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Step It Up: Increasing Physical Activity for Adults With Autism Spectrum Disorder and Intellectual Disability Using Supported Self-Management and Fitbit Technology

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Abstract

Adults with autism spectrum disorder and intellectual disability often do not engage in healthy levels of physical activity despite its many benefits. We conducted a randomized control trial to evaluate the effectiveness and feasibility of the Step It Up program, which used supported self-management strategies, on daily step counts, health measures, and perceived quality of life for adults with autism spectrum disorder and intellectual disability. Forty participants, ages 18 to 57, were randomly assigned to a control or intervention group. Males accounted for 70.6% of participant gender. Both groups received Fitbits and Fitbit training, and they participated in pre- and post-assessments. The intervention group participated in the Step It Up program. Participants in the intervention group had significantly higher step counts and lost more weight. Feasibility and acceptability were also high. This study provides valuable data on using a supported self-managed exercise program as well as insight into its feasibility in home settings.

Keywords

self-management, technology, adults, autism spectrum disorder, intellectual disability, physical activity, community and family support

Individuals with autism spectrum disorder (ASD) often do not engage in recommended levels of physical activity despite being an essential part of a healthy lifestyle (Bandini et al., 2013; Lang et al., 2010; Stanish et al., 2017). In addition, individuals with ASD tend to engage in less moderate-to-vigorous physical activity and are less active (e.g., take fewer daily steps) as they age (Garcia-Pastor et al., 2019). Low and declining levels of physical activity put individuals at an increased risk for conditions such as heart disease and obesity (Centers for Disease Control and Prevention [CDC], 2021). Lowering the risk for these conditions may be challenging due to barriers (e.g., motor, social, cognitive) to physical activity engagement for individuals with ASD (Bandini et al., 2013; Sorensen & Zarrett, 2014).

Motor impairments may increase frustrations for individuals with ASD who are trying to keep up with their peers (e.g., poor motor coordination; Srinivasan et al., 2014) and lead to preferences for sedentary activities such as watching television. Social and behavioral challenges may impact participation in group sports for individuals with ASD (LaLonde et al., 2014; Srinivasan et al., 2014). For example, highly restricted interests and preference for structured activities may limit activity choices (Srinivasan et al., 2014). In addition, individuals with ASD who also have an intellectual disability (ID) may be more likely to engage in lower levels of physical activity compared with individuals without ID (Peterson et al., 2008). Individuals with lower cognitive abilities tend to engage in lower levels of physical activity (Peterson et al., 2008; Wuang & Su, 2012), suggesting a critical need to target interventions to increase physical activity for individuals with ASD with co-occurring ID.

While barriers may impact engagement in physical activity for individuals with ASD and ID, several facilitators have been identified that impact engagement as well. For example, friends and family who were supportive or physically active were the most frequently reported interpersonal facilitators (Obrusnikova & Cavalier, 2011). When

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individuals with ASD and ID participated in exercise programs, research consistently indicated improvements in physical fitness levels and health profiles of individuals with ASD and ID including moderate to strong evidence for improved balance, muscle strength, and quality of life as well as a range of behavioral, social, and emotional improvements (Bartlo & Klein, 2011; Lang et al., 2010; Sowa & Muelenbroek, 2012; Todd et al., 2010). Exercise programs for individuals with ASD and ID also show promising evidence for disease prevention (e.g., obesity; Pitetti et al., 2007) and successful aging (e.g., reducing dementia and related symptoms; Hamer & Chida, 2009).

Several strategies used in exercise programs and interventions to promote physical activity for individuals with ASD and ID have been successful, including prompting, modeling, reinforcement, structured teaching, and goal setting (LaLonde et al., 2014; Savage et al., 2018; Todd & Reid, 2006; Valbuena et al., 2019). LaLonde et al. (2014) used a package with goal setting and praise to increase walking duration for young adults with ASD and ID while wearing a Fitbit tracker. Participants were successfully walking over 10,000 steps per day by the conclusion of the study (LaLonde et al., 2014). As students move through school and into adulthood, they are expected to be more responsible for managing their behaviors and setting and achieving goals.

The Current Study

The purpose of this study was to determine whether a supported self-managed exercise program, Step It Up, was an effective and feasible program to increase engagement in physical activity for adults with ASD and ID. We sought to answer the following research questions:

- **Research Question 1:** Compared with having access to a Fitbit and Fitbit resources (control), does the Step It Up program result in increased engagement in physical activity, improved health measures, and an increase in perceived quality of life for adults with ASD and ID?
- **Research Question 2:** Is the Step It Up program a feasible and acceptable intervention in home settings for adults with ASD and ID?

Primary outcome variables were measured before and after the intervention. We predicted participants in the Step It Up program would take more steps, decrease body mass index (BMI), and have a higher perceived quality of life compared with participants in the control group, controlling for baseline. We also predicted coaches would feel comfortable supporting adults with ASD and ID through the Step It Up program, rating it high in feasibility and acceptance.

