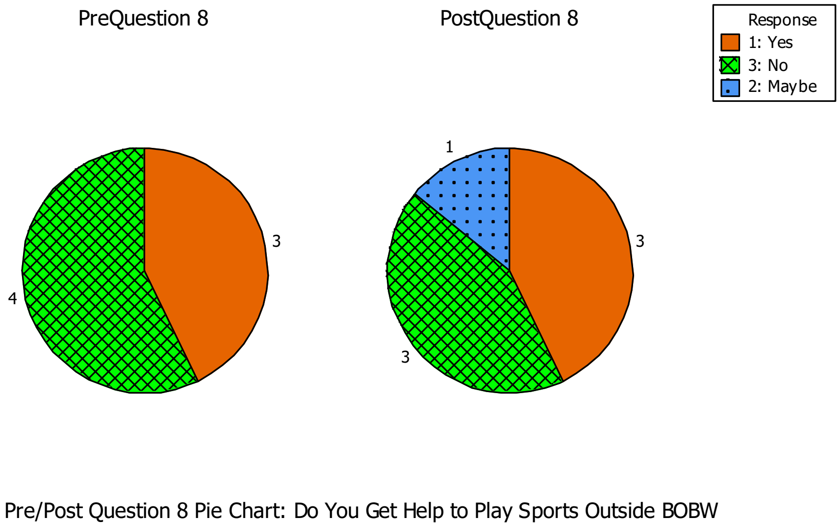

FIGURE 6 | **Question number eight asked if the students got any help to play sports outside the BOBW program**.

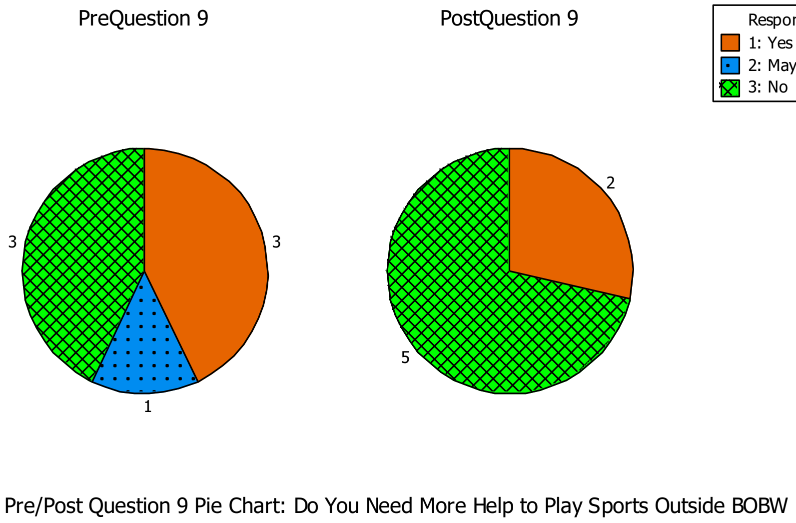

FIGURE 7 | **Question number nine asked if the students thought they needed more help to play sport outside the BOBW program**.

the remaining two students seemed to have a positive impact. Two students seemed to have a positive impact on this question from pre-questionnaire to post-questionnaire. Both Student 12 and 16 strongly agreed with the statement made in question 16 during the post-questionnaire showing an instance of gaining empowerment from the BOBW program.

Question number 17 asked the students if he/she could do things in their recreations activities that would help other people win more often (See **Figure 12**). This question showed no impact on four out of the eight students, while one student had a negative impact and three students had a positive impact. Three students showed a positive impact due to this question. Both Students 13 and 16 strongly agreed with the statement made in question 17 during the post questionnaire showing an instance of gaining empowerment from the BOBW program.

FOCUS GROUP RESULTS

The *apriori* and notable themes emerging from the data were identified and constantly compared with previous data. Strauss and Corbin (27) suggested that after data collection the researcher should analyze the data using a constant comparative method. Triangulation methods included crosschecking sources of data to improve credibility (24). This process was utilized to confirm the researcher's interpretations. The comparison of multiple data sources allowed the identification

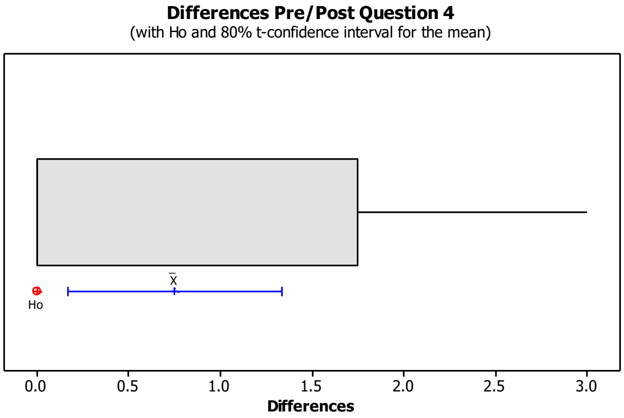

FIGURE 8 | Question 4 stated, "If someone started an argument with me, I could make him or her stop." This boxplot shows us the confidence interval (blue line margin), with the mean marked as an x on the boxplot at an 80% confidence level and the position of our null hypothesis value at 0.

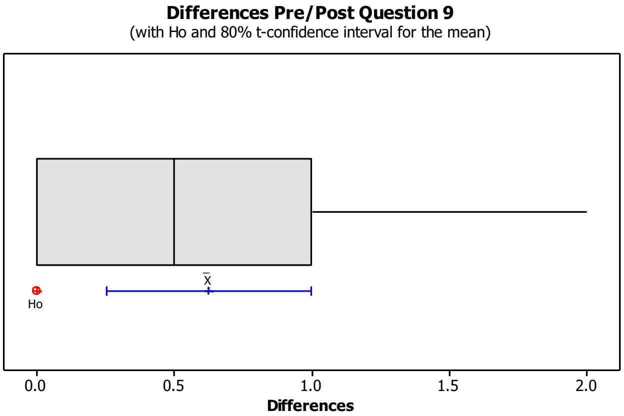

FIGURE 9 | Question 9 stated "I can make good things happen when I do recreation activities." This boxplot shows us the confidence interval (blue line margin), with the mean marked as an x on the boxplot at an 80% confidence level and the position of our null hypothesis value at 0.

of inconsistent or unclear information to be identified and clarified.

The data collected through the participants' questionnaires and transcribed focus group interview data were analyzed using QSR International NVIVO 10 for Windows qualitative software with open coding technique, which involved the researcher scanning the responses for themes or concepts found throughout the data. Once open coding was complete, axial coding was completed to formulate more encompassing categories of phenomenon based on the themes found with open coding. This was completed in the hope of finding connections between different themes found in the data. Finally, selective coding was completed in the hopes of developing an overall explanation for why the themes occurred from study.

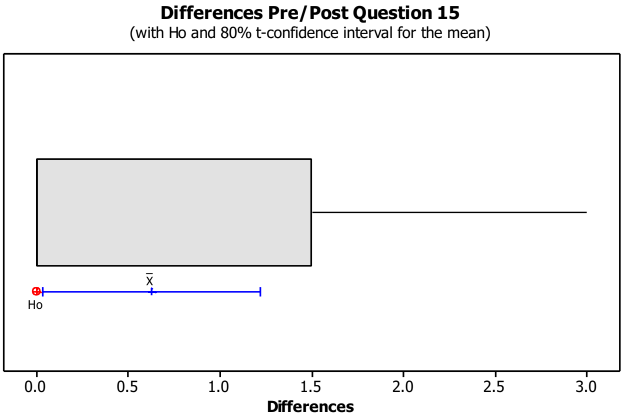

FIGURE 10 | Question 15 stated, "I can do things during recreation activities that will make other people like me more." This boxplot shows us the confidence interval (blue line margin), with the mean marked as an x on the boxplot at an 80% confidence level and the position of our null hypothesis value at 0.

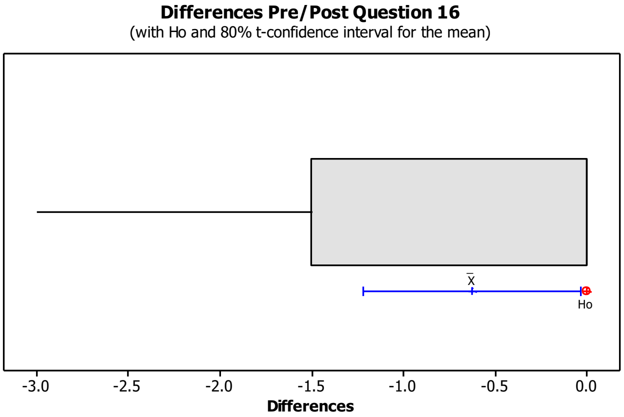

FIGURE 11 | Question 16 stated, "I can make recreation activities fun for everyone." This boxplot shows us the confidence interval (blue line margin), with the mean marked as an x on the boxplot at an 80% confidence level and the position of our null hypothesis value at 0.

Focus Group Data Discussion

Based on the review of literature, there were five *a priori* themes sought during the focus group data analysis. These five themes consisted of positive effect on empowerment, how happy the program made the students, what benefits the students gained from the program, the student's familiarity with the university peer buddies, and the environment, and, lastly, the students ability to ask for assistance when they need it. The analysis of the focus data revealed the following themes as positive effects of the intervention.

Positive Affect on Empowerment

There were a total of 32 references made pertaining to the affect on empowerment. Within this theme, there were three subthemes

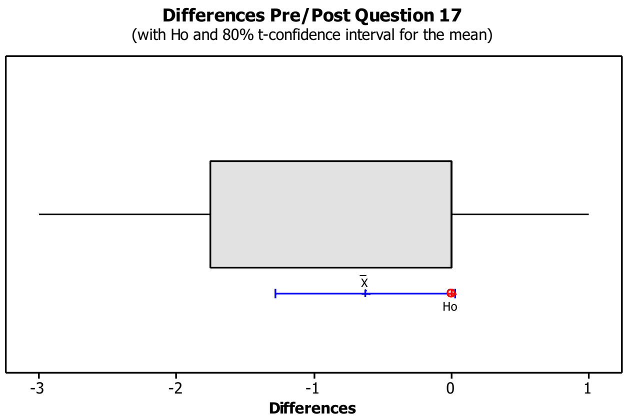

FIGURE 12 | Question 17 stated, "I can do things in my recreation activities that will help other people win more often." This boxplot shows us the confidence interval (blue line margin), with the mean marked as an x on the boxplot at an 80% confidence level and the position of our null hypothesis value at 0.

identified as follows: comfortable; confidence; and independence. The findings noted that the references made within this theme came from all four focus group data sources.

The participants made the following statements about becoming comfortable:

> Yes, when I first came back from my surgery I was a little uncomfortable. I'm a very shy person; I'm very quiet and sometimes not talkative at all. I am talkative with my buddies now (Focus Group 1).
>
> Like spending time with workout buddies and spending time with them on campus. Easy to get along with. Easy for me to introduce myself (Focus Group 2).
>
> I am more outgoing because of buddies. When I meet new people, I get really nervous and when I am with my buddies, I feel more comfortable (Focus Group 2).
>
> Pretty good, cool to hang out with; feel more comfortable (Focus Group 3).
>
> Feel comfortable telling buddies if weights are too heavy, etc. Feel more comfortable with buddies now, as compared to beginning of school year (Focus Group 4).

One negative instance was found when a participant stated "I feel good, no intimidation. Sometimes I feel nervous around them (buddy) when someone approaches me to talk" (Focus Group 4).

The participants made the following statements about gaining confidence:

> …more confidence with machines (Focus Group 2).
>
> Feel a little more outgoing; feel more comfortable on campus (Focus Group 3).
>
> Feel like I can talk to more peers (Focus Group 3).
>
> …feel safe with buddy and willing to joke around (Focus Group 4).

The participants made the following statements about being gaining independence:

> I like workout myself, I just like working out with Adam (a classmate) (Focus Group 1).
>
> …I could go to Lifetime and ask trainers to help me (Focus Group 3).

Happy

There were a total of 19 references made pertaining to participant Happiness. Within this theme, there were two subthemes identified as follows: Safety and Unhappy. The findings noted that the references made within this theme came from all four focus group data sources.

The participants made the following statements about becoming Happy:

> Made more buddies. We play games and basketball. Buddies make me feel happy (Focus Group 1).
>
> Buddies make me happy. Sarah and Hannah are my girls, they make me feel happy (Focus Group 1).
>
> It feels great. I feel happy because it's nice to be with friends here at [name] University. It's a nice campus, my friends think so too (Focus Group 1).
>
> The workout buddies think it is helpful for students to access or accommodate for needs on machines. Buddies help me and enjoy. Buddies feel pretty happy and seem excited to workout (Focus Group 2).

The participants made the following statements about becoming Safe:

> More social skills, more confidence with machines, safety when working out (Focus Group 2).
>
> Feel safe with buddy and willing to joke around (Focus Group 4).

There were two negative cases found as follow:

> Think it is kinda boring for my buddy; enjoys talking with my buddy (Focus Group 3).
>
> I think they enjoy, not sure how much they look forward to it (Focus Group 3).

Benefits

There were a total of 24 references made pertaining to participant Benefits. Within this theme, there were two subthemes identified as follows: Social and Workout. The findings noted that the references made within this theme came from all four focus group data sources.

The participants made the following statements about Social opportunities from engaging in the Workout/Recreation sessions:

> We have a good time (Focus Group 1).
>
> I am very talkative with my buddies now (Focus Group 1).

> Spending time with buddies to gain friends and social skills. They like to know how our weekends and weekends were (Focus Group 2).
>
> I am more outgoing because of buddies (Focus Group 2).
>
> I have gained not to say "birthday" all the time. My social skills are better (Focus Group 2).
>
> It seems fun, people look forward to seeing their buddies (Focus Group 2).
>
> Gained …communication skills, friendship (Focus Group 3).
>
> Feel a little more outgoing: feel more comfortable on campus (Focus Group 3).
>
> Enjoy seeing what buddy likes and what I like are the same (Focus Group 4).

The participants made the following statements about Working out from engaging in the Workout/Recreation sessions:

> Oh yeah, I like to workout with friends (Focus Group 1).
>
> My friends help me workout (Focus Group 1).
>
> The workout program is tons of help. Helps me to accomplish my goals (Focus Group 2).
>
> Enjoy workout with buddies (Focus Group 2).
>
> Gained strength (Focus Group 3).
>
> Working out helps me to relax and not get stressed (Focus Group 4).
>
> Buddies sometimes help muscles feel better (Focus Group 4).
>
> When I feel tired, buddies help me feel better and make me work (Focus Group 4).

One negative instance was noted

> Yes, not starting a conversation, but will talk if they start (Focus Group 4).

Assistance When Needed

There were a total of 14 references made pertaining to Assistance when Needed. Within this theme, there were two subthemes identified as follows: Help with Workout and Questions. The findings noted that the references made within this theme came from all four focus group data sources.

The participants made the following statements about obtaining Help.

> They (buddies) help me (Focus Group 1).
>
> My friends help me workout. We have a good time (Focus Group 1).
>
> When I am lifting, I realize some weights can be changed…. More confidence with machines, safety when working out. I could go to Lifetime and ask trainers to help me (Focus Group 2).
>
> Feel comfortable telling buddies if weights are too heavy, etc. (Focus Group 4).
>
> They remind me to wear my heart rate monitor, they help me (Focus Group 2).

The participants made the following statement about asking Questions.

> If I had any questions, they would answer them for me (Focus Group1).

Familiarity of Students and Environment

There were a total of 27 references made pertaining to participant Familiarity of Students and Environment. Within this theme, there were two subthemes identified as follows: Environment and Students. The findings noted that the references made within this theme came from all four focus group data sources.

The participants made the following statements about Familiarity with Students.

> Sarah and Hannah are my girls, they make me feel happy (Focus Group 1).
>
> Being around college peers is easy to make friends. Like spending time with workout buddies and spending time with them on campus. Easy to get along with. Easy for me to introduce myself (Focus Group 2).
>
> When I meet new people I get really nervous and when I am with my buddies, I feel more comfortable (Focus Group 2).
>
> People look forward to seeing their buddies (Focus Group 2).

The participants made the following statements about Familiarity with Environment.

> It's nice to be with friends here. It's a nice campus, my friends think so too (Focus Group 1).

They enjoy working out with buddies. Like large recreation groups and games (Focus Group 2).

> Feel more outgoing; feel more comfortable on campus (Focus Group 3).

Gaining Empowerment

From the data collected, one of the eight students gained empowerment in response between pre- and post-perceived leisure control scales pertaining to "getting people to do recreation activities even if they didn't want to." Barriers that the students were able to overcome due to this program include feeling comfortable around other college age peers, feeling comfortable when coming to a college campus to work/workout, having a feeling of being more outgoing due to the conversations with buddies, and gaining social skills that better their interactions with peers.

Assistance When Needed

Focus group data showed instances of the BOBW students feeling comfortable enough to ask for assistance when needed. Focus Groups 1 and 2 each showed an instance of being able to ask for assistance when they need it, "They remind me to wear my heart rate monitor, they help me" (Focus Group 1) and "If I had any questions, they would answer them for me" (Focus Group 2).

DISCUSSION AND RECOMMENDATIONS

In general, the BOBW program had a positive impact on empowerment of BOBW students throughout the semester. All students reported that they enjoyed the program from the beginning of the semester to the end, giving the BOBW program a positive aspect in their life. This was similar to the findings of Green and Reese (21) who noted that by giving these students the opportunity to become empowered and be able to feel comfortable around others at the gym provides them with opportunities to obtain a healthy lifestyle. Also, all students reported feeling a great amount of help throughout the program from the beginning of the semester until the end. These positive instances showed an increase in empowerment on the students' lives. Block et al. (9) noted similar findings that trying to eliminate barriers that were associated with disabilities and physical exercise help motivate and increase physical exercise in the students, as well as increasing support.

Similar to the findings of Block et al. (9), the program provided the students an opportunity of participation and involvement, the program was found to give them a sense of empowerment to make their own decisions and learn for themselves to become independent. Through participation with fitness and recreation programs, adults with disabilities learn to overcome self-imposed perceptions of their capabilities as well as how to turn their limitations into abilities. This was similar to Gabler-Halle et al. (16) who found that exercise has been shown to have a strong correlation between participation in an exercise program and positive changes in behavior for adults with disabilities. People who perceive themselves as competent, capable, and self-determining would be able to face and deal with life's challenges (9). Findings of gaining empowerment were similar to those of Block et al. (9) in that giving students with disabilities the opportunity to participate in fitness and recreation programs, they are able to gain empowerment from the experience.

However, there were some factors that made the BOBW students feel less empowered by the program. The researcher noted during focus groups that some of the BOBW students were not confident in starting conversations with their university peer buddies. Although the BOBW students felt a sense of losing empowerment with this specific instance, there was an overall positive impact on the BOBW students' empowerment. This is similar to what Tracy (19) noted, "Negative attitudes from peers can have a huge effect on the students and could potentially make the students feel uncomfortable and unwilling to come back" (19) (P. 347). By giving the students the opportunity to participate and socialize with peers their own age at a college setting, they were able to gain a sense of empowerment in their own life. The BOBW program university fitness center location was noted to be a friendly environment and this finding was contrary to that previously noted by Rimmer (5) who found the biggest barrier was that fitness and recreations facilities were unfriendly environments.

Limitations to Study

Limitations to this study included the number of participants. Working with a limited group of students in the program made it difficult for the researcher to acquire many participants. Also, during focus groups, some participants had limited communication skills. For example, the researcher could only obtain one to three words or affirmative responses from two participants. Convenience scheduling of focus groups occurred due to the individualized BOBW student work and community schedules; therefore, groupings of the students may have reduced the depth of discussion or the content of the discussion. Also, this study was conducted over a very short time period. Additionally, one BOBW student had a scheduled operation and missed a couple of weeks of the program which could have impacted the results.

Recommendations for Future Study

1. Given the fact that these research findings were based on data provided by eight BOBW Students over the course of a 3-month period, the first recommendation to be offered is that this study should be replicated on a broader scale with all BOBW students, as well as other transition programs that provide fitness and recreation opportunities.
2. Due to the limited empowerment theory literature within a transition program on a college campus, a longitudinal study should be employed to examine the empowerment of students by year of program as well as type and location of program.
3. Further study is also needed to determine if the impact of empowerment gained during the BOBW program impacts the students in other aspects of their lives as well as over the years.
4. Exploration is needed to determine how important empowerment is to gaining and maintaining jobs.

Recommendations for BOBW Workout/Recreation Program

These results could suggest that in the future, training for both the BOBW students and their university buddies could center around how to best start conversations or find similar topics of interest for discussion. Part of the BOBW program outcomes are for the students to self-advocate, adding this information to the buddy training sessions could help identify when the BOBW students needs assistance versus when the college buddies are negatively impacting the empowerment of the BOBW students. Continuing the practice of providing additional socialization time outside of the workout and recreation environment may positively impact the previously noted barriers to empowerment.

AUTHOR CONTRIBUTIONS

ACS was the Primary Investigator of this study.

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Conflict of Interest Statement: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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MINI REVIEW
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Physical Activity Participation of Disabled Children: A Systematic Review of Conceptual and Methodological Approaches in Health Research

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Physical activity (PA) participation is widely recognized as a critical component of health and development for disabled and non-disabled children. Emergent literature reflects a paradigm shift in the conceptualization of childhood PA as a multi-dimensional construct, encompassing aspects of physical performance, and self-perceived engagement. However, ambiguity remains around how participation as a health construct is integrated into PA research. The primary objective of the present mini-review is to critically examine current conceptual and methodological approaches to evaluating PA participation among disabled children. We conducted a systematic review of contemporary literature (published between 2000 and 2016). Seventeen articles met inclusion criteria, and their research approach was classified into guiding framework, definition of the key construct, and measurement used. The primary guiding framework was the international classification of functioning, disability and health. An explicit definition of PA participation was absent from all studies. Eight studies (47%) operationalized PA and participation as independent constructs. Measurements included traditional performance-based aspects of PA (frequency, duration, and intensity), and alternative participation measures (subjective perception of involvement, inclusion, or enjoyment). Approximately 64% of included articles were published in the past 2 years (2014–2016) indicating a rising interest in the topic of PA participation. Drawing from the broader discussion of participation in the literature, we offer a working definition of PA participation as it pertains to active, health-associated behaviors. Further description of alternative approaches to framing and measuring PA participation are offered to support effective assessment of health status among disabled children.

Keywords: assessment, disability, international classification of functioning disability and health, participation, physical activity, recreation and sport, systematic review

INTRODUCTION

Engagement in moderate to high intensity physical activity (PA) during childhood is advocated for in the promotion of optimal health outcomes and may offset predisposed risk for the development of secondary health conditions experienced by disabled children (1–3). Participation in PA opportunities is a fundamental childhood experience that fosters the psychosocial development of interpersonal skills, self-confidence, and self-efficacy (4). Increased PA participation is a primary goal expressed by parents and professionals for disabled children (5–7). Given our focus on physiological and psychosocial health outcomes, we use the term *PA participation* in reference to "engagement in a physically demanding movement, sport, game, or recreational play that results in energy expenditure and perceptions of communal involvement" (8, 9).

A consistent understanding of the PA participation construct is necessary for key stakeholders to successfully describe the health status of disabled children. *Participation* is broadly conceptualized as "involvement in life situations" (10) within psychology and disability related literature, but ambiguity surrounds the intended meaning of the term (8, 9) as a measurable index of health relative to being physically active. Recent efforts to integrate this construct in health literature are exemplified by Kang and colleagues (11). For children who experience physical disabilities, they define optimal recreation and leisure participation as the quality of child–environment interactions reflected in individualized (objective and subjective) physical, social, and self-engagement outcome measures (p. 1735). Kang et al. (11) cautions against inferring *poor* health from observed *differences* in frequency and intensity of PA participation between disabled and non-disabled children, without consideration for quality of children's experiences. Misperceptions about the extent to which a child can participate may result in fewer opportunities or expectations for disabled children and reduce engagement in this health-promoting behavior. Therefore, there is a critical need to further examine health indicators in an inclusive manner. The first step is to reach consensus on how PA participation is effectively discussed and measured as a health indicator for disabled children.

FRAMING PHYSICAL ACTIVITY PARTICIPATION

Physical activity has been traditionally discussed from a medical model framework in which health resides in the individual, represented by the absence of illness and body impairments. In response, PA has routinely been defined as "bodily movements that result in energy expenditure" (12). It is commonly operationalized as the frequency of activity attendance (13–16) or average daily time spent engaged at given intensity levels (e.g., light, moderate-to-vigorous) (17, 18). Subsequent attention has been given to identifying key activity restrictions or anatomical impairments, such as muscle weakness or low motor skill proficiency, to explain the limited PA engagement of disabled children (17, 19).

When using physiological performance outcomes as the single indicator of PA, there is an inherent assumption that functional deficits will inhibit disabled children from becoming "full" participants in community activities or sports teams. Reduced opportunities may limit a child's exposure to fundamentally important physical, social, and personal experiences for health development. From an equity standpoint, additional qualifiers are needed to describe and appropriately measure PA patterns as a health index across disabled and non-disabled children. This requires a comprehensive discussion of both physical performance and psychosocial aspects of inclusion. For example, measures of self-concept (20), identity (4), and enjoyment (21) need to be considered alongside fitness and motor skill proficiency, to allow for more accurate and sensitive measurement of PA participation improvement among disabled children. Efforts to capture this multi-dimensional health aspect of PA for disabled children use the term "PA participation" [e.g., Ref. (11, 13)].

The term participation gained hold as a health indictor following the introduction of the International Classification of Functioning, Disability and Health (ICF) framework from the World Health Organization (WHO) in 2001 (10). The ICF reflects a shift away from the impairment-based disablement framework toward emphasis on the personal, social, and environmental impacts of disability on health (22). In contrast to the traditional medical model's focus on individual attributes of health, this contemporary biopsychosocial model takes the perspective that disability occurs at a person-in-environment level. Within this framework, participation describes the extent to which a child is socially engaged in child-relevant life situations, such as organized and school-related sports, games, and recreational play with peers in the community (11, 23).

Ross et al. (23) published a guide for researchers to advance the study of childhood PA participation. Their guide includes three steps: (1) identify a health framework, (2) clearly define outcomes that operationalize PA within the context of a given research project, and (3) select appropriate PA measurements that map back onto the targeted conceptual dimension of health. As an extension of Ross et al. (23), the primary objective of the present mini-review is to critically examine current conceptual and methodological approaches to examining PA participation among disabled children. A systematic review of contemporary literature (published between 2000 and 2016), explicitly investigating PA participation as a health construct for disabled children, was conducted. The operationalized definition of this key construct and implemented measurement practices were evaluated to support our understanding of this phenomenon and inform future research efforts.

METHODS

A systematic review of contemporary literature (January 2000–January 2016) was conducted to examine the conceptualization and measurement practices for PA participation among disabled children. *Preferred Reporting Items for Systematic Reviews and Meta-Analysis* (PRISMA) standard guidelines were followed, as per recommended practice (24). An electronic database search was conducted in February 2016 and detailed in Appendix A in Supplementary Material.

Initial Screening and Inclusion

Given strong links between PA participation and health among disabled children (2, 25), the primary objective of this study was to examine the use of this term in reference to active, health-associated levels of PA. The primary inclusion criterion was the use of the key terms "physical activity, sport, active, or recreation" in combination with "participation" as a measurable construct.

