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Parent Physical Activity: A Systematic Review of the Literature and Recommendations for Parents of Children with Autism Spectrum Disorder

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# Abstract

## Background:

The aims of this review were to describe exercise interventions, facilitators, and barriers to physical activity for parents of children with autism spectrum disorder.

## Methods:

A systematic review of the literature, appraising the validity of each article with Melnyk and Fineout-Overholt's level of evidence, from different databases CINAHL, Cochrane, PsycINFO, PubMed, ProQuest, and Web of Science between 2000 and 2020 was conducted. As the initial search revealed no articles on exercise interventions and only 2 articles with children with autism spectrum disorder, the aim was widened to all parents of children.

## Results:

Forty-five articles were identified on barriers to physical activity including being the primary caregiving parent, perception of guilt and selfishness, and adhering to exercise programs they do as part of research, once research ends. Facilitators for physical activity including parents being more likely to exercise if they can bring their child with them and parents preferring exercise that is a lifelong habit, such as walking.

## Conclusions:

Due to the lack of research on parents of children with autism spectrum disorder, recommendations include development and testing of interventions for parents of children with this condition including family-based exercise interventions where children and parents have a choice to exercise together.

# Keywords:

meta-analysis, pediatrics, interventions

The prevalence of autism spectrum disorder (ASD) is estimated at 1 in 54 individuals in the United States.[1] Children with ASD have atypical language, and restrictive, repetitive behaviors.[2] Approximately 40% of children with ASD also have an intellectual disability[3] and other comorbid health conditions including obesity.[4] Meeting the many needs of caring for a child with ASD can be complex, and can lead to increased stress for parental caregivers.[5],[6] Parents of children with ASD are at greater risk of poor physical and mental health than parents of typically developing children.[6],[7] Mothers generally report having more parenting responsibility than fathers, and are at increased risk of poor health.[8] Parent self-care behaviors, such as sedentary activity, negatively influence the health of the caregivers, which consequently impacts the health of their children with ASD.[4],[9],[10]

The World Health Organization recommends adults participate in aerobic physical activity (PA) that is moderate-intensity for 150 to 300 minutes a week, or vigorous intensity for 75 to 150 minutes, or a combination of the 2 intensities.[11] Aerobic PA recommendation for children and adolescents, including those with disabilities, is an average of 60 minutes per day of moderate to vigorous intensity, and an average of 60 minutes per day of moderate to vigorous intensity aerobic PA per week.[11]

Physical activity can provide many health benefits to individuals who regularly exercise. General benefits induced by PA include improved mental, psychological, and social health and decreased risk of several unhealthy conditions and chronic diseases.[12] Participation in PA is associated with decreased stress for parents.[13] Participation in leisure-time PA by mothers of infants has been found to be associated with decreased depressive symptoms after controlling for demographic factors.[14] PA is also linked to improved quality of life and alleviation of the negative health associated outcomes of stress and depression, which have been linked with childhood obesity.[14]–[16]

# Problem

Autism spectrum disorder is a lifelong neurodevelopmental disorder that appears before age 3 years.[2] Although there is no cure for ASD, symptoms of ASD, such as challenging behaviors, can be improved via parent and child interventions.[2],[17] Child ASD symptoms include impulsiveness, hyperactivity, and injuries to self and others.[5] Furthermore, individuals with ASD may exhibit abnormalities with eating and sleeping habits.[4] In addition, there are numerous comorbid conditions, such as epilepsy, digestive disorders, anxiety disorder, sleeping disorders, and immune disorders, associated with ASD.[4] Therefore, caregiving for children with ASD can be energy depleting for parents, which can negatively impact their physical and psychological well-being.[5],[18] Unlike parenting typically developing children, parental caregiving for a child with ASD is a lifetime responsibility.[19] Therefore, preserving the optimal health of the parents of children with ASD is vital to optimal child well-being.

The PA is linked to improved thinking ability, reduced depression and anxiety, better sleep, weight management, and ability to manage everyday activity.[20] However, parents of children with ASD are less likely to engage in PA compared with parents who have a child who is typically developing.[21]

The aims of this review were to describe exercise interventions, facilitators, and barriers to PA for parents of children with ASD and other intellectual or developmental disabilities. Reviewing literature revealed that there were only 2 articles about PA that included parents of children with ASD.[21],[22] Given the limited research, we expanded the aim of the review to learn about the barriers and facilitators to PA of all parents of children, so that the information gained can be used to benefit parents of children with ASD with the goal of developing PA interventions that will improve the health outcomes of both parent caregivers and their children.

# Methods

The literature search for this systematic review of parent exercise interventions was conducted using the steps of Cooper et al[23]: (1) problem formulation, (2) data collection, (3) data evaluation, (4) analysis and interpretation, and (5) presentation of the results. The following databases were searched: CINAHL, Cochrane, PsycINFO, PubMed, ProQuest, and Web of Science. The keywords *exercise*, *physical activity*, *parents*, *autism*, *developmental disabilities*, *intellectual disabilities*, *health promotion*, *health education*, *patient education*, *consumer health information*, *program evaluation*, *program development*, *intervention*, and *stress management* were used in various combinations using the connectors "or" and "and." Articles included were those published in the English language and between the years 2000 and 2020. *Diet*, *nutrition*, *obesity*, and *overweight* were exclusion keywords utilized in the search to limit the intervention to PA. Exclusion criteria included dissertations, books, or editorials, exercise interventions for solely the child, and studies of adults with an intellectual or development disability. Inclusion criteria included PA or exercise intervention involving parents and family-based exercise interventions. The search was strictly electronic. No hand search or snowball search was performed.

Melnyk and Fineout-Overholt's[24] system of 7 levels of evidence from highest to lowest was used for the appraisal: (I) a systematic review or meta-analysis of randomized controlled trials (RCT); clinical guidelines based on systematic reviews or meta-analyses, (II) a minimum of one RCT, (III) controlled trials without randomization, (IV) case control and cohort studies, (V) systematic reviews of qualitative and descriptive studies, (VI) single descriptive or qualitative study, and (VII) opinion of authorities or expert committees. Based on the level of the evidence, a determination of the clinical usefulness of the information on barriers and facilitators to PA was discerned for parents. Level I evidence is considered superior to level VII evidence with this system. However, themes across level VII evidence can inform strategies to promote PA when there are limited level studies. A meeting was held for the 8 researchers and the themes were developed as an iterative process.

