NOVA
University of Newcastle Research Online

nova.newcastle.edu.au

Morgan, Philip J.; Young, Myles D.; Barnes, Alyce T.; Eather, Narelle; Pollock, Emma R. & Lubans, David R. "Engaging fathers to increase physical activity in girls: the "Dads And Daughters Exercising and Empowered" (DADEE) randomized controlled trial" Published in the *Annals of Behavioral Medicine*, Vol. 53, Issue 1, pp. 39-52, (2019).

Available from: http://dx.doi.org/10.1093/abm/kay015

This is a pre-copyedited, author-produced version of an article accepted for publication in the Annals of Behavioral Medicine *following peer review. The version of the above record is available online at: http://dx.doi.org/10.1093/abm/kay015.*

Accessed from: http://hdl.handle.net/1959.13/1398770

Engaging Fathers to Increase Physical Activity in Girls: The 'Dads And Daughters Exercising and Empowered' (DADEE) Randomized Controlled Trial

Philip J. Morgan[a,b], PhD, Myles D. Young[a,b], PhD, Alyce T. Barnes[a,b], PhD, Narelle Eather[a,b], PhD, Emma R. Pollock[a,b], BTeach/BHealth & PhysEd, & David, R. Lubans[a,b], PhD.

Affiliations: [a] Priority Research Centre for Physical Activity and Nutrition, University of Newcastle, New South Wales, Australia; [b] Faculty of Education and Arts, University of Newcastle, New South Wales, Australia.

Address correspondence to: Philip J. Morgan, Priority Research Centre for Physical Activity and Nutrition, University of Newcastle, University Drive, Callaghan NSW, 2308, Australia. [philip.morgan@newcastle.edu.au], +612 49 217 265.

Acknowledgements

This study was supported by project grants from Port Waratah Coal Services and the Hunter Children's Research Foundation to the Hunter Medical Research Institute. The funding bodies had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication. We would like to thank all of the fathers and daughters who contributed to this study. We would also like to thank University of Newcastle undergraduate students Alice Ianni, Adrienne Bull, Angus Leahy, Jasmin Courtenay, Joel Redman, Kirsten Murray, Kristen Pryor, Laura Harrison, Louisa Patel, Melanie Maslin, Sarah Nieuwenhuise, Sophie Martin and Teliah Buckton for their valued contributions to the study during data collection.

Abstract

Background: Existing strategies to increase girls' physical activity levels have seen limited success. Fathers may influence their children's physical activity, but often spend more time with their sons and rarely participate in family-based programs. *Purpose*: To test a novel program designed to increase the physical activity levels of fathers and their daughters. *Methods*: In a two-arm RCT, 115 fathers (29-53 years) and 153 daughters (4-12 years) were randomized to: (i) the *'Dads And Daughters Exercising and Empowered'* (DADEE) program, or (ii) a wait-list control. Eligible fathers lived with their daughter(s) at least 3 days/week. The 8-week program included weekly educational and practical sessions plus home tasks. Assessments were at baseline, 2 months (post-intervention) and 9 months. The primary outcomes were father-daughter physical activity levels (pedometry). Secondary outcomes included screen-time, daughters' fundamental movement skills (FMS; perceived and objective), and fathers' parenting practices. *Results*: Primary outcome data were obtained from 88% of daughters and 90% of fathers at 9 months. Intention-to-treat analyses revealed favorable group-by-time effects for physical activity in daughters (P=0.02, d=0.4) and fathers (P<0.001. d=0.7) at post-intervention, which were maintained at 9 months. At post-test and follow-up, significant effects (P<0.05) were also identified for daughters' FMS competence (objective: d=1.1-1.2; perceived: d=0.4-0.6), a range of fathers' parenting practices (d=0.3-0.8) and screen-time for fathers and daughters (d=0.4-0.8). Program satisfaction and attendance were very high. *Conclusions*: This was the first physical activity initiative to target fathers and daughters. The data supported the hypotheses and the feasibility and efficacy of this approach were confirmed.

Australian New Zealand Clinical Trials Registry: ACTRN12615000022561

Keywords: Exercise, girls, men, fundamental movement skills, parenting, gender equity

Engaging Fathers to Increase Physical Activity in Girls: The 'Dads And Daughters Exercising and Empowered' (DADEE) Randomized Controlled Trial

Participating in regular physical activity during childhood is vital for optimal growth and development (1, 2). However, physical inactivity in children is a global public health concern (3). Numerous studies have also highlighted that gender-prejudice negatively affects girls' participation in sport and physical activity at home, at school and in the community (4, 5). As such, girls are less active than boys at all ages (6) and experience fewer opportunities to develop physical confidence and competence (3, 7). Girls also have lower levels of cardio-respiratory fitness, hand-eye coordination and sports skills than their male peers (8, 9). By the time girls enter secondary school, less than 10% can adequately perform key fundamental movement skills (FMS, e.g., kicking, throwing, catching) (9) which are strongly associated with lifelong physical activity (10).

Increasing girls' physical activity levels is a public health priority, though current programs have seen limited success (11, 12). A recent review identified that most physical activity intervention studies for children have tested school-based, mixed-sex programs over a short timeframe and produced a small overall effect on girls' physical activity (11). Although larger effects were observed in studies that targeted girls only (11), few have implemented this strategy. Of studies that have targeted girls-only and included objective measures, the evidence has been limited by poor study quality and low levels of participant engagement, attendance and retention (12). Thus, innovative approaches are needed.

Targeting fathers to take an active role in increasing their daughters' physical activity levels may be one such innovation. Within families, fathers are often more likely than mothers to initiate co-participation in physical activity with their children (13, 14). They are also more likely to use play and physical activity as a bonding strategy from a very early age (15) and display an interaction style characterised by vigorous, stimulating, risky and

competitive physical play (15). Fathers also tend to provide a better model of sports skill performance, likely due to their increased opportunities and reinforcement to practice these skills throughout life (3, 7, 8). For these reasons, co-participation in sport and physical activity is recognized as a core context where fathers bond with their children (16). However, research suggests that fathers are more likely to share physically active experiences with their sons (13, 17), which reduces their daughters' opportunities for co-activity, sports skill development and bonding. Of interest, qualitative research has shown that when fathers do engage in co-physical activity with their young daughters, these experiences are often cherished by both parties for life (18). As such, a clear rationale exists to target fathers as agents-of-change to improve the physical activity levels of their daughters.

Despite their unique and important influence on children's health behaviors, a recent review reported that fathers represent only 6% of parents in family-based interventions targeting children's physical activity, diet and/or sedentary behaviors (19). This lack of participation may be partially explained by the dearth of interventions specifically targeting fathers, given many do not feel the need, or are uncomfortable, participating in programs predominantly attended by mothers (20, 21). Indeed, only one study has exclusively targeted fathers (22, 23). This intervention targeted overweight fathers who participated with their sons and/or daughters. In recognition of the under-representation of fathers in children's health programs, the American Academy of Pediatrics have recently called for researchers to increase the representation of fathers in future studies (24). Moreover, no previous interventions have targeted fathers as agents of change to improve their daughters' physical activity (19). Indeed, to the authors' knowledge, there have been no interventions specifically targeting fathers and their daughters' in any field.