Method

Design

We used a randomized control trial (RCT) to evaluate the Step It Up program. An RCT was used to control for threats to internal validity and to help ensure that any differences between the control (access to a Fitbit and Fitbit training) and intervention (Step It Up) groups were due to treatment effects. The institutional review board approved all study procedures. Procedures included a phone screening, initial visit to determine eligibility and gather pre-measures, baseline, second visit to discuss group placement, the 12–week intervention or control procedures, and a completion visit to gather post measures. Participants who met eligibility criteria were randomly assigned to a group using a random number generator using a 1:1 ratio.

Participants

Adults with ASD and ID. We developed a website with information about the Step It Up program as well as a space to enter contact information for recruitment purposes and promoted the website with local autism groups across two U.S. states (one Eastern and one Southern). Interested participants contacted us through the program website or via phone. Inclusion criteria were (a) self-report or caregiver report of clinical diagnosis of ASD independent of the study; (b) score of 28 or higher on the Childhood Autism Rating Scale–Second Edition (CARS-2; Schopler et al., 2010) administered and scored by trained team members; (c) IQ < 70 confirmed by trained team members administering the Leiter International Performance Scale, Third Edition (Leiter-3; Roid et al., 2013); (d) adult ≥ 18 years old; (e) self-report or caregiver report stating the participant had no medical restriction to increase step counts; (f) access to the internet and a computer or mobile device; (g) acceptance of the Fitbit; (h) weekly contact with an adult who consented to be a support coach; and (i) baseline weekly step count $< 70{,}000$ steps.

Recruitment, eligibility, and randomization procedures are reported in Figure 1. Eighty-eight participants or their caregivers completed a phone screening, which included a detailed description of the study as well as an initial screening for eligibility. Thirty-three participants were ineligible, with the most common reason for ineligibility at this stage being age (i.e., <18). The remaining caregivers or participants decided they were not interested in moving forward with the study. Of the 52 remaining participants who engaged in an initial visit, 40 were eligible for participation. Six participants scored over 70 on the Leiter-3 and six participants did not accept the Fitbit (i.e., did not meet wear time criteria during baseline). After 40 participants were randomized to one of two groups, two