Each of the included studies in this review was appraised using the following tools for methodologic quality. Two authors (N.J. and A.B.) assessed the quality of the articles and reached consensus. The Cochrane Risk Of Bias tool[25] was used to assess 7 domains: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other sources of bias. Bias was graded low, high, or unclear. The determination for the overall bias for each article matched the highest level of bias in the reviews.

The Risk of Bias in Non-Randomized Studies—of Interventions[26] was used to evaluate the risk of bias for the quantitative studies that compared interventions that were not randomized but had a control group. There were 7 domains assessed with this tool: bias due to confounding, bias in selection of participants, bias in classification of the interventions, bias due to deviations from the intended interventions, bias due to missing data, bias in measurement of outcomes, and bias in the selection of the reported results. Bias was graded low risk, moderate risk, or serious risk or no information. The overall bias matched the highest level of bias in the individual reviews.

The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)[27] guideline was used to evaluate the risk of bias for the observational studies. The STROBE checklist asks the following information (1 = reported; 0 = not reported; n/a = not applicable): (1) indicates study design in title and abstract and provides an informative and balance summary in the abstract; (2) gives the scientific background and rationale; (3) states specific objectives and hypotheses; (4) presents key elements of study design; (5) describes setting, location, exposures, follow-up, and relevant dates; (6) clearly defines eligibility criteria and methods of selecting participants; (7) clearly defines outcomes, exposures, potential confounders, predictors, and effect modifiers; (8) gives sources of data and clearly defines method of assessment; (9) describes potential bias; (10) explains how study size was arrived at; (11) explains how quantitative variables were handled in analysis; (12) clearly describes the statistical analyses; (13) reports number of individuals at each stage of study and gives reasons for nonparticipation; (14) gives characteristics of study participants and indicates number of missing data; (15) reports number of events (outcomes and/or exposures); (16) clearly provides the main results of analyses; (17) reports all the analyses performed; (18) summarizes key findings compared to study objectives; (19) reports limitations of the study; (20) presents cautious interpretations of the study; (21) reports the generalizability of the findings; and (22) lists funding sources and role of the funder.[27]

# Results

The selected literature was appraised to assess the level of evidence (see Table 1). In all, 94 studies met the inclusion and exclusion criteria. After removing duplicate articles there were a total of 45 articles included in the final analysis (see Figure 1). Research studies took place in the United States (n = 19), Australia (n = 11), Canada (n = 6), UK (n = 4), South Africa (n = 1), Poland (n = 2), Finland (n = 1), and the Netherlands (n = 1).