In the broader context where many men are insufficiently active (25) and the evidence for strategies to improve men's physical activity is weak (26), targeting co-physical activity

in fathers and daughters may also improve the physical activity levels of fathers (27). Although many men experience a sizeable decrease in physical activity during early fatherhood (28) those who maintain positive physical activity habits report newfound enjoyment from family-based physical activity and desire to be a positive role model (29).

The primary aim of this randomized clinical trial (RCT) was to evaluate a novel program designed to improve the physical activity levels of fathers and their daughters. The secondary aims were to examine the impact of the program on: i) daughters' FMS competency, ii) fathers' and daughters' screen-time, and iii) fathers' physical activity parenting practices. We hypothesized that: i) intervention fathers and ii) intervention daughters would be significantly more active at post-test (2 months) and follow up (9 months) than their control group counterparts.

Methods

Study Design

The study was a parallel-group, two-arm RCT conducted at the University of Newcastle, Australia. In January 2015, family units were randomized in a 1:1 ratio to either: (i) the '*Dads And Daughters Exercising and Empowered*' (DADEE) intervention, or (ii) a wait-list control group. The study received institutional ethics approval and was prospectively registered with the Australian New Zealand Clinical Trials Registry (ACTRN12615000022561). Written informed consent was obtained from all fathers prior to enrollment. The conduct of the study aligned with the CONSORT recommendations (30).

Participants

Families were recruited from Newcastle in New South Wales, Australia over 11 weeks. The primary recruitment strategy was a University media release that was featured in several local news outlets (television, radio, newspaper). Fathers (including step-fathers and male guardians) could enroll with one or more daughters if they were aged 18-65 and passed

a pre-exercise screening questionnaire (or provided a doctor's clearance to participate). Daughters were eligible to participate if they were currently attending primary school from Kindergarten to Year 6 (i.e., aged 4-12 years). In this efficacy trial, fathers were also required to live with their daughters for at least 3 days per week to ensure sufficient time to complete the shared home tasks.

The DADEE Intervention

The DADEE program was designed to energise fathers to become physical activity role models and advocates for their daughters, and vice-versa. The intervention components (Table 1) and program content (Electronic Supplementary Material 1) were informed by an extensive program of qualitative and quantitative research targeting fathers (e.g., (22, 23)) and mothers (e.g., (31)) to increase children's physical activity. The program included eight weekly sessions with educational and practical components. Sessions were delivered at the University by members of the research team and families attended on one of two nights per week. To increase family support, mothers and non-enrolled siblings were invited to one of the eight sessions and were told they could review the program resources at home if they were interested.

In addition to educating families about the importance of physical activity, the program engaged fathers and daughters in fun, co-physical activities targeting rough and tumble play, sports skills (i.e., FMS) and aerobic and muscular fitness. The education sessions gave fathers and daughters the knowledge and skills required to recognise, navigate and challenge the culture of gender prejudice that permeates all aspects of girls' lives, particularly in relation to participation in physical activity and sport. Fathers were also taught strategies to optimize their daughters' social-emotional wellbeing and improve the quality of their relationship.

To increase participants' autonomous motivation and perceived capabilities for long-

term behaviour change, the program targeted the core constructs of Self-Determination Theory (i.e., autonomy, competence, relatedness) (32) and Social Cognitive Theory (e.g., self-efficacy, goals, social support) (33). For a summary of which psychological mediators were targeted in each intervention component, refer to Table 1. In brief, the linked concepts of *relatedness* (i.e., desire to connect and care for others) and *social support* were built into all aspects of the program and operationalised through the notion of 'reciprocal reinforcement', where fathers were encouraged to role model positive behaviours and become physical activity advocates for the benefit of their daughters, and vice-versa. To increase the participants' sense of *autonomy* (i.e., choice and control), multiple options were provided to choose from to complete program activities and the home tasks (see Table 1 for examples).

By ensuring fathers and daughters could select challenges that allowed them to experience success, regardless of age, fitness or skill level, these variations were also designed to promote participants' *perceived competence* (i.e., behavioral mastery) and *self-efficacy* for physical activity. In addition to promoting mastery, self-efficacy was also targeted through the other key sources of information (33), including verbal persuasion and role modelling. To increase participants' positive *outcome expectations*, they were provided with information about the physical, mental, social and emotional benefits of co-physical activity and taught games that were designed to be fun and optimally challenging. Finally, fathers and daughters were encouraged to set personal and family-based physical activity *goals* and to track their progress throughout the program.

The program was also socioculturally-targeted to appeal specifically to fathers and daughters (34). For example, the design of the program incorporated several features linked to father engagement in the literature including the father-only nature of the program (20), the timing of the program (after work hours) (21), and the focus on spending quality time with their daughters engaged in enjoyable co-physical activities (22). The delivery of the program

was also socio-culturally targeted, which is particularly important given fathers place emphasis on the credibility of the program facilitators when considering participation (35). All program facilitators had tertiary health and physical education qualifications and considerable experience delivering community interventions. The facilitators for the fathers' and daughters' sessions were also male and female, respectively, to increase relatability.

Measures

Assessments were held in January 2015 (baseline) and March 2015 (2 months, post-intervention) at the University of Newcastle, Australia. Follow-up assessments planned for May 2015 (4 months) were rescheduled to September 2015 (9 months) shortly after trial commencement to allow for longer-term follow-up.

The primary outcomes were fathers' and daughter's physical activity levels, which were measured using Yamax SW200 pedometers (Yamax Corporation, Kumamoto City, Japan). These pedometers have been validated in children (36) and adults (37). All participants were advised to wear the pedometer for all waking hours (except when it could get wet or damaged) and to record their steps on a log sheet for seven consecutive days. Participants daily step average at each time point was included in the final analysis if they had completed at least four days, including one weekend day. To ensure that any additional activity completed during the program itself did not artificially inflate the study results, the post-intervention assessments were completed in the week after the final session. Pedometers were selected to measure the primary outcomes as they have good construct validity for measuring physical activity (38), show strong concordance with other physical activity measures (39), and are more accessible than accelerometers due to the substantially reduced cost per unit.

Participants also completed a range of secondary outcomes, which are described in Table 2. Demographic information included participant age and fathers self-reported

employment status, education level, country of birth, and marital status. Socio-economic status was determined using the Australian postal area index of relative socio-economic advantage and disadvantage (40). Additional psychosocial data were also collected, which will be reported elsewhere (41). Although assessors were blinded at baseline, this was not achieved for all families at follow-up (e.g., participants wearing program shirts).

Participants were also asked to document any additional activities they completed where they did not wear the pedometer (e.g., swimming), including details on intensity and duration. These additional activities were then converted into steps using a standardized formula based on guidelines for children and adults (e.g., 10 mins of moderate-to-vigorous physical activity = 1200 additional steps) (42, 43), and these additional steps were then added to the overall total for a secondary adjusted analysis.