Articles were excluded if the term PA referred to children's leisure or more broadly defined participation outside-of-school or in daily life activities. Three trained research assistants independently screened titles and abstracts using this primary inclusion criteria, in addition to the following: (a) target population included children or youth, mean age ≤18 years, (b) must have included primary data other than case reports, (c) available in English, and (d) published in a peer-review journal. Exclusion criterion included (a) absence of the key words from the title, abstract, or the text body, (b) participants' mean age was outside the target age range, (c) disabled children were not included as participants, or (d) the term "PA participation" was not used as a measurable outcome.

Data Extraction and Synthesis

Articles retained after the initial screening underwent full review by three independent researchers. Data on study characteristics, key term definitions, and related measurement and methodology characteristics were extracted and synthesized. Any ambiguity around how the key term was used in an article was discussed among primary authors. The final data set was reviewed for emergent themes in the guiding framework, definition of key terms and assessment measures. A summary of the search and screening process can be found in Appendix A in Supplementary Material.

RESULTS

A total of 17 articles were included in this review (13, 26–41). Key study characteristics of the included articles are presented in **Table 1**. The majority of studies were published within the last 2 years ($n = 11$, 64% published 2014–2016), and most frequently published in *Research in Developmental Disability* (27, 33, 35, 36) or *Disability and Rehabilitation* (32, 34). Articles were primarily published in journals within psychology or medical related fields (e.g., *BMC pediatrics, Developmental Medicine and Child Neurology, Disability and Rehabilitation, Child: Care, Health and Development*). Public health and kinesiology journals, although the minority, were also represented in our sample (e.g., *Adapted Physical Activity Quarterly, Journal of Physical Activity and Health, and Journal of Sport and Health Sciences*). There were only one or two articles per year published between 2007 and 2013. Prior to 2007, only one article published in 2002 met inclusion criteria (41). The majority of the research was conducted in Canada ($n = 5$, 29%) and included participants aged 6–12 years (middle childhood, $n = 11$, 65%) who were representative of a broadly defined disability population ($n = 5$, 29%).

Table 2 summarizes the research approach outlined by the included studies to investigate PA participation. It is organized in accordance with Ross et al.'s (23) guidelines, classifying the approach into (a) the guiding framework, (b) the operational definition of PA participation, and (c) aspects of the measurement tools used to capture this key construct.

The WHO-ICF (10), or the corresponding 2007 children's version [ICF-CY; (42)], was the primary guiding framework used ($n = 8$, 47%) (13, 29, 30, 32–34, 36, 37). The Physical Activity for Persons with Disability (PAD) framework, a PA-specific rendition of the ICF, was utilized in two articles (29, 40). Alternative frameworks included the Social–ecological model (39), Systems Theory (27), Theory of Planned Behavior (32), and Sports Participation Theory (41). An operational definition of PA participation was not explicitly provided within any of the included literature. Instead, when an operational definition was provided, participation and PA were presented as independent constructs. Participation was defined by approximately one-third of the studies ($n = 5$, 29%) as the "*involvement in life situations, … such as physical activity*" (13, 33–36) – a direct quote from the WHO-ICF framework [(10), p. 10] – or stated that "*sports [physical activity] participation falls under the broader ICF term 'participation'*" (32). Two studies noted "*aspects of sports participation include frequency, duration, and social (or subjective) experiences*" (35, 36). PA was operationally defined by only two studies, with both referencing Caspersen's [(12), p. 126] 1985's definition: "*voluntary movement produced by skeletal muscles that results in energy expenditure*" (29, 33). Nearly half of the studies did not provide an operational definition of either participation or PA ($n = 8$, 47%).

In accordance with Ross et al.'s (23) taxonomy of PA measurement, 10 studies (59%) used traditional performance-based measures of PA. This included outcomes of percent time in moderate-to-vigorous PA [i.e., *intensity*; (30)], number of PA opportunities attended in the last 6 months or year [i.e., frequency; (26, 33, 35, 36)], or physical ability to execute PA tasks [i.e., motor *performance*; (31)]. Three studies used an accelerometer to capture this data, whereas the remaining eight studies used PA-oriented surveys, daily logs, or interviews.

Physical activity was measured along an alternative involvement dimension of participation within 14 studies (82%). Assessments used included the *Children's Activity, Participation and Enjoyment* (CAPE) measure (13), the *Child Behavior Checklist* [CBCL; (35)], and the *Participation and Activity Limitation Survey* [PALS; (36)]. Emergent themes from questionnaires and interviews included questions of children's *experiences* during PA (e.g., where, why, and with whom; 29% of studies), the number of different types of PA opportunities they attended (i.e., diversity; 29% of studies), and their *attitudes or opinions* about personal PA (12% of studies) and their *perceptions* or level of *enjoyment* during PA (12% of studies). Of the 13 studies that used an involvement-oriented measure of PA participation, seven (41%) concurrently assessed PA participation with a performance-oriented measure and either referred to the ICF/ICF-CY or explicitly defined participation as a health construct.

Included studies were primarily descriptive research designs and aimed to (a) describe the perceptions and experiences of PA participation among disabled children and key stakeholders (13, 27–29, 31–34, 38, 41), (b) identify barriers and facilitators to PA participation (28, 29, 31, 34, 35), and/or (c) compare PA participation across groups of disabled children and in relation to non-disabled peers (13, 26, 30, 35, 36, 39). Key outcomes associated with these aims are presented in **Table 1**.

DISCUSSION

The primary objective of this mini-review is to critically examine current conceptual and methodological approaches to examining

TABLE 1 | Key study characteristics of included articles. Includes (1) journal and country of publication; (2) Description of participant population (*n* = sample size; M = mean age in years of sample); (3) Key word pertaining to physical activity participation used and definition when provided; (4) Assessment and measure(s) used to capture the key construct; and (5) brief summary of associated results.

Reference	Journal/country	Population (*n*, M age in years)	Key word and definition	Key word: assessment/ measure(s)	Results
Arim et al. (26)	*International Journal of Pediatrics/* Canada	NDD/D and TD (*n* = 1,805/7,314, school aged)	*Participation in PA*: informal (unorganized) and formal (organized) PA were considered a separate types of PA	*Survey*: frequency of attendance in (a) organized sport or PA and (b) unorganized sport or PA in the last year; Dichotomized indicator of participation (0 = about once a month or never; 1 = about once a week or more)	NDD/D less likely to participation in organized sport or PA (~50% participated) compared TD, with 70% participation, after controlling for child and family factors. No significantly different participation rates between groups in unorganized sport or PA Age, but not sex, was associated with participation in PA
Ayvazoglu et al. (27)	*Research in Developmental Disabilities/*United States	ASD (*n* = 6, M = 7.5)	*Participation in PA; PA participation*: operational definition *not* provided	*RT3 Accelerometers*: number of minutes of MVPA per day *Q-Sort of PA cue cards + Follow Interview*: rank Order and content analysis for emergent themes	Low levels of PA as indicated by accelerometer data (M = 34.33 min/day MVPA) Categories/*Themes:* (1) understanding PA in ASD: child (a) lacks social skills (b) is bullied or mocked (c) parental fear of being hurt (d) trouble transitioning; (2) living with a child with ASD: (a) lack of time, (b) too fatigued for PA, (c) external support (d) lack of money; (3) Awareness of ASD at school and community: (a) Why is child behaving that way? (b) Limited PA opportunity, (c) lack of disability knowledge, (d) teach PA skills (d) academics more important than PA
Bantjes et al. (28)	*International Journal of Disability, Development, and Education/*South Africa	CP (*n* = 15, M = 14.0)	*Participation in PA; participation in sport and exercise*: operational definition not provided	*Semi-structured, in-depth interview*: thematic analysis of the lived experiences of (1) range of involvement in PA and context of participation, (2) experience of participation in PA, (3) perception of factors that promote and hinder participation; and (4) ideas about factors that should be taken into account when developing programs	General consensus that there are limited number of sports and PA opportunities Themes about factors important for designing programs to promote [CP] participation in sport: (1) opportunities, variety, and choice; (2) adapted PA that take account of abilities; (3) autonomy and consultation; (4) friendship, social interaction, and belonging; (5) physical challenge and excitement; (6) coaching, progress, and mastery; (7) competition and opportunity to perform; (8) fairness and inclusion
Bloemen et al. (29)	*BMC Neurology/* Netherlands	SB (*n* = 33, M = 13.0)	*PA participation; Participation in PA*: "For this study PA consists of both PA in activities of daily life and participation in (un)organized sports. It is defined as 'any bodily movement, produced by skeletal muscles, that results in energy expenditure'"	*Focus groups and interviews*: thematic analysis with inductive strategy to identify positive and negative PA determinants, classify determinants as personal or environment based on ICF, and specify a detailed description of the PA, positive, negative determinant, or solution	Personal factors: (1) intention, (2) attitude, (3) self-efficacy, and (4) health condition Environmental factors: (1) social/family influence and (2) facilitators and Barriers *See original manuscript for detailed list of sub-themes*
Capio et al. (30)	*Journal of Sport and Health Science/* Australia	CP and TD (*n* =24/26, M = 7.2)	*PA participation; PA level; PA engagement*: "…PA level represents a participation component [of the ICF]"	*Uni-axial Accelerometer:* % time LPA and MVPA	Weekday ≠ Weekend PA levels for CP and TD FMS training associated with significant increase in LPA and MVPA for children with CP, but not for typically developing (training × group effect) Increase in PA level associated with positive gains in FMS movement and skill patterns for locomotion

(Continued)

TABLE 1 | **Continued**

Reference	Journal/country	Population (*n*, M age in years)	Key word and definition	Key word: assessment/ measure(s)	Results
Harvey et al. (31)	*Physical Education and Sport Pedagogy*/Canada	ADHD (*n* = 10, M = 10.3)	*PA behaviors; PA participation; PA experiences*: operational definition *not* provided	*TGMD-2, MABC-2:* movement skill level *Scrapbook-semi-structure interviews about PA experiences*: thematic analysis	Children scored as very-poor to average in movement skills Themes: (1) context (a) time and (b) environment, (2) play and types of PA engagement (a) organized activities, (b) leisure activities, (c) movement (i.e., function), and (d) positive outcome (e.g., social and enjoyment), (3) organization (a) constraints, (b) feelings, (c) how I learn, and (d) planning
Jaarsma et al. (32)	*Disability and Rehabilitation/* Netherlands	CWD, parents and health professionals (*n* = 30/36/17, M = 14.1)	*Sports participation*: "Sports participation falls under broader ICF term participation. Items of sports participation and disabilities were grouped according to components of TPB (attitude, subjective norm, perceived behavioral control)"	*Mail-Survey questionnaire*: type of sports participation	Almost all children participated in sports at school (96%) and after school (77%)
			[see original manuscript for definitions of each component]	*Semi-structured interviews*: thematic analysis of facilitator and barriers using ICF framework	Personal factors Barriers: (1) disability and (2) fatigue Facilitators: (1) health, (2) fun, (3) internal motivation, and (4) physical strength *Environmental* Barriers: (1) lack of facilities, (2) transportation, (3) dependency, (4) lack of acceptance, and (5) lack of information Facilitators: (1) social contacts, (2) support from family, (3) information, and (4) sports activities during school hours
King et al. (13)	*Child: Care, Health and Development/* Canada	CWD and TD (*n* = 781, school age)	*Participation in active PA; participation profile*: "Intensity of participation in active PA (e.g., doing team sports, racing or track and field)" "Recreational participation – the types of activities they tend to engage in and to prefer, who they do them with, how much they enjoy their participation and the extent to which their participation takes place at home or is community-based" "Children's participation – that is their involvement in life situations such as…"	*Children's Assessment of Participation and Enjoyment (CAPE)*[a] *and Preferences for Activities of Children (PAC)*: dimensions of participation: diversity, intensity, with whom, where, and enjoyment of children's participation in specific activity types (e.g., active physical activities)	Enjoyment and preference for active PA significantly correlated with athletic competence scores Intensity and preference of active PA participation significantly differed as a function of gender. Preferences also significantly differed by age[b]
Lauruschkus et al. (33)	*Research in Developmental Disabilities/* Sweden	CP (*n* = 364, M = 12.0)	*Participation in PA*: "PA defined as any voluntary bodily movement, produced by skeletal muscles, that requires energy expenditure. Participation in PA (in addition to performance, i.e., what one actually does) was defined as involvement in life situations, including physical, social, and self-engagement in activities"	*Structured Questionnaire* administered by trained professional: participation in PE at school (yes/no) and mean frequency of active participation in physical activities during the preceding year	Majority of participants actively participated in PE (87%), with active participation in PE 1–2 times per week reported by 74% of participants. Frequency of participation was observed to be a factor of age and level of functional impairment emerged as factors of

(Continued)

TABLE 1 | **Continued**

Reference	Journal/country	Population (*n*, M age in years)	Key word and definition	Key word: assessment/ measure(s)	Results
Lauruschkus et al. (34)	*Disability and Rehabilitation/* Sweden	CP (*n* = 16, M = 9.0)	*Sports participation*: "Participation is defined as involvement in life situations according to the ICF. For children with [CP] the attributes of child, family, environment and physical and social conditions, as well as the degree of self-engagement, are crucial with regard to participation"	*Interviews and Focus Group*: content analysis	Categories/Sub-Categories: (1) Facilitators, "Being physically active because…" (a) enjoying the feeling, (b) being capable, (c) feeling of togetherness, (d) being aware it is good for me, (e) using available opportunities; (2) Barriers, "Being physically active but…" (a) getting tired and experiencing pain, (b) something being wrong with my body, (c) being dependent on others, (d) not being good enough, (e) missing available opportunities
Marquis and Baker (35)	*Research in Developmental Disabilities/* United States	DD and TD (*n* = 63/98, M = 6.0)	*Sports participation; Participation in (physical) activities*: sports broadly defined to include any physical activity reported, from organized team sports to leisurely physical activities Operational definition of 'sport participation' *not* provided	*Child Behavior Checklist for ages 6–18 (CBCL)*: number of sports, number of consistent sports and highest relational sport (coded for autonomy/ relatedness continuous scale based on Self-Determination framework)	Sports participation was observed to be a factor of (a) child's delay status and (b) maternal education and hours of work, for all indices of participation. Age was no longer a significant predictor among children older than 8 years
Mâsse et al. (36)	*Research in Developmental Disabilities/* Canada	NDD/D and CMC (*n* = 145/180, M = 9.5)	*Participation in (un) supervised PA at school; Participation profile*: "The ICF defines participation as 'involvement in life situations' for children it involves participation in educational, social, recreational and physical activities. Participation in a broad range of activities… is thought to be a key indicator of a child's health, irrespective of disability"	*Participation and Activity Limitation Survey (PALS Survey)*: attendance (do you take part in?) and type of PA (0 = non-participation and 1 = participation)	NDD/D significantly more likely to participate in (un)supervised activities than CMC. Highest participation in PA at school was among 8–11 years old, compared to 12–14 years old, children with milder disabilities, and among families who did not receive familial assistance
Mitchell et al. (37)	*Developmental Medicine and Child Neurology/* Australia	CP (*n* = 102, M = 11.0)	*Participation in (sports and) PA*: operational definition *not* provided	*GT3X + Tri-Axial Accelerometer*: average activity counts/minute, standardized inactive time and MVPA	Average time spent inactive and in MVPA was a factor of gross motor function level, age, and sex
Moola et al. (38)	*Adapted Physical Activity Quarterly/* Canada	CHD (*n* = 13, M = 14.0)	*PA participation*: operational definition not provided	*Assessment of Life Habits (LIFE-H)* recreation domain: ability to participate in recreational task and level of difficulty or assistance required	Activity counts were shown to have a significant but weak correlation with participation scores ($r = 0.02$, $p = 0.89$)
				Participation and Environment Measure for Children and Youth (PEM-CY): frequency of participation in home, school and community	Activity counts were shown to have a significant but weak correlation with frequency of participation in the home ($r = 0.31$, $p < 0.001$), school ($r = 0.30$, $p < 0.01$) and community ($r = 0.38$, $p < 0.001$)
				Semi-structured interviews to examine perceptions of PA and sport participation, self-efficacy and facilitators and barriers to participation: *thematic analysis*	Themes: (1) Sport and PA[c] not a valued pursuit in relation to other, more important activities that youth engaged in; (2) low self-efficacy toward being physically active; (3) instrumental relationship with sport – participation not only important but instrumental for health benefits; (4) PA participation negotiated within prevailing experience of cardiac disease related to fatigue

(Continued)

TABLE 1 | **Continued**

Reference	Journal/country	Population (*n*, M age in years)	Key word and definition	Key word: assessment/ measure(s)	Results
Must et al. (39)	*Journal of Physical Activity and Health*/ United States	ASD and TD (*n* = 53/58, M = 6.0/6.7)	*Participation in PA*: operational definition not provided	*Parent-Completed Questionnaire* on perceived child/family, social, and community barriers to child's participation in PA: *total number of barriers in each category and overall*	Number of barriers to PA significantly differed between children with and without ASD. Approximately half of parents identified 6 or more barriers to PA
Shields and Synnot (40)	*BMC Pediatrics*/ Australia	CWD Professional stakeholders (*n* = 23/20, M = 13.9)	*Participation in PA*: operational definition *not* provided	*Questionnaire* on participation in (un)organized PA: total number of different activities per year; average number of hours per week spent in PA during the last year	Total number of barriers was inversely correlated with average number of hours in PA ($r = -0.27$, $p = 0.5$) and diversity of PA type per year ($r = -0.24$, $p = 0.08$)
				Focus Groups: thematic analysis	Themes: (1) similarities and differences exist between children with and without disabilities; (2) people make a difference; (3) one size does not fit all… it is about choice; (4) communication and connections between stake holders [See original manuscript for detailed list of sub-themes categorized by barriers and facilitators]
Sit et al. (41)	*Adapted Physical Activity Quarterly*/ China	CWD (*n* =237, M = 13.5)	*Sport participation; Sport participation patterns; Participation in PA*: "who participates in sport and why (i.e. demographics, motives, affordances, barriers, and benefits)" "…defined sport as physical activity for health, recreation, or competition that is perceived by children as fun, health, and goal oriented"	*Structured interviews with questionnaire*: (1) Membership of sport club/ organization, Frequency of attendance in sports or PA participation in past year motives for sport participation, motives for non-participation; (2) Desired and undesired sport and PA participation and type, frequency, and venue of desired sport participation	13% reported membership in sport club or organization[d] Frequency of sport participation ranged from 1–2 times per week to 1–2 times per month[d] 83% participated in at least 1 sport, 66% in at least 2, 46% in at least 3, and 33% in 3+. The majority of participation occurred in public or community venues[d] Themes: (1) motives: fun, fitness, achievement, friends, competence, praise, non-conformist, told to (2) non-participation: own thing, other leisure/ achievements, lack of skills, watch others, no friends, obligation, let down

[a] *CAPE considered direct measure of participation, documenting what a child does, not the child's competence in performing an activity or the degree of support the child requires to take part.*

[b] *Results used to support clinical and research utility of CAPE and PAC.*

[c] *Youth did not distinguish between sport and PA.*

[d] *Across indices, sport participation was function of gender and disability type.*

PA participation as an index of health among disabled children. The spike in publications inclusive of this term in 2015 indicates a growing interest in this phenomenon. As anticipated, discussion of PA participation is predominately occurring within fields of psychology and medical rehabilitation research [e.g., Ref. (8, 9, 11)]. The descriptive nature of the included studies, aimed at identifying *what PA participation looks like* and *what it means* to disabled children, indicates our understanding of this construct as an index of health is still in its early stages.

We found two patterns for how researchers approached the conceptualization of PA participation. The first approach framed PA as a context in which participation occurs. Articles using this approach started with the WHO-ICF/ICF-CY definition of participation – "involvement in life situations" [(10), p. 5]. This was followed by the identification of PA as an important context in which children participate. For example:

> The [ICF] defines participation as involvement in life situations and for children it involves participation in educational, social, recreational and [PA] [(36), p. 2246]
>
> …children's participation – that is their involvement in life situations such as personal maintenance, mobility, social relationship, home life and education.

TABLE 2 | Number of included articles reporting steps of research approach classified as (1) Theoretical guiding framework, (2) Operational definition of key construct – participation and/or physical activity, and (3) Assessment used to measure physical activity participation along a performance and/or involvement dimension.

Quality criterion	Number of studies (N = 17 total)
(1) Theoretical framework	
ICF or ICF-CY	7 (41%)
PAD	2 (12%)
Other	4 (24%)
None	4 (24%)
(2) Operational definition of	
Participation	
"(children's) *participation* is involvement in life situations, such as physical activities"	5 (29%)
"aspects of *sports participation* include frequency [and duration]"	2 (12%)
Physical activity	
"*physical activity* is defined as voluntary movement, produced by skeletal muscles, that results in energy expenditure"	2 (12%)
None	8 (47%)
(3) Assessment of physical activity participation	
Performance	
Intensity (i.e., level of exertion)	5 (29%)
Frequency of attendance	10 (59%)
Performance (i.e., physical ability to execute physical activity)	2 (12%)
Involvement	
Attitudes/opinions about personal physical activity patterns	2 (12%)
Diversity of activity type	4 (24%)
(Lived) experiences of participation (e.g., where, why, with whom child engaged in physical activity)	5 (29%)
Perceptions of the role of physical activity in child's life	1 (6%)
Preferences and *enjoyment* of physical activity involvement	1 (6%)

Studies may have been counted more than once within each quality criterion if they met more than one sub-category.

ICF, International classification of functioning, disability, and health; ICF-CY, International classification of functioning, disability and health: children and youth version; PAD, physical activity for people with a disability mode.

> Existing measures vary in scope, with some focusing on children's [PA], others on play, and some including school-based activities [(13), p. 29]

This approach contextualizes health behaviors within specific, child-relevant settings. While it provides a descriptive profile of what, where, with whom, and how often children engage in PA, it does not directly map these behaviors onto health outcomes. For example, Sit et al. (41) concluded that the number of sports disabled children attended was associated with their degree of functional impairment. There are challenges, however, with translating this to a scale of health, because we know little about the children's physical and psychosocial experiences while engaged in sport. Similarly, *differences in* frequency or intensity between age groups, gender, or disability status (13, 26, 33, 35–37, 41) are difficult to use as a direct *comparison* of health status across groups. For example, children of varying disability status may report low PA intensity due to physical impairments but equitable perceptions of communal involvement (43). However, this approach offers an important first look at the factors and mechanisms associated with PA participation that may be unique to disabled children.

The second approach framed PA as a multi-dimensional construct, with participation included as one of its dimensions. Compared to the first approach, PA served more directly as an index of physical and psychosocial health. It was described in terms of both performance outcomes (frequency and intensity of physical involvement in PA) and participation outcomes (social experiences, perceptions of inclusions or engagement, enjoyment). For example:

> For this study, [PA] consists of both [PA] in activities of daily life, such as (hand) biking to school or active play, and participation in (un)organized sports. It is defined as any bodily movement, produced by skeletal muscles, that results in energy expenditure [(29), p. 2]
>
> …empirical attention toward different aspects of sports participation (e.g., frequency and social nature of sport) should be expanded upon for a more comprehensive understanding of sports participation difference [between children with and without disabilities] [(35), p. 46]

This approach provides a foundation for mapping descriptive measures of PA participation to health status for disabled children. The connection between PA participation behaviors and health status is made transparent by the use of qualifiers. For example, Capio et al. (30) measured PA participation *level* (i.e., intensity) as an index of physical function and cardiovascular health. Harvey et al. (31) measured movement skill level as an index of PA participation *competence* or *performance*. King et al. (13) and Mâsse et al. (36) measured PA participation *profiles* to capture more global psychosocial *experiences* of children (enjoyment, perceptions of inclusion, satisfaction). From this framework, subsequent research can begin to translate descriptive PA participation behaviors onto scales of health. This effort would facilitate the identification of "levels" and "experiences" that put children at risk for poor health outcomes throughout life. It would further inform key aspects of PA participation that need to be supported throughout childhood to promote healthy development.

Drawing from the broader discussion of participation in the literature (8–11, 23, 44–48), we offer a working definition of PA participation as it pertains to active, health-associated behaviors:

> Physical activity participation describes "experiences in physically demanding movement, sport, game, or recreational play that results in energy expenditure and perceptions of communal involvement."

It can be qualified by:

(1) Level: *frequency of attendance and intensity of physical exertion* [e.g., Ref. (23, 48)].
(2) Quality of experience: *self-perceived feelings of social inclusion, enjoyment, self-efficacy, and satisfaction* [e.g., Ref. (47)].
(3) Overall profile: *extent to which a child's level of participation matches their expectation for a quality experience* [e.g., Ref. (11, 43)].

Our emphasis on qualifiers aligns with contemporary works advocating that "*participating in a sport activity for a child with a disability cannot be restricted to health and physical outcomes because participation does not only refer to taking part in an activity, particularly for children with disabilities*" [(20), p. 748]. The predominant use of interviews in the studies reviewed suggests that self-report is the preferred method for capturing PA participation *profiles* of disabled children.

Future efforts are needed to translate our working definition of PA participation into inclusive assessments that map onto indices of health in childhood. Framing PA as a context in which participation occurs was the necessary first step in understanding PA as a dynamic health experience. When framed in this way, we effectively say that PA occurs in life situations (which is self-evident) and is a kind of participation (i.e., we are physically active by participating in PA). The use of participation thereby serves as a filler word and is not, in and of itself, representing a measurable health behavior. We therefore recommend, that moving forward, researchers adopt the term PA *engagement* when referring to PA as a context for participation and measuring physiological behaviors and outcomes (i.e., energy exertion, attendance frequency), synonymous with traditional discussion of PA levels (49, 50). PA *participation* can then serve to represent a broader health experience associated with dynamic child-environment interaction (i.e., *self-perceived feelings of social inclusion, enjoyment, self-efficacy, and satisfaction*). Differentiating PA engagement and PA participation consistently within health-related fields, and approaching PA participation as a measurable construct are further required to support effective assessment of the health status among disabled children.

AUTHOR CONTRIBUTIONS

Substantial contributions to the conceptualization and development of this mini-review were made by the primary authors (SR, KB, SL, and LC). HT and JF made substantial contributions to the acquisition and synthesis of data. The manuscript was initially drafted by SR, with all authors contributing to the interpretation of results, development of the written manuscript. The final manuscript was approved by all authors.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at http://journal.frontiersin.org/article/10.3389/fpubh.2016.00187

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Why We Move: Social Mobility Behaviors of Non-Disabled and Disabled Children across Childcare Contexts

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Background: Social mobility is defined as the co-occurrence of self-directed locomotion and direct peer interaction. Social mobility is a product of dynamic child–environment interactions and thus likely to vary across contexts (e.g., classroom, gymnasium, and playground).

Purpose: The purpose of this present study was to examine differences in children's social mobility: (1) across contexts by age and (2) between non-disabled and disabled children.

Method: Participants ($n = 55$ non-disabled and three disabled children; $M_{age} = 3.1$ years, SD = 1.4) were video recorded within a university-based early learning center. Children were recorded for 20 min in each context: classroom, gymnasium, and playground. A 15-s momentary time sampling method was used to code social mobility, the simultaneous occurrence of self-directed locomotion, and direct peer interaction. This variable was calculated as percent time within each context.

Results: A planned Friedman's rank ANOVA ($n = 55$), stratified by age, indicated that older children (3–5 years old) differed across contexts in their social mobility [$\chi^2(2) \sim 7.3$–10.5, $p < 0.025$], whereas younger children (1–2 years old) were similar across contexts. Social mobility was significantly lower in the classroom compared with the playground and gymnasium (with no difference between the latter contexts) for older children. Visual analysis confirmed that disabled children ($n = 3$) engaged in substantially less time in social mobility (average 0–1%), compared with non-disabled, age-similar peers (2–3 years old average 1–12%) across all contexts.

