Research Article

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Effectiveness of Community Bowling Program for Youth with Disabilities

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Abstract

The pandemic related social distancing protocols and resultant limitations in recreational activities raised additional barriers for children with disabilities participating in sports and social events. This study describes the effects of an adaptive recreational community bowling program on quality of life (QoL) and physical abilities in children with disabilities during the COVID-19 pandemic. Thirty-four children participated at four different bowling locations. Pre- post-intervention data collected included the PedsQL: Parent Report Quality of Life and General Well-being scale for children, pinch strength test, grip strength test, trunk flexion test, and shoulder range of motion measure. Results showed significant improvements (p-value=0.01) in bilateral pinch strength, and thoraco-lumbar range of motion. No differences were found in grip strength or shoulder range of motion. Significant improvements were found in QoL (p-value=0.01) primarily related to social and emotional factors. This suggests that adaptive community recreational bowling programs can have therapeutic effects on children with disabilities.

Keywords: Community Intervention; Quality of Life; Biometric Measures; Disabilities; Adaptive Sports

Introduction

With National protocols for social distancing during the 2020-2021 school year, extracurricular programing was at a minimum for typical functioning school-aged children and almost non-existent for children with disabilities. Numerous mental health threats are associated with the Covid-19 pandemic and the related restrictions placed on social interactions [1]. Studies have shown that the restrictions on children with physical and/or intellectual disabilities had negative impacts that included poorer behavior, depressed mood, negative emotions, decreased fitness–including unhealthier diets and less exercise, social regression, reduced sleep quality, decreased learning, increased medication, relapse of mental illness and exacerbation of existing mental health issues [2,3,4]. Understanding that mental health risks are disproportionately higher for children and youth who are already disadvantaged and marginalized, Community Connections AR–a nonprofit that provides quality extracurricular activities for children and youth with special needs–sought ways to offer in-person programming for children with disabilities during Covid-19 safety protocols. This study evaluated the effectiveness of the Community Connections Arkansas bowling programs in regard to quality of life and physical ability in the Fall 2020.

Studies have shown that the quality of life (QoL) experienced by school-aged children receiving special education services is lower on all scales than that of children without disabilities [5,6]. COVID-19 added additional challenges for children receiving special education as they experienced social isolation and changes in delivery of educational and health-related services. While participation in adapted sports plays a role in enhancing health related QoL for children with disabilities [7,8], it is unknown if positive influences will extend during the COVID-19 pandemic.

The limitations imposed by the pandemic forced many school-aged children to remain isolated from peers as a precautionary measure, resulting in changes to overall physical activity levels. Prior to the lockdown, children were able to benefit physically and mentally from engagement in community-based physical activities. However, during the early stages of the pandemic, children demonstrated decreased physical activity and became more sedentary compared to pre-pandemic observations [9]. Parental surveys indicate that children performed approximately 8 hours of leisure-related sitting per day during April and May 20209. Further, children demonstrated alterations in sleep patterns, with reduced overall sleep time versus before the pandemic lockdown [10].

Along with reduced physical activity, negative effects upon mental health were observed during the pandemic lockdown. Children suffered from various conditions including anxiety, irritability, inattention, and depression [11]. Regressions in learning and behavior were observed in children and young adults with physical and/or intellectual disabilities [2]. Additionally, reports of boredom, frustration, and loneliness were documented by a study of children in the UK [10].

The purpose of this study was to explore how participation in a community-based adapted bowling program affected the quality of life in children with disabilities during the COVID-19 pandemic.

Researchers chose to evaluate the Community Connections adapted bowling program because the program operated simultaneously in multiple locations during the COVID-19 pandemic with easily followed and consistent infection prevention protocols. Participants in the program were required to wear masks. If needed, the program provided masks for compliance. The participants were socially distanced with a minimum of two lanes (10 feet) between the Community Connections group and anyone else using the bowling alley. The bowling alleys disinfected the equipment and cleaned the bowling areas and the bowling balls prior to and after the intervention.