Sample Size

The sample size was calculated to provide 80% power to detect a 1,500 step/day difference in physical activity change at post-intervention for both fathers and daughters ($P<.05$), assuming an attrition rate of 15%. For daughters, a sample size of 134 participants was required, assuming a pre-post correlation of 0.58 and a baseline standard deviation of 3,082 steps/day (23). Similarly, 86 fathers were required, assuming a pre-post correlation of 0.64 and a baseline standard deviation of 2643 steps/day (23). These values were derived from fathers and daughters who participated in the *Healthy Dads, Healthy Kids* pilot study (23), which informed the current trial. The study was not powered a-priori to detect changes in the secondary outcomes, which were included to complement the primary outcome data and inform future research.

Randomization

The randomized allocation sequence was generated by a statistician who did not have contact with participants. The allocation sequences (stratified by fathers' BMI) were

generated by a computer-based random number producing algorithm and stored in a restricted folder. Group assignment information was pre-packed into identical, sealed opaque envelopes and numbered according to the randomization schedule by a research assistant who was not involved in enrolment, assessment or allocation. Families completed all assessments before meeting with a research assistant who was not involved with assessments. The research assistant allocated families to the next available position on the appropriate randomization schedule before opening the corresponding envelope and providing details of the group assignment with a standardized protocol.

Statistical Analysis

Intention-to-treat linear mixed models were conducted in SPSS 17 (IBM Corp., Armonk: NY), to determine the efficacy of the DADEE intervention compared to the control group ($\alpha<0.05$). Linear mixed models are robust to the biases of missing data and include all randomized participants in the analyses, consistent with an intention-to-treat approach (44). The models assessed all outcomes for the impact of group (intervention vs control), time (categorical) and the group-by-time interaction. Where significant, the analyses were adjusted for age, socio-economic status and the interactions of these covariates with time and group. Cohen's d was calculated by dividing the mean difference in change by the standard deviation of change (45). To allow for comparison with previous studies, two post-hoc sensitivity analyses were also performed for the primary outcomes (completers only and last observation carried forward ANCOVAs, adjusted for baseline values).

Results

Participant Flow

As seen in Figure 1, 115 fathers and 153 daughters completed the baseline assessments and were randomized by family into the intervention group (57 fathers, 74 daughters) or a wait-list control group (57 fathers, 79 daughters).

Primary outcome data were obtained from 95% of fathers and 93% of daughters at post-intervention (2 months) and from 90% of fathers and 88% of daughters at follow-up (9 months). Despite strong retention in both groups, more control families returned pedometer record sheets at follow-up (97%) than intervention families (84%; χ^2=5.1, df=1, *P*=.02). This difference was not detected when considering retention at the follow-up assessments for other outcome measures. There were no significant differences in baseline characteristics between those lost to follow-up and those retained (all P>0.05).

Baseline Data

The mean (SD) ages of daughters and fathers at randomization were 7.7 years (1.8) and 41.0 years (4.6), respectively. The daughters' average step count (10,190 steps/day) aligned closely with data observed in a recent national sample of girls aged 5-8 years (10,147 steps/day) and 9-11 years (10,075 steps/day) (46). The fathers' average step count (8,926 steps/day), was slightly higher than the average observed for adult men in the same national sample (7,403 steps/day) (46). Overall, 22% of daughters and 33% of fathers were meeting daily physical activity recommendations of 12,000 and 10,000 steps, respectively. Both fathers and daughters were meeting guidelines in only 10% of families. Most fathers were employed (97%), born in Australia (89%), and were married or living with a partner (99%). Families were represented from most socio-economic areas. Additional demographic data are available in Electronic Supplementary Material 2.

Primary Outcomes

Significant and sustained intervention effects were detected for father and daughter physical activity levels (Table 3). As seen in Figure 2, the daughters' mean physical activity had increased by 1,277 steps/day in the intervention group at 2 months (post-intervention), compared to 405 steps/day in the control group (adjusted difference between groups = 875 steps/day, 95% CI, 135 to 1615). This intervention effect was also maintained at 9 months

(adjusted difference = 907 steps/day, 95% CI, 68 to 1747). Similarly, the mean physical activity level for intervention fathers had increased by 916 steps/day at 2 months (Figure 3), compared to a decrease of 458 steps/day in the control group (adjusted difference = 1374 steps/day, 95% CI, 622 to 2127) and this effect had increased by 9 months (adjusted difference = 2048 steps/day, 95% CI, 1057 to 3040). The results were consistent with those produced in the ANCOVA sensitivity analyses, though the linear mixed models produced the most conservative estimates (see Supplementary Material 3). As seen in Table 3, these effects were also consistent with the secondary physical activity analyses, where step counts were increased to account for documented non-ambulatory activity.

Secondary Outcomes

In the daughters, a large group-by-time effect was detected for objective FMS competency at post-intervention (adjusted difference = 7.8 points, 95% CI, 5.7 to 9.8), which was maintained at 9 months (adjusted difference = 6.4 points, 95% CI, 4.4 to 8.3). Significant and sustained intervention effects (all $P<0.05$) were also identified for the daughters' perceived FMS competence (d = 0.4-0.6), perceived sporting competence (d = 0.3-0.5) and screen-time (d = 0.5-0.8). For fathers, significant intervention effects (all $P<0.05$) were identified for MVPA (d = 0.4–0.5), co-physical activity (d = 0.5-0.7), physical activity modelling (d = 0.4-0.7), screen-time limit setting (d = 0.3-0.5), physical activity monitoring (d = 0.6-0.8) and screen-time (d = 0.4-0.5). There were no significant group-by-time effects for weight status or resting heart rate in daughters or fathers.

Process Outcomes

On a scale of 1 (poor) to 5 (excellent), both fathers and daughters reported mean (SD) program satisfaction scores of 4.9 (0.3). Fathers' mean (SD) satisfaction with the facilitators was 5.0 (0.3). In total, 93% of fathers and 89% of daughters attended at least seven of the eight sessions.

Discussion

This study evaluated the impact of a novel physical activity program that targeted fathers and their preadolescent daughters. Compared to a control group, the program increased objectively measured physical activity levels at 9 months by approximately 1000-2000 steps/day in fathers and daughters, respectively. There were also sustained intervention effects for numerous secondary outcomes including daughters' FMS proficiency, fathers' and daughters' screen-time, several parenting constructs and co-physical activity. Process evaluation data revealed very high levels of attendance, satisfaction and retention.

To the authors' knowledge, this was the first physical activity intervention internationally that targeted fathers and daughters and only the second lifestyle intervention to target fathers exclusively (19). The physical activity results are notable given the paucity of successful physical activity interventions targeting girls (11, 12), men (26), fathers (47), and families (48). In the current study, intervention girls maintained an increase in physical activity of approximately 900 steps/day over a control group at 9 months. While modest, this increase represents an important deviation from the usual physical activity decline observed in girls over time (3). The challenges of reversing this trend are clear, with a recent review identifying only one program for girls that significantly influenced physical activity behavior (12). In the previous study (49), the intervention group still recorded a 6% decrease in MVPA during the study, but MVPA levels for intervention girls had decreased by 2 minutes per day less than the control group.

Our paternal physical activity findings were positive and comparable to those observed in the two previous interventions that targeted fathers (22, 23). Relative to the control, DADEE fathers increased and maintained their physical activity levels by over 2,000 steps at 9 months, representing a large effect size. This effect size is larger than reported in most physical activity interventions targeting men in general (26, 50) and may signify the

importance of targeting fathers exclusively with socio-culturally relevant programs (26, 34).