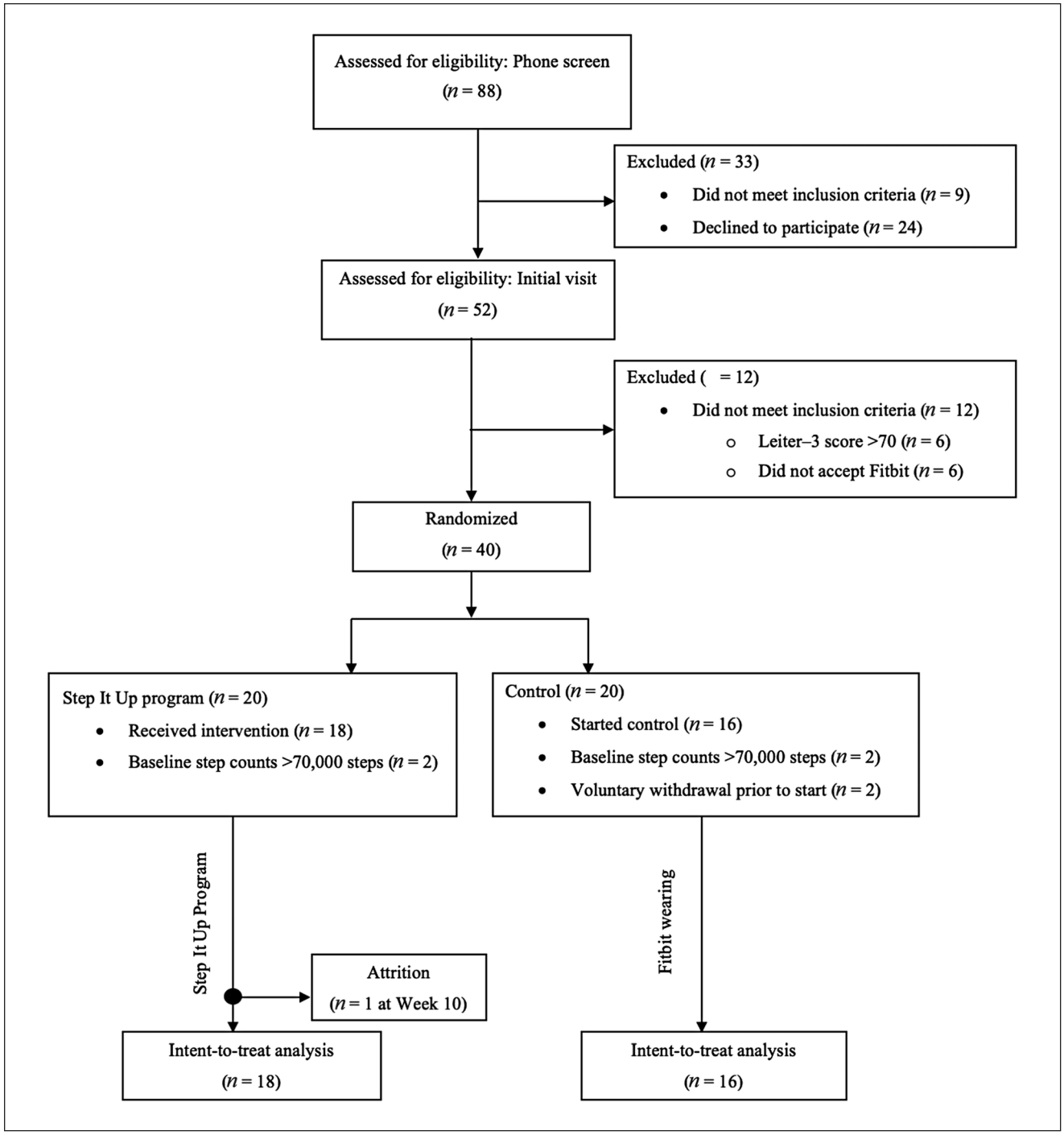

Figure 1. Recruitment, eligibility, and randomization of participants with ASD and ID.
Note. ASD = autism spectrum disorder; ID = intellectual disability.

Table 1. Demographic Information for Participants With ASD and ID.

	Step it up		Control group			
Characteristic	*n*	*M* (*SD*) or %	*n*	*M* (*SD*) or %	*T* or χ^2	*p*
Age (years)[a]	18	23.75 (5.67)	16	29.72 (10.85)	2.05	.05
Gender (%)					0.28	.60
Male	12	66.70	12	75.00		
Female	6	33.30	4	25.0		
Race or ethnicity (%)					6.26	.39
Black or African American	3	16.67	1	6.25		
Hispanic or Latino	0	0.00	1	6.25		
Multiracial/biracial	4	22.22	1	6.25		
White	11	61.11	13	81.25		
Nonverbal IQ	18	60.65 (10.23)	16	62.69 (7.61)	0.65	.52
CARS–2 autism severity	18	37.00 (6.72)	16	34.69 (5.87)	1.06	.30
Self-reported motor skills (%)					2.02	.36
Poor	6	33.33	7	43.75		
Typical	10	55.56	9	56.25		
Advanced	2	11.11	0	0.00		
Taking medications (%)					0.95	.33
Yes	13	72.22	9	56.25		
No	5	27.78	7	43.75		

Note. ASD = autism spectrum disorder; ID = intellectual disability.
[a]Age based on Leiter-3 assessment administration date.

participants (control) voluntarily withdrew from the study before the start and were not responsive to contact attempts. Four additional participants were already taking >70,000 weekly steps (baseline) and were, at that point, determined not eligible for participation in the program (two control and two intervention).

Thirty-four participants with ASD and ID in the study were included in the current *intent-to-treat* analyses (18 in intervention and 16 in control). Descriptive statistics for demographics and assessment variables are reported in Table 1. Chi-square analyses and independent samples *t* tests were performed to examine any group differences at baseline. There were no statistically significant differences between groups on demographic or participant characteristics. During Week 10 of the 12-week program, one participant (intervention) voluntarily withdrew from the study, resulting in a total of 33 participants with ASD and ID who completed the study.

Coaches. Participants in the intervention group had a coach to support them with the Step It Up program. Coaches included adults who had weekly contact with the participant and consented to be involved in the study. Approximately 80% of coaches were participants' mothers. Coaches agreed to complete the online training, introduce the participant to the program, support participant engagement in individual exercise sessions, meet with participants weekly for a goal setting meeting, and send data collection sheets and goal setting meeting videos to a secure drive. A total of 18 coaches participated in the study, with 17 participating through study completion. Refer to Table 2 for a summary of coach demographics.

Measures

Ascertainment

Autism severity. The CARS-2 (Schopler et al., 2010) was used to describe the severity of ASD symptoms. A trained research team member observed participants during the initial visit and also gave a parent/caregiver the CARS-2 parent/caregiver questionnaire to support the direct observation. The context for observations included a focus on how each potential participant (a) related to people and objects, (b) communicated both verbally and nonverbally, and (c) transitioned between initial visit activities. The standard version rating booklet was used for all participants as it is geared for individuals older than six with below-average estimated IQs. A score of 28 or higher was needed on the CARS-2 to be eligible for the study. For ages 13 and older, a score of less than 28 represents minimal-to-no ASD symptoms, 28 to 34.5 represents mild-to-moderate ASD symptoms, and 35 and higher represents severe ASD symptoms.

Intellectual disability confirmation. During the initial visit, a trained team member administered the Leiter-3 (Roid

Table 2. Demographic Information for Coaches in Intervention Group.