Another major factor influencing the selection of bowling as the intervention is the ease at which the sport can be modified for various skill and function levels. Bowling was established at the Special Olympics in 1975 and is one of the most popular sports at the Games [12]. Adaptations for this study were provided by all the participating bowling alleys and were based on identified needs. Available adaptations included: ramps to the bowling platforms, bumpers on the lanes, ball ramps, and various weighted ball options (6 lbs. and up). Other adaptations included having a bowling buddy (individual to assist the participant), bowling balls with retractable handles, and bowling ball pushers.

In addition to its adaptability, bowling provides physical activity in a social/group setting but is scored individually. Unlike team sports such as basketball or soccer where the teammates

ability affects the group as a whole, the weekly bowling program created a social atmosphere, but allowed for each participant to bowl as an individual. This allowed participants of different bowling abilities to still participate as part of the group or "team."

There were four bowling programs in the state at the start of study, two centrally located, one towards the western edge of the state, and one northwest area of the state. The ability to assess the same program in four different cities was necessary due to low numbers of participants. The format and protocol for the bowling sessions were standard across all sites, thus seeking to help minizine the effects of the local bowling program directors and the bowling alley business locations on the outcomes.

Methods

The IRB approved study consisted of secondary data analysis of a pre-experimental one-group pre-test post-test design consisting of a parent pre- post emailed survey of the Peds QL: Pediatric Quality of Life Inventory Version 4.0 Parent Report for Children (ages 8 to 12), Peds QL: General Well-Being Scale Parent Report for Children (ages 8 to 12), and a pre--post physical measures of the youth participants completed by either third year occupational therapy (OT) students or faculty from a school of physical therapy (PT). In addition to the Peds QL scale, the survey also asked bowling location and child's first name so that responses could be matched. The post survey asked one additional question "What effect has the Community Connections Bowling program had on your child?" The Peds QL was delivered via email by Community Connections Arkansas Program Director one week prior to the start of each bowling site's start date and one week after the conclusion of each bowling site's end date to all the parents or guardians of the participants. The survey took approximately 15 minutes or less to complete.

The physical measures included a pinch strength test, a grip strength test, a trunk flexion test, and a shoulder range of motion measure. These measures were selected based on body mechanics needed in bowling. The child participants completed the physical measures assessment at their first day of bowling and last day of bowling. These measures took approximately 10 minutes to complete per child. The children also received a written copy of their measurements. Goniometers were used to measure range of motion of the shoulder, dynamometers to measure grip and pinch strength, and spinal range of motion was measured with a bubble inclinometer. Participation in the physical measures was determined by attendance and consent by the parents on the day when the physical measures were taken. All these tests were non-invasive with the PT faculty and OT students trained on administration of these assessments. Once data was paired, names were removed, and numbers were assigned to each child/parent report by a Community Connections volunteer before the data was provided to the researchers. Assigned numbers were matched to link the parent survey with the children/youth's physical measures.

Participants were a non-probability convenience sample of the population of children and their parents in the Community Connections Bowling Program; participation in the study was voluntary. A free hour of bowling (including shoe rental) was provided as an inducement for the participants involved. The children in the program bowled socially for one hour, once a week for 6 to12 weeks depending on the location of the program. Adapted bowling measures were used for those children who needed them.

The first outcome measures collected were the children's strength and flexibility. Three repeated measures were collected for grip and pinch for both left and right hand. These three measurements were averaged together for each child before performing statistical tests. Children were evaluated for pre- and post-biometrics measurements to determine if statistically significant improvements were made due to intervention. Paired t-tests with the alternative hypothesis of less than were conducted on the balanced dataset (n=10) using Student's t-test13. For comparison of left and right (rather than before or after), the two-sided t-test was performed instead of the alternative hypothesis. Since the t-test requires normality with small sample sizes, Shapiro-Wilk's method for normality test based on the correlation between the data and the corresponding normal scores was performed14, 15. Given small sample sizes and lack of normality across all data, Wilcoxon tests, also known as Mann-Whitney tests16, 17 were conducted. For both Student t-tests and Wilcoxon tests, two-sided alternatives were used for comparing left versus right and less-than alternatives for comparing pre- versus post-biometrics. The 'null hypothesis' was no difference between left and right measurements using two-sided. The alternative hypothesis of improvement in measurements from pre- to post-biometrics. All analysis was conducted in R18. The participant's t-test

was supplemented with results from the Wilcoxon test when normality could not be assumed.