Conclusion: A substantial gap exists between non-disabled and disabled children for social mobility. There is an increase in magnitude and variability of social mobility around age three that suggests the gap between non-disabled and disabled children will continue to widen.

Keywords: locomotion, disability, early intervention, physical activity, play behaviors

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INTRODUCTION

Development in childhood is dynamic, non-linear, and embedded within day-to-day experiences (1). The dynamic systems perspective of child development illustrates this complexity as an interaction between constraints at the individual level (e.g., body function and structure, motivation), interpersonal level (e.g., caregiver and peer social relationships, attachments), and environmental level (e.g., accessibility for exploration and engagement) (1). Another related concept that can be applied to child development is grounded cognition, which places an emphasis on an individual's engagement in perceptual-motor experiences and their formative role in children's developmental trajectory across cognitive, social, and communication domains (2). Both dynamic systems and grounded cognition illustrate how the intersection of developmental domains within children's daily life shapes and defines their health and well-being. Physical activity is one type of perceptual-motor experience that has been linked to social interactions (3).

Physical activity engagement is a dynamic and interactive experience for children (4, 5). Physical activity is defined as "…any bodily movement produced by skeletal muscles resulting in energy expenditure" [(4, 6), p. 126]. However, an alternative and multidimensional definition of physical activity that captures the social component of movement has emerged. It describes physical activity as the "individual agency of activity related to movement, in relation to energy expenditure and social engagement" (i.e., voluntary, self-directed, and purposeful exploration and play) (7, 8). A substantial gap exists between non-disabled and disabled children in frequency, duration, and intensity of physical activity (3, 9). Limited research has examined how physical activity, social interactions, and play are interrelated during early childhood (10, 11).

Emergent research has examined the relationship between physical activity and social interactions in toddlers (10). Longitudinal data have shown spikes in the development of social interactions with mothers (e.g., vocalization and gesturing) and object use following achievement of motor milestones such as crawling and walking (12–14). Delays in gross motor development are analogously predictive of less mature forms of social play and language in later childhood (11, 15, 16). This research has lent to a consensus that motor skills emerge prior to, and are positively related to the future development of social and communication skills (10, 16, 17). A critical aspect that remains unknown is the co-occurrence of these behaviors in terms of developmental trajectories using time-locked observations. This knowledge would further our understanding of how these domains intersect and influence development at the moment-to-moment level that is emphasized by dynamic systems theory and grounded cognition.

This project is an extension of the original work published by Logan et al. (3). Logan et al. (3) explored the time-locked co-occurrence of physical activity and social interactions in 2-year-old non-disabled children ($n = 23$), alongside disabled children ($n = 2$), while engaged in routine experiences within an early learning center. Physical activity was broadly defined to include trunk and limb movements and/or locomotion (i.e., moving at least three feet in any direction). Social interactions were defined to include parallel play (i.e., children within three feet of each other but not directly interacting), direct peer interaction, and direct adult interaction. Results suggest that the two disabled children engaged in less frequent and less variable physical activity and social interactions, and these behaviors were less likely to co-occur in comparison to non-disabled children. This research provides initial insight into the dynamic nature of physical activity and play behaviors and highlights potential disparities between non-disabled and disabled children that we should aim to minimize *via* intervention, assistive technology, and community design.

The current study is a follow-up to the original work of Logan et al. (3) and includes 55 non-disabled children age 1–5 years old and three disabled children. The data of 21 2-year-old non-disabled children and 2 disabled children (Child A and B) from Logan et al. (3) are included in the current study. The current study extends Logan et al. (3) in three ways. First, the current study focuses on a specific behavior termed "social mobility," defined as children's simultaneous engagement in self-directed locomotion and direct peer interaction. In the original work, the occurrence and co-occurrence of physical activity, play, and object-use behaviors were reported but social mobility behaviors were not reported. Second, the current study examines social mobility behaviors separately across three contexts of the childcare setting (classroom, gymnasium, and playground). In the original work, physical activity, play, and object-use behaviors were combined across childcare settings and were not reported separately. Third, a wider age range of non-disabled children is included (1–5 years old). In the original work, only 21 non-disabled 2-year-old children were included. The specific aim of the present study is to examine the differences in children's social mobility (1) across contexts by age and (2) between non-disabled and disabled children. It is hypothesized that the occurrence of social mobility will vary across contexts and be greater among older children. Further, it is hypothesized that disabled children will engage in social mobility less often than non-disabled children across all contexts.

MATERIALS AND METHODS

Participants

Participants included 55 non-disabled children aged 1–5 years old (M = 3.1 years, SD = 1.4 years; 29 females). There were a similar number of children within each age group: 1-year old ($n = 10$), 2-year olds ($n = 11$), 3-year olds ($n = 9$), 4-year olds ($n = 13$), and 5-year olds ($n = 12$). Participants' parents reported their ethnicities as: Caucasian (47%), African-American (39%), Asian (12%), and Middle Eastern (2%).

Participants also included three disabled children. They will be referred to as "Child A," "Child B," and "Child C" to protect their identities. Cognitive function was not measured for any participants, thus we cannot rule out a cognitive influence on each child's behaviors observed for the present study. Child A was a Caucasian girl (age = 31 months old). Her primary diagnosis was cerebral palsy (Gross Motor Function Classification System – level IV) with secondary diagnoses of microcephaly, hypotonia, and cortical vision impairment/persistent fetal vascular syndrome.

She had the ability to interact with cause-and-effect toys such as those that light up or make sounds. She could also distinguish between different types of animals and colors. Furthermore, she was able to recognize and respond to different people such as her teacher, physical therapist, and parent/caregivers. She had the ability to roll on the floor and to sit on the floor with close supervision and hands-on support but was unable to pull to stand or walk (even with use of assistive technology). She used a manual wheelchair throughout the day for her seating and positing needs but required adult assistance for propulsion. She vocalized often, but did not say words. Child A received services related to language, fine and gross motor, and cognitive skills.

Child B was an African-American boy (age = 33 months old). His primary diagnosis was developmental delay with secondary diagnoses of mild hearing loss in the left ear and epilepsy (type: electrical status epilepticus during sleep). Similar to Child A, he responded to cause-and-effect toys and had the ability to categorize objects and responded to the people with whom he interacted with on a regular basis. He also had the ability to respond to and follow instructions, although there were demonstrated behavioral issues related to self-regulation. He was able to independently sit, stand, and walk without assistance. However, his movements were ataxic, and he usually required physical and/or verbal prompts and assistance to initiate movements. He vocalized often but said few words – generally names of people or objects. Child B received services related to language and gross motor skills.

Child C was an Asian boy (age = 4.1 years old). His medical history includes diagnoses of ventricular septal defect, bilateral clubfeet, and bilateral peroneal neuropathy. At 44 months of age, he underwent surgery to treat a tethered spinal cord. He wore solid bilateral ankle foot orthoses and used forearm crutches for mobility. He walked without assistance using forearm crutches over a variety of surfaces – hallway, grass, mulch, inclines, and declines. He received physical therapy services twice weekly, and his family received consultation once per month per his individualized education plan. The focus of physical therapy was to improve trunk, upper extremity, and lower extremity strength within the context of promoting function and participation within life situations. Child C did not receive services related to language, fine motor, or cognitive skills.

Procedure

The study procedure for the current study is reported in detail elsewhere (3). Approval from the university Institutional Review Board and written parent/guardian consent was obtained prior to data collection. In brief overview, children were video recorded while attending a university-based early learning center. Each child was video recorded for 20 min while engaged in routine activities in the classroom, gymnasium, and playground (i.e., 60 min total). The three disabled children were recorded for an extended time of 60 min per context. Physical activity and social interactions were assessed *via* video analysis and direct observation measures.

Observational behavioral coding was conducted by an experienced coding team, with an 85% intra- and inter-rater agreement established for 10% of recordings *a priori* using the ratio of [agreements/(agreements + disagreements) × 100] to establish a percentage of agreement. A 15-s momentary time sampling method was used to code the occurrence of locomotion, peer interaction, and social mobility. This method includes a 5-s observation period and 10-s record period that results in four observations per minute. Each non-disabled child had approximately 240 total behavioral observations evenly divided between the classroom, gymnasium, and playground. Each disabled child had approximately 720 total behavioral observations evenly divided between the classroom, gymnasium, and playground.

Behavioral Assessment

Assessment of Locomotion

The observed system for recording physical activity in children-preschool version (18) was used to assess children's physical activity intensity level. Intensity categories included stationary/motionless, stationary with trunk and limb movement, slow-easy, moderate, and fast movement. Locomotion was defined as three steps, or the equivalent, in any direction using any modality (walking, crawling, or running), at any intensity level (slow, moderate, or fast).

Assessment of Social Interaction

The Howes Peer Play Scale (19) was used to assess play behaviors including solitary play, parallel play, peer interaction, and teacher interaction (verbal or physical). Parallel play occurred when a child is within close proximity (<3 feet) to a peer or teacher but is not directly interacting. Peer interaction includes direct verbal and/or physical interaction that is initiated by or directed toward the key child by a peer.

Assessment of Social Mobility

Social mobility was defined as the simultaneous co-occurrence of self-directed locomotion and direct peer interaction, and operationalized as percent of assessment time observed.

Planned Data Analysis

It was expected that data would violate the underlying assumptions of normality and homogeneity given developmental variability within this age group, the small sample size, and our ordinal outcome variable (percent time spent in social mobility). Thus, a planned non-parametric statistical approach is described below and was conducted using SPSS (version 22, 2013). Statistical methods are not presently available to compare individuals to the group; therefore, visual analysis was used to compare non-disabled and disabled children. This approach offers valuable insight into real-world experiences of observed behaviors between non-disabled and disabled children in their natural settings (3).

Our planned analysis to examine social mobility across contexts and age groups (aim 1) was threefold. First, Spearman's correlations (rho) were calculated to examine the association between age in years and social mobility, independent of context. Significant correlations between age in years and social mobility supported subsequent analyses conducted with data stratified by age. Second, a Friedman's analysis of variance by ranks test was conducted to examine group differences in social mobility rankings across contexts and within stratified age groups. *Post hoc* comparisons were calculated (Pairwise Wilcoxon sum rank tests). Third, a Spearman's correlation (rho) was calculated to examine the association between individual social mobility rankings across contexts relative to age-similar peers. The strength of the correlation coefficients were interpreted based on Cohen's *d* guidelines (small = $r > 0.10$; moderate = $r > 0.30$; and strong = $r > 0.50$) (20). Visual analysis of the three disabled children allowed for comparison to non-disabled children across contexts and age groups (aim 2).

RESULTS

The Shapiro–Wilks test indicated that the data significantly deviated from a normal distribution for all contexts (classroom: $W = 0.80$, $p < 0.001$; gymnasium: $W = 0.80$, $p < 0.001$; playground: $W = 0.82$, $p < 0.0001$). The normality assumption was also violated when tested within specific age sub-groups. The Levene's statistic indicated that the variance of the data for each context was significantly heterogeneous (classroom: $W = 0.80$, $p < 0.001$; gymnasium: $W = 0.80$, $p < 0.001$; playground: $W = 0.82$, $p < 0.001$). As anticipated, a non-parametric approach with stratified age groups and exclusion of disabled children from group analysis was required to address our specific aims.

On average, children spent the greatest percentage of time in social mobility within the gymnasium (M = 11.8%; SD = 13.2%), compared to the playground (M = 10.8%; SD = 12.3%) and the classroom (M = 2.2%; SD = 2.3%). Similar trends were observed when stratified by age (**Table 1**; **Figure 1**). This indicates that the average time spent engaged in social mobility varies by context, regardless of children's age.

A significant rank order Spearman's rho correlation between age and social mobility was observed within the gymnasium [r_s (54) = 0.48, $p < 0.001$] and the playground [r_s (54) = 0.55, $p < 0.001$]. A non-significant Spearman's rho correlation was observed within the classroom [r_s (54) = 0.22, $p > 0.05$]. This indicates that significant, moderate to strong relationships exist between age and social mobility in the gymnasium and the playground. Therefore, subsequent analyses were conducted using age-stratified groups.

A Friedman's analysis of variance by ranks test revealed a significant difference in rankings of children's social mobility across contexts for age groups 3, 4 and 5 years [3-year olds: X^2 (2) = 7.37, ω = 0.41, $p < 0.05$; 4-year olds: X^2 (2) = 7.84, ω = 0.30, $p < 0.05$; 5-year olds: X^2 (2) = 10.50, ω = 0.44, $p < 0.01$] (**Figure 1**). Mean rankings of 1- and 2-year olds did not differ across contexts (**Figure 1**). This indicates that older children (3- to 5-year olds) differ across context in the percentage of time spent engaged in social mobility, whereas younger children (1- and 2-year olds) tend to be similar in social mobility regardless of context.

Post hoc Pairwise Wilcoxon Sum Rank tests were conducted to examine specific differences in social mobility between contexts for older age groups 3- to 5-year olds. Our analysis revealed that social mobility in the classroom was significantly lower than in both the gymnasium and on the playground for all older children (see **Table 2**). Social mobility did not significantly differ between the playground and the gymnasium for any of the older age groups (see **Table 2**). This indicates that, among older children,

TABLE 1 | Social mobility (% time) group means, SD, SE, mean rank, and results of Friedman's Rank Test contexts by age.

Age	Context	N	Mean			Mean rank
			Mean	SD	SE	
1	Classroom	10	1.1	0.8	0.3	1.5
	Gymnasium	10	3.3	2.4	0.8	2.3
	Playground	10	2.7	2.6	0.8	2.2
						$\chi^2(2) = 3.80$, ω = 0.19, $p = 0.15$
2	Classroom	11	3.3	3.3	1.0	1.4
	Gymnasium	11	6.7	3.9	1.2	2.3
	Playground	11	6.0	4.5	1.4	2.3
						$\chi^2(2) = 5.90$, ω = 0.27, $p = 0.05$
3	Classroom	9	1.0	0.8	0.3	1.3
	Gymnasium	9	12.2	9.0	3.0	2.4
	Playground	9	8.0	7.4	2.5	2.3
						$\chi^2(2) = 7.37$, ω = 0.41, $p = 0.03$*
4	Classroom	13	2.8	2.7	0.7	1.38
	Gymnasium	13	12.9	9.6	2.7	2.23
	Playground	13	13.0	11.8	3.4	2.38
						$\chi^2(2) = 7.84$, ω = 0.30 $p = 0.02$*
5	Classroom	12	2.5	1.9	0.6	1.25
	Gymnasium	12	24.3	20.3	5.9	2.25
	Playground	12	23.7	15.7	4.5	2.50
						$\chi^2(2) = 10.50$, ω = 0.44, $p < 0.01$*
Total	Classroom	55	2.2	2.3	0.3	1.4
	Gymnasium	55	12.3	13.2	1.8	2.3
	Playground	55	11.2	12.3	1.7	2.3
						$\chi^2(2) = 34.065$, ω = 0.310, $p < 0.001$*

Not inclusive of disabled children, mean rank based on % time of individual children within given age group (Friedman's Rank Sum Test).
**Significant at an a priori alpha = 0.05.*

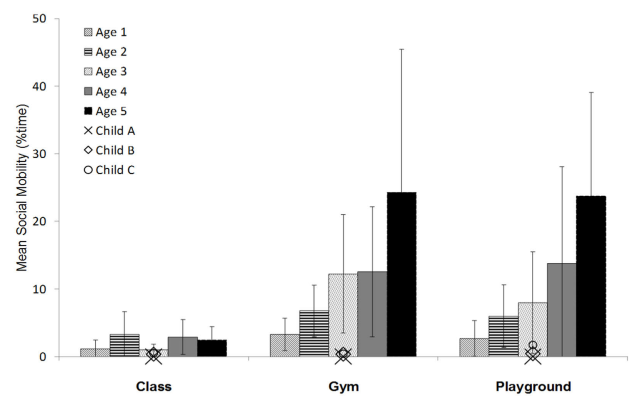

FIGURE 1 | Comparison of mean social mobility (% time) across 1- to 5-year-old age groups and contexts (classroom, gymnasium, and playground) and in relation to individual disabled children (Child A, B, and C).

TABLE 2 | Wilcoxon pairwise comparisons.

Age	Gymnasium vs. classroom	Playground vs. classroom	Playground vs. gymnasium
3	$Z = -2.497, p = 0.013$*	$Z = -2.547, p = 0.011$*	$Z = -0.866, p = 0.386$
4	$Z = -2.760, p = 0.006$*	$Z = -2.830, p = 0.005$*	$Z = 0.00, p = 1.00$
5	$Z = -2.824, p = 0.005$*	$Z = -2.903, p = 0.004$*	$Z = -0.078, p = 0.937$

**Significant at an a priori alpha = 0.05.*

social mobility engagement is similar within the gymnasium and playground, with the percent of time in social mobility in both these contexts being significantly greater than in the classroom.

The individual data points for social mobility of the three disabled children were plotted against the mean for each age group of typically developing peers (**Figure 1**). Visual analysis of this graph revealed a disparity in social mobility, regardless of context, relative to age-similar non-disabled children. However, the disabled children (aged 2–4 years) displayed trends in their variability of social mobility across contexts similar to younger peers. In other words, the individual disabled children did not differ in their time spent in social mobility between contexts, a trend consistent with 1- and 2-year-old non-disabled children (**Figure 1**). Of concern, increased social mobility in the gymnasium and on the playground was not observed for the 4-year old with a disability, as would be expected based on trends observed for age-similar peers. This indicates that disabled children may experience increasing gaps in social mobility compared to non-disabled children as they age.

DISCUSSION

The present study describes the differences in children's social mobility: (1) across contexts by age and (2) between non-disabled and disabled children. Our analysis indicated that the average social mobility within each context significantly differed by age. Older children spent a greater percent of time engaged in social mobility compared to younger peers. These results are consistent with our primary hypothesis. Additionally, younger and older children differed in the variability of social mobility across contexts. Among younger children, the time spent in social mobility was comparable in the classroom, gymnasium, and playground, whereas older children spent significantly more time engaged in social mobility within the gymnasium and playground than in the classroom. In support of our second hypothesis, disabled children engaged in less social mobility compared to non-disabled children within all contexts, with evidence that this gap increases with age.

The variability of social mobility for older, but not younger children, across contexts is consistent with expected developmental trajectories in the motor and social domains. On average, the onset of self-directed locomotion occurs between 10 and 14 months of age for non-disabled children (21). Children continue to advance in several skills within the motor domain across early childhood. Advancements from basic to more advanced cognitive and language skills similarly emerge during early childhood (17, 22). Children simultaneously advance in the quality of their self-directed movement from one place to another, their use of this self-directed locomotion for more advanced social interactions, and in maturity of their language and social skills (23). This transition is also reflected in the shift from primarily engaging in parallel play – individual play in the presence of a peer without direct interaction – that is observed among young toddlers, to interactive peer play during preschool years (3). However, comparable social mobility in the classroom between 3- and 5-year olds suggests that developmental trajectories accounts only partially for this behavior.

The observed differences across contexts for older children align with the dynamic systems and grounded cognition frameworks. Children are expected to interact dynamically with, and be influenced by contextual and intra- and interpersonal factors. For the observed children, the physical space dimensions, tasks provided, and teacher expectations in the classroom likely contributed to the reduced social mobility. Alternatively, the gymnasium and the playground share environmental similarities in terms of physical space to run and play, the presence of developmentally appropriate equipment and structures, and the opportunity to engage in tasks involving greater physical activity and verbal interaction. There also tend to be more open play and encouragement for peer interaction within these activity settings. There is a need to identify the key aspects of the environment that facilitate and hinder physical activity and social interactions to further support the development of social mobility as children age. Our results indicate the need to also consider characteristics unique to each age group in future discussions on this topic.

At an individual level, children who demonstrate high levels of social mobility are likely to move and engage more across all contexts. Disabled children, however, may engage in these behaviors less than their non-disabled peers, regardless of context. There is also an evident shift in social mobility behaviors relative to age, with younger children demonstrating less social mobility than older children. Thus, the gap between non-disabled and disabled children may continue to widen in early childhood as the normative bar is raised, and as physical play environments incorporate more complex and potentially inaccessible activities.

Limitations and Future Research

There are limitations of the current study. This study used a cross-sectional research design. This is an important first step in describing social mobility behaviors of children, yet only provides a snapshot in time regarding the individual and group differences of the social mobility behaviors of children. Future research may include the use of a longitudinal research design that will allow for the observation of the emergence and developmental trends of social mobility. Also, we did not formally assess cognition for the children in this study, so it is not clear if/how cognition impacted children's social mobility. It is possible that children with differing cognitive abilities may engage differently in social mobility. Future research can address this question by including a larger sample size of children with a variety of cognitive and physical abilities to determine how these abilities may influence the children's engagement in social mobility. Another limitation is the low sample size ($n = 3$) of disabled children. It is important to acknowledge the heterogeneity inherent in the wide range of disabilities of disabled children that were included in the current study. Results should be interpreted cautiously and without generalization to larger populations. It is difficult to conduct studies with a large sample size of disabled children in real-world settings such as early childcare centers. Further, fully inclusive practices are not well established in a majority of early childcare settings, therefore. curriculum design, teacher training and education, and environmental design may also be factors that influence social mobility for disabled children in particular (24–26). Future research may continue to examine the role of the environment, such as accessibility of play structures and toys, as well as the role of early childcare professionals to facilitate social mobility opportunities for disabled children.

CONCLUSION

In the original work of Logan et al. (3), co-occurrences of specific physical activity types and levels were reported with play behaviors, including parallel play, peer and teacher interactions. The current work reports the specific and time-locked co-occurrence of children's simultaneous engagement in self-directed locomotion and direct peer interaction. Results of the current study extend the findings of Logan et al. (3) by providing a better understanding of how locomotion specifically facilitates peer interaction, rather than play behaviors at a broad level. The findings from this study suggest that children's individual social mobility differs by context. Specifically, a child's social mobility level in the classroom is distinctly different from their engagement level within settings that are less guided by adults and that allow for increased movement, vocalization, and play, such as the gymnasium or playground. Further, disabled children display less social mobility behaviors, regardless of context, when compared to non-disabled children. The gap in participation between these groups is expected to increase with time. Future studies are needed to examine the impact of social mobility on future health and developmental outcomes, as well as to examine the environments and interactions, external to the child, that influence these behaviors. The long-term goal is to identify mechanisms that facilitate the development of motor and social skills among children, enhance movement and social interactions, improve inclusive practices and accessible environmental designs, and ultimately reduce the gap in participation between non-disabled and disabled children.

AUTHOR CONTRIBUTIONS

SL, JG, and MS contributed significantly to the conceptualization and development of this research. JG oversaw the project, with SL and MS serving as leads for collection and behavioral coding analysis. SR conducted statistical analysis and led the writing of this manuscript. All authors contributed significantly to the writing and development of this manuscript.

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Effect of the Children's Health Activity Motor Program on Motor Skills and Self-Regulation in Head Start Preschoolers: An Efficacy Trial

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Self-regulatory skills are broadly defined as the ability to manage emotions, focus attention, and inhibit some behaviors while activating others in accordance with social expectations and are an established indicator of academic success. Growing evidence links motor skills and physical activity to self-regulation. This study examined the efficacy of a motor skills intervention (i.e., the Children's Health Activity Motor Program, CHAMP) that is theoretically grounded in Achievement Goal Theory on motor skill performance and self-regulation in Head Start preschoolers. A sample of 113 Head Start preschoolers ($M_{age} = 51.91 \pm 6.5$ months; 49.5% males) were randomly assigned to a treatment ($n = 68$) or control ($n = 45$) program. CHAMP participants engaged in 15, 40-min sessions of a mastery climate intervention that focused on the development of motor skills over 5 weeks while control participants engaged in their normal outdoor recess period. The Delay of Gratification Snack Task was used to measure self-regulation and the Test of Gross Motor Development-2nd Edition was used to assess motor skills. All measures were assessed prior to and following the intervention. Linear mixed models were fit for both self-regulation and motor skills. Results revealed a significant time × treatment interaction ($p < 0.001$). In regard to motor skills, *post hoc* comparisons found that all children improved their motor skills ($p < 0.05$), but the CHAMP group improved significantly more than the control group ($p < 0.001$). Children in CHAMP maintained their self-regulation scores across time, while children in the control group scored significantly lower than the CHAMP group at the posttest ($p < 0.05$). CHAMP is a mastery climate movement program that enhance skills associated with healthy development in children (i.e., motor skills and self-regulation). This efficacy trial provided evidence that CHAMP helped maintain delay of gratification in preschool age children and significantly improved motor skills while participating in outdoor recess was not effective. CHAMP could help contribute to children's learning-related skills and physical development and subsequently to their academic success.

Keywords: intervention, motor skills, motor, school readiness, delay of gratification

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INTRODUCTION

Head Start is the largest federally sponsored early childhood education program in the United States and historically was developed to reduce socioeconomic disparities in school readiness (1). Currently, the percentage of children living in poverty has increased in the United States (2), and conditions associated with living in poverty (e.g., lack of desirable housing, family stress, and exposure to community violence) significantly contribute to poor school adjustment (3). Statistics also suggest that a growing percentage of American children, mainly those from families living in poverty, enter kindergarten lacking the skills (e.g., low self-regulatory skills) necessary for school success (4). These children are unprepared for the behavioral and learning demands of the classroom, and often experience poor academic outcomes that contribute to grade retention, early school dropout, and conflictual relationships with peers and teachers (5). Educational programs or interventions that target specific competencies, like self-regulatory skills, could positively influence school readiness outcomes in preschoolers (6). There is a need to support high-quality early childhood experiences or interventions that could contribute to school readiness, especially for children in low-income families (7).

Although self-regulation appears to be critical in predicting a range of outcomes, research in this area has been somewhat constrained by inconsistencies in how self-regulation has been defined. In general, self-regulation refers to the voluntary control of attentional, emotional, and behavioral impulses in accordance with a long-term goal (8, 9). Specifically, self-regulation measures a child's ability to sustain his/her concentration and behavioral control while engaging in challenging tasks. More recently, self-regulation has been described as two distinct but related processes, including cognitive skills that facilitate working memory, response inhibition, planning, and attention shifting (i.e., executive functions) and behavioral skills that predispose individuals to more impulsive and immediately rewarding behaviors, including reactive under-control, sensation seeking, and delay of gratification (10). There is also some evidence to suggest that while young children possess all of these cognitive and behavioral skills, the skills act in a unified manner during early childhood and do not differentiate into distinct processes until later in childhood (11). Regardless of the exact definition used, self-regulation involves weighing a more appropriate response that typically aligns with an individual's long-term goals against a more gratifying response that provides immediate satisfaction (12). Self-regulation has been shown to predict better school outcomes in preschool and elementary school (13), secondary school (14), and college (15). There is also a growing body of work linking self-regulation in childhood with health behaviors and health outcomes later in life (16–19). Evidence supports that children growing up in poverty and ethnic minority children, typically exhibit lower inhibitory control and delayed gratification along with increased problems associated with attention and working memory (20, 21). Thus, efforts to support the development of self-regulation skills for these children are particularly critical.

Self-regulatory skills develop rapidly between the ages of 2 and 5 years, as children enter preschool settings (22). Teachers consistently report that children are not entering kindergarten with the basic social–emotional skills needed to learn (4). As a result, efforts to design and test theoretically driven classroom- or curriculum-based programs that enhance these skills have increased dramatically in the past decade. The Chicago School Readiness Project (CSRP) targeted Head Start teachers' classroom management behaviors and was effective in improving attention, impulse control, and executive function of preschoolers. Improvements were associated with better kindergarten readiness skills, including improved reading and mathematic skills as well as reduced behavior problems (6, 23). Programs that target self-regulation skills have also been found to lead to better health outcomes including weight loss maintenance (24) and healthier food choices (25) among youth.