Characteristic	*n*	%
Gender		
Male	1	5.6
Female	17	94.4
Race		
Black or African American	3	16.7
Moroccan	1	5.6
White	14	77.8
Education level		
High school graduate/general educational development Test	4	22.2
Associates degree/TT/PC	3	16.7
Bachelor's degree	5	27.8
Master's degree and above	6	33.3
Relationship to athlete		
Job coach	1	5.6
Program director	1	5.6
Recreational therapist	1	5.6
Support agent	1	5.6
Mother	14	77.8
Household income	1	5.6
<$20,000	2	11.1
$20,000–39,999	3	16.7
$40,000–59,999	2	11.1
$60,000–79,999	3	16.7
$80,000–99,999	6	33.3
>$99,999	1	5.6
No response	1	5.6
Comfort with technology		
Very comfortable	9	50.0
Somewhat comfortable	8	44.4
Somewhat uncomfortable	1	5.6
Experience with PA tracker		
Yes	4	22.2
No	13	72.2
No response	1	5.6

Note. $N = 18$. TT = technical training; PC = partial college; PA = physical activity.

et al., 2013) to confirm ID diagnosis. Participants were presented with tasks on figure-ground, form completion, classification and analogies, and sequential order to test nonverbal intelligence and cognitive abilities. The assessment is nonverbal, and the participant engages in game-like tasks. A nonverbal intelligence score below 70 was needed to be eligible for the study.

Primary outcomes

Weekly step count. Participant step counts were measured using the Fitbit Flex2. The Fitbit Flex is a valid tracker for measuring step counts (Diaz et al., 2015). The tracker is worn on the wrist and is waterproof so that it could be worn during all daily activities (e.g., showering, swimming). Participants synced their devices to their Fitbit app. Reported step counts were measured during baseline and Week 12 of the Step It Up program or control.

BMI. BMI is calculated from height (measured at initial visit) and weight (measured at both initial and study completion visits). Height was measured to the nearest tenth of an inch and converted to meters. Weight was measured to the nearest 0.1 pounds using an *Aria Wi-Fi Smart Scale* and converted to kg. BMI categories included (a) underweight (BMI < 18.5 kg/m^2), normal range (BMI $= 18.5$–24.9 kg/m^2), overweight (BMI $= 25$–29.9 kg/m^2), and obese (BMI ≥ 30 kg/m^2) (CDC, 2021).

Quality of life. Participant perceived quality of life was measured using the Quality of Life Questionnaire (QOL.Q; Schalock & Keith, 1993). The QOL.Q was measured at the initial visit and the study completion visit. The QOL.Q is a 40-item rating scale designed to measure overall quality of life for individuals with ID. The scale was administered in an interview format with participants and yielded data regarding the overall perceived quality of life across four subscales: satisfaction, competence/productivity, empowerment/independence, and social belonging. If self-report was not appropriate, two raters who knew the individual well answered the questionnaire, and researchers used the average of the independent rater scores for the overall score. Schalock and Keith (1993) documented the scale's structural validity using factor analysis, and reported adequate internal (coefficient $\alpha = .90$), interrater ($r = .83$), and test–retest ($r = .87$) reliability as well as evidence of construct and concurrent validity.

Secondary outcomes

Participant fitbit feasibility. After the study, participants in both groups completed a 29-item Fitbit feasibility questionnaire. Topics included the Fitbit Flex2 physical activity tracker, the Fitbit app, and Fitbit help guides. Fitbit Flex2 questions focused on wearing (e.g., difficulty putting the tracker on, plans to continue wearing the tracker) and charging the tracker. Fitbit app questions related to perceived benefit related to health, information the app provided, app feature usage, and plans to continue using the app. Fitbit help guides included pictorial task analyses on wearing the tracker and using the app. Feasibility questions related to the use and support of guides. Visuals were presented with all potential responses.

Participant usage rating profile. After the study, participants in the intervention group completed the Adapted Childhood Usage Rating Profile (CURP)–Actual (Briesch & Chafouleas, 2009) to assess their opinions about the feasibility and acceptability of the intervention. Questions focused on intervention components and usage (e.g., the

project took too much time in my day, it is clear what I had to do). The questionnaire consisted of 21 items on a 4-point Likert-type scale. Visuals were presented with all potential responses.

Coach intervention feasibility. After the study, coaches completed the intervention feasibility questionnaire. Items focused on the web-based coach training, participant training, and the Step It Up program. There were 13 items on a 5-point Likert-type scale across the three sections as well as an open-ended response asking for feedback on the program.

Coach usage rating profile. After the study, coaches completed an adapted version of the Usage Rating Profile–Intervention Revised (URP-IR; Chafouleas et al., 2011) to assess their opinions about the feasibility and acceptability of the intervention. The measure is written for educators. However, the language of questions was changed to be meaningful for interventionist use in home and community settings. For example, changing *intervention procedures fit in with my current practices* to *intervention procedures fit in with my schedule*.

Coach interview. After the study, the researcher interviewed the coach to gather qualitative data related to the Step It Up program. Questions related to perceptions of their overall experience, including what they learned about themselves and the participants. In addition, a question asked whether additional family, friends, or community members got involved in the project, including their level of involvement. Interviews lasted approximately 30 min.

Procedures

Phone screening. We held a phone screening with potential participants or caregivers who contacted the research team. We discussed the study in more detail, and potential participants or caregivers were asked initial screening questions about the potential participant's age, clinical ASD diagnosis, and their current activity levels. Those that did not meet inclusion criteria were informed of their ineligibility and provided with community resources.