The second outcome measure was the parent reports on the quality of life and general well-being of the participants. The PedsQL Pediatric Quality of Life Inventory survey consists of four sections: physical functioning, emotional functioning, social functioning, and school functioning. The five "school function" items were omitted as most participants were not attending school in the traditional manner due to COVID-19. The PedQL General Well-Being Scale consists of well-being and overall health (1-item) sections. The parent report for children ages 8 to 12 was selected for both scales as most children in the intervention were this age and there was no way to individualize the email survey to the parents.

The tertiary outcome was the qualitative analysis of parents' perceptions based on the open-responses. Parents were able to respond with an unlimited character count to one open ended question during the post-assessment email survey. The data was extracted from the larger survey so that the researchers would not know the location, gender or age of the participant the parent was describing. Thematic analysis was used. After familiarizing themselves with the data, one researcher read and coded the data with initial codes. The open-ended questions were then coded independently by the remaining researchers and jointly organized into categories and sub-codes. The researchers then utilized axial coding to group the codes into meaningful patterns from which the themes emerged. The researchers met as a research team to share the codes and findings. The research team reviewed the codes and subsequent themes for consistency and agreement.

This study's potential limitations include the small n. As this study was specifically looking at in-person extracurricular activities for children diagnosed with special needs, it was assumed that the participant numbers would be lower than during a non-Covid socially distanced time-period. Since the Covid-19 restrictions have been lifted, Community Connections-AR has implemented additional bowling programs across the state. While the physical measures outcomes of the bowling program could be reproduced if this study was repeated, the social climate would be decidedly different thus potentially altering QoL outcomes. The small n led to an additional limitation not foreseen by the researchers: unbalanced data. As the physical measures were only collected at the first and last day of bowling by Community Connections volunteers, there was no way for the researchers to solicit additional data from the participants who happened to be absent that day. A strategy to mitigate this issue would have been to collect the physical measures for the first two and last two weeks of the bowling program, thus capturing more of the participants in the pre- and post- tests who may have been absent during data collection. Another limitation outside of the researchers' control was the number of weeks of the bowling intervention; it was not consistent across sites ranging from as few as six weeks to as great as twelve weeks. Results may have varied if the intervention was longer in some locations. This limitation could have been addressed by collecting data at the six-weeks at all locations, with an additional data collection at the end of the longer running programs. And finally, the survey data was sent via email without additional prompting from the researchers to the parents. A phone call or text reminder asking the parents to complete the survey may have increased the response rate.

Results

The database included 34 unique children (See Table1: Number of subjects by location and gender) that were represented at least once in biometrics or parents' qualitative surveys. Parents provided qualitative responses for 22 children, pre-intervention responses for 16 children, post-intervention responses for 15 children, and both pre- and post-intervention responses for nine children. At least one pre- or post- biometric measurement was collected on 29 children. Ten children had both pre- and post-intervention biometrics. Four children had both pre- and post-intervention parent responses and pre- and post-intervention biometrics collected. Most subjects (44%) attended the Conway event with 15 of 34. Little Rock had the second most subjects with seven. Fort Smith and Russellville each had six subjects. The mode age of participants was 12, with a range of 4 to 17 years old. (See Figure 1: Histogram of subjects' ages)

Table 1: Number of subjects by location and gender (n=34)

Location	Female	Male	N (%)
Conway	3	12	15 (44)
Fort Smith	0	6	6 (18)
Little Rock	0	7	7 (21)
Russellville	1	5	6 (18)
TOTAL	4	30	34 (100)