There are a number of possible explanations for our positive physical activity outcomes. Perhaps most importantly, the program educated participants about the complex social forces, pre-existing gender norms and feminine ideals that reduce girls' opportunity and encouragement to be physically active (51). Recently, researchers have described a paradox where many physical activity programs attempt to empower girls without providing the necessary awareness and skills to overcome the gendered barriers that exist in the real world (52). In contrast, the DADEE program had a primary focus on education, redefining gender norms, developing the girls' critical thinking skills, and eliciting meaningful support from their fathers as gender equity advocates. The girls were taught how to resist, question and negotiate real-world physical activity barriers in empowering ways (51).

Second, the program targeted reciprocal reinforcement, valued outcomes and co-physical activity. Through engaging home-based tasks, fathers and daughters became agents of change in their families to help each other become more active. This was demonstrated by the intervention effect for co-physical activity, which has been identified as a key strategy to increase physical activity in fathers and children (53). Notably, the program also met five key recommendations for family-based physical activity programs described in a recent review: i) ensure programs are socio-culturally tailored, ii) target social and psychological outcomes in addition to physical activity, iii) include children as agents of change, iv) combine goal setting and reinforcement techniques, and v) provide education to increase knowledge (48).

Third, the DADEE program operationalized self-determination theory and social cognitive theory constructs and taught behavioral skills through face-to-face learning experiences and home-based tasks. Our approach was different to many other interventions targeting girls, which have been characterized by multiple exercise sessions per week, little focus on behavior change, and failure to meaningfully engage parents (11, 12). Alternatively,

the DADEE program inspired fathers and daughters to redefine themselves, provided families with the necessary psychological resources to improve their activity levels and optimized social support systems. These strategies were recently highlighted as key pathways to promote long-term behavior change maintenance (54).

Fourth, the program greatly improved the girls' FMS proficiency, with very large effect sizes detected compared to other programs in the literature (55). Reviews have clearly established the association between FMS competency and physical activity (10). During the program, fathers learned 'how to teach' their daughters these skills through positive parenting and providing a mastery climate where all daughters could succeed. By reducing screen time and improving parenting skills (e.g., limit setting, monitoring) the program may also have contributed toward a more optimal physical activity home environment.

The acceptability of the DADEE program was established through very high levels of attendance, retention and satisfaction. In contrast, poor engagement and attendance levels have been major limitations of previous physical activity research with girls (12). A recent review of after school-based physical activity interventions identified a dose-response relationship where participants who attended at least 40% of the intervention sessions showed enhanced study outcomes (56). In the current study, 93% of fathers and 89% of daughters attended at least seven of the eight sessions (≥88%). Although fathers rarely participate in family-based research, this study has shown they are willing to engage in targeted programs that are designed to meet their unique preferences and interests and provide them with personally valued experiences. For researchers seeking to increase the inclusion and engagement of fathers in future research, our approach to designing socio-culturally relevant programs for fathers has been described elsewhere (19, 34, 57). Importantly, this tailoring process applies to both program design (i.e., program content and format) and delivery (i.e., facilitator characteristics and pedagogies).

This study addressed many limitations of previous research (11, 12, 26). Strengths included: a randomized design, intention-to-treat analysis, strong retention, objective physical activity data and follow-up assessments 7 months after the immediate post-intervention assessments. There were also some limitations. For pragmatic and budget purposes, the primary outcome was measured using pedometers, which capture total physical activity only. Future research should consider the use of accelerometers to provide measures of physical activity intensity and duration. This will also reduce the potential bias of a social-desirability effect given participants are not required to record their pedometer steps. In addition, the intervention was delivered in a university-environment by the research team and participation was skewed towards more active, socio-economically advantaged and co-residing fathers and daughters. Further research is needed to confirm the effectiveness and scalability of the program when delivered in community settings by trained facilitators to a more diverse range of families. In this pilot study, the analyses did not account for clustering at the family level, though this will be addressed in future research. Finally, formal mediation analyses are required to reveal greater insights into the specific mechanisms of action in the program.

Conclusion

There is limited high-quality evidence regarding efficacious strategies to promote physical activity in girls (11) and men (26, 50). This was the first study internationally to target the father-daughter relationship as a novel engagement mechanism to improve physical activity in both groups. The sustained improvements in physical activity and multiple secondary outcomes supported the study hypotheses. The acceptability of the approach was supported by very high levels of program attendance, retention and participant satisfaction. For clinical practice, this study provided the first experimental evidence that efforts to increase physical activity behavior in preadolescent girls would benefit from a meaningful engagement of fathers.

References

1. Janssen I, LeBlanc AG: Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act.* 2010, *7:*40.

2. Eime RM, Young JA, Harvey JT, Charity MJ, Payne WR: A systematic review of the psychological and social benefits of participation in sport for children and adolescents: informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act.* 2013, *10:*98.

3. Hallal PC, Andersen LB, Bull FC, et al.: Global physical activity levels: surveillance progress, pitfalls, and prospects. *Lancet.* 2012, *380:*247-257.

4. Bailey R: Physical Education and Sport in Schools: A Review of Benefits and Outcomes. *J Sch Health.* 2006, *76:*397-401.

5. World Health Organization: *Global status report on noncommunicable diseases 2014*. Switzerland, 2014.

6. Ekelund U, Luan J, Sherar LB, et al.: Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. *JAMA.* 2012, *307:*704-712.

7. Trost SG, Pate RR, Sallis JF, et al.: Age and gender differences in objectively measured physical activity in youth. *Med Sci Sports Exerc.* 2002, *34:*350-355.

8. Telford RM, Telford RD, Olive LS, Cochrane T, Davey R: Why Are Girls Less Physically Active than Boys? Findings from the LOOK Longitudinal Study. *PLoS ONE.* 2016, *11*.

9. Hardy LL, King L, Espinel P, Cosgrove C, Bauman A: NSW Schools Physical Activity and Nutrition Survey (SPANS) 2010: Full Report. Sydney: NSW Ministry of Health, 2010.

10. Lubans DR, Morgan PJ, Cliff DP, Barnett LM, Okely AD: Fundamental movement skills in children and adolescents: Review of associated health benefits. *Sports Med.* 2010, *40:*1019-1035.

11. Biddle SJH, Braithwaite R, Pearson N: The effectiveness of interventions to increase physical activity among young girls: A meta-analysis. *Prev Med.* 2014, *62:*119-131.

12. Voskuil VR, Frambes DA, Robbins LB: Effect of Physical Activity Interventions for Girls on Objectively Measured Outcomes: A Systematic Review of Randomized Controlled Trials. *J Pediatr Health Care.* 2016.

13. Zahra J, Sebire SJ, Jago R: "He's probably more Mr. sport than me" - a qualitative exploration of mothers' perceptions of fathers' role in their children's physical activity. *BMC Pediatr.* 2015, *15*.

14. Beets MW, Cardinal BJ, Alderman BL: Parental social support and the physical activity-related behaviors of youth: a review. *Health Educ Behav.* 2010, *37:*621-644.

15. Paquette D, Dumont C: Is father-child rough-and-tumble play associated with attachment or activation relationships? *Early Child Develop Care.* 2013, *183:*760-773.