Initial visit

Participants with ASD and ID. During the initial visit, we met with potential participants for approximately 120 min to (a) gather autism severity data for the CARS-2, (b) administer the Leiter-3 to obtain a nonverbal IQ, (c) gather participant height and weight, and (d) complete the QOL inventory.

Caregivers. A caregiver completed the CARS-2 parent/caregiver questionnaire to supplement direct observations by the research team. Caregivers also completed a demographics questionnaire and a caregiver report of the QOL inventory. Caregiver scores on the QOL inventory were not reported unless the participant with ASD and ID was unable to complete the inventory. For participants ($N = 3$) who were unable to answer QOL questions, answers from the caregiver and a second person who knew the participant were averaged for the reported QOL score, as recommended by Schalock and Keith (1993).

Fitbit instruction. At the end of the visit, participants were sized for a Fitbit band and shown how to wear the device on their wrist and how to charge the Fitbit (Fitbit Flex 2). A folder was provided with visual supports on wearing and charging the Fitbit, including how often to charge it, when it was safe to wear it, and when they could take it off. Participants were given instructions to wear the Fitbit for at least 7 full days to gather baseline data. While participants were asked to wear Fitbits for a full 7 days starting the day after the initial visit, we encouraged participants to wear them until the second visit to get used to wearing them daily. All potential participants with ASD and ID and caregivers received monetary incentives for completing the initial visit, regardless if they met the criteria to continue with the study.

Baseline. Following the initial visit, participants engaged in a 7-day baseline measure of daily step counts. They wore the Fitbit and engaged in daily activities *as per usual*. For baseline, we adjusted the settings on each participant's Fitbit so additional alerts/indicators would not occur throughout the week (e.g., turned reminders off, set up an unreachable step count goal so congratulatory vibrations and lights would not go off). Total step counts were not visible on the fitness tracker and participants did not have access to account information (i.e., participants could not track steps during baseline).

Second visit. We met with participants 9 to 14 days after the initial visit to sync the Fitbit, gather baseline data, discuss the responsibilities of the assigned group, and provide login information and directions for the Fitbit app. Participants practiced logging onto the Fitbit app and navigating the Fitbit dashboard. For participants in the intervention group, the coach was also present during the second visit to gather consent and review responsibilities.

Control. After the second visit, participants in the control group continued to wear the Fitbit and had access to traditional Fitbit resources such as the Fitbit app, as well as additional Fitbit resources (available for both groups). Participants had a Fitbit folder containing pictorial task analyses related to wearing, using, and monitoring step counts (e.g., how to charge the Fitbit, how to log onto the Fitbit app, how to sync the Fitbit). Participants engaged in the control procedures for 12 weeks, and after the study completion visit, participants kept the Fitbit Flex 2 and were given access to the Step It Up program materials.

Step It Up program. For the intervention group, participants also continued to wear the Fitbit and have access to traditional Fitbit resources and the same Fitbit folder as the control group. In addition, participants and their coaches completed the 12-week Step It Up program. The Step It Up program is designed for participants with ASD and ID to use self-management strategies to engage in program components and for coaches to provide support as needed. Coach data collection sheets provided reminders for coaches to let participants engage in each step of the program independently before providing support. Components included (a) coach and participant training, (b) individualized exercise sessions, and (c) weekly goal setting meetings. Refer to Table 3 for a breakdown of program components, including behavior change strategies used.

Coach and participant training. Each coach in the intervention group engaged in web-based training on the Step It Up program, including strategies used to increase step counts. This training was done individually and took approximately 90 min to complete. The web-based training discussed how to implement self-management strategies, including goal setting (i.e., weekly step count goal), schedule exercise sessions, set reminders, implement self-evaluation and self-monitoring procedures, and identify reinforcers. The training also included video demonstrations of goal setting meetings.

After coaches completed the web-based training, they met with participants in person to introduce the Step It Up program. Participants received a Step It Up program manual that included opportunities to practice skills with their coaches such as setting goals and number comparisons before beginning the project. Coaches followed a protocol created by the research team and provided participants with clear instructions, modeled skills, practiced together, gave feedback and behavior-specific praise, provided additional opportunities to practice skills without them, and worked together to identify potential reinforcers for the participant. All other materials participants and coaches needed for the project (e.g., weekly goal setting meeting templates, data collection sheets) were in the manual.

Coaches and participants with ASD and ID did not have to master a criterion in training to move forward; rather, the training was used to introduce and familiarize the participant and their coach to the intervention, including procedures and materials. However, fidelity was measured each week and a booster training was provided by a research team member if treatment fidelity fell below 90% (additional details in treatment fidelity section). Coaches received a monetary incentive for completing their training and training participants.

Individualized exercise sessions. Participants scheduled 2 days each week to focus on aerobic activities to increase step counts (e.g., walking, running, playing soccer) and were encouraged to check their step counts after exercise sessions and throughout the week to monitor their progress. The structure of 2 days per week for 30 min was recommended for each participant; however, they had instructions to adjust the schedule to meet their goal if needed (e.g., many participants needed to schedule 3 days or longer sessions as their weekly goals increased). Participants had the flexibility in choosing the type of exercise.