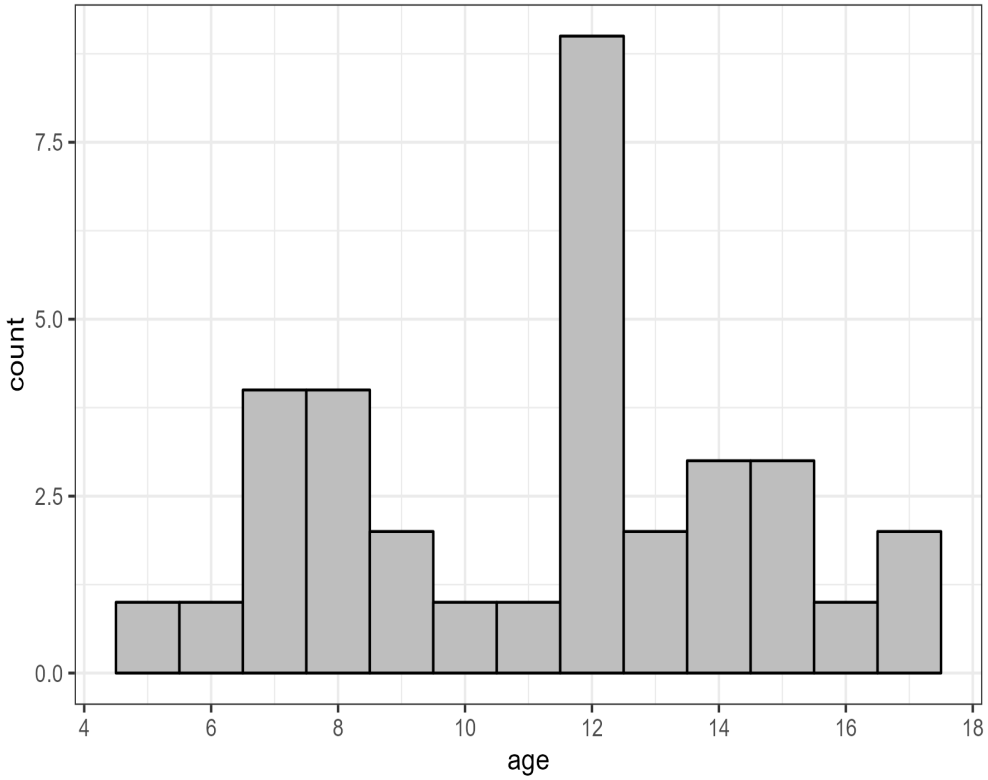

Figure 1: Histogram of subjects' ages

Diagnosis of the participants were parent reported. The most reported frequency of diagnosis was autism spectrum disorder (ASD) with 14 participants followed by attention deficit hyperactivity disorder (ADHD) with 5 participants. The other diagnosis ranged from developmental and intellectual delays to Atypical Complete DiGeorge Syndrome. Parents were able to list multiple diagnoses for their children.

Three repeated measures were collected for grip and pinch for both left and right hand. These three measurements were averaged together for each subject before performing statistical tests. Subjects were evaluated for pre- and post-biometrics measurements to determine if statistically significant improvements were made due to intervention. The null for normality was rejected ($p<=0.05$) for left grip, left pinch, post pinch, thoracic, left shoulder, and grip using Shapiro-Wilk's method (Table 2: Tests for normality and differences of biometric means via t-tests). Student's t-test results were supplemented with Wilcoxon tests given that normality could not be ensured.

Other than thoracic and pinch, biometric means remained unchanged or improved after the intervention (Table 2). Biometrics with statistically significant improvements after intervention included left grip, right grip, left pinch, and right pinch. Lumbar showed improvement with statistical signifi-

cance for Student's t-test only (null was failed to be rejected at p=0.10 for Wilcoxon test). The reader should note that Wilcoxon's test could not be conducted for post grip due to zeros in the data, i.e. identically equal biometrics for left and right measurements for two or more subjects. Pinch and grip strength measurements (Figure 2: Grip strength of participants) were compared to typical norms reported by Mathiowetz19 (Figure 3: Typical grip strength norms by age and gender).

