

Recreation Programs for Individuals with Autism:
A Review on Physical and Behavioral Benefits

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Abstract

Several articles have been published in the past two decades assessing various interventions for persons with autism spectrum disorder (ASD). These interventions entail physical activity, recreation, and leisure programs and evaluate behavioral and/or physical outcomes for this population. Research has shown that interventions are necessary to attempt to reduce frequency of stereotypical and challenging behavior, as well as improve the physical health and overall quality of life for people with ASD. This review synthesizes and analyzes the behavioral and physical results of several interventions and outlines the major findings in each category of the authors' disciplines. Implications for future research in this field of study are also discussed.

Introduction

Autism spectrum disorder (ASD) is defined by J. Nathan Copeland of the American Psychiatric Association (2018) as a “complex developmental condition that involves persistent challenges in social interaction, speech and nonverbal communication, and restricted/repetitive behaviors.” Prevalence and severity of symptoms vary with each individual's position on the spectrum. Common indicators of social interaction challenges include inability to make eye contact, take turns during conversation, and responding to social cues. Furthermore, some common examples of stereotypic behaviors in individuals with ASD include body rocking, hand-flapping, self-injurious behavior, yelling and abnormal gait or posture. These challenges greatly impact an individual's functioning in daily life and overall quality of life (Brown, R. I., Schalock, R. L., & Brown, I., 2009 ; Edrisinha, C., O'Reilly, M. F., Choi, H. Y., Sigafos, J., & Lancioni, G. E., 2011).

Professionals in a vast array of disciplines have sought to improve quality of life for the ASD population through implementation of various interventions. Some common disciplines include health sciences, kinesiology, physical education, physical therapy, occupational therapy, psychology, and special education. Extensive research has been published within all of these disciplines that seeks to understand how to improve quality of life for people with autism. Some primary goals of these interventions are to decrease prevalence of stereotypic behavior, improve social competency, and improve the overall physical health of an individual. Each discipline has focused on one or more of these primary goals and employed specific procedural methods in the implementation of recreation, leisure, or physical activity programs.

This paper reviews studies that were published within the last twenty years (1999-2019) in a variety of disciplines. Their primary focus is to implement interventions that improve quality of life through both physical and behavioral outcomes for individuals with autism. The studies were grouped based on primary discipline of the author/s. Table 1 shows the 35 studies grouped accordingly. For each, the table shows the sample size, age, intervention activity, setting, single-subject versus group design, and the type of results.

Table 1.

Study	Discipline	Sample Size	Age	Activity	Setting	Single-subject vs. Group	Results
Yan, Z., Finn, K., & Corcoran, M. (2015)	Health Sciences	22	22-34	Various fitness activities	Local YMCA	Group	Mixed
Guest, L., Balogh, R., Dogra, S., & Lloyd, M. (2017)	Health Sciences	13	8-11	Various sports	Day camp	Group	Mixed
Potvin, M. C., Snider, L., Prelock, P., Kehayia, E., & Wood-Dauphinee S. (2013)	Occupational Therapy	61	7-13	Various	Home residence	Group	Mixed
Lochbaum, M. & Crews, D. (2003)	Kinesiology	5	16-21	Stationary cycling and weight training	Special Ed. school	Group	Positive
Pan, C. Y., & Frey, G.C. (2006)	Kinesiology	30	10-19	Various PA	Various	Group	Mixed
Bremer, E., Balogh, R., & Lloyd, M. (2015)	Kinesiology	9	4	Various locomotor and object control activities	Children's Treatment Center	Group	Mixed
Fragala-Pinkham, M. A., Haley, S. M., & Goodgold, S. (2006)	Physical Therapy	28	6-14	Various exercise activities	Local YMCA	Group	Mixed
Pitetti, K. H., Rendoff, A. D., Grover, T. & Beets, M. W. (2007)	Physical Therapy	10	14-18	Treadmill walking	School gym	Group	Mixed
Fragala-Pinkham, M. A., Haley, S. M., & O'Neil, M. E. (2008)	Physical Therapy	16	6-11	Swimming	Public pool	Group	Mixed
Elmahgoub, S.M., et al. (2009)	Physical Therapy	30	14-22	Various exercises	School	Group	Mixed