Table 1 Summary of Articles Included in the Systematic Review

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Author** | **Study design** | **Sample size** | **Level of evidence** | **Intervention** | **Results** |
| Albright et al28 | Mixed-method parallel RCT. | Mothers (N = 154) of infants between 2 and 12 mo old and (N = 157) control. | II | TTCW PA intervention designed to initiate and maintain MVPA compared with a SWO PA intervention. | Telephone counseling somewhat facilitated the resolution of barriers and achievement of MVPA.Top barriers to PA in mothers were "too busy," "bad weather," "child or mom sick," and "too tired." Nonwhite ethnic groups were less likely to achieve their PA goals. |
| Albright et al29 | Quantitative pretest–posttest pilot study. | Postpartum women (N = 20) | III | Phone counseling, pedometers, referrals to community PA resources, and social support to increase the amount of moderate to vigorous LTPA. | A total of 55% experienced an increase of 60 min or more a week and 75% reported setting weekly goals and PA counseling helped increase PA. |
| Belanger-Gravel et al30 | Quantitative cross-sectional survey and secondary analysis. | Mother/daughter (N = 357), mother/son (N = 393), father/daughter (N = 117), and father/son (N = 133). | VI |  | Parent–daughter duos participated in less sedentary activities, had increased self-efficacy, and positive parental outcomes. Parent–son duos had more sedentary activities and increased BMI. |
| Bellows-Riecken and Rhodes31 | Mixed-method literature review of 25 studies. | Total participants (N = 64,694) | V |  | All but 3 studies reported negative relationships between parenthood and PA. Mothers were found to be less active than fathers due to lack of time, support, and childcare. |
| Berniell et al32 | Quantitative quasi-experimental study to examine the effects of health education that children receive in school on their parents. |  | IV |  | Positive effects were found on the impact of health education children received at school and fathers participating in PA. Fathers impacted were 12.4% more likely to be physically active than nonaffected fathers. No findings on mothers were reported. |
| Bronikowski et al33 | Intervention study without randomization or control group | Children (N = 24, 14 boys, 10 girls; mean = 7.96 ± 0.69) and parents (N = 22, 14 mothers aged, mean = 38.86 ± 2.96 and 8 fathers aged mean = 37.38 ± 2.97). | IV | 15-wk long intervention with 5 different sports. | Increased PA and reduced sedentary time after the program. Improved sport and motor skills, more frequent family walks, meals, and family "do-together" LTPA. |
| Cowie et al34 | Mixed-method cross-sectional survey. | Parents of very young children, mothers (N = 171), and fathers (N = 125). | VI |  | Parents of young children are aware of the benefits of PA but engage in lower levels of it regardless. A total of 54% of couples without children met PA guidelines, while only 34% of parents did. |
| Craike et al14 | Mixed-method survey. | Mothers (N = 4720) of infants. | VI |  | Negative association between the frequency of LTPA and the level of depressive symptoms showing that LTPA decreased depression regardless of life stress. |
| Diaz21 | Mixed-method survey and interview. | Parents of typically developing children (N = 87,943), parents of children with down syndrome (N = 150), parents of children with developmental disability (N = 2143), parents of children with an intellectual or developmental disability (N = 3403), and parents of children with other special needs (N = 8847). | VI |  | The difference in PA among parents of children with and without down syndrome was examined. Parents of children with down syndrome were found to have a greater likelihood of being physically inactive compared with parents of children with autism. The child's well-being is linked to the health of the caregiver. |
| Dlugonski et al35 | Mixed-methods randomized control trial. A 6-wk intervention. | Mothers (n = 86) between 18 and 64 y old with at least one child aged less than 26 y. | II | Social cognitive theory Moms UNITE (using networks to increase togetherness and efficacy) based walking intervention for mothers. | Pre–post changes were not maintained at follow-up. |
| Fahrenwalad et al36 | Mixed-method randomized control trial. | (N = 22) and control group (N = 22) women enrolled in the WIC program with experimental group. | II | A provider counseled PA intervention, Moms on the Move, was implemented for WIC mothers based on the Transtheoretical Model of Behavior. | Short follow-up limits the interpretation of the results; however, the intervention was effective in increasing PA for women who wanted to change. |
| Fjeldsoe et al37 | Mixed-method randomized control trial. | Women (N = 133) with children aged less than 5 y and a control group (N = 130). | II | "Mobile Mums," a PA intervention for women with young children. | The intervention group reported significantly more MVPA than the control group, both in terms of duration (28.5 min/wk) and frequency (1.6 d/wk). |
| Flett et al38 | Qualitative focus group interviews. | Youth participants (N = 23) and parent participants (N = 19). | VI |  | Children enjoyed nature-based activities but needed assistance to be more active and engaged. Adults appreciated restorative aspects of nature and children preferred competitive experiences. Community outreach programs should educate, train, and create opportunities to engage children in healthy activities that will become lifelong habits. |
| George et al22 | Qualitative cross-sectional survey. | (N = 207) Parents of children with ID involved in Best Buddies program. | VI |  | A total of 69% of parents of children with ID involved in the study were found to be overweight or obese. A total of 50% of the parents involved in the study described their child with ID as underweight or normal, when they were overweight or obese. |
| Halliday et al39 | Quantitative longitudinal, walking pilot study. | (N = 15) Parents of children with cancer. | IV | 12-wk long walking intervention. | Depression scores dropped from median 7 to 2, anxiety scores dropped from median 3 to 1, and stress scores dropped from median 13 to 7. |
| Hamilton and White40 | Qualitative cross-sectional interviews and focus groups. | Mothers (N = 21) and fathers (N = 19) with at least one child aged less than 5 y. | VI |  | All parents reported a change in their PA habits after having children. This was either a decrease in intensity or a decrease in frequency. Some parents reported that PA brings about feelings of guilt for caring for themselves instead of their kids. |
| Hamilton and White41 | Descriptive questionnaire based on Theory of Planned Behaviors and 1-wk follow-up on PA behavior. | Mothers (N = 288) and fathers (N = 292). | VI |  | Behavioral beliefs for improving parenting practices, interfering with commitments; normative beliefs about people I exercise with; and control beliefs about lack of time, inconvenience, and lack of motivation predicted PA behavior.Both mothers and fathers reported that they contemplate their parenting commitments before considering PA. |
| Hamilton and White42 | Qualitative focus groups. | Mothers (N = 6) and fathers (N = 6) with children aged less than 5 y. | VI |  | Parents more likely to engage in PA if they were told how it affects their children's behavior. Parents preferred exercises they could do in 10 min or less. |
| Hartman et al43 | Mixed-method longitudinal process evaluation. | Minority group mothers, Ghanaians (N = 37), Antilleans (N = 6), and Surinamese (N = 6). | VI |  | Ethnic minority mothers were more likely to be recruited to participate in PA study if the recruiter was the same ethnicity as them. |
| Hull et al44 | Prospective analysis. | Men and women (N = 638) and 48% males and 52% females. | IV |  | Young adults, 24–26 y, are not meeting PA recommendations. The life event of marriage does not significantly impact PA. However, having a child significantly decreases PA by 3 h/wk. |
| Kernot et al45 | Mixed-methods longitudinal study. Mothers with children aged less than 5 y that use Facebook | N = 25 | IV | "Mums Step It Up Program"—a team-based social networking PA intervention for women with young children App usability assessed. | Usage rates were high and logging steps was the most used feature. There was a decline in logging steps toward the end of the 28-d period. |
| Lewis and Ridge46 | Qualitative multiphase interviews. | Mothers (N = 40) with at least one child aged less than 5 y. | VI |  | Women face tensions, dilemmas, and tradeoffs regarding PA and motherhood. Women see themselves as central to the health of the family and PA is built around the needs of the family. There is cultural pressure on women to achieve a slender body type along with maternal obligations. |
| Mascaren-has47 | RCT | Mothers (N = 64). | II | Web-based quantitative online video exercise study testing the effectiveness of videoconferencing online (mobile app) "Moms online Video Exercise (MOVE)" PA interventions. | Mothers in the intervention group increased mean MVPA by 42.2 more minutes than mothers in the control group. Statistical decrease in depression amount in inactive women in the intervention group. |
| Mailey and McAuley15 | Mixed-methods PA intervention. | Working mothers in central Illinois age 25–52 y that are employed at least 25 h/wk with at least one child aged less than 15 y living at home (N = 141). | II | Social cognitive theory-based intervention used to increase PA in working mothers. | Improvements in PA were mediated by an increase in self-regulation and efficacy. Barriers to PA were lack of time, energy, social support, childcare, and guilt. Improved self-reported LTPA for intervention group did not match the accelerometer-based PA outcomes, that is, intervention group regressed back to baseline activity levels for both total activity and MVPA. |