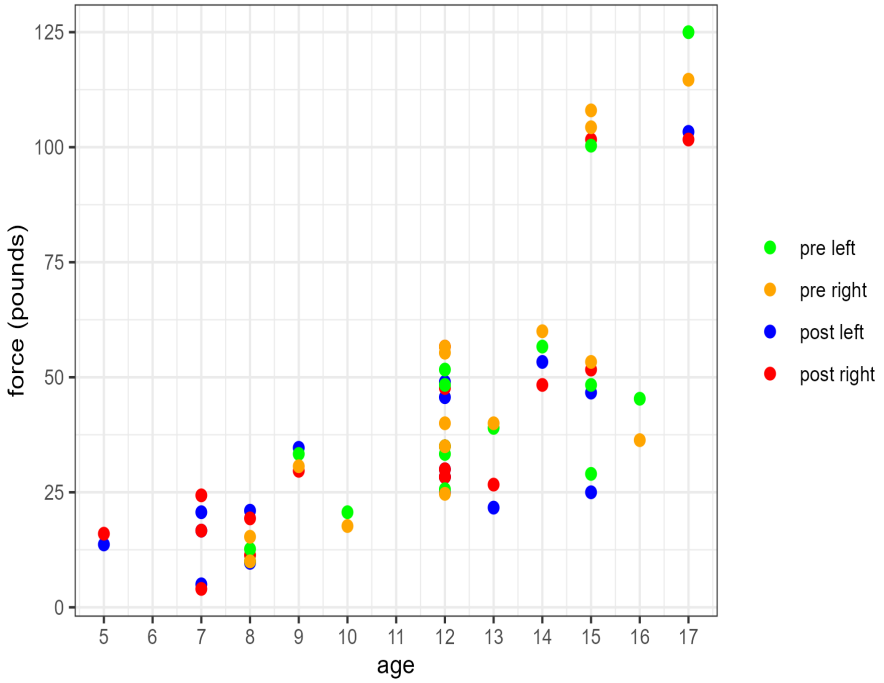

Figure 2: Grip strength of participants

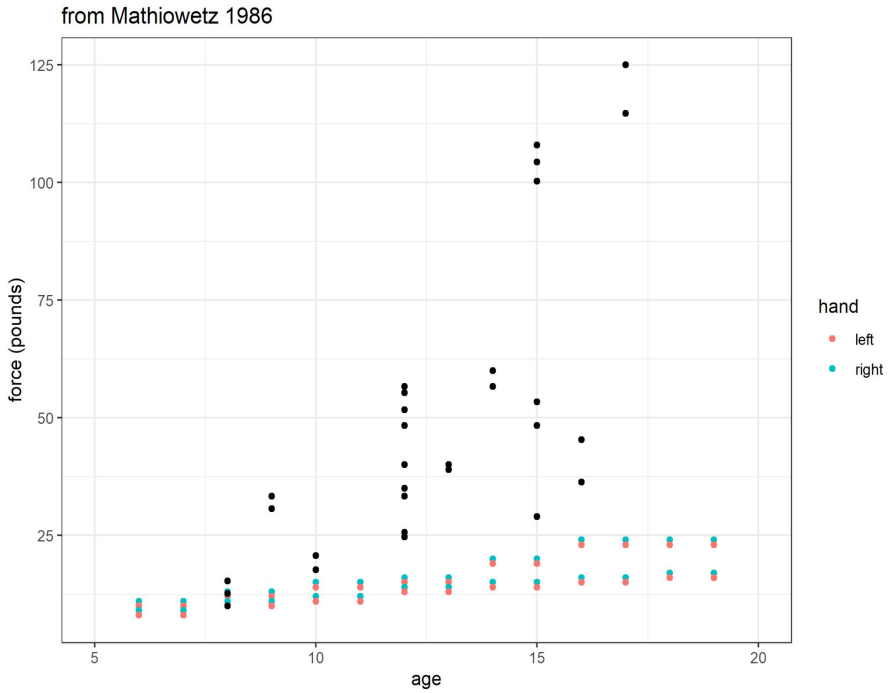

Figure 3: Typical grip strength norms by age and gender

Table 2: Tests for normality and differences of biometric means via t-tests (n = 10)

	Shapiro-Wilk variable 1 (p-value)	Shapiro-Wilk variable 2 (p-value)	Difference of means (x1 - x2)	Student's t-test (p-value)	Wilcoxon test (p-value)
leftGrip	0.08	0.01	-4.50	0.03	0.01
rightGrip	0.13	0.21	-5.17	0.00	0.01
preGrip	0.08	0.13	-8.63	0.29	0.19
postGrip	0.01	0.21	-9.30	0.27	NA*
leftPinch	0.35	0.05	-2.83	0.00	0.01
rightPinch	0.72	0.34	-2.77	0.00	0.01
prePinch	0.35	0.72	-1.33	0.21	0.34
postPinch	0.05	0.34	-1.27	0.31	0.44
lumbar	0.07	1.00	-18.00	0.05	0.12
thoracic	0.39	0.00	6.67	0.79	0.98
rightShoulder	0.37	0.96	0.00	0.50	0.54
leftShoulder	0.04	0.19	-4.40	0.28	0.69
grip	0.00	0.61	-0.67	0.63	0.36
pinch	0.45	0.57	0.07	0.89	1.00