Weekly goal setting meetings. Participants met with their coach each week to (a) determine whether they met their goal, (b) set up a goal for the upcoming week, and (c) schedule two exercise sessions for the upcoming week as well as set up silent alarm reminders in their Fitbit app for scheduled exercise days and times. At the meeting, participants synced their Fitbit and self-evaluated (did they meet their goal or not for the prior week), recorded the result on the graphic organizer, and, if the criterion was met, accessed the predetermined potential reinforcer. A goal setting meeting template (graphic organizer with an embedded self-monitoring checklist) was used to support the flow of the goal setting meeting, and pictorial task analyses were available to support the participant with tasks within the goal setting meeting such as calculating new goals and recording them in the Fitbit app. Participants checked off steps on the checklist as they moved through the meeting. The goal for the first week was individualized, starting at each participant's baseline level to set the participant up for success. At the goal setting meeting, if the participant reached their goal during the previous week, they set a new goal with a 10% increase from the previous goal. During the program, if they reached a goal of 70,000 weekly steps, the formula was changed to add 2,000 more steps each of the following weeks if goals were met. If the participant did not reach their goal, the participant and coach determined what happened during the week (e.g., poor weather, sickness) and kept the same goal for 1 additional week.

Treatment fidelity. Treatment fidelity was measured in the intervention group to determine whether this group received the intervention as intended. Participants and coaches referred to a checklist located on each weekly goal setting meeting template to support treatment fidelity. The checklist covered expected implementation steps for intervention components such as filling out goal setting sheets, entering new goals in the Fitbit dashboard, scheduling exercise days, setting reminders, and submitting goal setting and data collection sheets. Each week we confirmed fidelity by (a) reviewing the weekly goal setting template and data collection sheets submitted by the participant or coach and (b) logging into each participant's Fitbit dashboard (e.g., check to see if the goal was changed correctly in the app). During Weeks 2, 4, 7, and 11 coaches also video recorded goal setting meetings and we watched the videos

Table 3. Step It Up Program Components, Behavior Change Strategies, and Sample Images.

Step It Up components	Behavior change strategies
Coach web-based training 1. Watch training 2. Watch video demonstrations	• Presentation of new material • Demonstrations of target skills
Participant training 1. Program overview 2. Intro to Fitbit 3. Intro to meetings 4. Practice opportunities 5. Identify reinforcers	• Presentation of new material • Modeling • Guided practice • Independent practice • Behavior-specific praise • Feedback
Weekly meetings 1. Review step counts 2. Set goal for week 3. Set exercise schedule 4. Put information in Fitbit app 5. Email data sheets and video file	• Self-monitoring • Self-evaluation • Self-reinforcement • Goal setting • Pictorial task analyses • Least-to-most prompting • Feedback • Fitbit technology
Exercise sessions 1. Follow the schedule 2. Engage in exercise 3. Adjust schedule as needed to meet the goal	• Self-monitoring • Fitbit technology

as an additional fidelity measure. If fidelity fell below 90% during any week, we provided a booster training via phone or live video-conferencing.

Study completion visit. After the 12th week concluded, we met with participants and coaches. Participants in both groups completed the QOL inventory and Fitbit feasibility questionnaire. We measured participant weight using the same scale used in the initial visit. In addition, participants in the intervention group completed their usage rating profile. Coaches completed their feasibility questionnaire, usage rating profile, and an interview. Participants with ASD and ID in both groups kept their Fitbits after completing the study, and all participants and coaches received monetary incentives for completing the study.

Data Collection

University alias email accounts were created for each participant to create a Fitbit account that would be accessible for participants, coaches, and research staff. Participants in both groups created Fitbit accounts and were instructed to sync their devices to the Fitbit dashboard each week. A majority of participants used Bluetooth technology with the Fitbit app, so the step of syncing was automatic. Their device would sync whenever they were within 20 feet from a device with the Fitbit app. Some participants chose to sync manually, which required them to open the Fitbit app and follow instructions. Each week, we exported Fitbit data from each participant's dashboard remotely for analysis. After the study concluded, participants removed the university email address from the Fitbit account and switched to a personal account. Coaches submitted their data collection sheets and the participant's completed goal setting templates each week and uploaded videos of goal setting meetings to a secure university drive during Weeks 2, 4, 7, and 11. Instructions for uploading videos were provided in their manual.

Data Analysis

All analyses were conducted in SAS Version 9.4 and SPSS version 26. We conducted repeated-measures analyses of variance (ANOVAs) to examine the efficacy of the Step It Up program using PROC MIXED to conduct an intent-to-treat analysis using all available data and model the correlation between the measurement time points (Hyer & Waller, 2014). For two time points, repeated-measures ANOVAs using a mixed model to use all available data are recommended when correlations between pre- and post-test variables are present (Hyer & Waller, 2014). Chi-square analyses were performed to examine differences between the intervention group and control group on the participant feasibility form, examining the use of the Fitbit, Fitbit app, and Fitbit resources. Descriptive statistics were used for the intervention group to examine the participant usage rating profile, coach usage rating profile, and coach feasibility forms.

Table 4. Participant Primary Outcome Results.