16. Harrington M: Sport and leisure as contexts for fathering in Australian families. *Leisure studies.* 2006, *25:*165-183.

17. Lamb ME: *The role of the father in child development* (5th Ed.). New York: Wiley, 2010.

18. Barrett EL, Morman MT: Turning Points of Closeness in the Father/Daughter Relationship. *Human Comm.* 2013, *15:*241-259.

19. Morgan PJ, Young MD, Lloyd AB, et al.: Involvement of fathers in pediatric obesity treatment and prevention trials: A systematic review. *Pediatrics.* 2017, *139*.

20. Burgess A: *Engaging fathers in their children's learning: tips for practitioners*. Abergavenny: Fatherhood Institute, 2006.

21. Bayley J, Wallace LM, Choudhry K: Fathers and parenting programmes: Barriers and best practice. *Community Pract.* 2009, *82:*28-31.

22. Morgan PJ, Collins CE, Plotnikoff RC, et al.: The 'Healthy Dads, Healthy Kids' community randomized controlled trial: a community-based healthy lifestyle program for fathers and their children. *Prev Med.* 2014, *61:*90-99.

23. Morgan PJ, Lubans DR, Callister R, et al.: The 'Healthy Dads, Healthy Kids' randomized controlled trial: Efficacy of a healthy lifestyle program for overweight fathers and their children. *Int J Obes.* 2011, *35:*436-447.

24. Yogman M, Garfield CF, the Committee On Psychosocial Aspects Of Child and Family Health: Fathers' Roles in the Care and Development of Their Children: The Role of Pediatricians. *Pediatrics.* 2016, *138*.

25. Kohl HW, 3rd, Craig CL, Lambert EV, et al.: The pandemic of physical inactivity: global action for public health. *Lancet.* 2012, *380:*294-305.

26. Bottorff JL, Seaton CL, Johnson ST, et al.: An Updated Review of Interventions that Include Promotion of Physical Activity for Adult Men. *Sports Med.* 2015, *45:*775-800.

27. Pot N, Keizer R: Physical activity and sport participation: A systematic review of the impact of fatherhood. *Prev Med Rep.* 2016, *4:*121-127.

28. Hull EE, Rofey DL, Robertson RJ, et al.: Influence of marriage and parenthood on physical activity: a 2-year prospective analysis. *J Phys Act Health.* 2010, *7:*577-583.

29. Mailey EL, Huberty J, Dinkel D, McAuley E: Physical activity barriers and facilitators among working mothers and fathers. *BMC Public Health.* 2014, *14:*657.

30. Schulz KF, Altman DG, Moher D: CONSORT 2010 statement: updated guidelines for reporting parallel group randomized trials. *Ann Intern Med.* 2010, *152:*726-732.

31. Barnes AT, Plotnikoff RC, Collins CE, Morgan PJ: Feasibility and Preliminary Efficacy of the M.A.D.E (Mothers And Daughters Exercising) 4 Life Program: A Pilot Randomized Controlled Trial. *J Phys Act Health.* 2015, *12:*1378-1393.

32. Deci E, Ryan R: *Intrinsic motivation and self-determination in human behaivor*. New York: Plenum, 1985.

33. Bandura A: *Social foundations of thought and action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall, 1986.

34. Morgan PJ, Young MD, Smith JJ, Lubans DR: Targeted Health Behavior Interventions Promoting Physical Activity: A Conceptual Model. *Exerc Sport Sci Rev.* 2016, *44:*71-80.

35. Tully LA, Piotrowska PJ, Collins DAJ, et al.: Optimising child outcomes from parenting interventions: fathers' experiences, preferences and barriers to participation. *BMC Public Health.* 2017, *17:*550.

36. Eston RG, Rowlands AV, Ingledew DK: Validity of heart rate, pedometry, and accelerometry for predicting the energy cost of children's activities. *J Appl Physiol.* 1998, *84:*362-371.

37. Steeves JA, Silcott NA, Bassett DR, Thompson DL, Fitzhugh EC: Evaluation of the Omron HJ-720ITC Pedometer under Free-Living Conditions. *Med Sci Sports Exerc.* 2011, *43:*1791-1797.

38. Tudor-Locke C, Williams JE, Reis JP, Pluto D: Utility of pedometers for assessing physical activity: construct validity. *Sports Med.* 2004, *34:*281-291.

39. Tudor-Locke C, Williams JE, Reis JP, Pluto D: Utility of pedometers for assessing physical activity: convergent validity. *Sports Med.* 2002, *32:*795-808.

40. Australian Bureau of Statistics: Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia, 2011. Canberra: ABS, 2013.

41. Young MD, Lubans DR, Barnes AT, et al.: Impact of a Father-Daughter Physical Activity Program on Girls' Social-Emotional Well-being: A Randomized Controlled Trial. In revision.
42. Tudor-Locke C, Craig CL, Beets MW, et al.: How Many Steps/Day are Enough? for Children and Adolescents. *Int J Behav Nutr Phys Act.* 2011, *8*.
43. Tudor-Locke C, Craig CL, Brown WJ, et al.: How Many Steps/day are Enough? For Adults. *Int J Behav Nutr Phys Act.* 2011, *8*.
44. White IR, Horton NJ, Carpenter J, Pocock SJ: Strategy for intention to treat analysis in randomised trials with missing outcome data. *Br Med J.* 2011, *342:*d40.
45. Cohen J: *Statistical power analysis for the behavioral sciences* (2nd Ed.). Hillsdale, NJ: Lawrence Earlbaum Associates, 1988.
46. Australian Bureau of Statistics: Australian Health Survey: Physical Activity, 2011-12 (No. 4364.0.55.004) 2013.
47. Young MD, Morgan PJ: Paternal physical activity: An important target to improve the health of fathers and their children. *Am J Lifestyle Med.* 2017.
48. Brown HE, Atkin AJ, Panter J, et al.: Family-based interventions to increase physical activity in children: a systematic review, meta-analysis and realist synthesis. *Obes Rev.* 2016.
49. Webber LS, Catellier DJ, Lytle LA, et al.: Promoting physical activity in middle school girls: Trial of Activity for Adolescent Girls. *Am J Prev Med.* 2008, *34:*173-184.
50. George ES, Kolt GS, Duncan MJ, et al.: A Review of the Effectiveness of Physical Activity Interventions for Adult Males. *Sports Med.* 2012, *42:*281-300.
51. Spencer RA, Rehman L, Kirk SF: Understanding gender norms, nutrition, and physical activity in adolescent girls: a scoping review. *Int J Behav Nutr Phys Act.* 2015, *12:*6.
52. Rauscher L, Cooky C: Ready for anything the world gives her? A critical look at sports-based positive youth development for girls. *Sex Roles.* 2016, *74:*288-298.

53. Lloyd AB, Lubans DR, Plotnikoff RC, Morgan PJ: Paternal Lifestyle-Related Parenting Practices Mediate Changes in Children's Dietary and Physical Activity Behaviors: Findings From the Healthy Dads, Healthy Kids Community Randomized Controlled Trial. *J Phys Act Health.* 2015, *12:*1327-1335.

54. Kwasnicka D, Dombrowski SU, White M, Sniehotta F: Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *Health Psychol Rev.* 2016, *10:*277-296.