Notes: Difference: pre- minus post- or left minus right

* unable to perform test due to identical values in both variables

Grip and pinch strength measured in pounds

A total of nine parents answered the pre- post survey, though not all parents answered all questions. Responses to categorical questions were assigned values from 0 = Never, 1 = Almost Never, 2= Sometimes, 3 = Often, 4 = Almost Always on both the Parent Report of the Pediatric Quality of Life Inventory and the General Well-Being Scale. The General Well-Being Scale asked child's overall health scored from bad = 0, fair = 1, good =2, very good =3 excellent = 4. Before and after responses were differenced ("after minus before") for each respondent then summed. Minimum, maximum, and sum of scores are reported for each question along with means across respondents and number of parents responding to the question (n) (Table 3: Parents' Perceived Change due to Intervention: Pediatric Quality of Life Inventory Results) and (Table 4: Parents' Perceived Change due to Intervention: General Well-Being Scale Results). The overall health question was also answered by the parent. Differences between before and after responses were differenced ("after minus before") and calculated for all eight of each respondents then averaged. Scores from all respondents summed and mean calculated (Table 5: Parents' Perceived Change due to Intervention in Overall Health).

Table 3: Parents' Perceived Change due to Intervention: Pediatric Quality of Life Inventory Results

variable	min	max	sum	mean	n
Physical Functioning					
Walking more than 1 block	-1	1	0	0	7
Running	-2	1	-1	-0.14	7
Participating in sports activity or exercise	-2	1	0	0	7

Lifting something heavy	-1	1	1	0.14	7
Taking a bath or shower by self	-1	1	0	0	7
Having hurts or aches	-2	3	3	0.43	7
Low energy level	-2	0	-3	-0.43	7
Emotional Functioning					
Feeling afraid or scared	-2	0	-3	-0.43	7
Feeling sad or blue	-1	1	0	0	7
Feeling Angry	-2	1	0	0	7
Trouble sleeping	-1	2	4	0.57	7
Worrying about what will happen to self	-3	1	-3	-0.43	7
Social Functioning					
Getting along with other children	-4	1	-4	-1.33	3
Other kids not wanting to be friends	0	0	0	0	2
Getting teased by other children	0	1	1	0.5	2
Not able to do things that other children own age can do	-1	1	0	0	4
Keeping up when playing with other children	-4	0	-5	-1.25	4

Note: Positive (negative) means indicate improvement (deterioration), zero indicates no change.

Table 4: Parents' Perceived Change due to Intervention: General Well-Being Scale Results

variable	min	max	sum	mean	n
Feels happy	0	1	1	0.12	8
Feels good about self	-1	1	2	0.25	8
Feels good about own health	-1	1	0	0	8
Thinks good thinks will happen to self	-1	2	0	0	8
Thinks health will be good in the future	-1	1	-1	-0.12	8

Note: Positive (negative) means indicate improvement (deterioration), zero indicates no change.

The post-intervention parent's survey included an open-ended question written as "What affect has the Community Connections Bowling program had on your child?". Seven of the 22 parent respondents who completed the post-intervention survey did not provide any response to the open-ended question. Of those who did respond, a very strong theme emerged of Community Connections providing a place of belonging for their children. This belonging was expressed through the participants having their own activity/team or social group, forming friendships and improving self-esteem. As a result of this sense of belonging, especially during a time of pandemic social distancing, the parents overwhelmingly expressed how their children "loved" the program. This sense of having a place to belong and the participants love of the program is shown in this parent quote:

"It has given her such pleasure to have the program as one of her activities to be part of. She always looks forward to the

day she gets to bowl and mingle with others. I can't tell you enough how this program gave her such joy. She loves to tell her sisters, dad, and me about her social outings. They do her so much good. She can't wait to see everyone again."