Although there is evidence supporting the notion that self-regulation can be improved through interventions, very little research has examined this from a movement perspective. The body and brain work harmoniously together to understand and interpret the world around us, and the preschool years represent a period of rapid growth and development in both cognitive and motor skills. A recent systematic review found a weak-to-strong relationship between processes associated with self-regulation (i.e., cognitive skills) and motor skills in pediatric populations (26). Diamond (27) also concluded that preschoolers' motor and cognitive skills are related in early learning and development. For instance, Becker et al. (28) found that young children's fine motor skills were related to executive function (e.g., inhibitory control and working memory) and behavioral self-regulation (e.g., Head–Toes–Knees–Shoulders task). This finding supports a connection between motor skills and self-regulation that provides a strong rationale for using movement-based interventions to positively change self-regulation.

Lakes and Hoyt (29) found that compared to traditional Physical Education, a Tae Kwon Do approach lead to better self-regulation outcomes (working memory and inhibitory control) in elementary students. Palmer and colleagues (30) found that compared to a 30-min sedentary activity, an acute 30-min movement and physical activity-based intervention resulted in preschoolers demonstrating better sustained attention. These findings are promising and support that at least some aspects of self-regulation are malleable and can be enhanced through movement-based interventions.

This efficacy trial investigated the effect of an mastery climate motor skill intervention, the Children's Health Activity Motor Program (CHAMP), on motor skill performance and self-regulation in Head Start preschoolers. We had two research questions: (a) does participation in CHAMP lead to greater gains in preschoolers' motor skills? and (b) does participation in CHAMP lead to improvements or maintenance in preschoolers' self-regulation? Based on research documenting the effectiveness of mastery climate motor skill interventions in children (31–33), we hypothesized that children in CHAMP would demonstrate significantly greater gains in motor skills over preschoolers in the control group. In regard to the second research question, we expected that children in CHAMP would exhibit improvements or maintenance in self-regulation over preschoolers in the control group. This hypothesis is based on research documenting the effectiveness of broader interventions that target self-regulation in children (34–36).

MATERIALS AND METHODS

Participants and Settings

All participants were from a single Head Start center in the southeastern United States ($N = 113$, 45 girls, $M_{age} = 52.4 \pm 5.2$ months; 80.5% African-American, 8.8% Caucasian American, 7.2% Hispanic, and 3.5% other). Children were divided into two groups: control/no treatment ($n = 45$, 18 girls, $M_{age} = 51.6 \pm 5.2$ months) or an intervention group ($n = 68$, 27 girls, $M_{age} = 52.4 \pm 5.2$ months). All children completed the motor skills assessment, and only a subsample completed the delay of gratification task ($n = 65$, 26 girls, $M_{age} = 52.4 \pm 5.3$ months; 20 control, 45 treatment).

Motor Skills

Motor skills were assessed with the Test of Gross Motor Development-2nd Edition [TGMD-2; (37)]. The TGMD-2 is a criterion- and norm-referenced standardized assessment used to measure fundamental motor skills in children aged 3–10 years old. The TGMD-2 assesses two broad categories of motor skills: locomotor skills – ability to propel the body through space and object control skills – ability to propel or manipulate objects with the hands and feet. The six locomotor skills assessed are run, jump, leap, hop, gallop, and slide; the six object control skills are throw, strike off a tee, catch, kick, roll, and dribble. For each skill, three to five performance skill criteria are measured. For example, one performance criterion for running was that "arms move in opposition to legs, elbows bent." A "1" is awarded if the performance criteria is successfully completed, and a "0" is awarded it the performance criteria is not successfully completed. The highest total raw score a child can receive is a 96 (i.e., a maximum of 48 for both the locomotor and object control skill components). A higher score represents higher motor skill performance, whereas lower score indicates the absence of critical elements (i.e., lower motor skill performance). When testing, children are given a visual demonstration of a skill execution that includes all skill criteria followed by one practice trial and two test trials for each skill. All TGMD-2 test trials were video recorded and later coded by a single coder blind to the study. The coder had previously established inter-rater reliability of 97%. Mean test–retest reliability coefficients for the TGMD-2 subscales are 0.96 (locomotor) and 0.97 (object control).

Self-Regulation

The delay of gratification snack task of the Preschool Self-Regulation Assessment was used to measure self-regulation (38). Delay of gratification is resisting a smaller more immediate reward in order to receive a larger reward later and is related to patience, impulse control, self-control, and willpower. For the delay of gratification snack task, children are instructed to keep their hands flat on the table. The researcher places a single snack object (i.e., goldfish cracker) under a clear cup in front of the child. The child is instructed to wait for the researcher's cue before picking up the snack and placing it in another cup to save for later. This task is repeated four times using different delay periods – 10, 20, 30, and 15 s. Each time the child is given a numerical score based on their behaviors during the delay period: eats treat (1), touches treat (2), touches cup/timer (3), and waits for researcher's cue before touching the snack (4). Snack task score ranges from 1 to 4, with higher score denoting better delaying capacity. The average scale score across all four delay periods was used in the final analyses.

Children's Health Activity Motor Program

CHAMP is a mastery focused, evidence-based intervention that enhances motor skills (31–33), perceived physical competence (33, 39), and physical activity (40). CHAMP is grounded in Achievement Goal Theory (41–45) and adheres to the TARGET structures [*t*ask, *a*uthority, *r*ecognition, *g*rouping, *e*valuation, and *t*ime; (41, 46), **Table 1**]. Achievement Goal Theory refers to our beliefs, attributions, and affect that contribute to our behaviors and represents the way individuals approach, engage, and respond to educational- and classroom-based activities (41, 43). Achievement goals are either *mastery-(task-)* or *performance-(ego-)oriented* (41, 44). Mastery learners are driven to learn and develop new skills, try to understand their work, improve their level of competence, and achieve a sense of mastery based on self-referenced standards. Performance learners focus their abilities and sense of self-worth on doing better than others, public recognition, surpassing normative-based standards, and achieving success with little effort.

In a learning environment, achievement goals create an instructional climate (environment) that results in cognitive processes having "cognitive, affective, and behavioral consequences" [Ref. (47), p. 11]. Mastery-goal classrooms are associated with positive educational and achievement outcomes, like more effort contributes to success (48, 49); intrinsic interest and time on learning activities (50–52); positive attitudes toward learning (48, 51); and persistence in the face of difficulty (47). Mastery climates contribute to active engagement in the classroom that is characterized by the application of effective learning and problem solving strategies that could potentially enhance self-regulation. Self-regulation involves a child's ability to self-monitor and self-correct their actions in behavior, motivation, and cognition (53). Thus, it is possible that self-regulation could be enhanced when children engage in mastery-oriented climates. These climates allow individuals to make their own decisions relating to learning tasks, to create goals and strategies, and to implement actions to meet goals within a learning context while managing their emotions, focusing their attention, and planning their actions.

CHAMP uses as mastery climate approach to provide children the opportunity to navigate a developmentally appropriate movement environment (32, 33, 41, 42). CHAMP is an evidence-based program that draws on effective instructional pedagogies from the physical education literature and principles that focus on critical elements and cue words of motor skills, effective modeling and demonstration, continuous and appropriate feedback, and repetitive cycling of motor skills and tasks. Newell's constraints model is used to appropriately scaffold motor skills to promote motor

TABLE 1 | Description of TARGET structures and CHAMP application.

TARGET description	CHAMP alignment to TARGET structures	CHAMP link to self-regulation
Task: focuses on the presentation of the learning activities and tasks	• A "slanted rope effect" is used to provide variety of tasks that range in level of difficulty to meet the skill level and ability of the learner along with their needs and interests of the learner	• Learners self-select from a range of movement task and activities that vary in difficulty (low, moderate, and hard) (*SR skills = create goals and strategies, implement actions, plan actions and make decisions, self-manage behavior, self-monitor behavior, self-correct behavior*)
Authority: focuses on the interaction of the children and teacher within the learning environment with special consideration in classroom decision making	• Authority or the "decision-making process" is fostered by allowing children to actively participate in choices and decisions that relate to learning	• Learners are intrinsically driven to actively engage in environments that give them the opportunity to make decisions • Learners have to self-manage and continually self-monitor their behaviors (*SR skills = create goals and strategies, plan actions and make decisions, self-monitor behavior, self-correct behaviors, manage emotions, understand and appropriately navigate social environments*)
Recognition: focuses on informal and formal rewards, incentives, and praise that are used and distributed by teachers to facilitate motivation	• Avoid social comparison • Recognize individual progress and improvement • Recognition is private, the child's sense of pride and satisfaction is derived from doing his/her best and not from outperforming others	• Learners are encouraged to self-evaluate their own performance (*SR skills = self-monitor behaviors, self-reflection of progress*)
Grouping: focuses on grouping patterns	• Children are not grouped, but will be given the opportunity to move freely and independently within the environment • Allow the formation of heterogeneous cooperative groups that foster peer interaction (i.e., groups form and break up based on the individual desires of the child)	• Learners self-select the people they engage with giving them the ability to self-govern their learning experience (*SR skills = plan actions and make decisions, self-monitor behavior, self-correct behaviors, manage emotions, understand and appropriately navigate social environments, collaborative efforts*)
Evaluation: focuses on methods that are used to assess, monitor, judge, and measure children's behavior and learning	• Evaluation and feedback are based on individual progress and improvement along with the process of learning movement rather than the product • Involve children in self-evaluation • Make evaluation private and meaningful	• Learners are encourage to self-evaluate their own performance (*SR skills = working memory, self-monitor behaviors, self-reflection of progress, manage emotions, inhibition*)
Time: focuses on the workload, pace of instruction, and time allotment for children to complete learning activities and assignments	• Teacher facilitates a learning experience that is tailored to the needs for the child • Individualize instruction • No set time allocated (e.g., schedule flexibility and vary pace of learning)	• Child is allowed to self-direct their own learning (*SR skills = plan actions and make decisions, self-monitor behavior, self-correct behaviors, manage emotions*)

skill acquisition (54). CHAMP targets children's intrinsic motivation and persistence. Three theoretical tenets of Achievement Goal Theory are crucial to CHAMP: (a) the relationship between effort and personal progress, (b) learners' self-selection of tasks, and (c) the environmental climate [Ref. (41, 42, 46); see **Table 1** for a more detailed description of the alignment of these tenets with the TARGET structures, Ref. (55)].

CHAMP was implemented by two trained instructors in motor development – one Ph.D. researcher with 10 years of experience with implementing high-autonomy movement programs in pre- and elementary school settings and one Ph.D. student with 2 years of experience. Each session was 40 min in duration and consisted of (a) 2-min warm up designed to increase the heart and respiration rate, (b) 3–4 min of introductory activities where the motor skills were demonstrated, modeled, and the critical elements/cue words were instructed to the learners, (c) 20–25 min of motor skill engagement that adheres to the TARGET structures, (d) 5–7 min a large group activity that focused on reinforcing motor skills and increasing heart rate, and (e) 2–3 min of a closure activity that reinforced the critical elements and cue words of the motor tasks. For a more detailed description of the CHAMP intervention, refer to Ref. (31–33, 40).

Procedures

Prior to the start of data collection, all experimental procedures were approved by the Office of Human Research Compliance Committee for Institutional Review Boards (IRBs) for the Protection of Human Subjects in Research – Social and Behavioral Research section. Parental consent was first obtained on all children, which was followed by child assent. Children were then randomly assigned to either a CHAMP treatment or control (outdoor/free-play recess) condition. Children in the CHAMP group replaced their outdoor recess with CHAMP 3 days/week for 5 weeks, and children in the control group did not make any changes in their daily routine. The control condition was the preschool's typical movement program (i.e., outdoor/free-play recess) and was implemented according to the existing procedures within the preschool center. The center's outdoor program consist of outdoor free-play activity on a large playground area with a variety of play structures (e.g., swings, slides, and ladders) that promote gross movement and activity in preschoolers. All movement sessions were 40 min in duration. The total dose of the CHAMP intervention was 15, 40-min sessions = 600 min. All children completed the delay gratification snack task and TGMD-2 prior to the start (pre) and after (post) the intervention.

Statistical Analyses

Descriptive statistics (means and SDs) were obtained for delay of gratification and motor skills in both treatment groups. To mitigate potential statistical errors due to differences in sample sizes, main effects of time and treatment and potential time × treatment interactions were explored using linear mixed models. Separate linear mixed models were fit to determine changes in delay of gratification snack task and motor skills. Because of the autonomy supportive nature of the CHAMP intervention, the original model included only total TGMD-2 raw scores and secondary models were conducted for both locomotor and object control skill raw scores. Significant main effects and interactions were explored using *post hoc* paired or independent samples t-tests. All analyses were conducted in SPSS v.22. Alpha levels were set to 0.05 *a priori*.

RESULTS

Motor Skills

Pre- and post-motor skills assessments were measured on 113 children (68 CHAMP and 45 control). See **Table 2** for full descriptive statistics.

Main Effects

The linear mixed model fit for total TGMD-2 scores revealed a significant main effect of time [$F_{(1,111)} = 278.34$, $p < 0.001$] and treatment [$F_{(1,111)} = 55.45$, $p < 0.001$] as well as a significant time × treatment interaction [$F_{(1,111)} = 129.35$, $p < 0.001$; see **Figure 1**]. The secondary analysis for locomotor and object control skills found similar main effects of time [$F_{(1,110.8)} = 245.22$, $p < 0.001$ and $F_{(1,111.17)} = 249.14$, $p < 0.001$, respectively], treatment [$F_{(1,111.3)} = 58.52$, $p < 0.001$ and $F_{(1,111.5)} = 40.1$, $p < 0.001$, respectively], and time × treatment interaction [$F_{(1,110.8)} = 145.22$, $p < 0.001$ and $F_{(1,111.17)} = 81.58$, $p < 0.001$, respectively; see **Figure 1**]. Independent t-tests were used to explore simple effects of treatment, and paired sample t-tests were used to explore simple effects of time.

Simple Effects

Treatment

There were no significant between group differences at pretest in regard to total TGMD-2 scores [17.00 ± 9.87 vs. 17.69 ± 9.78, $t_{(111)} = -0.37$, $p = 0.72$], locomotor scores [8.20 ± 5.56 vs. 8.71 ± 5.38, $t_{(111)} = -0.36$, $p = 0.72$], or object control scores [8.68 ± 5.64 vs. 8.98 ± 5.58, $t_{(111)} = -0.30$, $p = 0.77$]. At posttest, the treatment group had significantly higher total scores [25.01 ± 16.48 vs. 60.19 ± 19.69, $t_{(111)} = 9.90$, $p < 0.001$, $d = 1.94$], locomotor scores [10.93 ± 6.62 vs. 29.12 ± 10.07, $t_{(110)} = 10.58$, $p < 0.001$, $d = 2.13$], and object control scores [14.68 ± 10.32 vs. 31.07 ± 10.27, $t_{(111)} = 8.23$, $p < 0.001$, $d = 1.59$].

Time

The control group exhibited significant improvements from pre- to posttest in total TGMD-2 scores [17.00 ± 9.87 to 25.01 ± 16.48, $t_{(44)} = 3.35$, $p < 0.01$, $d = 0.61$], locomotor [8.20 ± 5.56 to 10.93 ± 6.62, $t_{(43)} = 2.55$, $p < 0.05$, $d = 0.45$], and object control skills [8.68 ± 5.64 to 14.68 ± 10.32, $t_{(43)} = 4.06$, $p < 0.001$, $d = 0.75$]. The CHAMP group also showed significant improvements from pre- to posttest in total TGMD-2 scores [17.69 ± 9.78 to 60.19 ± 19.69, $t_{(67)} = 22.55$, $p < 0.001$, $d = 2.88$], locomotor [8.71 ± 5.38 to 29.12 ± 10.07, $t_{(67)} = 21.17$, $p < 0.001$, $d = 2.64$], and object control skills scores [8.98 ± 5.58 to 31.07 ± 10.27, $t_{(67)} = 20.59$, $p < 0.001$, $d = 2.79$].

Total Change

To determine total changes in motor skills across time, a change score was calculate by subtracting the pre- from the posttest for the total TGMD-2, locomotor, and object control scores (see **Figure 2**). Independent samples t-tests were conducted to determine if differences in motor skill changes were present between groups (i.e., CHAMP vs. control). Results showed that children in the control group did not improve as much as children in the CHAMP group in total TGMD-2 [8.71 ± 16.10 vs. 42.50 ± 15.54, $t_{(111)} = -11.37$, $p < 0.001$, $d = 2.14$], locomotor [2.73 ± 7.10 vs. 20.41 ± 7.95, $t_{(110)} = -11.98$, $p < 0.001$, $d = 2.35$], and object control scores [6.00 ± 9.81 to 22.09 ± 8.85, $t_{(110)} = -9.01$, $p < 0.001$, $d = 1.72$].

Self-Regulation

A total of 45 (17 girls and 28 boys, $M_{age} = 52.4 \pm 5.3$ months) children in CHAMP and 20 children in the control (9 girls and 11 boys, $M_{age} = 52.5 \pm 5.3$ months) completed both the pre- and posttest delay of gratification task. See **Table 3** for full descriptive statistics.

Main Effects

The linear mixed model revealed a main effect of treatment where the control group demonstrated significantly lower delay of gratification scores compared to the treatment group [−0.72, $t_{(65.76)} = -4.03$, $p < 0.001$]. The model also found a significant treatment × time interaction [0.49, $t_{(65.76)} = 2.31$, $p < 0.05$; see **Figure 3**]. The model did not find a significant main effect of time.

TABLE 2 | Full descriptive statistics for motor skills.

	CHAMP (n = 68)			Control (n = 45)		
	Total	Locomotor	Object control	Total	Locomotor	Object control
Pre	17.69 (9.78)	8.71 (5.38)	8.98 (5.58)	17.00 (9.87)	8.20 (5.56)	8.68 (5.64)
Post	60.19 (19.69)	29.12 (10.07)	31.07 (10.27)	25.01 (16.48)	10.93 (6.62)	14.68 (10.32)
Difference	42.50 (15.54)	20.41 (7.95)	22.09 (8.85)	8.71 (16.10)	2.73 (7.10)	6.00 (9.81)

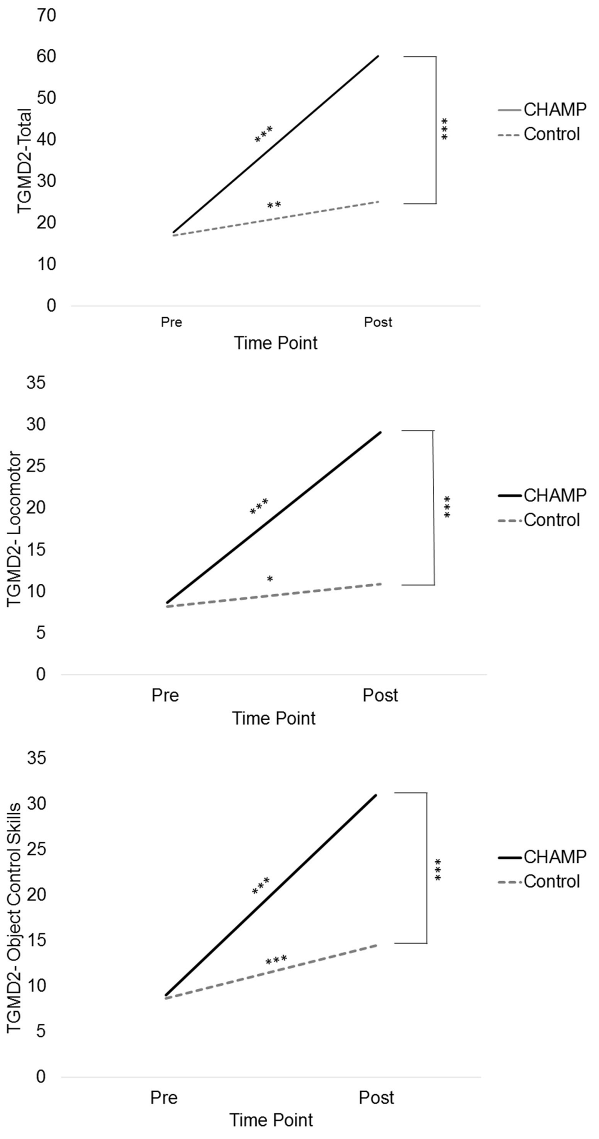
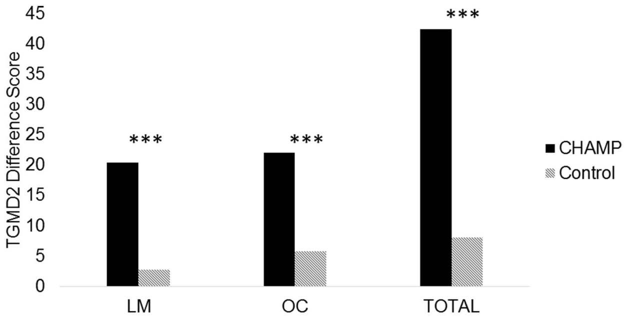


FIGURE 1 | **Total, locomotor, and object control skill scores across time according to treatment group**.



Note: ***, $p<.001$

FIGURE 2 | **Differences between groups in motor skills change scores**.

TABLE 3 | **Full descriptive statistics for delay of gratification.**

	CHAMP ($n = 45$)	Control ($n = 22$)
Pre	3.80 (0.38)	3.57 (0.66)
Post	3.79 (0.49)	3.08 (1.29)

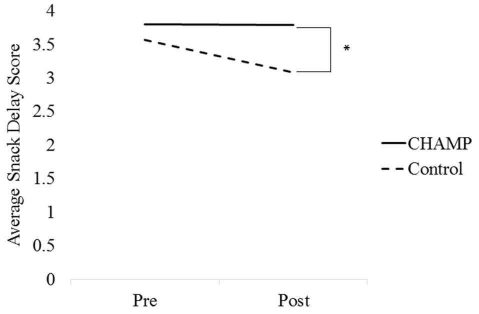


FIGURE 3 | **Delay of gratification scores across time according to treatment group**.

Simple Effects

Post hoc t-tests revealed that at the pretest there were no significant differences between the treatment and control groups [3.80 ± 0.38 vs. 3.57 ± 0.66, $t_{(27.74)} = -1.50$, $p > 0.05$] but significant differences were present at posttest [3.79 ± 0.49 vs. 3.08 ± 1.29, $t_{(21.45)} = -2.41$, $p < 0.05$, $d = 0.73$].

DISCUSSION

The present study focused on the effects of a mastery climate movement program, CHAMP that has been shown to promote motor skills, perceived motor competence, and physical activity in young children (31–33, 39, 40). This intervention efficacy trial tested the treatment effects of preschoolers' participation in CHAMP or outdoor recess/free-play (control) on motor skill performance and self-regulation skills. Significant treatment effects were found for both motor skills and self-regulation scores. Specifically, children in CHAMP demonstrated significantly greater motor skill performance and also maintained high self-regulation scores compared with the control.

CHAMP and Motor Skills Outcomes

Motor skills are necessary for children to independently navigate their environment (32, 33, 56) and are the foundation for more complex movement (57, 58). Motor skills have an essential role in supporting positive developmental trajectories of health (58). Despite the fact that motor skills support healthy development, the inclusion and instruction of motor skills in early childhood programs are often non-existent. However, findings from previous work have shown that developmentally appropriate and well-designed movement programs are effective in promoting motor skills (31, 32, 59). Further evidence also supports that children who receive no formalized instruction demonstrate no improvements in these skills (31, 32, 59).

Our first hypothesis aligned with the previous literature (31, 32, 59). Specifically, we found that all children significantly improved their motor skills across time but the greatest gains were seen in children who completed CHAMP. CHAMP participants demonstrated a ~42 points improvement in TGMD-2 raw scores while control participants only exhibited an ~8 point improvement. This is a difference of 34 points. As a reminder, the children demonstrated similarly motor skills at pretest and differences were only present following the intervention – CHAMP participants exhibited motor skills at the 76th%tile, while the control group was at the 10th%tile. These findings support that motor skills are not naturally occurring behaviors but are skills that need to be taught, practiced, and reinforced with high-quality instruction and feedback.

CHAMP and Self-Regulation Outcomes

Self-regulatory skills are also important and aid in healthy child development. These skills allow individuals to monitor and control their behavior, emotions, or thoughts and alter them based on the demands of the current situation. Research supports that these skills predict school success and achievement (60). With self-regulation occurring during the early childhood years, there is a need for effective intervention programs. The theoretical foundation and implementation structure of the CHAMP intervention aligns with both cognitive and behavioral components of self-regulation, making it a potential avenue to simultaneously enhance self-regulation and health outcomes in this population.

We predicted that the CHAMP participants would exhibit greater gains or maintenance in self-regulation over preschoolers in the control group. The children began the intervention with similar scores on the delay of gratification snack task, but our findings indicate that the control group scored significantly lower than CHAMP participants after the intervention. These findings provide great promise as it relates to the potential use of CHAMP to maintain self-regulation in preschoolers. In this current efficacy trial, it was difficult for the preschoolers' delay of gratification scores to increase since they scored close to the maximum at pretest (i.e., ~3.8 out of 4.0). However, the CHAMP participants self-regulation (i.e., delaying capacity) was maintained across the 5-week period. The TARGET structures that were manipulated within CHAMP to create a mastery climate appear to support self-regulatory skills. For example, students were given authority and responsibility to decide how they engaged in the movement environment as it related to the task activities they chose, level of difficulty, time allotment (time management), and grouping (peer interaction). They also had to self-evaluate their own progress/performance and self-manage their behavior (**Table 1** provides a detailed description of the TARGET structure and alignment with CHAMP and self-regulation). These behaviors align with the behavioral regulation (i.e., inhibition of an immediate, impulse control, and inappropriate behavior) skills that are necessary to complete the delay of gratification task.

There could be several reasons why we did not see an increase in self-regulation scores in the current study. Lakes and Hoyt (29) used a Tae Kwon Do treatment during physical education to promote self-regulation in K – 5th graders and found positive improvements in working memory and inhibitory control. The intervention dose was a total of 1080 min (26, 45 min sessions over 3 months) compared to the CHAMP treatment that was 600 min (15, 40-min sessions over 5 weeks). Other early childhood intervention studies that are not movement-based have also seen benefits from a treatment with a larger dose (61, 62). To the best of our knowledge, this is the first movement-based intervention that addressed this question in preschoolers. Future work examining the impact of movement-based interventions to promote self-regulation outcomes is needed. The CHAMP intervention appeared to be effective in maintaining self-regulation which was a positive finding, but the sample size could have also been another limiting factor.

Limitations and Future Research

Although the present study supports the preliminary efficacy of a mastery-based movement program, CHAMP, on motor skill performance and self-regulation in preschool age children, there are some limitations. One limitation of this study was that only one measure, delay of gratification snack task, was used to assess self-regulation in the preschoolers. In an ideal experiment, a combination of direct measures, teacher reports, and classroom observations would be used to provide a comprehensive understanding of children's self-regulation skills. Due to the fact that this was an efficacy trial, it was not feasible but future work should incorporate a board range of assessments. Additionally, various constraints within the preschool schedule (e.g., field trip, weather closures, and delays), we were unable to conduct pretest delay of gratification assessments on all of the children which contributed to the smaller sample size. This was beyond our control and a limitation of the efficacy trial.