Calders, P., et al. (2011)	Physical Therapy	45	18-60	Various exercises	N/A	Group	Mixed
Elmahgoub, S.M., et al. (2011)	Physical Therapy	45	14-22	Various exercises	School	Group	Mixed
Lancioni, G. E., Gigante, A., O'Reilly, M. F., Oliva, D., & Montironi, L. (2000)	Special Education	2	31-35	Walking and task engagement	Residential facility	Single	Mixed
O'Reilly, M. F., Lancioni, G. E., & Kierans, I. (2000)	Special Education	4	37-42	Various social activities	Local bar	Single	Positive
Lancioni, G. E., et al. (2004)	Special Education	2	15-21	Stationary cycling and stepping	Disability center	Group	Positive
Vuran, S. (2008)	Special Education	2	21-23	Basket-making	Special Ed. Center	Group	Positive
Cannella-Malone, H.I., Tullis, C. A., & Kazee, A. R. (2011)	Special Education	3	8-11	Various exercises	Various	Single	Positive
Garcia-Villamisar, D. A. & Dattilo, J. (2010)	Psychology	37	17-39	Various leisure activities	Various	Group	Mixed
Garcia-Villamisar, D. A. & Dattilo, J. (2011)	Psychology	31	27-38	Various leisure activities	Various	Group	Mixed
Garcia-Villamisar, D. A., Dattilo, J., & Muela, C. (2017)	Psychology	43	25-41	Various recreational activities	Various	Group	Positive
Hesselmark, E., Plenty, S., & Bejerot, S. (2014)	Psychology	68	19-53	Various recreational activities	Various	Group	Mixed
Prupas, A. & Reid, G. (2001)	Physical Education	4	5-9	Walking/jogging	School gym	Group	Positive

Yilmaz, I., Yanardag, M., Birkan, B., & Bumin, G. (2004)	Physical Education	1	9	Swimming	Pool	Single	Positive
Zhang, J., Cote, B., Chen, S. & Liu, J. (2004)	Physical Education	1	39	Bowling	Gymnasium	Single	Positive
Yilmaz, I., Birkan, B., Konukman, F., & Erkan, M. (2005)	Physical Education	4	7-9	Aquatic play skills	Indoor pool	Single	Positive
Pan, C. Y. (2008)	Physical Education	48	7-12	Various PA	Playground	Group	Mixed
Pan, C. Y. (2009)	Physical Education	25	7-12	Various PA	Playground	Group	Mixed
Yilmaz, I., Konukman, F., Birkan, B., & Yanardag, M. (2010)	Physical Education	3	9	Swimming	Indoor pool	Single	Positive
Pan, C. Y. (2010)	Physical Education	16	6-9	Swimming	Pool	Group	Mixed
Pan, C. Y., Tsai, C. L., & Hsieh, K. W. (2011)	Physical Education	95	14	Various sports and activities	School phys. ed. class	Group	Mixed
Boer, P. H., et al. (2013)	Physical Education	54	17	Sprinting	Special Ed. School	Group	Mixed
Alexander, M., Smeltzer, A., Dummer, G., & Denton, S. (2011)	Physical Education	4	14-24	Soccer	Indoor soccer facility	Group	Mixed
Todd, T. & Reid, G. (2006)	Physical Education	3	15-20	Snowshoeing and walking	Local park	Single	Inconclusive
Yanardag, M., et al. (2011)	Physical Education	4	7-9	Tennis	Indoor gym	Single	Positive

Yilmaz, I., Ergu, N., Konukman, F., Agbuga, B., & Zorba, E. (2009)	Physical Education	16	11-15	Swimming and water exercises	Local pool	Group	Positive
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Methodology

Studies included in this literature review were selected by searching on social science search engines ERIC, Pub Med, PsychARTICLES, Education Full Text, and PsycINFO. The searches were focused on experimental studies assessing either physical or behavioral results of recreation and leisure activities for people with autism spectrum disorder (ASD). Keywords such as recreation, autism, leisure, and physical activity were primarily used to conduct these searches. Only articles published within the last twenty years (1999-2019) were included in this synthesis. Manual searches of the reference sections of these studies were then conducted to identify additional relevant articles that fit the inclusion criteria.

An Excel database was produced to categorize each of the articles and their reference information, as well as the categorical criteria being included in the review. These categories include sample size, age group, single subject versus group design, author discipline, setting, activity for the intervention, and the rationale and type of results for each study. The type of results for each study was categorized as positive, negative, mixed, or inconclusive. The author disciplines for each study were categorized as physical education, special education, psychology, health sciences, physical therapy, occupational therapy, or kinesiology. A total of 35 articles were included in this literature review based on the following inclusion criteria (a) published between 1999 and 2018 (b) participants had a diagnosis of autism spectrum disorder (c) included an experimental design and (d) the intervention involved recreation, leisure activity, or physical activity and assessed behavioral and/or physical results. Animal-assisted interventions were excluded from the criteria in this review.