| Mailey and McAuley48 | Secondary analysis of a mixed-methods PA Intervention. | Working mothers in central Illinois age 25–52 y that are employed at least 25 h/wk with at least one child aged less than 15 y living at home (N = 141). | II | Brief intervention of 2 group-mediated workshop sessions with content based on social cognitive theory (behavior modification strategies for the barriers to activity, and strategies and goals, and showed them video clips of active moms). | Stress level declined in both groups. Changes in stress were negatively associated with changes in self-efficacy and self-regulation, and changes in self-efficacy predicted perceived stress at 6-mo follow-up. Need for social support as key facilitator of PA adherence. Working mothers are likely to feel more efficacious if they have family and friends who are committed to helping them achieve their goals. |
| Mailey et al49 | Descriptive correlational longitudinal survey. | Mothers (N = 226) and fathers (N = 70) of children aged less than 16 y. | VI |  | Self-efficacy was related to exercise directly and indirectly through perceived barriers and prioritization/planning. Some of the biggest barriers included tending to other responsibilities, not having enough time, being too tired, working full time, and having children aged less than 5 y. Prioritization and planning also mediated the relationship between perceived barriers and exercise. These paths remained significant at 12 mo. Efforts to increase PA in parents should focus on improving confidence to overcome barriers. |
| Mailey et al50 | Mixed-method longitudinal survey to understand the goals that drive parents to exercise based on self-motivation theory. | Mothers (N = 226) and fathers (N = 70) of children aged less than 16 y. | VI |  | Exercising to achieve stress management and revitalization for daily well- being predicted health behaviors across 1 y. Exercising to achieve weight management and improve appearance did not predict future exercise behavior. |
| Miller et al51 | Controlled intervention trial incorporating repeated data collection, with randomization into 1 of 3 experimental conditions. | Mothers of preschool-aged children (N = 554) | II | Control group and 2 intervention groups. Both intervention groups received print information to overcome PA barriers. One of the groups also discussed strategies to promote PA among mothers of young children, such as increasing partner support, social advocacy, and capacity building. | Interventions were assessed with mothers to see if PA increased and what mediators contributed to the change. The interventions of print and community involvement increased PA at the 8-wk check mark, but the intervention effect was not maintained long term. |
| Milton et al52 | Qualitative descriptive study of walking intervention. | Adults (N = 36), adolescents (N = 10), and children aged less than 10 y (N = 68) were selected from a town with the highest health inequalities. | VI |  | Parents found that they enjoyed walking as a family unit because it promoted social interaction with other families. Walking in groups made the parents feel more confident and less worried about their children's behavior because other children were around. Family bonding was promoted and there was an increased awareness of time spent walking. |
| Naidoo et al53 | Qualitative study with in-depth interviews. | A convenience sample was selected from a mental health hospital with mothers (N = 26), fathers (N = 6), and caregivers (N = 6). | VI |  | Most common personal barriers to good health were unhealthy eating, substance use, and physical inactivity. Parents felt a responsibility to their families to promote and educate health. Overall, the parents had a comprehensive understanding of healthy and unhealthy behaviors. |
| Norman et al54 | Mixed-method RCT. | 2 interventions were tested on 2 groups of mothers (N = 62) and (N = 73) | II | Physical therapy exercises and health education. | There was a significance in scores on the outcome: Edinburgh Postnatal Depression Scale between the control and intervention group between baseline and 8 wk. There was no significance in scores between 8 and 12 wk. |
| Pluta et al55 | Descriptive questionnaires | Girls (N = 14) and boys (N = 10) and mothers (N = 14) and fathers (N = 8). | VI | The 15-wk family-based PA intervention. | Children were motivated by enjoyment and wanting to be better and sports; parents were stimulated by good looks and body mass control. |
| Quinlan et al56 | Protocol description paper: Mixed-method longitudinal randomized control trial of couples expecting first child. | At baseline, couples (N = 152) completed the first portion and (N = 80) completed the follow-up. | VII | Brief theory-based intervention designed to prevent a decrease in PA amongst new parents over a 6-mo period. | The results of the study are ongoing but should give a deeper understanding of parents' attitudes toward PA. |
| Ransdell et al57 | Mixed-methods randomized trial. | Mothers and daughters (N = 40). | II | Home- vs university-based exercise interventions. | No difference was reported between the university-based and home-based interventions. Both interventions increased participation in PA and the mother–daughter duos reported that their relationship had improved, along with their support for PA. |
| Rhodes et al58 | Quantitative longitudinal cohort study. | 3 cohorts of married couples: no children (N = 102), expecting first (N = 136), expecting second (N = 76). | IV |  | Couples without children engaged in significantly more MVPA at baseline then couples with 2 children. First time mothers had a significantly larger decrease in MVPA compared with women without children. Husbands and wives had similar baselines for MVPA, but husbands engaged in more light intensity than wives. Fathers were more inactive compared with males without children. |
| Rhodes and Lim59 | Mixed-method survey of belief elicitation measures of theory of planned behavior, as well as coactivity and program preferences. | Parents (N = 483) with children between 6 and 14 y. | VI |  | A total of 37% of respondents stated that coactivity would provide a quality family bonding time. A total of 51% of parents cited general healthy lifestyle as a key behavioral belief. Parents prefer outdoor activity, close to home, after work, and originally delivered from community health professionals via internet or face-to-face means. |
| Rhodes et al60 | Quantitative randomized control trial. | Inactive families (N = 65) with young children were randomized to either a standard condition (n = 34) (or the intervention (n = 31) | II | Intervention: (1) Family of guide to PA guidelines, (2) activity guide for the local recreation center, and (3) materials to create "implementation of intentions to plan family PA (workbook, calendar, and magnets) and problem solve PA barriers.Standard condition: Just (1) and (2). | The Intervention group had higher informal unstructured PA family activities frequency than the standard condition over 4 wk. |
| Rhodes et al61 | Mixed-method longitudinal cohort study with 2 cohorts of couples. | Married couples (N = 136) expecting their first child and couples (N = 102) not expecting. | IV |  | Over a year span, couples with and without children had similar baseline profiles. First time, mothers showed a significantly larger decrease in MVPA across the 12 mo compared with women without children. Women with one child had larger positive associations between the belief that MVPA improved energy than men with their first child. |
| Rhodes et al62 | Mixed-method randomized control trial. | Parents (N = 68) of inactive children between 10 and 14 y | II | Exergame condition (n = 36) or the standard bike condition (n = 32). | Parents with the exergame cycling condition did not show higher use than a standard stationary bike (self-recorded minutes in a logbook), suggesting that entertainment-based exercise may not be a successful method to increase PA in adults. Use of exercise equipment decreased over months after receiving it. Parents with more perceived control, intrinsic motivation, and affective attitude were more likely to use the bikes (P <.05). |
| Rowley et al63 | Mixed-method surveys. | Families (N = 50) with children 0–4 y. | IV |  | The walking programs provided an acceptable and supported opportunity for parents and children to participate in PA. The participants increased their level of activity and reported psychological benefits. |
| Sadler and Cowlin64 | Mixed-method longitudinal case-control study. | Student mothers (N = 102) enrolled in Polly T. McCabe program. | IV |  | A school-based program prenatal program for pregnant adolescents combined traditional parent education with creative PA to support mothers. The program was associated with improved grades and had continued enrollment and successful graduation. There was a decrease in low-birth weight infants and less welfare dependence at 6 and 12 y. |
| Solomon-Moore et al65 | Quantitative cross-sectional survey. | Parent–child pairs (N = 1067) with children 5–6 y old. | IV |  | Survey examined associations between parents' motivation to exercise and intention to engage in family-based activity. Parents' external regulation was associated with children performing 2.93 min fewer of PA per day. |
| Tuominen et al66 | Quantitative experimental pilot study without randomization. | The intervention group is mother–child pairs (N = 23) and the control group is mothers only (N = 13). | III | Music and video content designed for mother to exercise with child. | The use of music and video content together may be beneficial in reducing sedentary behavior. Less sedentary time was recorded for the mother and child intervention groups compared with the respective controls. |
| Urizar et al13 | Mixed-method cohort study. | Mothers (N = 68). | IV |  | Results of the study showed that as participation in moderate PA increased, it was significantly associated with a reduced number of maternal stressors between baseline and 10 wk. |
| Webber-Ritchey et al67 | Quantitative cross-sectional online surveys. | African American parents and caregivers (N = 96) of children between 6 and 12 y old. | VI |  | Findings supported the relationship between parents' PA and environmental factors, such as environmental safety. The presence of light traffic, sidewalks, and safety from crime are associated with greater participation in PA. |