One may argue that an outdoor recess (free-play) is not a true control. But, it is quite difficult to withhold the standard practice in an early childhood programs when the intervention is a movement program. There is a vast amount of evidence from the motor development literature that clearly establishes the use of outdoor recess (free-play) as control group for intervention studies due to the fact that children in these groups see no improvements in this motor skills (31, 32, 59), physical competence (33, 39), or physical activity participation (40). In this efficacy trial, the control participants (i.e., outdoor recess/free-play) demonstrated a significant decline in self-regulation when everything in their preschool day was held consistent to their CHAMP counterparts. Therefore, we assume that the mastery climate, CHAMP intervention was a determining factoring that positively affected the children's delayed of gratification.

Future studies should also consider other aspects of the interventions that could also affect children's self-regulation. For this efficacy trial, no data were assessed on the classroom and home environment. Information regarding the classroom teachers, classroom environment, parenting style, and home environment would have been useful, since these factors have a significance influence on the development of children's self-regulation (63).

Practical Implications and Conclusions

There is a growing priority to promote motor skill competence in children as it contributes to positive health trajectories (57, 58). CHAMP delivers a high-quality movement program in a mastery climate environment. CHAMP is an evidence-based intervention that enhances motor skills, perceived motor competence, and physical activity in children (31–33, 39, 40). This efficacy trial provides evidence that CHAMP also aids in maintaining a key competency that is associated with school readiness outcomes in preschoolers' (i.e., delay of gratification). The present study has the potential to shape and inform preschool curricula as a means of integrating movement education and school readiness that will help preschoolers enter school healthy, activity, and ready to learn.

AUTHOR CONTRIBUTIONS

LR conceptualized and designed the study. LR and KP implemented the intervention and data acquisition. LR and KP completed data analyses and interpretation. LR, KP, and KB contributed to the writing of the manuscript. LR, KP, and KB agreed with manuscript results and conclusions. All authors reviewed, made critical revisions, and approved of the final manuscript.

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Autism Spectrum Disorder Updates – Relevant Information for Early Interventionists to Consider

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Autism spectrum disorder (ASD) is a pervasive developmental disorder characterized by deficits in social communication skills as well as repetitive, restricted or stereotyped behaviors (1). Early interventionists are often found at the forefront of assessment, evaluation, and early intervention services for children with ASD. The role of an early intervention specialist may include assessing developmental history, providing group and individual counseling, working in partnership with families on home, school, and community environments, mobilizing school and community resources, and assisting in the development of positive early intervention strategies (2, 3). The commonality among these roles resides in the importance of providing up-to-date, relevant information to families and children. The purpose of this review is to provide pertinent up-to-date knowledge for early interventionists to help inform practice in working with individuals with ASD, including common behavioral models of intervention.

Keywords: ASD, early intervention

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Public awareness about autism spectrum disorder (henceforth autism or ASD) is growing rapidly as prevalence statistics estimate that 1 in 64 children are diagnosed with autism (4). This means more than a 10-fold increase in prevalence since the 1980s (5). With ASD rates climbing across racial, ethnic, and socio-economic groups, ASD continues to hold the public's attention as the most common childhood neurodevelopmental disorder (6). Fortunately, up-to-date research is at our fingertips, as the field refines its knowledge about ASD, it is imperative for early interventionists to stay informed about the most current information and best practices, as they relate to early intervention. The purpose of this review is to provide pertinent up-to-date knowledge for clinicians to help inform practice about early intervention and related knowledge.

Autism spectrum disorder is a complex neurodevelopmental disorder that typically presents during toddlerhood (7, 8). The hallmark characteristics of ASD are deficits in social communication skills as well as repetitive, restricted, or stereotypical behavior (1). For example, children with ASD may have difficulty with reciprocal social interaction, joint attention, social initiations, gestures, using body language for non-verbal communication, appropriate facial expressions and eye contact (9, 10). Individuals with ASD may also display repetitive and restricted behaviors. These behaviors are broad but might look like a preoccupation with a specific interest, adherence to a specific routine and repetitive non-functional movements (11). For example, in young children, hand-flapping (stereotypical behavior) or lining up toys (repetitive/restrictive behavior) would characterize such behaviors. In older children with ASD, a preoccupation with a particular television show, animal, or topic of interest would be considered a restrictive behavior. Although we all have our own unique interests, in this context the preoccupation characteristically restricts the child from traditional social interactions, and interrupts daily living routines. For example, it might be difficult to have a conversation without the child bringing the conversation back to their own preoccupied interest or, when a child is hand-flapping he or she may not be focused on learning the task at hand.

The previous iteration of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (12), used pervasive developmental disorder (PDD) as the umbrella term for five unique diagnoses – autistic disorder, Asperger's disorder, Rett's disorder, childhood disintegrative disorder (CDD), and PDD – Not Otherwise Specified (PDD-NOS), all of which share deficits in social communication skills as well as a limited range of repetitive or stereotyped activities and interests. The most current edition of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (1) is more focused on one diagnosis of ASD – this restructure from previous iterations of the DSM was focused on commonalities of the unique diagnoses mentioned above (1, 13). Although DSM-IV terminology lingers (e.g., Asperger's syndrome), it is important to consider the new diagnostic criteria in practice. In other words, similarities in respect to the core characteristics of ASD are routed in early intervention services, yet these characteristics will differ significantly by each individual.

Other comorbid disorders commonly associated with ASD may include, Attention Deficit Hyperactivity Disorder (hyperactivity, short attention span, impulsivity), aggressive behaviors, tantrums, self-injury, chronic sleep problems, atypical eating patterns, over-responsiveness or under-responsiveness to sensory stimulation, and affective difficulties (depression, anxiety) (14). Although these behaviors are common, they are not exclusive to individuals with ASD, nor are they necessary for a diagnosis of ASD.

ETIOLOGY

Researchers and clinicians are working collaboratively and around-the-clock to better understand the etiology of ASD. While there is evidence to suggest genetic underpinnings of ASD, there is no known specific cause of ASD (15–17). While ASD prevalence is higher among boys than girls, it has not been shown to be more prevalent among specific racial, ethnic, or socio-economic groups. Furthermore, while ASD has been primarily considered a neurodevelopmental disorder, there is growing evidence that ASD impacts multiple whole body systems (18). Although an in-depth discussion of the possible etiology of ASD is beyond the scope of this article, we would highly encourage follow-up with recent reviews focused on the following cause theories: genetics (16, 17, 19), environment (18), and obstetric complications and systemizing theory (20).

DIAGNOSIS

Importance of Early Diagnosis

Parents of children with ASD tend to notice abnormalities during the child's first 2 years and many parents notice the first signs of abnormal development before the child's first birthday (21). The most common concerns are delays in speech and language development (8, 22) followed by abnormal social responsiveness, medical problems, difficulties sleeping and eating, delays reaching milestones, abnormal developmental trajectories, and developmental regression (21, 23–26). The American Academy of Pediatrics (AAP) has recommended universal ASD screening for all young children twice before their second birthday (27). However, in practice the AAP recommendations are not always followed and many children are not diagnosed before age five (28). The importance of early diagnosis is gaining momentum within the ASD community, especially as the understanding of how the disorder presents at younger ages grows (29). Clinically observed behavioral markers of ASD have been recognized well before 24 months of age (30) and more recent findings support reliable diagnosis as young as 12 months of age (7, 31). In essence, early diagnosis leads to earlier eligibility for intervention services, and evidence-based research has clearly indicated that early intervention leads to better prognosis (9, 32–34).

SCREENING AND ASSESSMENT

Although AAP guidelines recommend global screening twice before the second birthday, adherence appears to be lacking (28). The lack of adherence could be due to the subjectivity within screening, screening tools, or specific knowledge about ASD. In part, this may also be due to the plethora of ASD research focused on the latest up-to-date diagnostic and screening mechanisms. As diagnostic criteria change, assessment tools can become difficult to interpret as they are based on outdated information (29, 35). Common screening mechanisms that early interventionist may use to screen ASD include, but are not limited to the modified checklist for autism in toddlers, revised (M-Chat-R™) (36), social responsiveness scale (SRS) (37) and the social communication questionnaire (38).

Evidence-based research indicates the use of multiple sources for the diagnosis of ASD (31, 39). This includes, but is not limited to multiple diagnostic tools, developmental assessment, daily living skills as well as clinical judgment. Currently, the "gold-standard" in autism diagnosis consists of the autism diagnostic observation schedule, second edition (ADOS-2) (7, 10, 40), the autism diagnostic interview-revised (41), and developmental assessments (appropriate for age and level of development at the time of assessment) (29). Additionally, the ADOS-2 and ADI-R have strong interrater reliability as well as strong sensitivity and specificity in the algorithms (31, 42, 43).

A child can be diagnosed with ASD through an educational diagnosis, using criteria from the Individuals with Disabilities Education Act (IDEA), where the purpose of diagnosis is to indicate if the child qualifies for special education services (44). One limitation to an educational diagnosis is that children have already entered school; therefore, it is "too late" to take advantage of early intervention services. In addition, educational diagnoses have been less aligned with DSM-V criteria; thus, it is possible that some students are missed, within an educational diagnosis. Clinicians and early intervention specialists on the forefront of meeting families and recognizing ASD characteristics in children need to thoughtfully consider best practice in diagnosis and signs that may be present at an early age.

TREATMENT AND INTERVENTION

The hallmark characteristics of ASD are deficits in social communication skills as well as repetitive and restricted behaviors (1, 11). For the most part interventions are driven by these hallmark characteristics. For example, interventions have focused on improving social communication skills, such as language skills, play, and reciprocal communication. The necessity of early intervention has been clearly indicated as a priority in autism research (34, 45). Findings indicate that children who enter early intervention have a better prognosis (46, 47). In 2010, the first randomized clinical control trial of an early intervention for children with autism was published (46). Young pre-school aged children who received this early intervention had improved IQ, language, adaptive behavior, and a better diagnostic prognosis. Other early intervention studies for young children with autism have also had promising results, including but not limited to, better joint attention skills, daily living skills, and ultimately better social and communicative behaviors (9, 33, 34, 48). Amidst this paucity of research promising findings indicate that early intervention has far-reaching positive effects, especially when children enter intervention at a young age. Research about early intervention for children with autism is ongoing, but best practice recommendations suggest: early entry, intensive instruction all day (representative of a school-day) 5-days per week, year-round, and inclusive settings (45, 49, 50).

Early intervention is a priority of ASD research and consensus among professionals suggests any type of intervention is better than no intervention (34). Current research is testing how intervention types compare to each other to better understand if one modality is better than another. This section reviews widely used intervention strategies – however, it is important to note that many of these intervention methods are continually being assessed for content.

Treatment Modalities

Treatment modalities for ASD can be divided into three broad categories: psycho-educational or behavioral models, psychopharmacological models, and alternative and complementary models (51, 52). This article will discuss some popular behavioral models.

BEHAVIORAL INTERVENTION MODELS

One of the earliest documented and most widely cited early interventions for young children with ASD is applied behavioral analysis (commonly known as ABA) (53). Positive results from this intensive 40-h per week behavioral intervention include improvements in intellectual and educational functioning (53). A similar, yet unique early intervention is discrete-trial training (DTT). Proponents of DTT view ASD as a multitude of unique behaviors and reject the idea of one central deficit that can be found in all individuals with ASD.

Discrete-trial training is based on operant-conditioning behavioral models – with reinforcement control as the basis for behavior change. In practice, clinicians and educators use reinforcement, backward chaining, shaping, prompting, and prompt fading to implement DTT. DTT relies on intensive discrete-trial sessions that consist of four parts: (1) the trainer's presentation of stimuli, (2) the child's response, (3) the consequence, and (4) a short pause prior to the next stimuli (54). There are two phases, phase one engages 40 h per week of one-on-one DTT, administered by trained DTT professionals and the children's parents over a 1- to 2-year period. Phase two focuses on expressive and receptive language skills, abstract play, and social play and uses both DTT and generalization to playgroup and/or supported preschool experiences (55). The behavioral principles of DTT can be successfully applied to children with ASD and the goal is that when placed in environments utilizing DTT, children will emulate typical learning patterns (56). Criticisms of DTT include a loose relationship between the method rationale and the diagnosis of ASD, a narrow approach to language development, the need for "prompt" dependence, and the high cost of the program (57). A controlled study has been conducted and although initial results suggested success, follow-up studies indicated that the learned skills did not improve at a level consistent with peer developmental trajectories (58). Other methodological issues included the lack of random assignment, participant-sampling bias toward higher functioning children with ASD, and assessors who were not blind to study participants (57). In addition, other studies have failed to show similar results to the original controlled study. Yet, DTT is commonly used in practice.

The Pivotal Response Model has no age restriction and has shown effectiveness for increasing positive behavior and decreasing negative behaviors in children of all ages. The literature suggests that the Pivotal Response Model is the most useful in young children, as an early intervention (59). This model is based on the principle that intervention in a few core (or pivotal) areas will increase skills in all areas (even those not directly targeted) and decrease problem behaviors. The pivotal areas include motivation, multiple cues, self-management, and the initiation of social interaction (59). Outcome studies have reported improvements in speech and language, social skills, and generalizing learned skills beyond the treatment setting (60, 61).

Treatment and Education of Autistic and related Communication-Handicapped Children (TEACCH) was originally developed for children, but is now used as an intervention at all ages. The overarching goal of TEACCH seeks to work toward participant independence (57). Key principles from the TEACCH model include, careful ongoing assessment, using the strength of the participant as a building block, the use of environment embedded within the behavioral framework and the involvement of parents.

The TEACCH intervention includes diagnosis, parent training, education, social and leisure skills development, communication, vocational training, and supported employment (57). Behavioral strategies include the use of schedules, a visual independent work system, and clearly organized instructional materials to create a structured and predictable learning environment. If children's progress becomes hindered, then the environment is often modified to accommodate the identified issue (62). TEACCH has successfully improved self-help skills, social skills, and communication, enhancing quality of life and reduced inappropriate behavior (63). When children partaking in TEACCH were compared with matched peers participating in DTT, the TEACCH children had outcomes three to four times greater than the control group (DTT) on all measures (64). The results of this study should be interpreted with caution as there was no random assignment; therefore, it is hard to draw concrete conclusions between the success of the two programs. Although TEACCH is a widely used intervention strategy, no large, well-controlled study has been conducted to assess its effectiveness (57, 65).

The use of Social Stories is a common behavioral intervention in which short, simple stories written from the perspective of the child are used to deliver instruction on appropriate social behavior. These stories are carefully designed to be within the comprehension level of the child and can be used with younger and older children accordingly (66). Although Social Stories are widely accepted due to the connection to prevailing theories of autism, evidence-based research is needed. Case studies as well as other experimental design studies that have been conducted but indicate mixed results. Workshops for parents, teachers, and assistants have been successful toward implementing the use of social stories in the participants' respective environment (67). Other case studies about Social Stories have also displayed mixed results.

The use of visual supports is particularly popular and useful in working with individuals with autism. One such approach is the Picture Exchange Communication System (PECS), which aims to build language skills and teach communication response and initiation (57). Pictures are used to make requests and to form simple sentences. It is a low-cost intervention that does not depend on eye contact or the training of multiple partners, is compatible with TEACCH and the Lovaas method, and works well with pre-verbal or non-verbal children (57).

Many behavioral early interventions consist of specific techniques and require dedicated time by an interventionist or caregiver, often consisting of up-to 40 h per week of practice. More general best practice recommendations for early intervention include building skills into daily routines, the use of natural environments, and about 25 h per week of direct skill practice (68). It should be noted that successful early interventions have been indicated with as little as 1 h per week (69), while more standard practice is about 40 h per week (56).

A SPECIAL FOCUS ON ASD IN EDUCATIONAL SETTINGS

Background on Individuals with Disabilities Education Act

The IDEA passed in 1990 and its successor, the Individuals with Disabilities Education Improvement Act (IDEIA, still referred to as IDEA), was reauthorized in 2004. IDEA protects the rights of children with disabilities and the parents of the children, guarantees that children with disabilities have an appropriate public education adhering to their unique needs, at no cost (Building the Legacy: IDEA 2004, 2010).

Individuals with Disabilities Education Act has its roots in the Education for All Handicapped Children's Act of 1975 (PL 94–148) that provided federal funding to states for free, appropriate public education to children with disabilities. Amendments throughout the 1980s and 1990s added provisions for vocational training and transition services, services, and programs for children birth to age 3 years, transition planning for teenagers, and mandates that schools report children's progress to parents (Building the Legacy: IDEA 2004, 2010) (70). The 2004 reauthorization of the IDEA as well as President George W. Bush's Commission on Excellence in Special Education made attempts to revamp inefficiencies in the special education system.

Individualized Education Plans (IEP) are the foundation of special education services provided to children with disabilities in the public school system. Inclusion requirements for an IEP are mandated at the federal and state level; furthermore, it is mandated that students are educated in the least restricted environment (e.g., students should be placed in general education settings, when the necessary supports are in place and if this meets the needs of the student). Federal requirements consist of a statement of the child's present levels of academic achievements and functional performance, measurable annual goals, a description of benchmarks, a description of how the child's progress toward meeting the annual goals will be measured, and a description of when periodic reports on the progress the child is making toward meeting annual goals will be provided (concurrent with issuance of report cards) (Building the Legacy: IDEA 2004, 2010). When a child turns 16 years of age, the IEP must include a statement of appropriate measurable postsecondary goals related to training, education, employment, and/or independent living skills and a statement of transition services needed to reach those goals. IEPs should allow the child to make progress in the general education curriculum as well as other educational curriculum as needed on an individual basis (Building the Legacy: IDEA 2004, 2010).

ASD, IDEA, and IEPs

Designing IEPs, specific to individuals with ASD, the objectives, target behaviors, and levels of supports should all be clearly defined, specific, and developmentally appropriate (14). Specific IEP goals should be individualized, but reflective of common characteristics of autism, including communication goals related to requesting, labeling, identifying, following directions, making conversation, using spontaneous and generalized communication skills, greeting, and using and understanding non-verbal communication. Social interaction goals and objectives for an IEP could include joint attention and early social engagement skills, social play, pretend play, consideration of the perspective and feelings of others, friendship, social skills, and problem-solving (14). Lastly, goals and objectives related to restricted and repetitive behaviors could include managing and reducing or eliminating stereotypic behaviors, understanding and demonstrating flexibility, and managing and reducing obsessive thoughts and compulsive behaviors. Other consideration's within IEP goals might reflect behaviors related to emotional self-regulation (mood, anxiety) and behavior management (self-injury, aggression, anger management, staying on-task), academic skills (pre-academic skills, critical thinking, working/being in a group), adaptive skills (feeding, sleeping, dressing, toileting, self-care and self-management, functional independent play, daily living skills, participation in family and community, leisure skills, vocational skills, transition to adulthood) (14).

IMPLICATIONS FOR CLINICIANS

Interventions targeted at social communicative behaviors are necessary for children of all ages diagnosed with autism. Behavioral, personal, and environmental circumstances are all taken into consideration in developing intervention models (69). Early intervention has been particularly targeted due to the positive prognosis indicated through evidence-based research (9, 33, 34, 46). There is widespread agreement on the necessity of early intervention but there is less consistent agreement on specific content (34). As little as 6 h of parent training (didactic group sessions for parents) has been shown to have positive effects on the child's social communicative behaviors (26, 69). On the contrary, more than 40 h of intensive intervention for most waking hours of the child's day has been advocated (53). Standardized diagnostic measures identify children with autism at an early age have been successful (7, 31), but providing immediate and effective resources to help families cope with the new diagnosis is lacking (49). Parent-implemented interventions aimed at promoting socialization and communication have had successful results, but more work is needed in order to provide clear instructions and design user-friendly manuals with relevant, easy-to-understand parental resources for families of children with ASD (71). Even though early intervention for some of the youngest children with ASD appear on the forefront of research initiatives, more work is needed to establish effective, meaningful, and parent-friendly intervention techniques (71). Clinicians play a meaningful role in addressing the necessary steps toward active participation in early intervention. Starting with assessment, and finishing with the right intervention "fit" for children and the family.

It is of the utmost importance that clinicians disseminate current research (35). In short, clinicians are most likely to assist children and families in connecting the dots. Clinicians are often the first person, aside from the family, to acknowledge ASD characteristics. Becoming familiar with up-to-date research and better understanding ASD resources within the community will help establish a seamless transition from the clinic to behavioral interventions and further assist families in learning more about how to provide the necessary supports to their child with ASD.

AUTHOR CONTRIBUTIONS

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Evaluating Exercise as Evidence-Based Practice for Individuals with Autism Spectrum Disorder

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Background: The purpose of this study was to conduct a systematic review of the literature to evaluate empirical support for the use of exercise as an evidence-based practice (EBP) for individuals with autism spectrum disorder (ASD), aged 1–21 years, using the Adapted Physical Activity Taxonomy (APAT) (1).

Method: A systematic review of research, published within the past 10 years and accessible in SPORTDiscus, ProQuest Nursing, Science Direct, ERIC, Ovid MEDLINE, and PsychINFO databases, was conducted following seven inclusion criteria. An initial 169 articles were identified of which 23 articles were found that met the inclusion criteria including implementation of an exercise intervention for participants diagnosed with ASD and utilization of an experimental/quasi experimental, correlational, single–subject, or qualitative research design. These 23 articles were evaluated using the APAT to determine the quality of the research and the strength of the recommendation in establishing exercise as an EBP.

Results: Of the 23 articles evaluated, 17 employed an experimental/quasi experimental design, 1 article employed a correlational design, and 5 articles employed a single-subject design. Only one article (2) was found to meet the minimum overall quality indicator of moderate (i.e., Level 2) when evaluated on the APAT. In total, 13 of the 23 articles (57%) had method sections evaluated as weak, and 17 of the 23 articles (74%) had results sections evaluated as weak.

Conclusion: From the findings of this systematic review, and in accordance with the *Every Student Succeeds Act* of 2015 (3) definition of an EBP, it appears that exercise can be considered an EBP for school-aged children with ASD. However, this recommendation is based solely on moderate evidence from one well-designed and well-implemented experimental study; therefore, generalization is still pending further similar findings. Recommendations for future research are offered.

Keywords: evidence-based practice, exercise, autism spectrum disorder, systematic review, adapted physical education

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Autism spectrum disorder (ASD) is defined by the American Psychiatric Association (APA) as a group of developmental disabilities causing significant delays in communication (e.g., limited expressive language) and social skills (e.g., difficulty with social reciprocity) and is associated with repetitive behavior (e.g., engages in hand-flapping) and stereotypical movements (e.g., body rocking) (4). Recent investigations of the motor and exercise patterns of individuals with ASD have also established motor development delays as an attribute of ASD (5–7). Individuals diagnosed with ASD will be categorized as one of three levels based on support needed: Level 1, requiring support; Level 2, requiring substantial support; and Level 3, requiring extreme support at all times (APA). These individual attributes and the levels of support needed by individuals with ASD may interfere with the development of age-appropriate motor skills and participation in exercise.

The physical benefits of exercise reported for children with ASD include improvements in cardiorespiratory functioning (8–10), motor skill performance (11), and muscular strength (10, 12), as well as a reduction in body mass index (13). Along with physical benefits, behavioral and cognitive functioning improvements have been reported. Exercise, as an intervention, has also been shown to reduce maladaptive behaviors (14, 15) and stereotypic behaviors (16) as well as increase on-task behaviors (17) and academic responding (e.g., participating in instructional tasks, asking, and answering questions) (18). Exercise has also been shown to improve academic achievement (19) and social skills (20). However, the research studies cited above provide varying definitions of exercise, utilize different methods to determine levels of heart rate or energy expenditure, and examine differing health-related fitness components. These research studies also involve participants across a wide age range and participants who include, but may not be exclusive to, individuals with ASD. These factors contribute to the difficulties of establishing exercise as an evidence-based practice (EBP). Furthermore, to date, no systematic review has been completed that examines the quality of the research or the strength of the recommendation needed to establish exercise as an EBP.

EVIDENCE-BASED PRACTICE

While the exact definition may vary between professions, EBP can generally be defined as an instructional strategy, intervention, or teaching program that is grounded in scientifically based research (21). Within legislation, the Individuals with Disability Education Improvement Act of 2004 lacks a definition but does imply that teachers use EBPs, mandating instructional interventions grounded in "scientifically based research," when teaching students with disabilities (22). Conversely, the newly passed Every Student Succeeds Act of 2015 (ESSA) (3), after which the reauthorization of IDEA may be modeled, does clearly define evidence-based as:

> an activity, strategy, or intervention that—(i) demonstrates a statistically significant effect on improving student outcomes or other relevant outcomes based on—(I) strong evidence from at least 1 well-designed and well-implemented experimental study; (II) moderate evidence from at least 1 well-designed and well-implemented quasi-experimental study; or (III) promising evidence from at least 1 well-designed and well-implemented correlational study with statistical controls for selection bias; or (ii) (I) demonstrates a rationale based on high-quality research findings or positive evaluation that such activity, strategy, or intervention is likely to improve student outcomes or other relevant outcomes; and (II) includes ongoing efforts to examine the effects of such activity, strategy, or intervention (22).

Prior to the Federal definition to guide educational practice, a number of organizations including the National Professional Development Center on Autism Spectrum Disorder (NPDC) and the National Autism Center (NAC) reported on EBPs used in school settings with children with ASD. Both organizations included exercise in their EBP reports but with differing results regarding the effectiveness of exercise, based on the taxonomies used for evaluation.

The NPDC defined EBP as interventions that have been proven through research to be effective and used their own criteria for evaluation when reviewing peer-reviewed research in scientific journals to reported on 27 EBPs for children with ASD (23). NPDC recognized exercise as an EBP and purported that exercise improves physical fitness, increases desired behaviors, and decreases inappropriate behaviors for children with ASD, aged 3–5 years (14, 18); and adolescents with ASD, aged 12 through 14 years (12, 24).

At the same time that the NPDC was releasing their report, the NAC released the *National Standards Project: Phase 2 Report* (25). For their report, the NAC adopted the definition of an EBP offered by Dr. David Sackett and his colleagues in *Evidence-Based Medicine: How to Practice and Teach EBM* (26) and systematically evaluated peer-reviewed research using a Scientific Merit Rating Scale and a Strength of Evidence Taxonomy. Within their *National Standards Project: Phase 2 Report* (25), the NAC identified 14 established EBPs, for children and young adults under the age of 22 years, but did not identify exercise within the established EBPs. Rather, the NAC identified exercise as an intervention with an emerging level of support and indicated that more high-quality studies were needed that consistently documents the effectiveness of exercise. The discrepancy between the conclusions drawn by the NPDC and the NAC, two leading organizations for research on children with ASD, makes the selection and implementation of EBPs problematic for teachers and researchers.

In order to gain scientific corroboration, there is a need to determine evidence for the establishment of exercise as an EBP for individuals with ASD. However, to date, no systematic review of the literature has been completed on exercise as an EBP using a taxonomy specific to the field of adapted physical activity or the discipline of kinesiology that educators could use to justify their use of exercise as an EBP. Therefore, the purpose of this study was to conduct a systematic review of the literature to evaluate empirical support for the use of exercise as an EBP for individuals with ASD, aged 1–21 years, using the Adapted Physical Activity Taxonomy (APAT) (1).

METHOD

Systematic Review Procedures

This systematic review of the literature (27) focused on the use of exercise as an intervention for children and youth with ASD. Prior to conducting the literature search, the reviewers unanimously agreed to (a) the operational definition for exercise for the study as "a subcategory of physical activity that is planned, structured, repetitive, and purposive to improve or maintain one's physical fitness" (p. 250) (28) and (b) the minimum APAT (1) Quality of Study rating (i.e., Level 1 or Level 2) and Level of Recommendation (i.e., A or B) needed for the establishment of exercise as an EBP. These parameters, along with the inclusion criteria, guided the systematic review (see **Figure 1** for an overview of the procedures).