The next section of this paper includes summaries of each group of studies based on the authors' discipline. The summaries will evaluate the primary focus of each disciplines' studies, as well as highlight the main procedural outcomes.

Summary of Studies Grouped by Author Discipline

Health Sciences

Two studies in the discipline of health sciences were included in this review. Yan, Z., Finn, K., & Corcoran, M. (2015) conducted a study with a group design. The intervention involved educational, aerobic, balance, and strength training components and each participant was matched with a peer student in a Health Science course. The students evaluated each participant's safety with equipment, adherence to and comprehension of instructions, and ability to count repetitions. Results showed significant improvements in waist circumference, physical activity, sit-to-stand test, and balance test. There were no significant results for BMI, hand grip test, and the 6-minute walking test.

Guest, L., Balogh, R., Dogra, S., & Lloyd, M. (2017) conducted a study that implemented a pre-test, post-test quasi-experimental design with an 8-week follow up for a multi-sport camp intervention for girls with ASD. The camp lasted five days and entailed locomotor and object control skills being taught and progressing in difficulty. The skills were implemented in a variety of sports settings, including track, basketball, baseball, and soccer. The results of this study were generally mixed. Significant improvements in physical self-perceptions and self-efficacy of physical activity were scored by one testing measure, but not another. Furthermore, small increases in social skills were found at the post-test, but there were

no significant results in improvement of social skills as a group. Lastly, results showed that each participant's motor skills had significant improvement upon completion of the summer camp.

These studies in the health sciences field primarily focused on variables related to physical health, including motor skills, BMI and waist circumference, and various fitness tests. The interventions also concentrated heavily on physical activity, whether through sports, aerobic exercises, or balance and strength exercises. Overall, results between the two studies were mixed.

Occupational Therapy

Only one article in the field of occupational therapy met the inclusion criteria for this review. Potvin, M. C., Snider, L., Prelock, P., Kehayia, E., & Wood-Dauphinee S. (2013) conducted a study that compared children with high functioning autism (HFA) and their typically-developing peers in terms of various factors regarding recreation. Some of these factors include diversity, location, personal intensity level, and general social aspects of the activity choice. The study implemented several rating scales and tests through an interview format with both the participant and his or her family. The primary outcomes of this study found that children with HFA participated in fewer activities, did not show greater intensity of activities, and did not differ with their typically-developing peers in terms of overall enjoyment, preference, and social-type of activity.

Kinesiology

Three studies in the discipline of kinesiology met the inclusion criteria and were assessed in this literature review. Lochbaum, M. & Crews, D. (2003) implemented an exercise training program for people with ASD that involved stationary cycling and six upper and lower body

exercises. Results were primarily positive, as all participants showed improvement in aerobic fitness, bench press, low row, and leg press workouts.

Pan, C. Y., & Frey, G.C. (2006) published an article that studied the patterns in physical activity for people with ASD in different age groups. The participants wore an accelerometer and additionally completed a physical activity questionnaire. Results showed that there were no consistent patterns in physical activity with regard to day and time for all participants. Furthermore, the data showed that elementary youth with ASD were more consistently active than middle and high school youth with ASD.

Lastly, Bremer, E., Balogh, R., & Lloyd, M. (2015) used a wait-list control experimental design to assess groups of different intensity in a fundamental motor skill program. Both groups participated in a total of 12 hours of the intervention, which focused on locomotor and object control skills progressing in difficulty over time. Results showed an improvement in motor skills for both groups, but no change in social skills and adaptive behavior. There were also no differences in results for each of the groups differing in intensity.

These kinesiology studies generally yielded mixed results. The studies assessed outcomes based on physical health factors, such as physical activity level and intensity, motor skills, fitness exercises. One did, however, evaluate the impact of a motor skill program on social skills and behavior, as well as physical health aspects.