Abbreviations: BMI, body mass index; ID, intellectual disability; LTPA, leisure-time PA; MVPA, moderate to vigorous PA; PA, physical activity; RCT, randomized controlled trials; SWO, standard website only; TTCW, tailored telephone counseling plus website; WIC, women, infants, and children. Note: Levels of evidence, (I) a systematic review or meta-analysis of RCT and clinical guidelines based on systematic reviews or meta-analyses, (II) a minimum of one RCT, (III) controlled trials without randomization, (IV) case-control and cohort studies, (V) systematic reviews of qualitative and descriptive studies, (VI) single descriptive or qualitative study, and (VII) opinion of authorities or expert committees.[24]



Figure 1 —Consort diagram of studies included in the systematic review. IDD indicates intellectual disability.

## Methodologic Rigor

The scores for the methodologic rigor of (1) randomized, and (2) nonrandomized interventions, and the (3) quantitative observational studies are presented in Table 2. Five categories describing barriers and facilitators of PA of parents were identified in this review. Three themes for barriers to PA emerged from the literature review and 2 themes for facilitators to PA. The themes for the barriers include: (1) being the primary caregiving parent, (2) perception of guilt and selfishness, and (3) adhering to exercise programs they do as part of research once research ends. Two themes for facilitators for exercise included: (1) parents are more likely to exercise if they can bring their child with them and (2) parents prefer exercise that is a lifelong habit, such as walking.