Initial Search Procedure

Potential articles, published in the past 10 years, were initially located *via* online indexing system searches. The reference lists of the articles found through the online search were also manually searched for potential articles. The reviewers conducted an initial search of the literature using the indexing systems/research platforms of SPORTDiscus, ProQuest Nursing, Science Direct, ERIC, Ovid MEDLINE, and PsychINFO. Searches were conducted with search limiters of English language journals published within the last 10 years, and the keywords of exercise and ASD including the terms autism, Asperger's syndrome, and PDD-NOS.

Criteria for Inclusion

The following seven inclusion criteria were selected by the five authors and required that articles be (a) published between January 2006 and April 2016; (b) published in English language journals; (c) located in periodical publications (i.e., books, unpublished papers, conference proceedings and book chapters were excluded); (d) involved implementation of an exercise intervention consistent with the adopted operational definition for exercise; (e) provided a clear description of the participants as individuals diagnosed with ASD, to include participants with autism, Asperger's syndrome and Pervasive-Developmental Disorder—Not Otherwise Specified (i.e., studies with participants with ASD who were diagnosed with other/secondary disabilities were excluded); (f) included participants between the ages of 1 and 21 years; and (g) utilized an experimental/quasi experimental, correlational, single-subject, or qualitative research design (i.e., systematic reviews and meta-analyses were excluded). Only articles that met these criteria were eligible for evaluation.

Title and Abstract Review

Research studies, identified through the initial search procedure, were then evaluated using a three-step process. First, reviewers conducted a title and abstract review on the potential studies identified in the initial search to confirm studies met inclusion criteria. Articles identified as reviews of literature were excluded but the reference lists from these articles were examined for additional potential articles. In the second step, articles meeting the inclusion criteria were then independently evaluated by one of the authors using the APAT. Finally, the second author independently evaluated each article to confirm agreement on the evaluation of the article as a Level I, II, or III.

Instrumentation

The APAT Quality of the Study and Letter of Recommendation (1) were used as the decision-making tool to rate the quality of each individual study and the strength of the recommendations for each of the identified articles. Designed to address four types of research designs (i.e., experimental/quasi experimental, single-subject, correlational, qualitative), the APAT contains five evaluation domains (i.e., introduction, method, results, discussion, and others) with quality indicators delineated within each domain. See **Tables 1–3** for additional details regarding the content evaluated within each domain. These domains guide the evaluation of the article and provide an APAT Quality of the

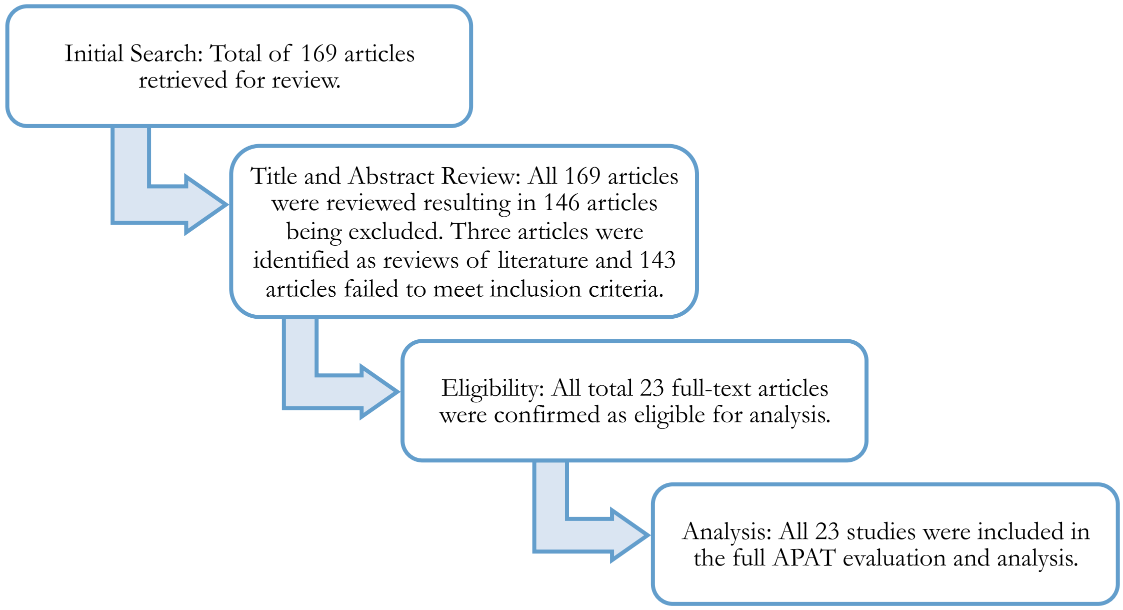

FIGURE 1 | Summary of systematic review process procedures.

TABLE 1 | Exercise intervention studies for individuals with autism spectrum disorder (ASD): study design, participant information, intervention type, and outcomes.

Study	Study design	Participant information		Intervention type	Outcomes
		Sample size	Age range (years)		
Anderson-Hanley et al. (29)	Quasi-experimental	*N* = 12 *N* = 22	CA = 10–18 CA = 8–21	Exergaming cybercycling	RSB, EF: decreases in repetitive behaviors and improvements in executive functioning following exergaming
Arzoglou et al. (30)	Experimental	*N* = 10	CA = 16	Greek dance training program	SRF: improvements in measures of neuromuscular coordination following participation in Greek dance intervention program
Bahrami et al. (31)	Experimental	*N* = 30	CA = 5–16	Kata (karate)	RSB: decreases in stereotypical behavior after intervention
Chan et al. (32)	Experimental	*N* = 46	CA = 6–17	Nei Yang Gong (Chinese mind-body exercise) versus progressive muscle relaxation	SBI, RSB: greater improvements in self-control and reductions in typical autistic symptoms and daily emotional and behavioral problems of children with ASD after Nei Yang Gong intervention than progressive muscle relaxation
Fragala-Pinkham et al. (9)	Single subject	*N* = 16	CA = 6–11	Group aquatic exercise program	HRF: improvements in cardiorespiratory endurance after a group aquatic intervention with a high adult to child ratio and specific goals to maintain training heart rates
Fragala-Pinkham et al. (24)	Quasi-experimental	*N* = 12	CA = 6–12	Aquatic exercise program	HRF, MSD: no significant between-group changes found for swimming skills, cardiorespiratory endurance, muscular endurance, and mobility skills. Within-group improvements for swimming skills were found for the intervention group
Goodarzi and Hemayattalab (33)	Experimental	*N* = 50	CA = 8–10	6-month program of weight bearing exercises (three sessions per week) and/or the addition of dietary calcium rich food (250 mg calcium/serving)	BD: greater increases in bone mineral density with additional weight bearing exercise and calcium supplementation than control
Hawkins et al. (34)	Single subject	*N* = 2	CA = 7–11	5-week equine-assisted therapy program	SRF, HRF, MSD: moderate to large gains in body coordination, strength and agility, and overall gross motor skills as a result of participation in an equine-assisted therapy intervention
Hillier et al. (35)	Quasi-experimental	*N* = 18	CA = 13–27	8-week physical exercise and relaxation program	SBI: significant reductions in salivary cortisol levels and self-reported anxiety measure following intervention
Koenig et al. (36)	Experimental	*N* = 48	CA = 5–12	16-week get ready to learn classroom yoga program	SBI, RSB: significant improvements in classroom behaviors as measured by the ABC-community scored by teachers but no significant difference as scored by parents following the intervention
Lee and Porretta (37)	Single subject	*N* = 3	CA = 3–6	16-session physical activity program focused on object manipulation and locomotor activities	RSB, TOT: locomotor activities found to be effective in decreasing stereotypic behaviors and increasing time-on-task when compared to object manipulation activities
Lourenco et al. (38)	Experimental	*N* = 16	CA = 4–10	20-week trampoline training program	MSD, HRF: significant improvements in motor performance for intervention group. No significant differences for body mass index
Morrison et al. (39)	Single subject	*N* = 4	CA = 10–21	Antecedent physical exercise program (e.g., stationary bike, therapy ball) prior to instruction	SBI: antecedent exercise and access to leisure items reduced problem behaviors decreased during and post-intervention
Movahedi et al. (40)	Experimental	*N* = 30	CA = 5–16	14-week Kata technique training program	SBI: significant improvements in social interactions for the intervention group
Neely et al. (41)	Single subject	*N* = 2	CA = 7–8	Antecedent physical exercise prior to instruction	RSB, TOT: increases in academic engagement and reduced levels of stereotypy during the instructional sessions, which followed antecedent physical exercise
Pan (2)	Quasi-experimental	*N* = 16	CA = 6–9	20-week water exercise swimming program	MSD, SBI: improved aquatic skills and decreased the total antisocial behaviors after intervention

(*Continued*)

TABLE 1 | Continued

Study	Study design	Participant information		Intervention type	Outcomes
		Sample size	Age range (years)		
Pan (12)	Correlation	*N* = 95 With ASD (*n* = 19) and without ASD (*n* = 76)	CA = 14	16-week physical education program	SBI, HRF: steps per minute for students with ASD were significantly lower than their peers without disabilities. Intervention features including physical activity content, lesson location, and instructor-related characteristics were associated with student MVPA. Social interactions were positively related to physical activity levels of students with ASD
Pan et al. (42)	Experimental	*N* = 22 Control (*n* = 11), Intervention (*n* = 11)	CA = 6–12	12-week physical activity intervention focused on table tennis and body movement skills	HRF, SRF, EF: significant interaction effects and intervention induced improvements for the intervention group on measures of manual coordination, body coordination, strength, and agility as well as executive functioning
Pitetti et al. (13)	Quasi-experimental	*N* = 10	CA = 14–19	9-month treadmill-walking program	HRF: significant increases in mean monthly treadmill-walking program frequency, speed, elevation, and calories expended along with a reduction in BMI as a result of the intervention
Ringenbach et al. (43)	Experimental	*N* = 10	CA = 8–16	Assisted cycling therapy (ACT), voluntary cycling (VC), and no cycling (NC)	EF: significant improvements in inhibition with improvements in cognitive planning and set-switching approached significance after a single session of ACT. No improvements were found in inhibition, cognitive planning, or set-switching following the VC or NC sessions. Exercise perception improved after the VC session but did not change after the ACT or NC sessions
Rosenblatt et al. (44)	Quasi-experimental	*N* = 24	CA = 3–16	8-week multimodal yoga, dance, and music therapy program based on the relaxation response	SBI: significant differences on the BASC-2 behavioral symptom index, with positive non-significant impacts on the BASC-2 externalizing scale and internalizing scale and ABC-irritability scale following intervention
Todd and Reid (45)	Single subject	*N* = 3	CA = 15–20	Snowshoe/walk/jog program, twice a week for 30 min for 28 sessions	HRF: increases in distance snowshed/walked/jogged and decreases in need for verbal cueing to persist in physical activity sessions
Wuang et al. (46)	Experimental	*N* = 60	CA = 6–8	20-week simulated developmental horse-riding program	MSD: improved motor performance and sensory integrative functions post-intervention that were sustained for at least 6 months

SBI, social and behavioral issues; RSB, repetitive and stereotypical behaviors; HRF, health-related fitness; MSD, motor skill development; SRF, skill-related fitness; EF, executive functioning; TOT, time-on-task; BD, bone density.

Study rating (i.e., Level 1 = strong; Level 2 = moderate; Level 3 = weak). The APAT also follows a standardized decision-making process to determine an APAT Level of Recommendation (i.e., A, B, and C Levels of Recommendation) for the research reported within the article. Articles evaluated as having a Level of Recommendation of A are those studies with outcomes that meet at least one of the following: (a) "result in significant value that can be applied to educational, recreational, and disability sport settings"; (b) have "consistent findings from at least two good-quality randomized controlled trials or a systematic review/meta-analysis"; or (c) have a "validated intervention decision relevant to a disability population" [APAT: Level of Recommendation (Part II)].

Inter-Rater Agreement

The authors of this article independently assessed all the titles and abstracts to determine whether the studies met the criteria for inclusion using a dichotomous scale (yes or no). In instances of disagreement, articles were re-assessed until an inter-rater agreement of 100% was reached. All of the articles were also independently evaluated by at least two of the current authors using the APAT. There were no instances of disagreement during the evaluation using the APAT; hence, there was 100% inter-rater consensus.

RESULTS

The initial search of the literature identified 169 exercise-based intervention studies targeting individuals with ASD, aged 1–21 years (see **Figure 1**). Of the 169 articles identified through the initial search, 146 articles were excluded from further analysis as a result of failing to meet 1 of the 7 inclusion criteria. Three of the 146 articles were excluded because they were identified as reviews of literature in the title and abstract review. The references for these articles were examined for additional articles. None of the potential articles found on the reference list met the publication year inclusion criteria. See **Figure 1** for a summary of the systematic review process.

The resulting 23 articles remained for analysis and were evaluated using the APAT, with 17 articles evaluated as experimental/

TABLE 2 | Adapted Physical Activity Taxonomy quality indicator ratings for correlational research reviewed.

Quality indicators	Reference
	Pan (12)
Introduction	
Hypothesis/research question stated, theory or conceptual model, significance and need, alignment of purpose, solutions and challenges, and literature support	1
Method	
Research design appropriately aligns with the hypothesis/research question, instrument currently validated reliable within the target population, appropriate measures are used to control for participant and researcher bias, data collection conducted throughout the treatment; if appropriate substantial baseline obtained, participants reflect the intended study, population is adequately represented description of inclusion/exclusion criteria, sampling technique(s), replication, description of settings, IV and DV explained, confidentiality, fidelity	3
Results	
Percent agreement between observers is >90%, or coefficient *r* is >0.7, analyses of raw data are clearly described, effect size is provided, confidence intervals are presented for reliability coefficients and sample statistics, univariate measures are used only when appropriate, reliability and validity interpretations are very detailed	3
Discussion	
Discussion of results clearly address the hypothesis/research question, findings compared to prior research, limitations defined, recommendations, representativeness addresses target population, and other possible issues	2
Other	
Complete listing of references pertinent to the study concept, appendices provided when appropriate	1
Level of quality	3
Letter of recommendation	A

quasi experimental, 1 article as correlational, and 5 articles as single-subject designs. **Table 1** presents a summary of each article reviewed including the study design, participant information, intervention type, and study outcomes. The studies evaluated employed fitness-focused exercise (*n* = 8), aquatics (*n* = 3), karate and martial arts training (*n* = 3), motor skills programming (*n* = 3), yoga (*n* = 2), dance (*n* = 2), equine-assisted programming (*n* = 2), relaxation training (*n* = 2), and exergaming (*n* = 1) interventions. These exercise interventions implemented attempted to address ASD-related issues including social and behavioral issues (*n* = 8), repetitive and stereotypical behaviors (*n* = 5), health-related fitness (*n* = 4), skill development (*n* = 4), skill-related fitness (*n* = 3), cognitive functioning (*n* = 2), and time-on-task (*n* = 2). While the interventions were implemented with participants with ASD from 4 to 27 years of age, a majority of the studies (74%) targeted adolescents with ASD as participants.

In addition to the descriptive summary table, a summary of the APAT evaluation ratings for the 23 articles reviewed are presented, by research design, in **Tables 2–4**. A closer examination of the articles presented in **Tables 2–4** reveals that 13 of the 23 articles (57%) had method sections evaluated as weak (i.e., Level 3 rating), and 17 of the 23 articles (74%) had results sections evaluated as weak. This weak rating is problematic as

TABLE 3 | Adapted Physical Activity Taxonomy (APAT) quality indicator ratings for experimental/quasi experimental research reviewed.

Quality indicators	Reference																
	Anderson-Haley et al. (29)	**Arzoglou et al. (30)**	**Bahrami et al. (31)**	**Chan et al. (32)**	**Fragala-Pinkham et al. (9)**	**Fragala-Pinkham et al. (24)**	**Goodarzi and Hemayattalab (34)**	**Hillier et al. (35)**	**Koenig et al. (36)**	**Lourenco et al. (38)**	**Movahedi et al. (40)**	**Pan (2)**	**Pan et al. (42)**	**Pitetti et al. (13)**	**Ringenbach et al. (43)**	**Rosenblat et al. (44)**	**Wuang et al. (46)**
Introduction	1	1	2	3	2	2	3	1	1	1	1	1	1	3	3	1	1
Method	2	3	2	2	3	3	3	3	1	3	1	2	2	3	3	2	2
Results	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
Discussion	1	3	3	2	1	1	3	1	1	3	3	1	1	1	3	1	1
Others	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Level of quality	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
Letter of recommendation	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A

Details specific to each of the APAT quality indicators for experimental and quasi-experimental research have been omitted for table brevity.

TABLE 4 | Adapted Physical Activity Taxonomy quality indicator ratings for single-subject design research reviewed.

Quality indicators	Reference				
	Hawkins et al. (34)	**Lee and Porretta (37)**	**Morrison et al. (39)**	**Neely et al. (41)**	**Todd and Reid (45)**
Introduction					
Hypothesis/research question stated, theory or conceptual model, significance and need, alignment of purpose, solutions and challenges, and literature support	1	3	3	3	3
Method					
Research design aligns with the hypothesis/research question, data collection substantiates trustworthiness, baseline if needed, adequate representation of population, inclusion criteria, information for replication, description of setting, sample techniques, intervention and conditions explained, participant information defined and clear, threats to internal validity addressed	3	3	3	3	2
Results					
Percent agreement between observers is ≥80%, or coefficient r is ≥0.7, raw data clearly described, pattern of experimental control defined, 3 or more different experimental effects over 3 different periods presented	2	3	1	1	1
Discussion					
Discussion of results clearly address the hypothesis/research question, findings compared to prior research, limitations defined, recommendations, inclusion and exclusion criteria, generalizability, DV supported, IV practical and cost effective	1	3	3	3	3
Other					
Complete listing of references pertinent to the study concept, appendices provided when appropriate	1	3	3	3	3
Level of quality	3	3	3	3	3
Letter of recommendation	A	A	A	A	A

the method and results sections provide details essential to quality design and study replication as well as the research findings. Additionally, 10 of the 23 articles (43%) were published without a clearly stated hypothesis or theory.

As can be observed from the aforementioned tables, only 1 article (2) from the 23 articles reviewed was found to meet the minimum overall quality indicator of Level 2 when evaluated on the APAT. In his research, Pan (2) examined the effects of a water exercise swimming program on the aquatic skills and social behaviors of children, aged 6–9 years, diagnosed with ASD. The participants were split into two groups, Group A ($n = 8$) and Group B ($n = 8$). Group A received water exercise swimming program in the first 10-week phase followed by a week break and then a 10-week phase of baseline treatment/activity. Group B received treatments in reverse order. Pan (2) found improved aquatic skills as well as a decrease in the frequency of antisocial behaviors (e.g., spinning, rocking, and delayed echolalia) in children with ASD. While Pan (2) was able to report significant improvements in aquatic skills, sustainability of improvements, and significant decreases all antisocial behaviors, the research article as a whole was evaluated as having only moderate strength of quality. More specifically, when evaluated *via* the APAT, the Pan article (2) was strong (i.e., Level 1) in the introduction, discussion, and other section but only moderate in the method section (e.g., sampling technique described but not replicable), and the results section (e.g., reliability and validity interpretation lacked detail) producing a moderate overall rating.

DISCUSSION

The purpose of the current study was to conduct a systematic review of the literature to evaluate empirical support for the use of exercise as an EBP for individuals with ASD, aged 1–21 years. A total of 23 articles were evaluated. Based on the findings of this systematic review, and utilizing the newly enacted ESSA (2016) definition of an EBP, it appears that exercise can be considered an EBP for school-aged children with ASD. However, this recommendation is based solely on moderate evidence from one well-designed and well-implemented experimental study (2), therefore, generalization is still pending further similar findings. These current systematic review findings are consistent with that of Lang et al. (47) who reported a limited literature base and called for additional high-quality research, especially studies using a strong experimental design, which could assist educators in developing effective programing for individuals with ASD.

As researchers move forward with designing and conducting the research to further establish the evidence base, they need to be mindful of the research-to-practice gap. It has been established that interventions that are too narrowly focused, complex, difficult to implement or costly; or interventions that do not meet the perceived needs of the community (48) perpetuate the gap and impede the process of converting empirically supported discoveries into routine educational practices. For example, within his study, Pan implemented a 10-week water exercise swimming program with multiple swimming instructors (i.e., a one instructor-to-two student instructional setting) and two 90-min instructional sessions per week. This design, while ideal for research purposes, is not easily implemented in PK-12 settings where instructional sessions are often shorter, staff ratios higher, and pools present in only some of the schools. Furthermore, researchers must take care to report all of the information critical to their research design and findings, such as those quality indicators outlined in the APAT (1), in order to improve the quality of the study and strengthen the resulting recommendations. We recognize that this can be a daunting task, but it is essential if exercise, or any other instructional strategy, intervention, or teaching program is to be firmly established as an EBP (21) for use with children and youth with ASD.

AUTHOR CONTRIBUTIONS

The first author, SD, was responsible for designing and guiding the systematic review and was responsible for the preparation/writing of the manuscript. The remaining authors (DA, LG, SM, and MB) were involved in the systematic review of the literature including the evaluation of the 23 articles using the Adapted Physical Activity Taxonomy. The second (DA) and third (LG) authors provided significant assistance to the first author in the development of the manuscript. The fourth (SM) and fifth (MB) authors also provided editorial assistance in the development of the manuscript but to a lesser extent than the second and third authors.

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Methodology to Promote Physical Activity Monitoring Adherence in Youth with Autism Spectrum Disorder

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Background: Objective physical activity (PA) monitoring *via* accelerometry is both costly and time consuming. Furthermore, overall adherence to a monitoring protocol is often complicated by disability. Therefore, it is essential that strategies for supporting accelerometer wear for youth with disabilities are maximized. The purpose of this perspective was to provide researchers a set of efficacious PA monitoring strategies based on the retrospective examination of support methodology on adherence rates for youth with autism spectrum disorder (ASD).

Method: Accelerometer data were collected from 163 participants with ASD in three independent cohorts. Each cohort was provided a varying set of support strategies to help maximize adherence. Chi-square analysis was used to determine differences in adherence between each cohort.

Results: Adherence rates significantly increased from 51.9% in cohort 1 to 88.7% in cohort 2 [$\chi^2(1) = 18.333$, $p < 0.001$] and again from 88.7% in cohort 2 to 97.4% in cohort 3 [$\chi^2(1) = 2.663$, $p = 0.103$]. The greatest increase in adherence was observed from 51.9% in cohort 1 to 97.4% in cohort 3 [$\chi^2(1) = 19.837$, $p < 0.001$]. Support strategies associated with these increases included (1) social story, (2) incentive, (3) concealing techniques, and (4) 24 h/day wear instructions.

Conclusion: Adherence to PA measurement increased when additional support strategies were utilized in combination with a traditional protocol. We recommend these support methodology to be considered as preliminary best practices when measuring objective PA in youth with ASD with likely success in other disability populations.

Keywords: accelerometer, measurement, pediatrics, disabilities, pedometer, exercise, obesity, adapted

INTRODUCTION

Autism spectrum disorder (ASD) is the fastest growing developmental disability in the United States (1); as such, there is a critical need to research and intervene on the modifiable factors contributing to known health disparities, such as rising rates of overweight and obesity (2–4). The prevalence of obesity in children with ASD aged 2–19 years is estimated at over 30% (4). One factor which has surfaced as a major health concern contributing to the obesity epidemic is the rise in physical inactivity (5). Evidence suggests that both typically developing children and children with disabilities are falling well below recommended physical activity (PA) guidelines with increasing sedentary behavior as they age (2, 6–10). In addition, given the current spot light on motor skill competence in children with ASD, motor skill interventions focused on motor and PA outcomes are gaining significant attention yielding the need for improved measurement methodology (8, 11–20). In order to maintain insight of the levels and patterns of PA in youth, valid and reliable methods of objective PA measurement must be incorporated. Therefore, it is imperative to continue to evolve evidence-based best practices in activity measurement to enhance research efforts in understanding and addressing this global epidemic.

Current best practices in activity measurement include an objective measurement of PA using motion detectors such as an accelerometer which is worn around the waist, wrist, or ankle (21). Despite recent reports highlighting the importance of measuring PA using an objective method (21), many researchers still resort to implement self-reported and recall instruments. Common methods include retrospective measurement of previous activity with recall varying from 24 h to 1 year, a parental report of the child's activity, or an activity interview with a log (22). There are several issues with self-reported measures, including inaccurate representation on the frequency, duration, and intensity of PA following bouts of activity which are retrospectively recalled (22). Additionally, youth and their caregivers have a tendency to over-report their PA (21). Despite these issues, self-reported questionnaires are often considered for cost efficiency reasons. Caution, however, should be taken when considering results from large epidemiological studies, with outcomes associated with programing or intervention recommendations when recall methodology is used. To avoid misrepresenting the levels of PA in youth, particularly those most sensitive to program modifications (children with disabilities), employing an objective measurement such as accelerometry, can more accurately inform policy makers and service providers regarding the current PA behavior of targeted populations.

An important component used to inform PA measurement methodology for future research should be the reporting of adherence results from prior studies. Unfortunately, reporting of adherence to PA measurement procedures is rarely published (7, 23, 24). Adherence to accelerometer measurement procedures is likely to vary by population (children or adults) and experience (no. of observations). However, reporting the number of participants who are able to successfully achieve the minimum amount of wear needed to meet reliability criteria provides an accurate estimate of participants who may potentially adhere in future studies; valuable information which can be used to inform sample size and research budgets. Similarly, studies examining the minimum days and hours of PA monitoring required for reliability have the potential to reduce participant burden while increasing adherence (25, 26). A recent study examined the minimum number of days required to reliably measure PA in youth with developmental disabilities (27). Results indicated that 4, 6, and 8 days of monitoring were required to reliably quantify typical levels of PA during the week, weekend, and combined week and weekend, respectively (27). Additional studies examining the minimum number of days required for monitoring will provide further support for these findings, and ultimately provide valuable information which can be used to develop best practices when examining PA in youth with disabilities.

Another consideration in the measurement of objective PA *via* accelerometry in youth is cost. The majority of expenses are typically associated with cost of the device, which can range from $250 to $450. Required software costs also vary substantially. In addition to hardware and software costs, expenses relating to research procedures can accumulate. One such cost is providing incentive. Since PA monitoring can be burdensome for some children, particularly those with disabilities, it may be wise to provide an incentive for wearing the monitor; a recommendation that is substantiated by the current report. Also, the cost of postage should be considered given that monitors are most efficiently delivered and returned *via* mail. Finally, data reduction and analysis are time consuming; therefore, it is also wise to consider the cost of hiring personnel to assist with this process. Despite these considerable expenses which are further burdened by poor adherence, the reporting of strategies to increase PA monitoring adherence is scarce.

Taken together, objective PA monitoring *via* accelerometry is both costly and time consuming. Therefore, it is essential that strategies for supporting accelerometer wear for youth with disabilities are maximized (24). The purpose of this retrospective investigation was to compare adherence rates of accelerometer measurement protocols across three independent cohorts, to differentiate the effects of support strategies offered to increase protocol adherence, and to offer our perspective on accelerometer adherence promoting strategies that should be considered when monitoring PA in children and youth ASD.

METHOD

Participants

We performed a retrospective comparison of PA monitoring adherence data obtained from three independent cohorts (28–30). For each cohort, an independent sample was recruited to participate in an intervention which included the measurement of habitual PA *via* an accelerometer. A total of 163 youth aged 9–18 years with ASD participated (cohort 1, $n = 27$; cohort 2, $n = 97$; cohort 3, $n = 39$). Demographic data for each cohort are summarized in **Table 1**. The research protocol was approved by the Health Sciences and Behavioral Sciences Institutional Review Board. All participants were consented to participate and assent was obtained from each.