Physical Therapy

Six articles in the discipline of physical therapy met the inclusion criteria for this review. Fragala-Pinkham, M. A., Haley, S. M., & Goodgold, S. (2006) conducted a study with a quasi-experimental single group pretest-posttest design. A fitness program was implemented and

involved warm-up exercises, strength training, aerobic conditioning, and a cool-down. Some of the strengthening activities in this program include sit-ups, pushups, wall squats, and other exercises with cuff weights and resistance bands. Repetitions and weight gradually increased as the program progressed. The aerobic conditioning aspect of the program involved participating in games, sports drills, obstacle courses and other activities that gradually increased in intensity and time. Results showed that all clinical outcomes showed some improvement, especially functional mobility. The other outcomes included isometric muscle strength of knee extensors, hip abductors, and ankle plantar flexors, walking energy expenditure, and fitness.

Pitetti, K. H., Rendoff, A. D., Grover, T. & Beets, M. W. (2007) implemented a 9-month treadmill walking program for adolescents with autism. Increases in speed and grade were behavior dependent and frequency and duration was slowly increased by an average of 1 day every 3-5 weeks and 1 minutes every 2-3 weeks, respectively. Results showed that the experimental group experienced a significant decrease in BMI and a non-significant decrease in weight. Exercise capacity and monthly caloric expenditure also increased for the intervention group. The control group, on the other hand, showed no significant changes for BMI.

Fragala-Pinkham, M. A., Haley, S. M., & O'Neil, M. E. (2008) conducted a study with a non-randomized, A-B group design. The intervention employed was an aquatic exercise program held twice a week for 14 weeks. Each session involved a warm-up, aerobic exercise, strength training, a cool-down, and stretching. Aerobic exercise entailed relay races, swimming laps, and other games, and the strength training entailed exercises with noodles, bar balls, and water resistance. The results of this intervention showed a significant reduction in time for a half-mile walk/run but no significant outcomes for the secondary measures of strength in knee extensors, hip abductors, knee flexors, and ankle plantar flexors. Modified curl-ups and motor

skills evaluated through the Multidimensional Pediatric Evaluation of Disability Inventory (M-PEDI) Functional Skills Mobility Scale had moderate effect sizes.

Sami Mohammed Elmahgoub et al. (2009) conducted a study that implemented a combined exercise training program. Each session of the intervention incorporated a warm-up, cycling, strength training of biceps and triceps muscles, stepping, strength training of quadriceps and hamstrings, and a cool-down. Results showed a significant decrease in weight, BMI, and waist and fat mass and a significant increase in fat-free mass for the experimental group. Furthermore, the intervention group showed significant decreases in triglycerides, total cholesterol, and low-density lipoprotein (LDL) cholesterol and a significant increase in high-density lipoprotein (HDL) cholesterol. Overall distance walked increased and peak VO_2 decreased significantly.

Patrick Calders et al. (2011) conducted a controlled trial that involved a combined exercise training program for adults with intellectual disabilities. Participants were either in the combined training group (COM), an endurance group (END), or a control group (C). The COM group received both strength and endurance training which involved a warm-up, cycling, strength training of various muscle groups, running, functional training of the back and abdominals, and a cool-down. The END group participated in a similar intervention, except strengthening exercises were replaced with endurance activities. These include cycling, stepping, and running or walking. The C group were not supervised and participated in daily activities. Results of this study showed no significant differences within or between the three groups for weight, height, BMI, fat mass, fat free mass, and waist measurements. Compared to the C group, the COM group showed significant improvements in cholesterol levels, aerobic capacity, muscle strength, and systolic blood pressure. The END group had significant

improvements in aerobic capacity and systolic blood pressure compared to the C group. The COM group showed more significant improvements in cholesterol, hand grip strength, muscle fatigue resistance, sit-to-stand, systolic blood pressure, and strengthening for lower limb, upper limb, and abdominal muscles compared to the END group.

Sami S. Elmahgoub et al. (2011) incorporated an interventional design into a combined exercise training program assessing the role of training frequency. One intervention group participated 2 times per week over a 15-week period and the other intervention group participated 3 times per week over a 10-week period. The intervention involved a warm-up, cycling, strength training of biceps and triceps muscles, stepping, strength training of quadriceps and hamstrings, and a cool-down. No significant differences were found between the two groups besides in strength training for the lower limbs, which favored exercises 3 times per week. They experienced evolution in peak VO_2 , peak power, peak heart rate, and relative peak VO_2 . Both groups showed significant decreases in BMI, waist circumference, and fat mass and a significant increase in relative fat-free mass. Both groups also experienced significant decreases in total cholesterol and LDL and a significant increase in HDL.