Table 2 Quality Assessment Results

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| **i. Cochrane handbook for systematic reviews of interventions quality assessment risk of bias RCTs** | | |  | |  | | |  | | | |  | |  | | | |  | | | |  | | |  | |  | | |  | | |  | |
|  | | | **Albright et al28** | | **Dlugonski et al35** | | | **Fahrenwalad et al36** | | | | **Fjeldsoe et al37** | | **Mascarenhas47** | | | | **Mailey and McAuley15** | | | | **Mailey and McAuley48** | | | **Norman et al55** | | **Ransdell et al57** | | | **Rhodes et al60** | | | **Rhodes et al62** | |
| Random sequence generation(selection bias) | | | Unclear | | High | | | Unclear | | | | High | | Unclear | | | | Low | | | | Low | | | Low | | Unclear | | | Unclear | | | Low | |
| Allocation concealment(selection bias) | | | Unclear | | Unclear | | | High | | | | High | | High | | | | Low | | | | High | | | Low | | High | | | Low | | | High | |
| Blinding of participants and personnel (performance bias) | | | Unclear | | Unclear | | | High | | | | High | | High | | | | Low | | | | High | | | Low | | High | | | Low | | | High | |
| Blinding of outcomes assessment(detection bias) | | | Unclear | | Unclear | | | High | | | | High | | High | | | | Low | | | | High | | | Low | | High | | | Low | | | High | |
| Incomplete outcome data (attrition bias) | | | High | | Unclear | | | Low | | | | High | | Low | | | | Low | | | | Low | | | Low | | High | | | High | | | Low | |
| Selective reporting(reporting bias) | | | High | | Unclear | | | Low | | | | Low | | Low | | | | Low | | | | Low | | | Low | | High | | | Low | | | High | |
| Other sources of bias (other bias) | | | High | | High | | | Low | | | | Low | | Low | | | | Unclear | | | | High | | | Unclear | | High | | | High | | | High | |
| Overall risk of bias | | | High | | High | | | High | | | | High | | High | | | | Low | | | | High | | | Low | | High | | | High | | | High | |
| **ii. ROBINS-I assessment of risk of bias in nonrandomized studies of interventions** | |  | | | | |  | | |  | | | | | |  | | | |  | | |  | | | | | |  | | |  | | |
|  | | **Confounding** | | | | | **Selection of participants** | | | **Classification of interventions** | | | | | | **Deviations from intended interventions** | | | | **Missing data** | | | **Measurement of outcomes** | | | | | | **Selection of reported results** | | | **Overall risk of bias judgement** | | |
| Albright et al28 | | Serious | | | | | Serious | | | Moderate | | | | | | Moderate | | | | Serious | | | Serious | | | | | | Moderate | | | Serious | | |
| Tuominen et al66 | | Moderate | | | | | Serious | | | Moderate | | | | | | Moderate | | | | Moderate | | | Moderate | | | | | | Moderate | | | Serious | | |
| **iii. STROBE criteria ratings for observational studies** |  | | |  | |  | | |  | |  | |  | |  | |  | |  | |  | | |  | |  | |  | | |  | | |  |
|  | **Belanger-Gravel et al30** | | | **Berniell et al32** | | **Cowie et al68** | | | **Craike et al14** | | **Diaz21** | | **Hamilton and White37** | | **Hull et al41** | | **Mailey et al49** | | **Mailey et al50** | | **Rhodes et al58** | | | **Rhodes et al61** | | **Rhodes and Lim59** | | **Rowley et al63** | | | **Sadler and Cowlin70** | | | **Urizar et al13** |
| 1a | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 0 | | 0 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 1b | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 1 | | | 1 | | | 1 |
| 2 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 1 | | | 1 | | | 1 |
| 3 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 4 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 5 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 1 | | | 0 | | | 1 |
| 6a | n/a | | | n/a | | 1 | | | 1 | | n/a | | n/a | | 1 | | 1 | | 1 | | 1 | | | 0 | | n/a | | n/a | | | n/a | | | n/a |
|  | n/a | | | 1 | | n/a | | | n/a | | n/a | | n/a | | n/a | | n/a | | n/a | | n/a | | | n/a | | n/a | | n/a | | | n/a | | | n/a |
|  | 1 | | | n/a | | n/a | | | n/a | | 1 | | 1 | | n/a | | n/a | | n/a | | n/a | | | n/a | | 1 | | 0 | | | 0 | | | 1 |
| 6b | n/a | | | n/a | | 1 | | | 1 | | n/a | | n/a | | 1 | | n/a | | n/a | | n/a | | | n/a | | n/a | | n/a | | | n/a | | | n/a |
|  | 1 | | | 1 | | n/a | | | n/a | | 1 | | 1 | | n/a | | n/a | | n/a | | n/a | | | n/a | | 1 | | n/a | | | n/a | | | 1 |
| 7 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 8 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 9 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 10 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 0 | | 0 | | 0 | | | 0 | | 1 | | 0 | | | 0 | | | 1 |
| 11 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 12a | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 12b | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 12c | 0 | | | 1 | | 1 | | | 1 | | 1 | | 0 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 12d | n/a | | | n/a | | 0 | | | 0 | | n/a | | n/a | | 0 | | 1 | | 1 | | 1 | | | 1 | | n/a | | n/a | | | n/a | | | n/a |
|  | n/a | | | 1 | | n/a | | | n/a | | n/a | | n/a | | n/a | | n/a | | n/a | | n/a | | | n/a | | n/a | | n/a | | | n/a | | | n/a |
|  | 1 | | | n/a | | n/a | | | n/a | | 1 | | 1 | | n/a | | n/a | | n/a | | n/a | | | n/a | | 1 | | n/a | | | n/a | | | 1 |
| 12e | n/a | | | 1 | | n/a | | | n/a | | n/a | | n/a | | n/a | | n/a | | n/a | | n/a | | | n/a | | n/a | | 0 | | | 0 | | | n/a |
| 13a | 1 | | | 0 | | 1 | | | 0 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 13b | 0 | | | 0 | | 0 | | | 0 | | 0 | | 0 | | 0 | | 1 | | 1 | | 1 | | | 1 | | 0 | | 0 | | | 0 | | | 0 |
| 13c | 0 | | | 0 | | 0 | | | 0 | | 0 | | 0 | | 0 | | 1 | | 1 | | 1 | | | 1 | | 0 | | 0 | | | 0 | | | 0 |
| 14a | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 14b | 0 | | | 0 | | 1 | | | 1 | | 1 | | 0 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 14c | n/a | | | n/a | | 1 | | | 1 | | n/a | | n/a | | 1 | | 0 | | 0 | | 0 | | | 0 | | n/a | | 0 | | | 0 | | | n/a |
| 15 | n/a | | | n/a | | 1 | | | 1 | | n/a | | n/a | | 1 | | 1 | | 1 | | 1 | | | 1 | | n/a | | 0 | | | n/a | | | n/a |
|  | n/a | | | 1 | | n/a | | | n/a | | n/a | | n/a | | n/a | | 1 | | 1 | | 1 | | | 1 | | n/a | | n/a | | | 0 | | | n/a |
|  | 1 | | | n/a | | n/a | | | n/a | | 1 | | 1 | | n/a | | 1 | | 1 | | 1 | | | 1 | | 1 | | n/a | | | n/a | | | 1 |
| 16a | 0 | | | 0 | | 1 | | | 1 | | 1 | | 0 | | 1 | | 1 | | 1 | | 1 | | | 0 | | 1 | | 0 | | | 0 | | | 1 |
| 16b | 0 | | | 0 | | 0 | | | 0 | | 1 | | 0 | | 0 | | 1 | | 1 | | 1 | | | 0 | | 1 | | 0 | | | 0 | | | 1 |
| 16c | 0 | | | n/a | | 0 | | | 0 | | 0 | | 0 | | 0 | | n/a | | n/a | | n/a | | | 0 | | 0 | | 0 | | | 0 | | | 0 |
| 17 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | n/a | | n/a | | n/a | | | n/a | | 1 | | 0 | | | 0 | | | 1 |
| 18 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | n/a | | n/a | | n/a | | | n/a | | 1 | | 0 | | | 0 | | | 1 |
| 19 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 20 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| 21 | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | 0 | | 1 | | 0 | | | 0 | | | 1 |
| 22 | 1 | | | 0 | | 0 | | | 0 | | 1 | | 1 | | 0 | | 1 | | 1 | | 0 | | | 1 | | 1 | | 0 | | | 0 | | | 1 |
| Total Score | 25 | | | 25 | | 26 | | | 25 | | 29 | | 25 | | 26 | | 28 | | 28 | | 28 | | | 25 | | 29 | | 3 | | | 2 | | | 29 |

Abbreviations: RCT, randomized controlled trial; ROBINS-I, Risk of Bias in Non-Randomized Studies—of Interventions; STROBE, Strengthening the Reporting of Observational studies in Epidemiology. Note: Low—comparable with a well-performed randomized trial, moderate acceptable for a nonrandomized study, but not as sound as a well-performed randomized trial; serious—problems present; critical—no useful evidence to show effect of intervention, Overall risk of bias is represented by the most severe level of bias found in any domain. aThe STROBE checklist asks the following information (1 = reported; 0 = not reported; n/a = not applicable):

1. Indicates study design in title and abstract and provides an informative and balanced summary in the abstract.

2. Gives the scientific background and rationale.

3. States specific objectives and hypotheses.

4. Presents key elements of study design.

5. Describes setting, location, exposures, follow-up, and relevant dates.

6. Clearly defines eligibility criteria and methods of selecting participants (1) cohort, case control, cross-sectional, and (2) cohort, case control.