A sub-theme of sense of belonging was that the program provided a socially safe place to exercise or play a sport. One parent wrote, "Everyone is so kind and patient. As slow as some disabilities can seem, I have never felt like my child was rushed to do any of the {bowling} games." Another parent said, "Bowling with Community Connections allows him to be successful and not embarrassed by his disabilities." While a few parents spoke of the program providing physical activity related benefits, it was always coupled with the social benefit, such as, "It was great for exercise and socializing" and "[My child] is more confident in his physical abilities and social skills."

Table 5: Parents' Perceived Change due to Intervention in Overall Health

	min	max	sum	mean	n
Overall Health	-1	0	-1	-0.12	8

Note: Positive (negative) means indicate improvement (deterioration), zero indicates no change.

Discussion

This study aimed to assess the effectiveness of an adapted bowling program in regard to changes in physical skills and quality of life in children with disabilities during the COVID-19 pandemic. Our results showed improvements in pinch strength, thoraco-lumbar range of motion, and social emotional factors related to quality of life. It is important to note that none of the study participants tested positive for COVID-19 during the study duration. This study's findings regarding changes in quality of life are in line with existing research among adults, adolescents and children with disabilities and show that participation in a community-based, adapted sport contributes to improved motor function and social emotional skills[7, 8]. While the restrictions regarding social interaction during COVID-19 is believed to have had negative effects on the mental health of people across the globe, the pandemic highlighted and exacerbated the social isolation experienced by those with disabilities[20]. This is evident in our study with the items where the parents reported decline in some factors. Children with disabilities were extremely vulnerable and experienced enhanced social isolation, increased screen time as they transitioned to on-line education and health related services, increased parental stress, increased symptoms of psychological stress, and disruptions to their daily routines[21]. While this study showed many positive results, the decline in overall health was alarming. It is difficult to determine the cause of this negative result, the easy explanation is to blame the restrictions due to COVID-19, which leads to the question of how poorly would the children have fared if they were not in this bowling program. The results showed that the children had "feeling afraid and scared," and "worrying about what will happened to self" at the same time they had negative thoughts that "health will be good in the future" which could possibly explain the negative results in overall health. The strong relationship between mental health and physical health[22] has been established, thus, the concern about the future may have been the cause of the decline in overall health. It is important to note that as children, they did not have the perspective of time that accompanies age[23] hence making the restrictions due to Covid-19 seem even more ominous. When looking at the individual questions of the survey, items related to the children themselves in the moment–such as better sleep and feeling happy–were generally more positive whereas the questions about the future were generally more negative. Thus, the quality-of-life improvements as well as the deterioration seen by the participants of this study are extremely relevant.

The qualitative results theme of providing a place of belonging for children with disabilities was unanticipated. From the parents' perspective, their children having their own team and forming friendships outweighed the physical benefits of the program. It is important for educators and organizations working with children with disabilities to realize that positive outcomes may be occurring from programming but are not being measured.

Parents of children with disabilities and organizations that provide educational and health-related interventions often seek to select therapeutic activities that provide benefit in multiple areas including motor and social-emotional skills. Bowling offers participants physical activity and competition in a social setting with scores awarded at the individual level. As bowling is easily adapted at the individual level it is an ideal recreational activity for many persons with disabilities.

The choice of bowling for children with mental or intellectual disabilities was intentional because, as mentioned, it is a social activity that does not rely on other teammates to fulfill the objective of the game. The participants' scores were all individual. In most ball sports, the teammate's ability to carry or pass the ball to other teammates affects the outcome of the game, in other words, one person's actions affect the whole team. In bowling, the participants of this intervention were able to bowl as a "team" without their individual actions changing the outcome for their "teammates." Organizations that are seeking sports activities for children with disabilities could consider looking at sports, such as swimming or running, that are considered team sports yet the teammates participate individually.

The Community Connections-AR bowling programming could be easily replicable in other locations. The costs are low and the modifications easy to implement. Future studies with higher paired pre- post-test results would give additional data on the benefits of community bowling programs for children with disabilities. Future studies could also compare the QoL benefits of a community bowling program with less restrictive social isolation protocols in place. Overall, this study suggests that adaptive community recreational bowling programs can have therapeutic effects on children with disabilities, even during COVID-19 social restrictions.

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