These six articles regarding physical therapy yielded mixed results. Most of the procedures involved combined training of a warm-up, cool-down, strength training, and some type of aerobic exercise. Many of the outcomes that were evaluated were some aspects of physical health, such as strengthening of particular muscles, weight, BMI, energy expenditure, and cholesterol levels.

Special Education

Five articles in the field of special education were included. Lancioni, G. E., Gigante, A., O'Reilly, M. F., Oliva, D., & Montironi, L. (2000) found mixed results in their ABC designed study. The intervention involved two morning and two afternoon sessions that required participants to either walk to a destination or complete a task without prompting. Following completion of the intervention, results showed no change in bone mineral density, a decrease in bone metabolism, a decrease in body weight, no change in step width, an increase in independent exercise, and an increase in rising performance.

O'Reilly, M. F., Lancioni, G. E., & Kierans, I. (2000) used a multiple baseline design across pairs of participants in their study. The intervention required participants to learn a problem-solving approach to properly implement social skills at a local bar. Researchers found that the participants were generally successful in their implementation of appropriate social skills for ordering drinks and interacting with people and maintained the skills for up to three years.

Lancioni, G. E. et al. (2004) implemented a multiple probe design across exercise tools in a study that assessed an exercise intervention with automatically delivered stimulation. The intervention required participants to use a stationary bicycle for 10 minutes or a stepper for 5 minutes, with 2-4 exercise sessions per day. Results showed that frequencies of intervals with indices of happiness experienced an overall increase by the end of the intervention.

Vuran, S. et al. (2008) conducted a study with a multiple probe design that implemented a most to least prompting and instructional procedure in the intervention. This intervention tested the participants on their skills on masking a basket out of clay, and results showed that the task was completed with full independence for up to six weeks following the skill instruction.

Cannella-Malone, H.I., Tullis, C. A., & Kazee, A. R. (2011) conducted a study with a multiple baseline across participants design. The intervention involved participants performing a variety of exercises, including lunges, jumping jacks, and jogging, in 1-20 minute intervals during each hour of the school day. The outcomes of this intervention showed a general decrease in frequency of challenging behavior in all of the participants.

These studies in the field of special education yielded a majority of positive results of recreation and leisure interventions for people with ASD. The types of interventions used within this field of study varied, as some focused on exercise and physical activity and other studies primarily focused on skill implementation and task completion. However, a majority of these studies assessed dependent variables regarding behavioral and social factors, including indices of happiness, prevalence of challenging behavior, and skill or task completion and independence.

Psychology

Four articles in the field of psychology met the inclusion criteria for this review. Garcia-Villamizar, D. A. & Dattilo, J. (2010) conducted a year-long study with a repeated measures design. The intervention consisted of group recreation activities including media interaction, games, crafts, exercise, and attending events. The experimental group experienced significant improvements in quality of life factors and a significant decrease in stress levels. The control group, however, showed no significant improvements in quality of life or stress levels.

Garcia-Villamizar, D. A. & Dattilo, J. (2011) implemented a pre-test, post-test experimental design in a year-long leisure program. The program consisted of group recreation activities including media interaction, games, crafts, exercise, and attending events. Results showed that socio-emotional and executive function indicators had mixed significance, but the

experimental group showed a significant improvement in social behavior based on the Vineland Adaptive Behavior Scales-Interview Edition Survey Form (VABS) compared to baseline.

Garcia-Villamizar, D. A., Datillo, J., & Muela, C. (2017) conducted a preliminary pre-test, post-test randomized control group experimental design study. The study implemented a therapeutic recreation (TR) program focusing on increasing executive function (EF), social skill and adaptive behavior, and general wellness of participants. The TR-EF program involved physically active, social, and electronic learning games, as well as recreation activities. A decrease in behavior problems and an increase in well-being occurred for the TR-EF group but not for the wait list group. Both groups experienced overall improvement in EF.

Hesselmark, E., Plenty, S., & Bejerot, S. (2014) conducted a preliminary randomized controlled open trial with parallel design study. Two interventions were implemented, a cognitive behavioral therapy intervention and a recreational activity intervention. The cognitive behavioral therapy intervention (CBT) involved lectures, relaxation and mindfulness exercises, and homework that focused on structure, group setting, psycho-education, social training, and cognitive behavioral techniques. The recreational intervention focused primarily on structure and group setting and participants voted for the activities that they participated in. Results of this study showed no change in psychiatric symptoms and no significant difference between the interventions. The CBT intervention resulted in more general improvement among participants, and both interventions showed improvement in quality of life measures for participants.