Procedure

A baseline measure of objective PA *via* an accelerometer was collected for each cohort. Type of accelerometer used was individually decided by the research team for each cohort and therefore varies. The Actical accelerometer (Actical, Philips Respironics; Bend, OR, USA) was used for cohorts 1 and 2. The Actigraph accelerometer (Actigraph GT3X, Actigraph; Pensacola, FL, USA) was used for cohort 3. These devices are very similar in size and shape and therefore are not considered as a factor affecting adherence.

Data Reduction

Data were reduced using specific reliability criteria and validated cut points (31, 32). Data were considered reliable when the accelerometer was worn for a minimum of 10 h on 4 days in short succession, one of which must have been a weekend day. Data were only included in further analysis if reliability criteria were met. We used reliability criteria as the critical factor in determining whether adherence was met. If criteria were met, then adherence to the PA protocol was met, yielding usable and reliable data. If criteria were not met, then adherence was also not met.

Adherence Methodology

For each cohort, a standardized set of adherence strategies were provided to participants in an effort to increase the likelihood that reliability criteria were met. With each successive cohort, new adherence strategies were added to the original protocol procedures at the discretion of the research team. Original protocol procedures used consistently for all three cohorts included a 1-week monitoring period, providing written instructions, a monitoring log, and providing a self-addressed and stamped envelope for returning the monitor. Additional adherence strategies implemented for cohorts 2 and 3 included verbal instructions, in-person training, providing a social story, increased daily wear instructions to 24 h/day, concealing and decorating wear techniques, and incentive payment (cohort 3 only). Due to the *post hoc* nature of this investigation, we were unable to manipulate support strategies among the three samples in a systematic way, limiting specific interpretations. Please see **Table 2** for a full description of protocol procedures and adherence strategies as well as which cohorts incorporated their use.

TABLE 1 | Demographic data of participants by cohort.

Characteristics	Cohort 1 *n* = 27	Cohort 2 *n* = 97	Cohort 3 *n* = 39
% of female	27	23	19
Age (years)	11.9 ± 2.4	12.1 ± 2.3	11.8 ± 2.5
Height (cm)	147.0 ± 12.9	149.6 ± 13.3	145.1 ± 10.9
Weight (kg)	46.9 ± 19.3	48.8 ± 19.9	40.4 ± 14.3
BMI	20.6 ± 7.0	21.1 ± 5.4	18.8 ± 4.3
SRS score	–	81.0 ± 13.9	81.8 ± 13.0
ADOS-2 CSS	–	–	6.75 ± 1.5
WASI-2	–	81.0 ± 18.9	85.5 ± 19.7
PPVT-4	74.9 ± 26.4	–	–

BMI, Body Mass Index; SRS, Social Responsiveness Scale; ADOS, Autism Diagnostic Observation Schedule; CSS, Calibrated Severity Score; WASI, Wechsler Abbreviated Scale of Intelligence; PPVT, Peabody Picture Vocabulary Test.

Statistical Analysis

All PA data were reduced with computer software using the previously mentioned reliability criteria. Actical data were reduced using a specially designed computer program (33). Actigraph data were reduced using ActiLife 6.0. Adherence was used as a binary outcome variable and classification of "adherence" or "non-adherence" was based on whether or not reliability criteria were met (10 h/4 days + 1 weekend day). Analyses included determining the percentage of the sample that adhered to the PA measurement protocol for each study. Chi-square analysis was used to determine differences in adherence between each cohort. Support strategies utilized were then compared and contrasted accounting for observed differences in adherence outcomes.

All statistical analyses were conducted using IBM SPSS Statistics 20 (SPSS Inc., Chicago, IL, USA). Differences were considered significant at an alpha level of 0.05.

TABLE 2 | Use of traditional accelerometry procedures and additional support strategies by cohort.

Adherence supports[a]	Brief description	Cohort 1 *n* = 27	Cohort 2 *n* = 97	Cohort 3 *n* = 39
Monitoring period[b]	Amount of time participants are instructed to wear accelerometer	1 week	1 week	1 week
Method of delivery				
Mail	Participants received accelerometer by mail	x		x
In person	Participants received accelerometer in person		x	
Instructions				
Written[b]	Provided a simple letter detailing instructions	x	x	x
Verbal	Provided in-person verbal instructions		x	
In-person training	Conducted home visits to provide in-person training		x	
Social story	Provided social story to increase comprehension and reduce anxiety		x	x
Monitor log[b]	Provided a monitoring log to record non-wear periods	x	x	x
Wear time instructions				
Waking hours	Participants instructed to wear accelerometer during waking hours	x		
24 h/day	Participants instructed to wear accelerometer 24 h/day		x	x
Wear techniques				
Concealing	Taught participants to conceal accelerometer under clothing		x	x
Decorating	Allowed participants to decorate accelerometer with stickers		x	
Returned by mail[b]	Participants returned accelerometer in pre addressed/stamped envelop	x	x	x
Incentive	Incentive provided upon return of accelerometer with complete data			x

x = used adherence support.

[a] *Supports are presented as a semi-sequential timeline of when supports are typically utilized during physical activity measurement.*

[b] *Original protocol procedures.*

RESULTS

The results present *post hoc* comparison of accelerometry adherence rates from three independent cohorts, each of which incorporated a varying combination of support methodology. For cohort 1, 14 of 27 participants met reliability criteria indicating 51.9% adherence. For cohort 2, 86 of 97 participants met reliability criteria indicating 88.7% adherence. For cohort 3, 38 of 39 participants met reliability criteria indicating 97.4% adherence.

To evaluate the meaningfulness of additional adherence support strategies from one cohort to another, group differences of adherence were calculated using chi-square. Adherence significantly increased between cohorts 1 and 2 [$\chi^2(1) = 18.333$, $p < 0.001$]. Additional supports included (1) in-person delivery of accelerometer, (2) verbal instructions, (3) in-person training, (4) providing a social story, (5) increased daily wear instructions to 24 h/day, (6) concealing wear techniques, and (7) decorating wear techniques.

There was a non-significant increase in adherence between cohorts 2 and 3 [$\chi^2(1) = 2.663$, $p = 0.103$]. One additional support was included during that period. Incentive payment was provided to participants upon the return of the accelerometer containing complete data. Supports that were omitted for cohort 3 which had been previously utilized for cohort 2 included (1) in-person delivery of accelerometer, (2) verbal instructions, (3) in-person training, and (4) decorating wear techniques.

Adherence significantly increased between cohorts 1 and 3 [$\chi^2(1) = 19.837$, $p < 0.001$]. Additional supports included (1) providing a social story, (2) increased daily wear instructions to 24 h/day, (3) concealing wear techniques, and (4) providing incentive payment.

DISCUSSION

Successful adherence to objective PA measurement protocol for youth with ASD aged 9–18 years was increased over the progression of three independent cohorts. This improvement coincides with the addition of many adherence support strategies. The contribution of each subsequent support is suspected of influencing the significant increase observed in adherence. These results are positive and the first to contribute to the development of best practices when conducting objective PA measurement *via* an accelerometer in youth with disabilities.

Adherence rates significantly increased by 45.5% from cohort 1 to cohort 3. Adherence support strategies that both cohorts 2 and 3 shared in common include providing a social story, increasing wear time to 24 h/day, and offering concealing tips to participants. These supports were not included in the first cohort. Given the progression of increased adherence, it is likely that the addition of these supports to the PA measurement protocol influenced adherence. However, caution must be warned in making an assumption of causation given the lack of a true control group.

To further facilitate improved adherence, one additional support was utilized for cohort 3 which had not been previously attempted. Participants were offered a small monetary incentive if they returned the accelerometer with complete data, meaning that they wore the monitor long enough to accumulate the minimum amount of data to achieve reliability. The use of the incentive support stimulated an additional non-significant increase in adherence of 8.7% between cohorts 2 and 3, even in the absence of other helpful supports utilized for cohort 2. Anecdotal evidence suggested that providing the incentive gave participants (or their caregivers) a perceived benefit in completing the PA measurement, thereby increasing dedication to the task. In addition, the research garnished a higher return rate of monitors when incentive was offered.

We believe that the incentive support greatly improved adherence, to the extent that we are now tentative in recommending other supports that were only offered to cohort 2. Those supports included in-person delivery of the accelerometer with in-person training and verbal instructions. These supports clearly increased adherence by 36.8% between cohorts 1 and 2; however, we demonstrated that adherence continued to improve even after omitting these supports for cohort 3 when an incentive is offered. Given the increased costs to the research in time, effort, and budget, we do not recommend in-person delivery, in-person training, or verbal instructions be incorporated into your measurement protocol unless resources allow for these extra costs, so long as incentive is offered following the return of the accelerometer with complete data.

Limitations exist which could affect interpretations. First and foremost, we are not examining the effects of sample characteristics to adherence of accelerometer procedures, but rather the effects of the adherence supports and instructional procedures provided by the research team. Assessments utilized to summarize IQ and ASD severity varied between cohorts, essentially limiting such analyses. Despite this, IQ determined *via* the Peabody Picture Vocabulary Test-4 and the Wechsler Abbreviated Scale of Intelligence-2 resulted in comparable IQs for all cohorts. Minimal differences in BMI are also noted, with no statistically significant differences between cohorts. Despite this, the relation of adherence rates to BMI was not investigated. Additionally, we are not comparing PA between the samples. For that reason, information regarding epoch length, cut points, and PA intensities are not reported. Finally, this retrospective data analysis was performed after the conclusion of measurement of all cohorts, yielding us little control over the systematic planning of support use, accelerometer type, or population. Having said this, the research made every effort to control for environmental and participant demographics. Measurement occurred during a 1-week period in the spring time in the same geographical region in the United States during each study. The sample included only youth diagnosed with ASD. The mean age of participants across studies was stable, only varying by a few months. Accelerometer model varied, but most would conclude this had little impact on adherence given the size similarities between the Actical and Actigraph.

These limitations prompt caution regarding causation. Given the lack of a true control group or the inability to manipulate support use in a systematic way, it is difficult to quantify the individual effects of each strategy. Also, we are unable to differentiate between child and parent driven adherence but can attest that all supports were provided to parents by the research team and in many cases were disseminated to the child from the parent.

Finally, we acknowledge our limited ability to remark on the influence of autism severity and functional status on adherence rates. Given inherent variability in the severity and functional status of children on the autism spectrum, a well-controlled prospective study is warranted to validate the effectiveness of these strategies for enhancing PA monitoring adherence in children with comparable functioning.

As a result of incorporating multiple adherence supports into the practice of objective PA measurement *via* an accelerometer for youth with ASD, adherence rates increased yielding more reliable data and fewer missing data. One common issue experienced by PA researchers are participants who wear the device as described but fall just short of reaching the minimum amount of wear time needed to meet reliability criteria. Oftentimes, these participants' miss reliability criteria by only a few hours on a given day or by missing a weekend day of wear. For this reason, it is important that research continue to examine the minimum wear criteria needed to produce reliable data in special populations. If criteria are reduced, adherence will likely be increased. A reduction of wear time would decrease research costs and ease burden for participants.

In conclusion, adherence to objective PA measurement *via* an accelerometer can be increased when extra support strategies are utilized. We feel that adherence is stimulated most by increasing wear time to 24 h/day, providing a social story, offering concealing tips to participants, and providing an incentive upon the return of the accelerometer with complete data. These support strategies should be used in combination with traditional protocol components including a 1-week monitoring period, providing written instructions, a monitoring log, and providing a self-addressed stamped return envelope. These methods were recently utilized with a younger sample of children with ASD with a 95% adherence rate (11, 34). This suggests utility of these supports in younger samples. These strategies can be generalized to objective PA monitoring using other devices such as pedometers and for use in children without disabilities. Adding these strategies to your pediatric PA measurement protocol is likely to increase research efficiency and decrease non-incentive related costs. Finally, we advise these support methodology be strongly considered as preliminary best practices when measuring objective PA in youth with ASD.

AUTHOR CONTRIBUTIONS

JH contributed to the research design, data collection, statistical analysis, and preparation of the draft of the manuscript. LK contributed to data collection, statistical analysis, and editing the draft of the manuscript. DU contributed to the research design, securing funds, data collection, and editing the draft of the manuscript.

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Physical and Mental Health of Children with Developmental Coordination Disorder

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Developmental coordination disorder (DCD) is a neurodevelopmental condition characterized by poor motor proficiency that interferes with an individual's activities of daily living. These problems in motor coordination are prevalent despite children's intelligence levels. Common symptoms include marked delays in achieving motor milestones and clumsiness, typically associated with poor balance, coordination, and especially handwriting skills. Currently, DCD is said to impact about 2–7% of school-age children. More importantly, DCD is considered to be one of the major health problems among school-aged children worldwide, with unique consequences to physical and mental health. Because these children and adolescents often experience difficulties participating in typical childhood activities (e.g., riding a bike), they tend to be more sedentary, more overweight/obese, at a higher risk for coronary vascular disease, and have lower cardiorespiratory and physical fitness than their typically developing peers. From another perspective, the motor difficulties have also been linked to an increased risk for mental health issues, such as higher anxiety and depression. The understanding of the health consequences associated with DCD offers practical applications for the understanding of the mechanisms and intervention protocols that can improve the consequences of this condition. In this review, I will explore such consequences and provide evidence for the implementation of interventions that focus on improving physical and mental health in this population.

Keywords: developmental coordination disorder, physical health, mental health, motor skills, children

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DEVELOPMENTAL COORDINATION DISORDER

Developmental coordination disorder (DCD) is defined as a neurodevelopmental condition characterized by poor motor proficiency that interferes with an individual's activities of daily living (1). This disorder defines children who, for no medical reasons, fail to acquire adequate motor skills despite their intelligence levels (2). The movements of children with DCD are often described as "clumsy" and "uncoordinated," and frequently lead to performance difficulties that typically developing (TD) children perform easily. Children with DCD are not just low in athletic ability; they struggle to perform the everyday activities that most of us take for granted – zipping a knapsack, tying shoes, using scissors, or buttering bread (3). Other general difficulties commonly associated with DCD include poor fine and gross motor control, speech fluency, abnormal muscle tone (hypo/hypertonia), poor body awareness, and gross motor sequencing. Those general complications can be observed when children with DCD attempt to plan a motor task, organize movements, perform a coordinated action, and adjust movements when demands change, such as moving fast to catch a ball (4).

Developmental coordination disorder has been described as a "hidden problem," (5) with an estimated prevalence as high as 10% in school-aged children. In general, estimates of 2–7% are more likely (6), implying that most school classes have at least one affected child. Estimates suggest that DCD affects four times more males than females, and children born prematurely and/or with extremely low birth weights are at a significantly increased risk of demonstrating this condition (7). Interestingly, these difficulties associated with motor learning and control can last well into adolescence and adulthood (8, 9).

Children with DCD are often diagnosed with other developmental disorders. The most common disorder is attention deficit hyperactivity disorder (ADHD), with 50% of the population showing both disorders. Dyslexia is also a relatively common comorbidity, as well as learning disabilities, speech/language impairment, and most recently, autism spectrum disorders (ASD). Most likely, these diagnoses come before the DCD evaluation, and most of the interventions focus on the comorbidity first. In addition, only ~25% of children with DCD are referred and diagnosed before starting school. The remaining 75% are referred during the first few years in primary school. Presentation at this age includes persistence of the problems noted in the preschool years, such as slow, immature, and laborious handwriting and difficulties in copying from the blackboard. Handwriting problems are readily apparent to classroom teachers, but might be only the tip of the iceberg for children who have significant DCD, indicating that other motor coordination difficulties are present (10). This marked impairment in the development of motor coordination is the first item on the assessment criteria created by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). In this document, DCD is characterized as a Neurodevelopmental Disorder and has four items that must be followed for a correct diagnosis:

1. Acquisition and execution of coordinated motor skills are below what would be expected at a given chronologic age and opportunity for skill learning and use; difficulties are manifested as clumsiness (e.g., dropping or bumping into objects) and as slowness and inaccuracy of performance of motor skills (e.g., catching an object, using scissors, handwriting, riding a bike, or participating in sports);
2. The motor skills deficit significantly or persistently interferes with activities of daily living appropriate to the chronologic age (e.g., self-care and self-maintenance) and impacts academic/school productivity, prevocational and vocational activities, leisure, and play;
3. The onset of symptoms is in the early developmental period;
4. The motor skills deficits cannot be better explained by intellectual disability or visual impairment and are not attributable to a neurologic condition affecting movement (e.g., cerebral palsy, muscular dystrophy, or a degenerative disorder).

CONSEQUENCES OF DCD

Developmental coordination disorder is considered one of the major health problems among school-aged children worldwide (11), with the outcomes often extending beyond the motor domain to include secondary mental and physical health issues. Most specialists agree that these consequences are the biggest issue when it comes to DCD. While it is possible to remediate some of the motor skill problems in childhood, the mental and physical outcomes can significantly compromise quality of life and health of this population for their entire life. An overview of these outcomes is presented below.

MENTAL HEALTH IN DCD

Recently, robust evidence has been added to the notion that children with DCD have an increased risk for mental health difficulties (12, 13). Teachers report that school-aged children with DCD have fewer friends and are more socially isolated than their peers (14, 15), and tend to report lower self-esteem, possibly because of the fewer social contacts and friendships (15, 16). The feelings of inadequacy accompanying poor motor coordination may be constantly reinforced through interaction with peers in school (17).

Several research studies have shown that children with DCD have lower levels of participation in physical activities than their peers without DCD in recess and are less likely to engage in both structured and unstructured activities when compared to TD children (18, 19). It is likely that children with DCD frequently withdraw from physical activities due to poor motor coordination and low perceived competence in sports (20). Children with DCD often face frustration engaging in self-care activities (e.g., dressing), school-based activities (e.g., writing), and have less confidence in their ability to play with other children, mainly due to their motor coordination problems (21). As a result of repeatedly being unable to master daily activities, many children with DCD experience a chronic sense of failure that reduces their willingness to participate in physical activities and trying novel tasks (22). Many children with DCD also report lower levels of enjoyment in free play activities, physical education classes, or organized sports (18, 23, 24).

Empirical evidence directly examining the co-occurrence of motor coordination difficulties and depression is growing (3, 25–27). A 3-year longitudinal in which children identified with probable DCD at age 7 were reassessed for mental health difficulties at age 10 reported that children at risk for DCD were significantly more likely to develop mental health problems relative to their peers (12). Even more interesting, this study found that several factors mediated the connection between DCD and subsequent mental health problems. Specifically, those children with probable DCD who had higher verbal intelligence, higher self-esteem, stronger academic performance, good social communication skills, and an absence of bullying were less likely to develop mental health difficulties over time (12). Children with DCD also have been shown to have higher levels of anxiety than children without the disorder (28–30). A recent large study has reported on more symptoms of anxiety and also depression, but only in a population of children with DCD combined with ADHD (31). Interestingly, this was true for both children and parents. This finding leads to the belief that the level of mental health and socioemotional functioning in those with DCD might also be associated with the degree and number of other comorbidities. These problems may be common problems across neurodevelopmental disabilities, and issues can be compounded beyond the lack of engagement in movement settings shown in children with DCD.

In relation to age, a recent systematic literature review found that differences in groups of TD and children with DCD start to emerge between 8–10 and 12–14 years of age – preschool children did not experience or perceive any significant difference (32). It also is possible that the population with DCD may be overrepresented within high school dropouts (33) and adult mental health clinics (30, 34). It is apparent that in late childhood and adolescence, the emotional impact of DCD may be more severe than the primary motor difficulties that are experienced (35). Thus, as individuals with DCD age, the presentation of difficulties may begin to include more psychosocial issues that are more than likely to affect one's quality of life. For example, adults with a DCD reported significantly lower levels of quality life satisfaction in all domains when compared to TD adults (35). They also report significantly more symptoms of depression, state, and trait anxiety than their peers (36). Retrospectively, adults with DCD have described the anxiousness that they felt about their movement problems in settings, such as physical education and recess (37).

Fortunately, there is recent evidence that it is possible to improve psychological well-being in this population. A pilot study exploring whether two group intervention programs improved several psychological variables (anxiety, adequacy, and predilection for physical activity; participation, preferences, and enjoyment for activities) and motor skills from the perspective of a child with DCD as well as parental perceptions of motor skills, rate of function, and strengths and difficulties (38). The programs were unique in characteristics: Program A focused on task-oriented activities in a large group involving motor skill training and collaboration and cooperation among children, and Program B was composed of three groups with a direct goal-oriented approach for training of skills chosen by the children. Results indicated that children improved motor skills after both programs but showed distinct results in regards to other variables – after Program A, children showed higher anxiety and lower levels of enjoyment, even though parents detected an improvement in rate of function and a decrease in peer problems. With Program B, children decreased anxiety levels and parents noted a higher control of movement of their children. This study establishes a new concept in interventions for children with DCD – while it is important to improve motor skills, most researchers and therapists in the field will agree that prevention and treatment of mental health difficulties should be a key element of intervention for children with DCD (15). Obviously, more studies should be conducted, but an identification of factors that may be modifiable and that can be targeted through intervention is likely to be a critical component of addressing the long-term mental health outcomes of children with DCD (31).

PHYSICAL HEALTH IN DCD

Several studies have also identified that children with DCD are physically inactive and less fit when compared to their TD peers (1, 39–42). According to a recent systematic review, 13 of 18 studies examining the relationship between motor proficiency and body composition found that children with poor motor proficiency had significantly higher BMI, waist circumference, and percent body fat compared to their peers (1). The prevalence of overweight and obesity is higher in DCD children, according to a recent systematic literature review. Longitudinal research has also shown poor motor coordination to predict negative changes in body weight, including increased risk of overweight and obesity (43, 44).

Several measures of health-related fitness have been investigated with this population. In a longitudinal study comparing a group of TD children to a group of children with DCD, results indicated that the TD group showed significant long-term changes in BMI and long jump, while the DCD group showed significant increases in BMI values and decreases in flexibility, as measured by the sit and reach task. In general, children with DCD performed worse on the items of flexibility, muscle strength, and muscle endurance after the first year. Compared to age- and gender-matched norms, children with DCD not only were less physically fit but also showed a significant long-term decline in flexibility and abdominal or core strength (45).

Children with lower motor competence also demonstrate significantly poorer performance on important components of physical fitness, such as aerobic and anaerobic endurance and muscular strength, when compared against developing typically peers (46). Several factors that may contribute to poorer fitness in children with DCD have been identified, such as muscular strength, inability to exert maximal force, and variability in rate of power and timing in performing work (47). A recent study has found that children with DCD perform significantly worse than TD children in the five-jump test, triple-hop distance, the modified agility test, and walking distance (48). It also appears that the DCD population also shows lower performance in several physiological measurements, as in poorer lung function (42), earlier exercise fatigue (49), higher blood concentration, heart rate, respiratory exchange ratio, salivary alpha amylase, lower plain threshold (50), and reduced baroreflex sensitivity (51). Overall, it can be easily concluded that indices of health-related physical and cardiorespiratory fitness are lower in children with DCD.

Despite the number of physical health concerns in these children, it appears that it is possible to alleviate some of these issues. As it is been established with mental health, there is recent evidence that it is possible to improve physical health in children with DCD. A recent study explored the effects of a motor skill training on exercise tolerance and cardiorespiratory fitness in this population (48). A DCD training group, DCD control non-training group, and a TD control group were tested for cardiopulmonary exercise test (CPET), pulmonary function testing, and 6-min walking test (6MWT) with an interval of 8 weeks. The training group participated in three sessions per week for 8 weeks. The sessions emphasized improvement of motor skills and fitness. The results indicated that the DCD group improved in maximal power output at anaerobic threshold and at peak level, walking distance, and maximum heart rate. They also reduced perceived exertion, while the other groups did not change any of the measures.

CONCLUDING REMARKS

Developmental coordination disorder is a disorder diagnosed on the basis of poor motor skills. However, the physical and mental consequences of the condition, when present, are substantial and can cause significant long-term outcomes. While it is likely that poor motor coordination results in withdrawal of most, if not all, physical activity settings, it is not known precisely how children with DCD subsequently develop mental health problems like depression and anxiety (24, 36, 52). There are several potential mediators between poor motor coordination and physical/mental health – peer and social relationships, bullying, and self-esteem. We can conclude, in general, that this population is at a significant risk for physical and mental health outcomes, and these risks should be treated seriously and should be the focus of the work with this population, even before symptoms or concerns appear. With that, it is important to recognize that there is also evidence for a lack of differences in children with DCD and TD children in feelings of social acceptance and general self-worth (32) – while this may be due to sample bias and/or other confounding factors, it is important to highlight that some children with DCD may never have mental health problems. However, it is probably best to treat all the DCD population as "high-risk," and work on prevention of any future health problems.

It is been well-documented that interventions based on everyday motor skills have been effective for the DCD population (53). These interventions focus on findings and implementing strategies that facilitate the accomplishment of motor tasks that are otherwise difficult (e.g., handwriting, tying shoes, etc.). With the latest findings regarding the physical and mental health outcomes, it is imperative that interventions are employed to enhance both physical and mental health in everyday life. Ideally, these interventions would be holistic and focus on prevention of these consequences. Missiuna and Campbell (31) reinforce that a focus on interventions that may be preventative is particularly important in light of the mounting evidence that DCD is a chronic condition that cannot be "fixed" and will persist into adulthood (37, 54, 55).

As these types of interventions might be challenging for professionals, it might be important to start with promoting models that analyze relationships among all factors that place children with DCD at risk for psychological problems in the first place. For example, Cairney et al. (52) explores the environmental stress hypothesis, which suggests that DCD may be a primary stressor leading to secondary stressors, potentially leading to problems such as depression and anxiety. As physical and mental health follow parallel paths, it is important to explore models that account for both. Interventions that account for the factors mediating poor motor coordination and its consequences should be a priority – and as such would need the involvement of several professionals at different levels and expertise. The program Partnering for Change (56) is one such intervention that is currently being tested. While it is complex, and perhaps even overwhelming for health and education professionals to see DCD as more than a motor coordination problem and to focus on prevention of the consequences associated with it, we believe that studies, such as the ones by Caçola et al. (38) and Farhat et al. (48), give some good indications that it is certainly worth trying.

An important consideration in all the research and intervention for children with DCD is causality. Establishing causality will only be possible with long-term studies that map trajectories (31) and monitor potential mediators and outcomes over time. The evidence, currently, suggests that DCD is the primary stressor. For example, when it comes to physical health, DCD is typically diagnosed before signs of overweight status, so it is assumed to be the cause of high body fat. However, little is known about the relationship between weight, DCD, and its comorbidities. Research also shows that obesity status is higher in populations with ASD and ADHD, therefore more research is needed to explore the interaction between weight and these comorbidities with DCD.

Obviously, there are many limitations in the studies that looked at physical and mental health of children with DCD. Further research is needed to establish several parameters of this disorder. The issue of comorbidities needs to be explored in detail. In addition, normal difficulties that happen in adolescence, a period of high risk for both the emergence of neuropsychological problems as well as an increase in obesity and decrease in physical activity, should be ruled out. Nonetheless, much of the evidence is leading to the fact that individuals with DCD show consistent and early emergence of mental and physical health problems, which can greatly impact healthcare, in both costs for the government and wellness of the patient, especially long term.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and approved it for publication.

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The Participation Patterns of Youth with Down Syndrome

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Purpose: The purpose of this paper was to investigate the participation patterns of children with Down syndrome (DS) using the construct of participation as defined by the International Classification of Functioning Disability and Health (ICF).

Methods: Sixty-two children with DS were recruited between the ages of 9 and 17 years. All participants were given an interview-administered version of the Children's Assessment of Participation and Enjoyment (CAPE) to measure participation (1).