7. Clearly defines outcomes, exposures, potential confounders, predictors, and effect modifiers.

8. Gives sources of data and clearly defines method of assessment.

9. Describes potential bias.

10. Explains how study size was arrived at.

11. Explains how quantitative variables were handled in analysis.

12. Describes (1) all statistical analyses including those used to control for confounding, (2) methods used to examine subgroups and interactions, (3) how missing data were addressed, (4) cohort study—explains loss of follow-up if applicable; case control—explains how matching of cases and controlled was addressed if applicable, cross-sectional—analytic methods taking account of sampling strategy if applicable.

13. Reports number of individuals at each stage of study and gives reasons for nonparticipation, (1) at each stage, (2) reason for nonparticipation, and (3) considers use of flow diagram.

14. Gives characteristics of study participants and indicates number of missing data, (1) characteristics, (2) number with missing data, (3) cohort study— summarize follow-up time.

15. Reports number of events (outcomes and/or exposures). Cohort—report numbers of outcome events or summary measures over time, case control— report numbers in each exposure category, or summary measures of exposure cross-sectional—report numbers of outcome events or summary measures.

16. Clearly provides the main results of analyses (1) unadjusted estimate and, if applicable, confounder-adjusted estimates and confidence intervals. Makes clear which confounders were adjusted and why they were included, (2) reports category boundaries when continuous variables were categorized, and (3) considers translating estimates of relative risk into absolute risk for a meaningful time if relevant.

17. Reports all other analyses done.

18. Summarizes key findings with reference to study objectives.

19. Discusses limitations of the study.

20. Provides a cautious overall interpretation of the study.

21. Discusses the generalizability of the findings. 22. Gives the sources of funding and role of the funder.

## Barriers to Exercise for Caregivers of Children

### *Being the Primary Caregiving Parent*

Mothers, who tended to be the primary caregivers, were less active than fathers.[58],[31],[32] Fathers were less active compared with males without children.[58],[44] Mothers were primarily interviewed because they were seen as the primary caregivers for children with ASD. Since the mothers were primarily caring for the children, the men tended to have more time to spend on other activities, which included spending time on exercise. This finding reflects the notion that men are typically more active and less sedentary than women according to the literature review. For example, 2 research articles report findings that mothers had more sedentary minutes per day and were typically less active than fathers.[58],[31] This increase in activity by men was seen through baseline PA.[58],[30] Women having more responsibilities for activities of daily living and caretaking contributed to less PA in 2 studies.[61],[46] Mothers may have more responsibilities for household duties underlies the notion that men are more active due to having more available time in these studies.

### *Perception of Guilt and Selfishness*

Mothers often perceived it to be selfish to take time to exercise. Five articles described the emotions and thoughts that mothers felt in response to them being able to exercise. Mothers reported feelings of guilt and selfishness when taking time away from their child's needs to improve their own physical health.[15],[46]–[49] Mothers tended to see themselves as central to the health and well-being of the family and viewed taking time away as detrimental to the family.[15],[46] Parents also identified taking time away from other activities as a primary barrier to participating in PA.[68] In a qualitative study, Lewis and Ridge[46] explored the various dilemmas and trade-offs for women when they attempt to balance family life with PA. The authors reported the reality of motherhood is a double-edged sword as there are societal pressures to be the perfect supermom, which reinforced mothers' negative connotations about the acceptability of putting themselves first.[46] Hamilton and White[41] found that parents focused on their parenting role and commitments when deciding whether to engage in regular PA. This study was framed by the theory of planned behavior, which posits that underlying cognitive structure determines an individual's intentions and subsequent behavior.[69]

### *Parents Have Trouble Adhering to Exercise Programs They do as Part of Research, Once Research...*

Adherence to an exercise program and continuing PA after ending a research study that involved their participation in a PA intervention was the third theme. Although there were short-term effects seen after implementation of the physical exercise program, there were no significant effects for parents seen in the long term.[15],[58],[35]–[59] Most notably in a low risk for bias RCT, Mailey and Mcauley[15] found that improved self-reported leisure-time PA for the intervention group did not match the accelerometer-based PA outcomes, that is, the intervention group regressed back to baseline activity levels for both total activity and MVPA.[15] Likewise,[46] Fjeldsoe et al[37] found when they utilized a "telerehab" intervention to promote PA for women with children, there was an immediate post intervention effect of increased PA, but there was no sustained effect 6 months after the study had ended.[37]

The PA facilitated by a bicycle game for parents did not show effects sustained over time.[62] Use of exercise equipment decreased over time after receiving it during the study.[62] In another study, while group exercise intervention using videoconferencing and mobile apps was a feasible and acceptable way to deliver a PA intervention to mothers, the researchers did not report whether the improvements were sustained over time.[62] These findings exemplify the theme of lack of adherence to participating in PA once an intervention study is over.

## Facilitators to Exercise for Caregivers of Children

### *Parents More Likely to Exercise if They can Bring Child With Them*

Family as the key normative belief was found to be relevant to parents' decision-making about PA that was reported in many interventions. In a formative study of a family-based walking intervention,[52] a total of 114 participants were committed for the 12-week long program including both parents and children. In their interviews, the parents noted that they enjoyed walking as a family unit during the led walks because it promoted social interaction with other families. The primary reason the program attracted many young families was it was free of charge and was also viewed as a good opportunity to spend time as a family.[52] In an evaluation of walking programs for mothers and their young children, Rowley et al[63] reported that the programs provided an acceptable and supported opportunity for parents and children to participate in PA.

Parent beliefs influence their participation in PA. In a family-based intervention, Rhodes and Lim[59] found that child–parent bonding and an opportunity for set family time were the most common subthemes of interpersonal-related behavioral beliefs regardless of parent gender and child age and sex. In studying community outreach programs, Belanger-Gravel et al[30] found that parent–daughter duos had less sedentary activities than parent–son duos and that coparticipation was significantly associated with increased PA. In another study, Flett et al[38] found that all 6 focus groups including parents and children expressed the belief that that youth activities should include parents. The youth in the study reported openness to doing PA with their parents. Furthermore, since lack of social support and childcare were also noted as barriers to maternal PA,[15] being able to exercise with their child would be beneficial.