These four studies in the field of psychology primarily yielded mixed results. The interventions focused on group setting with a combined variety of activities involving recreation, leisure activities, and exercise. Quality of life, general well-being, and social behavior were common variables that were evaluated based on results of the interventions.

Physical Education

Fourteen articles published in the field of physical education were included in this review. Andrea Prupas and Greg Reid (2001) published a study about a multiple frequency exercise program with a time series design. The baseline lasted four days and evaluated the prevalence of stereotypic behaviors for each participant during different times of the day to detect any patterns. The single frequency group walked or jogged for ten minutes one time at the beginning of the school day, while the multiple frequency group walked or jogged for ten minutes three times per day at the same intensity of the single frequency group. Results showed that both groups experienced a significant reduction of stereotypic behaviors following exercise and suggest that the multiple frequency program may yield more lasting results because a reduction was present throughout the entire day.

Yilmaz, I., Yanardag, M., Birkan, B., & Bumin, G. (2004) implemented a 10-week swimming training program for an individual with autism. The Halliwick Method was used in this program to assess adjustment to water, rotations, control of movement in water, and movement control out of water. Following the program several fitness tests were completed by the participant, including a six minute walk, balance, thrust, standing broad jump, grip strength, muscle strength, and speed. Results yielded improvements in balance, speed, agility, power, hand grip, upper and lower extremity muscle strength, flexibility, and cardiorespiratory endurance. The frequency of stereotypic behaviors for the child decreased and the child oriented to the water following the program.

Zhang, J., Cote, B., Chen, S. & Liu, J. (2004) implemented a single-subject ABAB design and constant time delay (CTD) procedure to teach a bowling skill to a 39-year-old participant. Verbal direction was used as a task stimulus while physical assistance was involved as a

controlling prompt during each intervention phase. The first B phase of the procedure was a delay of 0 seconds for two sessions and the rest of the first phase as well as the second B phase was a 5-second delay. The participant was being taught the one-step portable bowling skill during each intervention session. Results showed that during the intervention phases, the frequency of correct responses increased significantly after the CTD procedure was implemented, particularly after the 5-second delay.

Yilmaz, I., Birkan, B., Konukman, F., & Erkan, M. (2005) also implemented a CTD procedure with a single-subject multiple probe design across behaviors to teach aquatic play skills to children with autism. Probe sessions occurred before training target behaviors and 0-second and 4-second time delays were used for controlling prompts. The intervention used the single opportunity method over a 10-week period. By the end of the program, all participants had significantly increased correct target skills and maintained them during the first, second, and fourth generalization phase weeks.

Chien-Yu Pan (2008) published an article that sought to compare measured physical activity levels between children with and without autism during inclusive recess settings over 5 consecutive school days. Overall recess, three morning recesses, one lunchtime period, and three afternoon recesses were considered in this study. Participants wore accelerometers to track prevalence of moderate-to-vigorous physical activity throughout these time periods. Results of the accelerometer data showed that children with ASD were less physically active during overall recess, first and second morning recess, and lunchtime. Neither group participated in enough physical activity during recess time per day.

Chien-Yu Pan (2009) published an additional article that evaluated associations of age, social engagement, and physical activity levels in both structured and unstructured settings. The

structured setting in this study was physical education, and the unstructured setting was recess. Accelerometer data over 5 consecutive school days was used again for this study. In addition, social engagement was assessed using the Engagement Check procedure with behavior divided into two types, with adults and peers, and two forms, interactive and non-interactive. Results of this study showed that the children with ASD were more physically and socially active during physical education, rather than recess. Age was found to positively correlate with physical activity and social engagement and social engagement with adults was associated with higher levels of physical activity.

Yilmaz, I., Konukman, F., Birkan, B., & Yanardag, M. (2010) published a study that implemented a most-to-least prompting procedure and single-subject multiple baseline design across subjects with probe conditions. The single opportunity method was used again during the intervention to teach a simple progression swimming skill. The first stage of the most-to-least prompting intervention involved physical cues and direct verbal prompts, the second stage involved verbal directed prompts and gesture-mimic prompts, and the third stage involved verbal cues only. Results showed that the most-to-least prompting procedure was effective as all participants increased correct target skills in simple swimming progression. These skills were maintained during the first, second, and fourth generalization phase weeks.