Measure	Intervention group		Control group		Time × Group interaction *p*
	Pre-test *M* (*SD*)	Post-test *M* (*SD*)	Pre-test *M* (*SD*)	Post-test *M* (*SD*)	
Weekly steps	47,420 (14,039)	60,241(4,510)	46,227 (18,095)	46,377 (6,821)	.03
Weight	182.49 (49.18)	179.51 (47.73)	176.22 (48.85)	179.79 (50.09)	.04
Body mass index	28.95 (7.00)	28.19 (6.88)	28.28 (7.48)	28.71 (7.45)	.07
Quality of life total	84.69 (10.52)	85.79 (10.88)	82.13 (11.15)	76.94 (22.88)	.92

Results

Primary Outcome Measures

A series of four repeated-measures ANOVA was performed with time, intervention group, and a Time × Intervention Group and the primary outcome variables of average weekly step count, BMI, weight, and overall quality of life. Refer to Table 4 for descriptive statistics at the pre-test and post-test. Average weekly step counts across the 12 weeks compared with participants' baseline weekly step count were examined between the intervention and control groups. There was a statistically significant interaction between time and intervention group, $F(1,32) = 5.10$, $p = .031$. Participants in the intervention group took, on average, greater average weekly steps across the intervention period controlling for their baseline weekly step count (adjusted Post-Test $M =$ 61,548 $SE = 5,471$) compared with the control group (adjusted Post-Test $M = 46, 377$, $SE = 46,377$). There was also a statistically significant Time × Group interaction for participants' weight, $F(1,30.4) = 4.74$, $p = .04$. Participants in the intervention group, on average, lost more weight from baseline to post-test (M weight loss = 3.25 pounds), whereas the control group made a slight gain in weight. The intervention group's differences of least squares mean weight difference was statistically significant, suggesting a significant weight loss, $t(30.4) = 2.10$, $p = .049$. The control group's differences of least squares mean weight difference from baseline to post-test was not statistically significant suggesting their weight stayed stable, M weight loss = −1.78 pounds, $t(30.3) = 1.01$, $p = .30$. The BMI model did not have a statistically significant main effect of Time, Group, or Time × Group intervention, $F(1,30.4) =$ 3.42, $p = .07$, nor were there statistically significant main effects of Time, Group, or Time × Group interaction for the overall quality of life model, $F(1,32.4) = 0.01$, $p = .92$.

Secondary Outcomes

Fitbit feasibility. Chi-square tests were performed to examine the differences between intervention and control groups in their percentage agreement or yes responses on the Fitbit feasibility questionnaire. There were no significant differences across any of the items. Overall, feasibility and acceptability were rated high (84%−94%) across both the Fitbit and the Fitbit app. This finding was consistent with (a) feedback from interviews describing the Fitbit app as being easy to navigate and (b) observing videos of participants using the Fitbit and Fitbit app during meetings. Participants used a variety of app features, with participants mainly using the step track counter. Many participants in both groups (68.8%) also used the Fitbit help guides.

Intervention feasibility

Participant and coach intervention feasibility. Adults with ASD and ID in the intervention group reported high ratings on the usage rating profile ($M = 3.65$, $SD = .33$, Max = 4.0). The average procedural fidelity was 90.9%. Coaches reported high feasibility (Max = 5.0) for the coach training ($M = 4.40$, $SD = .28$), participant training ($M = 4.08$, $SD = .55$), and overall project ($M = 4.36$, $SD = .36$) as well as high ratings on the usage rating profile ($M = 5.02$, $SD =$ .30, Max = 6.0). Many coaches felt the Step It Up program helped participants reach weekly goals and the visual supports helped participants to do more things without relying on the coach. Notably, a majority of coaches indicated intent to support participants in continued physical activity engagement after study completion.

Discussion

The current pilot study examined the effectiveness and feasibility of the Step It Up program, a supported self-management intervention to increase physical activity for adults with ASD and ID. The Step It Up program is a cost-effective, feasible intervention that makes a difference on important metrics that can have a big impact on health outcomes. Across the 12 weeks of the intervention, participants in the Step It Up program had significantly higher average weekly step counts and lost more weight than the control group. Feasibility and usage ratings were also high for both participants and coaches.

Physical Activity, Health, and Quality of Life Outcomes

Participants with ASD and ID in the Step It Up program demonstrated significant gains in step counts throughout the program, averaging 47,420 steps in baseline and 60,241

steps during week 12 of the program. These results are similar to gains in step counts for adults with ASD who used goal setting and praise in LaLonde et al. (2014). For the current study, similar gains were not reached in the control group with baseline steps averaging 46,227 and Week 12 steps averaging 46,377. While participants in both groups gave high feasibility ratings for the Fitbit and Fitbit app, results indicate that it takes more than access to an accepted fitness tracker and tracker resources to promote behavior change for adults with ASD and ID.