Results: Children with DS participated the most often, based on frequency, in recreational activities ($p < 0.001$); social activity types represented the greatest extension into the community based on with whom the children participated with ($p < 0.05$); finally, physical and social activities represented the greatest extension into the community geographically ($p < 0.001$). In addition, children with DS are significantly more active in activities that are informal in nature.

Conclusion: Children with DS participate in a number of activities; however, the extent of their participation within these activities differs depending on the participation pattern examined. Implications for educational and community-based programs are discussed.

Keywords: Down syndrome, children and participation

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INTRODUCTION

The physical, social, academic, and spiritual growth of children and adults with and without disabilities is positively influenced by active participation (2–5). Active participation is the level of participation that allows individuals to gain positive outcomes in multiple domains such as the physical, cognitive, and social (6) that contribute to personal growth and development (7). When initiated at a young age, active participation in physical activity can positively influence physical activity patterns into adolescence and adulthood (8, 9).

Increased physical activity over the life span can play a part in reducing potential health risks associated with physical inactivity later in life. Unfortunately, children with disabilities engage and participate less often than their peers without disabilities (10–12). This is particularly alarming considering the increased health risks for many children with disabilities (13, 14). Even with knowledge of health- and psychological-related benefits physical activity and active participation provide for this population (15, 16), participation patterns among children with disabilities are still largely underexplored (3, 17).

It was not until the acceptance of the International Classification of Functioning Disability and Health (ICF) model that participation was established as a construct in understanding disability (18, 19). The ICF's model of disability suggests three levels of human function that are as follows: (1) body functions and structures, (2) activities, and (3) participation. Further, it states, an impairment at one or more of these three levels constitutes a disability (18). The nature and level of an individual's disability can affect the level of participation that individual is capable and comfortable participating in (20).

Participation as defined by the World Health Organization (WHO) is "the nature and extent of a person's involvement in life situations" (18). Although active participation has been linked to a healthy lifestyle, the acceptance of the ICF model identified the importance of participation within the broader context of disability (21). An individual's involvement in these life situations may be effected differently based on the person's disability and the needs associated with their disability (20). As a result, multiple aspects of participation should be considered when attempting to increase physical activity involvement, this may include the activity itself, other participants, where the activity is taking place, and how often participation occurs.

Down syndrome (DS) is the most common genetic cause of intellectual disability and occurs in approximately 1 in 700 live births (22). Individuals with DS are at an increased risk for obesity, osteoporosis, musculoskeletal disorders, and cardiovascular-related health problems (23). When children with DS were compared to their older siblings, they were found to be heavier and spent less time in vigorous physical activity (11, 24). Activity levels in children with DS have been found to decrease over time (25, 26), and the current participation patterns of children with DS remain under investigated (24, 27).

The lack of evidence-based research in this area warrants attention since community involvement and active lifestyles have been associated with positive health outcomes (23, 27, 28). In addition to physical health benefits, participation provides an opportunity for peer interaction in an environment that fosters social support, security, and self-esteem (29). The construct of participation, within the ICF model, aims to understand the whole person in a social context (23, 30, 31). Participation is influenced by personal, familial, and environmental factors, which all need to be considered during assessment and program planning (3).

Previous findings suggest that continuous participation is influenced by factors such as, participating with others, having fun, feeling successful, and independently completing activities (32, 33). Family values also influence the activities that children with disabilities have access to, which affects participation patterns (33). Though complex, understanding specific participation patterns for this population could have implications for educators and health professionals to help inform intervention and program needs for children with and without disabilities.

Evidence-based research about participation patterns in individuals with disabilities is limited (3, 34–36). Existing literature indicates that children with disabilities participate in informal activities, such as playground games more than formal activities, such as community-based sport programs (3). This is concerning given that formal activities have been associated with improved skills (motor skills, social skills, etc.), competencies, and social relationships (3). When the participation patterns of children with DS, autism spectrum disorders, and typical development were compared, children with typical development engaged in more social and recreational activities and more activities with friends (36). This participation disparity further exemplifies that children with DS have more limited opportunities to participate in activities that foster psychosocial health-related benefits (29).

By investigating the participation patterns of children with DS, intervention and community programs can be tailored to meet age-appropriate needs. School curricula and individual education plans (IEP's) can be developed to support prerequisite skills needed to encourage participation in selected activities. Currently, the participation patterns of children with DS are unknown, thus the primary purpose of this study was to investigate the participation patterns of children with DS through the construct of participation as defined by the ICF.

MATERIALS AND METHODS

Participation patterns of children with DS were collected through an interview-administered version of the Children's Assessment of Participation and Enjoyment (CAPE) (1). The CAPE was administered to children with DS in a one-on-one interview, approximately 45 min in length. The CAPE was administered during the baseline data collection for an adapted physical activity intervention (37). Two interviewers (graduate students in Kinesiology) met with all of the participants in this study as well as their caregivers to collect data. Both administrators trained together on CAPE administration and procedures. In addition to training for the CAPE, both administrators had multiple years of experience administering a variety of interview-based assessments [Autism Diagnostic Observation Schedule (ADOS), Peabody Picture Vocabulary Test (PPVT), Wechsler Abbreviated Scale of Intelligence (WASI)] to individuals with DS, intellectual disabilities, and autism spectrum disorders.

Participants

Participants were recruited from an existing study that focused on implementing and adapting a physical activity program for children with autism or DS. A total of 62 children (28 males and 34 females) with DS were recruited through an adapted physical activity program in the Midwest region of the United States. The participants ranged in age from 9 to 17 years (mean age = 13.15, SD = 2.60). The ethnicities of the participants were Caucasian ($n = 53$, 85.5%), African American ($n = 2$, 3.2%), Hispanic American ($n = 2$, 3.2%), Asian American ($n = 1$, 1.6%), and unspecified ($n = 4$, 6.5%). All participants gave verbal and written assent, and a caregiver for each participant signed informed consent. All procedures were approved by the Institutional Review Board.

Data Collection

The interview-administered version of the CAPE was used to measure participation (1). The CAPE is reliable and valid for children aged 6–21 years with and without disabilities. Validity and reliability of the CAPE was established using data from a study involving 427 children with physical disabilities (3). Intensity, enjoyment, and preference scores were significantly correlated with environmental, family, and child variables ($r = 0.10–0.20$), and all predictions reached statistical significance ($p < 0.01$, two tailed). Analysis showed sufficient internal consistency, test–retest reliability, and construct validity (3). Although primarily used in studies focused on children with physical disabilities, the CAPE has been used to survey individuals with DS (38). In addition, a special issue on participation specifically noted the importance of reaching out to diverse populations, such as the population of this study (39).

The CAPE consists of items (activities), and children respond based on activity participation during the past 4 months. Each item (or activity) is measured on five dimensions: diversity (whether or not the child participated in the activity), intensity (how often the child participated in the activity), with whom the child participated, where the child participated in the activity, and enjoyment of the activity. Each dimension is scored on an ordinal scale; a higher score represents a greater extension into the community, with the exception of enjoyment (see **Table 1**). Each activity is categorized into one of five distinct activity types: recreational, physical, social, skill-based, or self-improvement. Activities are further classified as formal or informal, based on work by Sloper and colleagues (40). Formal activities are those that require prior planning, have specific goals or rules, and have a coach, leader, or instructor. Informal activities are less structured and are often initiated by the child, such as playground play.

Each activity was presented on a large cue card with an illustration of the activity and a phrase to describe it. The interviewer asked each question verbally. If the child responded "yes" to participation, the interviewer asked subsequent questions about the activity on each dimension (how often they participated in the activity, with whom they participated, where they participated, and how much they liked the activity). If the child answered "no" (to participation), the interviewer moved on to the next activity. Participants were accompanied by at least one parent or caregiver and were encouraged to answer questions independently. Parents occasionally provided participants with assistance when answering questions within a 4-month timeframe and to conceptualize vague questions in a more familiar context [i.e., when participants were asked the question, "do you ever participate in school clubs?" An example of a parent creating a more familiar context might be "what days do you go to reading club?" or "what do you do with Ms. Smith (an instructor for a specific club)"?]. Responses were recorded by the interviewer on a summary score sheet. A subset of 15 participants were interviewed twice (7 females, 8 males, mean age = 13.3, SD = 2.3) within a 3-week time period to estimate the test–retest reliability of the CAPE for youth with DS.

Data Analysis

All data were analyzed using PASW Statistics (18.0) for Windows. A frequency analysis was conducted on the activities within each activity type, based on participation. Differences in participation across activity types (recreational, active physical, social, skill-based, and self-improvement) were determined by computing the average activity type score for each dimension (diversity, intensity, with whom, where, and enjoyment). A Wilk's Lambda multivariate analysis was performed, to account for the within- and between-subject factors, on the mean activity type score within each of the five dimensions to verify whether or not significant differences existed by activity type within each dimension. When significant differences were found, a Bonferroni *post hoc* pairwise comparison of activity types was conducted for each dimension. To compare formal and informal activity participation, the overall diversity and intensity scores within each domain were compared using a chi square test.

Test–retest reliability was determined using the overall (total) scores for each of the five dimensions. The overall scores for diversity, intensity, with whom, where, and enjoyment were compared over two administration occasions. All scores were calculated as indicated by the scoring procedures in the CAPE manual (1). The overall diversity score was calculated by summing the diversity score across all 55 items. The overall intensity score was calculated by summing the intensity score across items and dividing by the total number of items (55). The overall with whom, where, and enjoyment scores were calculated by summing the score and dividing by the overall diversity score, which accounted for the number of activities that the child participated in.

RESULTS

A frequency analysis found the most common activities based on activity type; these results can be found in **Table 2**.

Dimension Scores

A Wilk's Lambda multivariate analysis was performed on the five activity types for each dimension: diversity, intensity, with whom, where, and enjoyment (**Table 3**). Significant *post hoc* activity type differences ($p \leq 0.05$) are indicated by superscript in **Table 4**.

Within the diversity dimension, recreational activities were participated in significantly more than physical ($p < 0.001$),

TABLE 1 | Dimensions proceeding diversity and ordinal scoring values.

Diversity	Ordinal scale scoring values						
	1	2	3	4	5	6	7
Intensity	1 time in the past 4 months	2 times in the past 4 months	1 time a month	2–3 times a month	1 time a week	2–3 times a week	1 time a day or more
With whom	Alone	Family	Other relative	Friends	Others	–	–
Where	Home	Relative's	Neighborhood	At school	Your community	Beyond community	–
Enjoyment	Not at all	Somewhat	Pretty much	Very much	Love it	–	–

TABLE 2 | All activities categorized by activity type in order of frequency.

No. of participants	Recreational activities
62	Watching TV or a rented movie
60	Playing board or card games
58	Doing crafts, drawing, or coloring
57	Playing computer or video games
56	Doing pretend or imaginary play
54	Playing with things or toys
54	Going for a walk or a hike
51	Playing with pets
51	Playing on equipment
48	Doing puzzles
47	Taking care of a pet
43	Collecting things
	Physical activities
47	Playing games
43	Doing snow sports
40	Doing individual physical activities
37	Playing non-team sports
37	Bicycling, in-line skating, or skateboarding
37	Doing team sports
27	Doing water sports
23	Gardening
19	Fishing
16	Racing or track and field
10	Participating in school clubs
9	Doing a paid job
4	Doing martial arts
	Social activities
60	Listening to music
59	Talking on the phone
57	Going to a party
57	Visiting
57	Making food
57	Hanging out
56	Entertaining others
55	Going to the movies
45	Going to a live event
36	Going on a full-day outing
	Skill-based activities
55	Dancing
39	Playing a musical instrument
31	Participating in community organizations
30	Swimming
15	Learning to dance
11	Taking music lessons
10	Learning to sing (choir or individual lessons)
10	Horseback riding
6	Taking art lessons
5	Doing gymnastics
	Self-improvement activities
61	Shopping
60	Reading
59	Doing a chore
55	Doing homework
50	Going to the public library
49	Doing a religious activity
40	Writing letters
31	Writing a story
20	Doing volunteer work
16	Getting extra help for schoolwork from a tutor

TABLE 3 | Group differences in activity type by dimension.

Dimension	Welch (df1, df2)	*p* value
Diversity	187.92 (4, 151.42)	<0.001
Intensity	17.28 (4, 148.19)	<0.001
With whom	22.48 (4, 148.23)	<0.001
Where	31.05 (4, 147.88)	<0.001
Enjoyment	9.20 (4, 147.66)	<0.001

TABLE 4 | Diversity sum and intensity mean score by activity type.

	Recreational	Physical	Social	Skill-based	Self-improvement
Diversity	10.34^{a}	5.63^{b}	8.79^{c}	3.42^{d}	7.11^{e}
Intensity	5.12^{a}	3.48^{b}	4.07^{bc}	3.78^{b}	4.50^{ac}

Post hoc significant differences are denoted by different superscripts in each row.

social ($p < 0.001$), skill-based ($p < 0.001$), and self-improvement activities ($p < 0.001$). Physical activities were participated in significantly more than skill-based ($p < 0.001$) and significantly less than social ($p < 0.001$) and self-improvement activities ($p < 0.001$). Social activities were participated in significantly more than skill-based ($p < 0.001$) and self-improvement activities ($p < 0.001$). Self-improvement activities were participated in significantly more than skill-based activities ($p < 0.001$).

Within the intensity dimension, *post hoc* pairwise comparisons showed that recreational activities were participated in significantly more often than physical ($p < 0.001$), social ($p < 0.001$), and skill-based activities ($p < 0.001$). Self-improvement activities were participated in significantly more often than physical ($p < 0.001$) and skill-based activities ($p < 0.001$).

Within the other dimensions, fewer *post hoc* differences were found (Bonferroni). In the dimension of with whom, participants had a significantly greater extension into the community when they participated in social activities compared to all other activity types, recreational ($p < 0.001$), physical ($p < 0.05$), skill-based ($p < 0.01$), and self-improvement ($p < 0.001$). Within the dimension of where, participants were significantly less geographically integrated into the community when they participated in recreational activities compared to physical ($p < 0.001$), social ($p < 0.001$), skill-based ($p < 0.01$), and self-improvement activities ($p < 0.001$). Within the dimension of enjoyment, two significant differences were found. Children with DS enjoyed social activities significantly more than physical ($p < 0.001$), skill-based ($p < 0.001$), and self-improvement activities ($p < 0.001$). They also enjoyed recreational activities more than physical ($p < 0.001$) and skill-based ($p < 0.001$) activities.

This sample of children participated in a higher proportion of informal activities compared to formal activities (chi square = 343.211, $p < 0.001$).

Test–Retest Reliability of the CAPE for Children with DS

The test–retest reliability of the CAPE resulted in the following moderate intraclass correlation scores for each of the overall dimension scores of diversity, intensity, with whom, where, and enjoyment: overall diversity $R = 0.67$, overall intensity $R = 0.69$, overall with whom $R = 0.58$, overall where $R = 0.91$, and overall enjoyment $R = 0.80$. These results demonstrate a moderate-to-high test–retest reliability.

DISCUSSION

Children with DS participate in all activity types represented in the CAPE, which include recreational, physical, social, skill-based, and self-improvement activities. The participants in this study engaged the most often in recreational activities followed by social, self-improvement, physical, and skill-based activities (see **Table 4**). Understanding the participation patterns of children with DS allows for educational and community-based programs to be aimed at age-appropriate preferences with the intent of achieving balanced participation. Understanding what activities individuals with DS participate in along with where and whom they are participating with provides an initial step in exploring their motivations and impediments.

Recreational activities were participated in the most among children with DS (the most common activities for recreational activities and other activity types are listed in **Table 2**). Activities within this category included playing board games, watching TV, playing computer and video games, crafts, drawing, or coloring. The results of this study support previous work, which indicate that children with DS lead physically inactive lifestyles (24, 41). To that end, the least participation occurred in the active physical and skill-based activity types – it is noteworthy that these activity types consisted of many physical activities (see **Table 2**) (1).

Although this study was not aimed solely at understanding physical activity participation, there is a consistent trend in the data favoring physical inactivity for children with DS. Given the health-related concerns facing children with DS as they age, such as increased risk for obesity, osteoporosis, musculoskeletal disorders, and cardiovascular related health problems (23), it is important to embed active physical and/or skill-based activity types in educational and community-based programs. Educators and health professionals should work toward providing balanced activities that include the children's activity preferences without neglecting other priorities, such as physical activity (42).

The CAPE measures participation on a social and geographic continuum through the dimensions of "with whom" and "where." Lower scores in these dimensions are reflective of more solitary activity (with whom) with a closer proximity to the home (where), and higher scores reflect more engagement within the community on a social and geographic continuum (1). Based on the results within these dimensions, youth with DS extend their social and geographic network the most when they participate in the active physical and social activity types. In contrast, social and geographic networks extend the least when they participate in the recreational activity type. Based on the results of this study, each activity type has unique benefits focused on different aspects of participation. This information can guide programs and help educators and community programmers to create activities based on the various needs of the program and the needs of the children.

Similar to previous studies on the participation patterns of children with disabilities, we found that children with DS prefer activities with an informal structure. King et al. (34) found that as children with physical disabilities get older, participation in recreational activities declines, and participation in social activities increases. This result is not surprising given that meaningful participation is impacted by enjoyment, and children's interests change as they get older (33). As children get older, often the availability of resources and supervision needs decrease, understanding this impact on participation needs is important (43).

A combination of preferences and activity priority should be taken into consideration for program development. Within this study, many recreational activities were participated in frequently, while enjoyable, these activities provide little physical activity. The health-related concerns of children with DS have direct relationships to physical inactivity making physical activity a priority (42). Educational and community-based programs may be better informed through balance (a variety of activity types), preference (activity types that children enjoy participating in), and priority (activity types that focus on priority based on appropriate assessment).

For example, a child who has a priority of forming friendships should be encouraged to participate in social activities. While a child with a priority of being more physically active should focus on physical and skill-based activities. Targeting educational and community-based programs to increase participation for individuals with DS may make a significant contribution to improving their health and well-being (43). Choosing activity types targeted at priorities and preferences can allow children to participate in a balance of activities, including activities with direct health-related benefits and activities with psychosocial-related benefits such as improved social support, security, and self-esteem (29).

Understanding these participation patterns helps researchers, clinicians, interventionists, and educators better prepare for program needs that help to enhance the overall community participation for children and youth with DS. Previous research suggests a behavior phenotype for individuals with DS to engage in specific activities (44). Understanding these activities along with the less popular activities could be beneficial for practitioners working with individuals with DS. Many of the participants in our study reported deficits in the areas of formal, physical, and skill-based activity participation. These deficits could indicate a need for increased school- and community-based programs in these areas.

There are several logical next steps to extend this research. Future research can seek to link motivation to activity participation. In addition to motivation, future researchers might seek to examine potential social and motor skills necessary for successful participation. For example, adults with DS often report difficulty in finding someone to be active with (45) in addition to previous research indicating delays achieving motor milestones (46).

Limitations

The test–retest reliability of the CAPE shows moderate-to-high levels of consistency. The small subsample used to test reliability could have been larger and produced more normal and stable measures of variability and helped improve reliability. There were some additional factors in administering this tool to youth with DS that need to be considered. Previous research suggests that CAPE administration takes approximately 30–45 min to complete (1). During this study, the approximate administration time of the CAPE for youth with DS ranged from 1 to 1.5 h. This extended amount of time was necessary to allow participants to fully understand and process each question before responding or getting assistance from a parent or guardian. Some participants struggled to pay attention, especially in the later portion of the CAPE administration. It may be helpful to offer a break to some children, in order to refocus and answer each question as accurately as possible.

Although the interview-administered CAPE was directed to the youth participant, parental assistance was often helpful [see Bogner (47), for an interesting review]. Discrepancies between the youth participant and their parent occasionally existed when estimating intensity, with whom they participated, or where the activity took place the most often. From the researcher's perspective it appeared that parental estimates showed more accuracy. With a parental prompt, the youth participant usually recalled what the parent suggested. For example, when the children were asked how often they visited with others, the parents might suggest specific people with whom the child typically visited, to prompt accuracy in determining the frequency of visits.

The protocol for administering the CAPE requires the participants to establish a 4-month reference period. This was difficult for some of the participants to comprehend, and parental assistance was often required. The visual cue cards provided pictures that were helpful in describing some of the activities, but at times further explanation for both the youth and parents was necessary. A good CAPE administrator must be prepared to make items more concrete. For example, clarification was needed for the activities titled "hanging out," "visiting," and "entertaining others." The level of intellectual disability appeared to influence a child's ability to self-report. Intellect was not formally measured for the purpose of this study, but it was evident that some youth were more capable of completing the questionnaire independently, while others needed more assistance from their parents.

Future Direction

Since many participants received help from their parents during the administration of the CAPE, it might be interesting to compare parental report to youth self-report to further verify the reliability of the CAPE for youth with DS. Parents of youth with DS appear to know a lot about what their children participate in, where they participate, and with whom they participate with.

The lengthy administration time of the interview caused difficulty in sustaining attention for some of the youth. An alternative study might focus on a subset of the questions from the domains of the most interest. Decreasing the timeframe necessary to administer this participation tool would be helpful in sustaining attention for the duration of the questionnaire.

Future research might also investigate participation engagement over time. Which activities do children continue, and which activities are dropped? A longitudinal analysis might be helpful in better understanding how participation in different activity types changes over time as well as contribute to the long-term participation patterns of children with DS.

CONCLUSION

Children with DS participate in all activity types represented in the CAPE. Based on the results of this study, different activity types support different priorities. Children with DS participated the most in recreational activities. Physical and social activities allowed the greatest geographic extension into the community. Social activities involved the greatest social extension into the community. Proportionately, children with DS participate more in informal compared to formal activities. Consistent with Menear (26), the findings of this study support the need for a variety of community-based programs for youth with DS. Understanding the activity preferences of individual with DS can potentially aid parents, educators, and allied health professional in identifying attractive, meaningful, and motivating activities.

ETHICS STATEMENT

All participants gave verbal and written assent, and a caregiver for each participant signed informed consent. All procedures were approved by the Institutional Review Board at the University of Michigan.

AUTHOR CONTRIBUTIONS

All the authors contributed to this manuscript. MM conceived the idea, methodology, data analysis, and interpreted results. JL contributed to the section of the manuscript focused on informal and formal activities. PE assisted in interpreting results. NC updated this manuscript with relevant literature. DU mentored MM throughout this process.

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BOOK REVIEW
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Book Review: A Teacher's Guide to Adapted Physical Education: Including Students with Disabilities in Sports and Recreation, 4th Edition

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Keywords: adapted physical education, book review, teacher's guide, sport and recreation, inclusion

A book review on
A Teacher's Guide to Adapted Physical Education: Including Students with Disabilities in Sports and Recreation, 4th Edition

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The fourth edition of this book is organized into four sections. Section I: Foundations (Chapters 1–3) provides an in-depth description of physical education, inclusion, and taking a team approach to inclusion in physical education. Section II: Inclusive practices and Planning (Chapters 4–7) focus on planning and assessment along with instructional, curricular, game, and sport modifications. Section III: Understanding Specific Needs (Chapters 8–16) provides information related to understanding specific needs including intellectual, learning, and sensory disabilities as well as emotional disturbance. Section IV: Supporting Across Contexts (Chapters 17–21) focus on social acceptance, making physical education safe, behavior management, inclusion in community-based recreation, and multicultural education and issues of diversity. At the end of the book, there are comprehensive reference and index sections.

The fourth addition of this book has changed a number of areas from the previous third edition. First, this edition includes downloadable materials, which includes customizable PowerPoints for individuals who will be teaching a course using this book. Instructions on how to retrieve the material are also provided. Second, there is a notable difference in the number of collaborators for different chapters of the book. Block identifies in his acknowledgments how "thrilled he was to get some of the leaders in physical education for students with specific disabilities" to contribute to the new chapters. Third and perhaps the most notable change is the addition of nine chapters focusing on understanding the needs for specific disabilities (section III). Finally, block has changed some of the organization of the chapters. Most notably, (a) the book is now organized into four themed sections, (b) chapters 4 and 5 from the third edition (Planning for inclusion in physical education, assessment to facilitate successful inclusion) have been combined to create chapter 4 in the fourth edition (Program Planning and Assessment), (c) the aquatics chapter from the third edition has not been included in the newest edition, and (d) the new chapters on Understanding specific needs (chapters 9–16) have been inserted after the game and sport modifications chapter moving chapters on facilitating social acceptance, making inclusive physical education safe, positive behavior supports, community-based recreation, and multicultural education and diversity issues to comprise the last section of the book (Supporting Across Context). The organization of this book has an intuitive flow progressing from basic to more complex content regarding adapted physical education.

SECTION I: FOUNDATIONS (CHAPTERS 1–3)

This section does an excellent job of describing quality physical education along with developmentally appropriate programing and curricular models. This section spends ample time on answering the question "what is inclusion?" and includes current research on inclusion in physical education as well as strategies for supporting inclusion in physical education. This section also spends an entire chapter on using a team approach to inclusion, discussing who is a part of the collaborative team (Physical Education Integration Team), and offers practical strategies for productive communication and managing conflict.

SECTION II: INCLUSIVE PRACTICES AND PLANNING (CHAPTERS 4–7)

This section is filled with concrete ways to plan and modify curriculum, instruction, assessments, and games and sport. I especially liked the chapter on instructional modifications. This chapter (chapter 5) identifies different models related to modifications, selecting appropriate modifications, accommodations related to class organization, how information is presented, and providing structure and routine. This chapter also includes a well-designed sample peer tutoring training manual and training evaluation in the appendix.

SECTION III: UNDERSTANDING SPECIFIC NEEDS (CHAPTERS 8–16)

Section III focuses on understanding specific disabilities (Intellectual Disabilities, Learning Disabilities, ADD/ADHD, Autism Spectrum Disorder, Emotional Disturbance, Deafness or Hard of Hearing, Visual Impairments and Deafblindness, Physical Disabilities, and Other Health Impairments). Each chapter describing the causes, incidence, and characteristics of various disabilities. Each chapter also provides instructional strategies, and modifications to help include students with these disabilities in physical education. Each chapter has some slight variation based on the specific needs for the disability that is being discussed. For example, chapter 11 (Autism Spectrum Disorder) spends time introducing behavior management strategies where as chapter 15 (Physical Disabilities) spends time discussing secondary health conditions, such as pressure sores and contractures. This section is very informative and well put together. At the end of each chapter is a list of current resources (more information on sport, camps, and support).

SECTION IV: SUPPORTING ACROSS CONTEXTS (CHAPTERS 17–21)

This section has various topics including facilitating social acceptance, making inclusive physical education safe, positive behavior support, such as students with disabilities in recreation, and multicultural education and diversity issues. This section really rounds out this text book. It covers many of the topics that some may feel were not addressed in other areas and again provides current information and resources. The chapter on multicultural education and diversity issues explores issues related to disability and diversity like ableism, and individuals with disabilities as a minority group. The chapter also spends time discussing awareness of individuals with disabilities coming from a culturally diverse background and understanding the views of individuals with a disability and how they are represented in the media.

Overall, this book is an excellent choice for any adapted physical activity course that is preparing educators. The layout of the book is very easy to navigate. One of my favorite things as an instructor is that each chapter has clear objectives stated at the beginning of the chapter. While there are not very many pictures in this textbook, each chapter has tables and figures that help explain the content and the topic headings help break things up, so it is easy to read. This is the perfect book for physical educators (adapted or not) to have as a resource for understanding how they can best prepare and teach their students. While this book is focused on adapted physical education many of the topics, strategies and models that are provided could also benefit students without disabilities in physical education.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and approved it for publication.

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