Chien-Yu Pan (2010) used a within-participant repeated-measures design for a 10-week water exercise swimming program (WESP). The program paired two individuals with ASD with one instructor and involved social and floor warm-ups, small group instruction, whole group games and activities, and a cool-down. The WESP improved aquatic skills in four out of five measured stages and also decreased total antisocial behavior. However, it did not increase social competence behaviors.

Pan, C. Y., Tsai, C. L., & Hsieh, K. W. (2011) used accelerometer data to assess potential correlates that influence physical activity for adolescents with autism. Accelerometer data was collected from thirty-eight physical education sessions. Furthermore, social engagement was divided into two types, with adults and with peers, and two forms, social interaction and social initiation. Results showed that steps per minute measurements were significantly lower in adolescents with ASD compared to peers without disabilities. In addition, fitness testing and free-play activities showed higher activity than team and individual activities and participants were less active with male teachers and certified teachers. Physical activity level was also greater when it was held in an outdoor versus indoor setting. Social interaction and initiation were more prevalent with peers than with adults and both interaction and initiation were positively correlated with physical activity measurements such as steps/min and percentages of moderate, vigorous, and moderate-to-vigorous physical activity.

Pieter-Henk Boer et al. (2014) established a sprint interval training (SIT) program for adolescents with and without intellectual disabilities (ID) compared to a control group and a continuous aerobic training (CAT) group. Tests and outcomes that were incorporated into this program include a maximal cardiopulmonary exercise test, sit-to-stand test, muscle fatigue resistance, blood pressure, lipid profile, fasting blood glucose and insulin, height, and weight. The SIT group experienced significant positive evolution of waist circumference, fat percentage, blood pressure, lipid profile, fasting blood insulin levels, insulin resistance, peak VO_2 , ventilatory threshold, 6-minute walk distance, muscle fatigue resistance compared to the control group. Compared to the CAT group, the SIT group showed improvements in fat percentage, blood pressure, LDL, fasting insulin levels, peak VO_2 , peak power, and ventilatory threshold.

Alexander, M., Smeltzer, A., Dummer, G., & Denton, S. (2011) conducted a study with a single-subject ABCA quasi-experimental repeated measures design for special Olympic athletes. Only one of the four participants had an autism diagnosis. The intervention involved an introduction and baseline phase to assess social skills, a classroom phase to receive instruction on proper social interaction, a soccer phase to implement instructed social skills and exercise, and a party phase on the last day of the program that celebrated the participants' accomplishments. Results of this study showed that the participant with autism improved his ability to contribute relevant information and retained this for up to five weeks following the program completion. Two other particular skills that he improved on were eye contact and taking turns in conversation.

Terri Todd and Greg Reid (2006) incorporated a changing conditions design into a program that involved circuits of walking/jogging and snowshoeing. A self-monitoring board, verbal cues, and edible reinforcers were implemented into the intervention. Results of this program were generally inconclusive. All participants increased the number of circuits completed and distance travelled. Verbal cueing and edible reinforcers gradually decreased throughout the duration of the program. Verbal encouragement decreased slowly for walking/jogging and verbal directives remained relatively stable throughout the walking/jogging program.

Mehmet Yanardag et al. (2011) incorporated a least-to-most (LTM) prompting procedure with a single-subject multiple-probe design with probe conditions across behaviors in their study. The intervention involved teaching basic tennis skills, including ball dribble, air dribble, and line dribble drills. Target behaviors were selected based on the ideas that they should be functionally similar to and independent of each other. A single opportunity method with one-to-one

instruction was used in this program. Results showed that every participant increased correct basic tennis skills during both the probe and teaching phases and following the LTM procedure.

Yilmaz, I., Ergu, N., Konukman, F., Agbuga, B., & Zorba, E. (2009) implemented a 10-week water exercise and swimming program that used pre- and post-test measurements. These measurements were the 25-yard dash, bent arm hang, leg lift, thrusts, static balance test, and 300 yard run/walk. Results showed significant improvements in all dependent variables of cardiovascular endurance, muscular endurance, speed, static balance, and agility.

These studies in the field of physical education generally yielded either positive or mixed results. Common procedural aspects among these studies include constant time delay, most-to-least or least-to-most prompting, single opportunity methods, and probe designs. Many of the interventions targeted physical skills for different sports, such as tennis, bowling, or swimming, or assessed general physical activity levels based on accelerometer data. Furthermore, some common variables that were focused on regarded both physical and social health, such as stereotypic behavior frequency, target social skills, and various fitness tests.