55. Morgan PJ, Barnett LM, Cliff DP, et al.: Fundamental movement skill interventions in youth: A systematic review and meta-analysis. *Pediatrics.* 2013, *132:*e1361-1383.

56. Beets MW, Beighle A, Erwin HE, Huberty JL: After-school program impact on physical activity and fitness: a meta-analysis. *Am J Prev Med.* 2009, *36:*527-537.

57. Morgan PJ, Young MD: The Influence of Fathers on Children's Physical Activity and Dietary Behaviors: Insights, Recommendations and Future Directions. *Curr Obes Rep.* 2017.

58. Michie S, Richardson M, Johnston M, et al.: The Behavior Change Technique Taxonomy (v1) of 93 Hierarchically Clustered Techniques: Building an International Consensus for the Reporting of Behavior Change Interventions. *Ann Behav Med.* 2013, *46:*81-95.

59. Godin G, Shephard RJ: A simple method to assess exercise behavior in the community. *Can J Appl Sport Sci.* 1985, *10:*141-146.

60. Plotnikoff RC, Taylor LM, Wilson PM, et al.: Factors associated with physical activity in Canadian adults with diabetes. *Med Sci Sports Exerc.* 2006, *38:*1526-1534.

61. Davison KK, Li K, Baskin ML, Cox T, Affuso O: Measuring parental support for children's physical activity in white and African American parents: The Activity Support Scale for Multiple Groups (ACTS-MG). *Prev Med.* 2011, *52:*39-43.

62. Lee SM, Nihiser A, Strouse D, et al.: Correlates of children and parents being physically active together. *J Phys Act Health.* 2010, *7:*776-783.

63. Larios SE, Ayala GX, Arredondo EM, Baquero B, Elder JP: Development and validation of a scale to measure Latino parenting strategies related to children's obesigenic behaviors. The parenting strategies for eating and activity scale (PEAS). *Appetite.* 2009, *52:*166-172.

64. Ulrich DA: *Test of gross motor development. Examiner's manual* (2 Ed.). Austin, Texas: PRO.ED, 2000.

65. Barnett LM, Ridgers ND, Zask A, Salmon J: Face validity and reliability of a pictorial instrument for assessing fundamental movement skill perceived competence in young children. *J Sci Med Sport.* 2015, *18:*98-102.

66. Marsh HW, Richards GE, Johnson S, Roche L, Tremayne P: Physical Self-Description Questionnaire - Psychometric Properties and a Multitrait-Multimethod Analysis of Relations to Existing Instruments. *Journal of Sport & Exercise Psychology.* 1994, *16:*270-305.

67. Hardy LL, Booth ML, Okely AD: The reliability of the Adolescent Sedentary Activity Questionnaire (ASAQ). *Prev Med.* 2007, *45:*71-74.

68. Smith JJ, Morgan PJ, Plotnikoff RC, et al.: Smart-phone obesity prevention trial for adolescent boys in low-income communities: the ATLAS RCT. *Pediatrics.* 2014, *134:*e723-731.

69. de Onis M, Onyango AW, Borghi E, et al.: Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ.* 2007, *85:*660-667.

Figure Captions

Figure 1. Participant flow for primary outcome data (father and daughter physical activity).

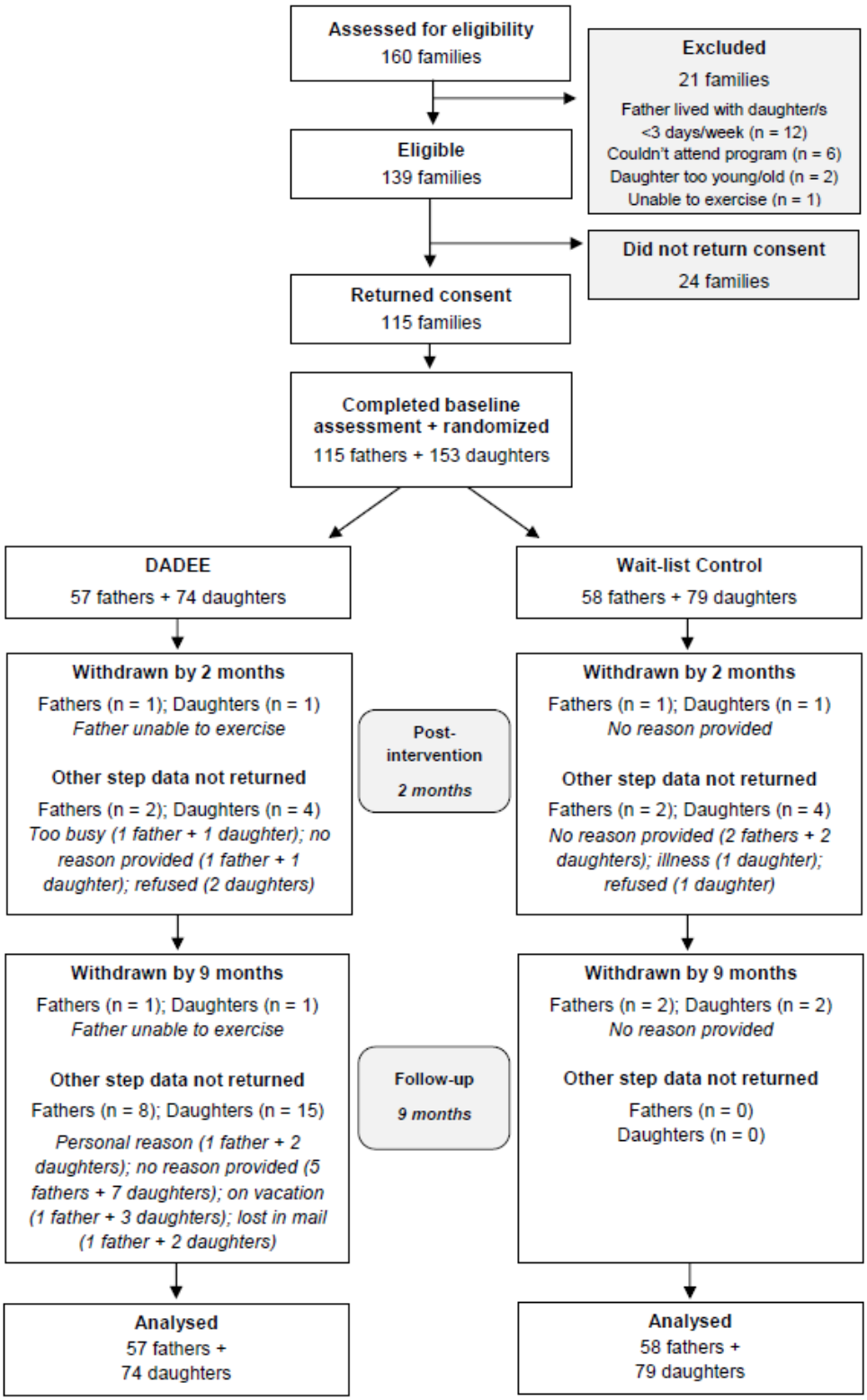

Figure 2. Intention-to-treat analysis of daughters' physical activity change by treatment group. Data are means and 95% confidence intervals.