### *Parents Prefer Exercise That is a Lifelong Habit, Such as Walking*

In focus group interviews to assess the characteristics of an ideal community outreach program, parents (N = 19) and children (N = 23) preferred exercise that is a lifelong habit, such as walking as part of a community program.[38] Parents did voice some concerns about the safety of their child in these programs if they were not there with their child, noting the possibility of injuries due to lack of supervision and training of instructors. While safety was a concern, researchers also found that the youth lacked adequate education from school on the value of healthy active lifestyles. The educational deficiency emphasizes the importance of taking time and promoting fundamental skills for a healthy active life to promote outdoor community lifetime habit group PA.[38] To that end, it was noted that parents were more likely to walk outside if they felt they were not in danger, that is, light traffic, sidewalks, and low crime.[67] Rhodes and Lim[59] found that parents prefer activities to be outdoors, close to home, after work, and originally delivered from community health professionals via internet or face-to-face means. Adding music to the PA intervention was also noted to help motivation to participate in PA.[66]

In a study of 36 adults, 10 adolescents and 68 children (≤10 y of age), adult participants reported several barriers to walking, including concerns over their children's behavior and their ability to maintain "control" of their children.[52] The habit of walking in a group with other families was noted to give parents the confidence to plan and participate in additional walks with their children and other parents, which allowed for social interaction.[52] The most successful walks incorporated specific destinations and an activity to undertake upon reaching the destination.[52] Incorporating other activities along the way also helped to keep the children engaged.[52]

# Discussion

No studies on PA interventions for parent caregivers of children with ASD were located or included in this review; thus, there is no evidence for PA interventions for this at-risk population. However, this systematic review reports on the facilitators and barriers for PA interventions for typically developing parents that can inform interventions for ASD families. Recommendations for how findings in this review could apply to the ASD families are provided.

There are several high-quality research studies on PA interventions for parents of typically developing children, according to Melnyk and Fineout-Overholt's[24] system for rating the evidence level of journal articles available through this systematic review of the literature. There were 12 level II, 2 level III, 11 level IV, 1 level V, and 17 level VI, and 1 Level VII articles on PA of parents. However, the use of additional risk of bias tools for the RCTs, non-RCTs, and the observational studies revealed risks for bias for the findings.

No studies were located that focused solely on an exercise intervention for parents of children with ASD. There was only one level VI study that had parents of children with ASD in the sample, and that study compared the PA levels of parents of children with and without Down syndrome to children with other special health care needs including ASD, vision abnormality, cerebral palsy, or typical development, not an exercise intervention.[21] A limitation of this study was that the perception of PA was by parent report.[21] Parents of children with Down syndrome were reported to be the most inactive of all the groups.[21]

In general, findings across studies showed that parents of typically developing children often place their personal needs aside to dedicate adequate time to care for their child.[46] Parental attitudes, beliefs, and behaviors have been found to impact how parents perceive PA, food, and nutrition.[22] Parents may also underestimate their child's weight. In a study on parent perception of the health of their child, 69% of parents of children with intellectual disability involved in the study were found to be overweight or obese yet 50% of the parents involved in the study described their child with intellectual disability as underweight or normal, when they were overweight or obese.[22]

While many parents believe that PA is a critical component to health and feel that it is their responsibility within their family to promote health, their own personal PA is one area that is often neglected.[53] Parents reported a variety of barriers that limited their ability to engage in PA; the barrier most often identified was being too busy to exercise.[15],[28],[31],[49] This finding matches the recent systematic review (n = 3) on the prevalence of PA and barriers and facilitators to PA in informal carers of adults with dementia, Alzheimer's, and multiple sclerosis PA in the United Kingdom. These carers noted that their lack of time, along with the increasing age of the caregiver, and not wanting to leave the person they are caring for alone as barriers to their PA.[70]

Becoming a mother is associated with a 2-fold increase in parent inactivity over a 4-year period[71] yet fathers are also less active compared with males without children.[44],[50] Facilitators for PA include an appreciation of the benefits of engaging in exercise, previous participation in activities, group activities with similar individuals, and having some free time.[71] Motivation for PA, reported by Mailey et al,[53] includes achieving a feeling of daily well-being, rather than just weight loss. Thus, interventions that promote self-efficacy and self-regulation skills through cognitive behavioral interventions are necessary. In addition to sustain PA in mothers,[48] there clearly is the additional need for social support as a key facilitator of PA adherence. For example, working mothers were likely to feel more efficacious if they had family and friends who were committed to helping them achieve their goals.[48] Moreover, it appears that family regulatory approaches may also be the critical agent for enacting change rather than interventions aimed at improving attitudes.[60] Therefore, future research should look at engaging both children with ASD as well as parents and friends in PA at the same time.

Including the child with the parent could facilitate parent PA and meet the child's need for exercise. There are reported barriers for children with ASD participating with their typically developing peers in PA due to the need for more supervision of the child, the lack of skills needed by the parent to include their child, and limited friends.[72] This behavior was associated with less time in PA and more screen time.[72] Developing interventions that facilitate the parent and child engaging in PA together is recommended.

Parents also noted that they preferred participating in an activity that the parent would be able to do throughout their life, such as walking. Hamilton and White[41] recommended fitting PA in to the work day, with parents taking breaks for 10-minute brisk walks around their workplace, in order to fit PA into their busy lives.[41] Rhodes and Lim[63] found that 19% parents preferred to partake in PA when it was a group or co-activity, such as walking programs. In fact, parents reported increased feelings of confidence when participating in groups compared with when they exercised by themselves.[63]

Therefore, group exercise with a walking program (eg, outdoors, close to home, after work, and originally delivered from community health professionals via internet or face-to-face means[59]) may be a way to increase participation in PA, as increasing PA in parents who care for a child diagnosed with ASD can be challenging. Future research is indicated studying the effect of parent/child walking programs for parents of children with ASD. Providing parents with a choice of either individual or group activities could increase their PA participation because they may be more likely to adhere if the PA choice suits their individual needs.

Further development and research on family-based exercise interventions where children and parents exercise together could benefit the physical and psychological health of children with ASD and their parents. Parent/child exercise is acceptable to children and adults.[30],[38] There is a need to overcome the barriers to PA that impact the parents' ability to maintain PA programs over time. Future research is needed to test effectiveness of parent and child exercise interventions compared with child-only interventions and family adherence.

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