Results

Among these 35 studies, 21 yielded mixed results, 13 yielded positive results, 0 yielded negative results, and 1 yielded inconclusive results. There were a total of 27 studies that utilized a group research design and 9 with a single-subject research design. Several disciplines had key interests in evaluating the effectiveness of different interventions for the ASD population. Studies within each discipline showed common trends in the procedure, overall study design, and the outcomes that were measured. Interventions within each discipline were also primarily focused on different aspects of health, physical or social.

Several articles assessed an intervention's impact on physical factors related to health. The two studies in the discipline of health sciences were both group design studies that yielded mixed results. The primary focus of the interventions was physical health factors relating to fitness, physical activity level, motor skills, weight, and BMI. The articles within the field of kinesiology were also all group designs. Two of them yielded mixed results, while the other yielded positive results. This discipline also focused primarily on physical health factors and motor skills, just as the health sciences studies did. One kinesiology study did, however, assess the effectiveness of an intervention on social skills in addition to physical health aspects. All six of the studies published within the field of physical therapy were group designs and yielded mixed results. The interventions often had a specific sequence beginning and ending with a warm-up and cool-down and involving some type of strength or aerobic training in between. Similar to the health sciences and kinesiology disciplines, the articles within the field of physical therapy primarily focused on similar physical health aspects and also assessed the strengthening of particular muscle groups as a result of the intervention.

Several articles evaluated an intervention's impact on social and behavioral aspects related to health. The study within the field of occupational therapy had a group design and yielded mixed results. This study assessed social aspects of recreation, such as personal intensity and enjoyment level, activity preference, and frequency of participation in certain activities. The five articles within the discipline of special education also focused primarily on social health aspects. Three of the articles were of single-subject design and the other two were of group design. Only one of the articles yielded mixed results, while the other four yielded positive results. Although some of the interventions involved tasks regarding physical activity and exercise, the variables that were evaluated as a result of the interventions primarily regarded

social and behavioral health. These variables include indices of happiness, challenging behavior frequency, task completion, and social skills and independence. The four studies within the field of psychology were all of group design. Three of them yielded mixed results and one of them yielded positive results. Factors that were commonly evaluated in these interventions regarded general well-being and social behaviors. Lastly, there were nine articles of group design and five articles of single-subject design in the field of physical education. This disciplinary area generated the largest amount of studies with eight articles yielding positive results, six articles yielding mixed results, and one article yielding inconclusive results. Although many of these procedures implemented different sports or general physical activity, they assessed social and behavioral measures in addition to fitness measures.

Discussion

This review of various disciplinary areas and their interventions has contributed to the current need to improve quality of life for people with ASD. Several studies were effective in implementing recreation or leisure programs that improved physical health factors, social competency, and overall behavior of this population. However, many of the studies outside of special education and psychology used a group design in the intervention. The sample in each of these studies is not homogenous and it is difficult to compare results between different groups of people with special needs. A single-subject design in many of these studies might have been more effective in yielding more accurate results.

Furthermore, two vital topics that were rarely assessed by these studies was overall quality of life and indices of happiness. Four studies within the psychology and special education fields used these two factors as dependent variables. However, as a whole, this group of articles lacked research on these variables. Physical and behavioral benefits are extremely

vital in improving the quality of life for this population, but these benefits may not be acquired without proper enjoyment and motivation of the participants. Overall quality of life can be more effectively improved with a combination of good physical health, good behavioral and social competency, and a motivated and positive mental state. However, to summarize, these studies showed that physical activity, recreation, and leisure programs can positively impact both physical and behavioral aspects of health for individuals with ASD.

Future Directions

Future research is needed to analyze the effects of physical activity, recreation, and leisure programs on indices of happiness and overall quality of life. These factors can be implemented into data collection as categorical dependent variables. Enjoyment and motivation are necessary for participants with ASD to effectively engage in these programs in order to receive their full benefits.

A few articles included in this review did implement quality of life and indices of happiness variables into their interventions. However, each disciplinary area had its own primary focus on different aspects of health. Each field also had its own strengths and weaknesses in its procedure and data collection methods. To more effectively impact the ASD population to improve overall quality of life and increase indices of happiness in conjunction with physical and behavioral benefits, an interdisciplinary approach is recommended. This way, each discipline can incorporate their own assets to lead to a more wholesome and sufficient approach that benefits all aspects of health and quality of life for individuals with ASD.

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