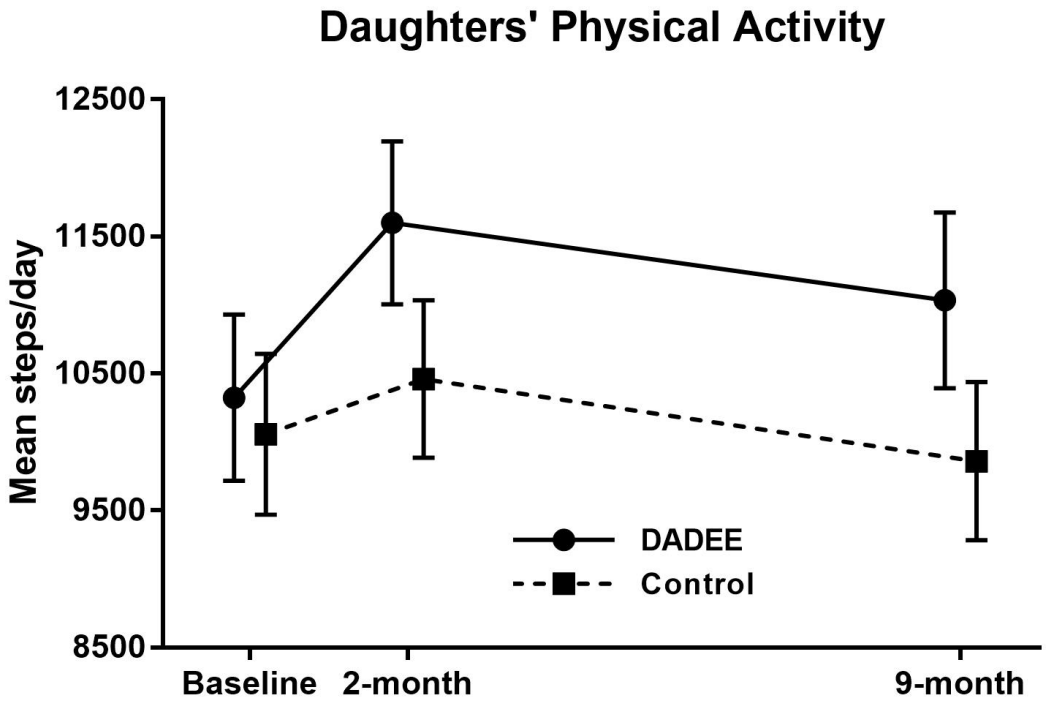

Figure 3. Intention-to-treat analysis of fathers' physical activity change by treatment group. Data are means and 95% confidence intervals.

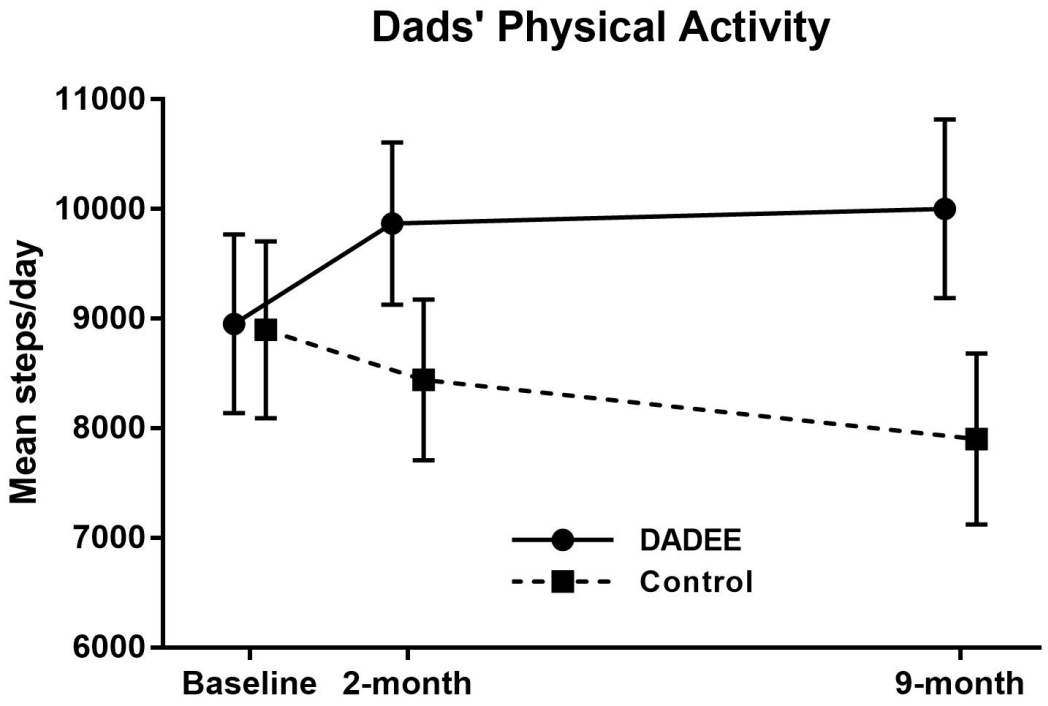

Table 1. Description of intervention components in the DADEE program.

Intervention component	Description	Physical activity behavior change techniques [a]	Targeted theoretical mediators
Group sessions	Fathers and daughters attended 8 x 90-min sessions over 8 weeks. Sessions included: *Combined education session (15-min)*: Engaging introduction to the session with father-daughter icebreakers and a brief overview of the session content. *Father-only education session (30-min)*: Information delivered by a male researcher with experience in men's health promotion and health and physical education qualifications (PJM). Key topics covered in these sessions are outlined in Electronic Supplementary Material 1. *Daughter-only education session (30-min)*: Led by two female researchers with health and physical education qualifications (ATB, EP). The content included age appropriate strategies to become more active with a focus on developing one key social-emotional skill each week (see Electronic Supplementary Material 1) *Combined practical session (45-min):* The practical sessions were designed to increase the daughters' intrinsic motivation for physical activity by providing them with novel and engaging physical activity experiences in a supportive and positive environment. The practical included fun and active father-daughter games and challenges targeting rough and tumble play, sports skills (i.e., FMS) and aerobic and muscular fitness.	• Social support (practical, emotional) • Increase positive emotions [b] • Instructions on how to perform the behavior • Information about consequences (health, social + environmental, emotional) • Demonstration of the behavior • Graded tasks • Credible source • Identification of self as role model • Framing/reframing • Verbal persuasion about capability	• Social support / relatedness (SCT/SDT) • Autonomy (SDT) • Self-efficacy / perceived competence (SCT/SDT) • Outcome expectations (SCT) • Goals (SCT)
Fathers resources	*Dads' log book*: Fathers completed tasks to promote physical activity behavior (e.g., SMART goal setting, physical activity monitoring) and nurture the father-daughter relationship. *Dads' folder*: Copies of each week's session slides.	• Goal setting (behavior) • Action planning • Self-monitoring of behavior • Self-incentive • Non-specific incentive Social support (practical, emotional)	• Goals (SCT) • Social support / relatedness (SCT/SDT)

Table 1. Description of intervention components in the DADEE program.