While there was no significant difference in BMI, the significant difference between groups for weight over time is promising. For adults with ASD and ID who take medications that have reported side effects such as weight gain (e.g., risperidone; Dove et al., 2012), engaging in exercise programs may also benefit controlling body weight. With obesity being associated with leading causes of death (e.g., heart disease, diabetes) as well as poorer mental health outcomes and reduced quality of life (CDC, 2021), it is critical to examine programs that can have a significant impact on weight loss as well as focus on prevention in earlier years. Hebden et al. (2012) found that adults who participated in physical activity interventions following physical activity guidelines (e.g., moderate-to-vigorous activity, strength training) and lasting 16 weeks or longer had significant weight loss compared with other interventions (Hebden et al., 2012). Lengthening a program like Step It Up and adding opportunities for more vigorous activity and strength training could further enhance the program, leading to potential increases in health profiles for participants.

In the current study, there was a slight increase in post quality of life scores for adults in the intervention group and a decrease for adults in the control group, but differences were not significant. This is different from the findings in the Bartlo and Klein (2011) systematic review of physical activity benefits for adults with ID. A different quality of life measure may better capture change in health-related quality of life outcomes as well as extending this program or other programs beyond 12 weeks. Quality of life is considered a significant outcome in adulthood, and more research is needed to understand factors that influence the quality of life in adults with ASD and ID and the impact of exercise on quality of life for adults with ASD and ID.

Step It Up Program

The Step It Up program incorporated various evidence-based practices within the program components to promote behavior change over the 12-week program. Participants utilized visual supports, including a graphic organizer with a self-monitoring checklist and pictorial task analyses to walk themselves through the program components. Since program components and practices used within components were not isolated, the most critical component or practice is unknown. However, participants and coaches felt the pictorial task analyses supported participants in taking a more active role during goal setting meetings, and weekly goal setting meetings helped participants stay on track. Similar to previous research (LaLonde et al., 2014; Todd & Reid, 2006), self-management strategies supported an increase in physical activity for adults with ASD and ID. Coach support appeared to be important as well. Some participants began to run their weekly meetings more independently (e.g., decreased the number of prompts needed from their coach) and self-faded use of visual supports such as the pictorial task analyses as weeks progressed, but most continued to utilize supports. While supports such as prompting hierarchies are often used in studies (Lang et al., 2010), gradual fading of both coach support and visual supports should be investigated in future research. A few coaches also added accommodations. During meetings, for participants needing more extensive supports, some coaches isolated steps (i.e., participants only saw one step at a time). Another coach created a number line to help the participant decide if they met their goal or not by putting their goal and actual step counts on the number line for comparison.

Similar to previous studies (LaLonde et al., 2014; Savage et al., 2018), this study also supports using technology to promote physical activity engagement for adults with ASD and ID. As technology continues to evolve, devices often serve multiple functions. In this study, the Fitbits and Fitbit app were used as a data collection tool to track one of our primary outcome measures, but participants also used the Fitbit and Fitbit app to self-monitor their weekly progress, set alarms as reminders to exercise, and listen to the Fitbit "buzz," indicating they reached a daily step count that was on pace with them reaching their weekly goal. Some participants used their smartphones to set reminders for individual exercise sessions instead of using the Fitbit app. The flexibility to choose their preferred method for scheduling reminders was a perceived benefit. The physical activity trackers and mobile devices used for the app were transportable, available, practical, and engaging (TAPE), following the TAPE framework (Bouck et al., 2012).

Limitations and Future Directions

There were several limitations in this study that warrant attention. While the sample size reflects the preliminary nature of a pilot study and there are valuable findings and contributions, the sample size resulted in inadequate power to detect small between-group differences and reduces the generalizability of the current study. Results should be interpreted with caution and replicated in larger trials. In addition, the lack of standardized measures for confirming ASD diagnoses such as the *Autism Diagnostic Interview–Revised* (Le Couteur et al., 2003) was a

limitation (due to financial constraints) and such measures should be used in larger trials.

The components of the Step It Up program were implemented with coach support, however, the frequency of contact between coaches and participants during the program was not measured. While we did not measure coach frequency, changes from pre to post for intervention were positive for participants who had a coach living outside of the home and for those whose coach was a parent. While this suggests the frequency of coach contact may not significantly impact the program, it could influence results. Future studies using a coach to implement similar programs should measure contact between participants and coaches for further analysis and conclusions.

A majority of participants in the intervention group were from middle-to-upper class families. Individuals who experience economic challenges may face additional barriers in participating in a similar program. While trackers can average over $100 for similar features, an advantage of the Fitbit Flex 2 was the $50 price tag. Future research should consider various measures for physical activity tracking that are cost-effective and acceptable for the user.

Finally, there were a handful of participants who did not accept the activity tracker that could have benefited from the Step It Up program. Participants who were ineligible because they did not wear the activity tracker regularly during baseline had more severe autism symptoms (CARS-2 scores averaged 40.4 compared with 36.7) and lower nonverbal IQ scores on average (54.0 vs. 62.7) compared with participants who accepted the tracker. In addition, four of the six individuals who did not accept the tracker lived in a group home. While supports were available during baseline to promote tracker wearing, further assistance may be needed in settings where multiple adults with extensive support needs reside. Researchers should investigate implementation across various home environments and explore these barriers further.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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