Daughters resources	*Em Power Folder*: Included weekly physical activity tasks daughters could complete with their fathers to earn unique 'Em Power' collector cards. The challenges were designed to increase physical activity, foster positive social-emotional development and improve the father-daughter relationship. *Word of the Week Tasks*: Daughters earned stickers by completing one of four tasks designed to improve their understanding of various social-emotional skills (e.g., self-control, persistence, positivity, resilience, critical thinking, kindness). *Daughters' folder:* Copies of each week's session slides	• Material incentive (behavior) • Instructions on how to perform the behavior • Graded tasks • Self-talk • Increase positive emotions [b]	• Social support / relatedness (SCT/SDT) • Goals (SCT) • Autonomy • Self-efficacy / perceived competence (SCT/SDT)
Family resources	*Sports skills program*: Included a suite of fun, engaging and age-appropriate games for fathers and daughters to play at home to improve the daughter's sports skills (i.e., kicking, catching, throwing (over- and underarm), bouncing, striking). *Sport equipment pack*: Pack included: 1x soccer ball, 1x basketball, 1x tee-ball set (adjustable stand, bat, ball), 1x handball, 1x beanbag, 6x cones). *Pedometer*: Families received one Yamax SW200 pedometer to assist with physical activity monitoring. *DADEE app:* To encourage long-term behavior maintenance, families were provided with access to a web-based app at the conclusion of the program, which included all of the 'Em Power' challenges given to daughters' during the program. The app also included information on the key skill components for each object control FMS. *Other resources*: T-shirts, water bottles, backpack, sports directory (description and contact information of local sporting clubs/activity centers).	• Increase positive emotions [b] • Graded tasks • Instructions on how to perform the behavior • Self-talk • Prompts/cues • Adding objects to the environment	• Social support / relatedness (SCT/SDT) • Self-efficacy / perceived competence (SCT/SDT) • Autonomy (SDT) • Goals (SCT)

[a] Techniques refer to those outlined in the 'behavior change technique taxonomy' (v1) (58). [b] Technique to be included from behavior change taxonomy (v2).

Table 2. Secondary outcomes measured in the DADEE study.

Outcome	Description
Fathers only	
MVPA	Average weekly moderate-to-vigorous physical activity (MVPA) was measured with a modified version of the *Godin Leisure Time Exercise Questionnaire* (59). In addition to average number of weekly MVPA bouts, the participants also indicated the average bout length (60). These values then were multipled to give an overall measure of weekly MVPA.
Physical activity parenting practices	Parenting practices were measured with several validated scales including physical activity modelling (61) and co-physical activity (days per week where father and daughters were physically active together) (62). Fathers also completed items from the *Parenting Strategies for Eating and Activity Scale* to assess their control, limit setting, discipline and monitoring in relation to their daughter's physical activity and screen time (63).
Daughters only	
Fundamental movement skills (FMS)	FMS competency was assessed with six object control skills described in the validated *Test of Gross Motor Development* (kicking, catching, striking a stationary ball, stationary dribble, overhand throw [TGMD-2] and underhand throw [TGMD-3]) (64). After watching a live demonstration, daughters were filmed performing each skill twice. For each skill, daughters received a score of 1 or 0 for the presence or absence of various performance criteria (e.g., ball is caught by hands only). The combined scores for both attempts across all skills represented the overall object control score.
Perceived competence [a]	Perceived FMS competence was measured with a validated pictorial scale for young children based on skills measured with the TGMD-2 (65). To align with the objectively-measured FMS skills, an additional item was added to measure the underhand throw (TGMD-3). Daughters were presented with two pictures featuring a girl providing a 'good' or 'poor' demonstration of each skill and asked to choose which picture was most like them. If they selected the 'good' demonstration they were asked if they were 'really good' or 'pretty good' at the skill. If they selected the 'poor' demonstration they were asked if they were 'sort of good' or 'not that good'. Scores were combined across the six skills to provide an overall measure of perceived FMS competence. Perceived sporting competence was also measured with the sports competence scale of the *Physical Self-Description Questionnaire* (66).
Fathers and daughters	
Screen-time [b]	Screen time was assessed with a modified version of the *Adolescent Sedentary Activity Questionnaire* (67). Fathers were asked to report the total time they spent sitting using screens (of any kind) for anything outside of work (or homework when reporting for daughters) on each day in the previous week. This adapted measure has shown good sensitivity to change in previous behavior change research with adolescents (68).
Weight status	Weight was measured in light clothing, without shoes on a digital scale to 0.01 kg (model CH-150kp, A&D Mercury Pty Ltd, Australia). Height was measured using the stretch stature method on an electronic stadiometer to 0.1 cm (model BSM370, Biospace, USA). For daughters, BMI-z scores were calculated by using the LMS method (World Health Organization growth reference centiles) (69).
Resting pulse	Resting pulse was assessed for fathers and daughters using POLAR H7 heart rate sensors. Participants were fitted with the sensor before being seated to complete questionnaires. After five minutes rest, participants resting pulse was recorded every ten seconds for one minute using the 'Polar Team' app. The average of the six measures was used for analysis.
Process measures	Process outcomes included average attendance, program satisfaction and study retention.

[a] Daughters' questions were interviewer administered one-on-one to ensure comprehension. [b] Daughter screen time reported by fathers in relation to eldest enrolled daughter.

Table 3. Changes in Primary and Secondary Outcomes for Study Participants.

Outcome	Group	Baseline	2-month change from baseline (Mean, 95%CI)			9-month change from baseline (Mean, 95%CI)		
		Mean (SE)	Within-group [a]	Mean difference between groups [b]	p-value [Cohen's d]	Within-group [c]	Mean difference between groups [b]	p-value [Cohen's d]
Primary outcomes								
Steps/day								
Daughters	Treatment	10323 (307)	**+1277 (744, 1811)**			**+711 (86, 1335)**		
	Control	10056 (297)	+403 (-110, 916)	**+875 (135, 1615)**	**0.02 [0.38]**	-197 (-758, 364)	**+907 (68, 1747)**	**0.03 [0.35]**
Fathers [d]	Treatment	8952 (411)	**+916 (382, 1450)**			**+1050 (330, 1771)**		
	Control	8899 (408)	-458 (-988, 71)	**+1374 (622, 2127)**	**<0.001 [0.68]**	**-998 (-1679, -317)**	**+2048 (1057, 3040)**	**<0.001 [0.77]**
Secondary outcomes								
Adjusted steps/day [e]								
Daughters	Treatment	11433 (351)	**+1619 (993, 2245)**			**+1425 (646, 2204)**		
	Control	11805 (339)	-393 (-992, 205)	**+2013 (1147, 2879)**	**<0.001 [0.75]**	-158 (-865, 548)	**+1583 (532, 2635)**	**<0.001 [0.48]**
Fathers	Treatment	10490 (519)	**+960 (249, 1671)**			**+1343 (429, 2256)**		
	Control	10452 (514)	-533 (-1234, 169)	**+1493 (494, 2491)**	**<0.001 [0.56]**	**-919 (-1784, -54)**	**+2262 (1004, 3250)**	**<0.001 [0.67]**
Fathers' MVPA (mins/week)	Treatment	148 (16)	**+63 (36, 90)**			**+68 (35, 111)**		
	Control	175 (16)	+8 (-19, 35)	**+55 (16, 93)**	**0.005 [0.53]**	+4 (-39, 46)	**+65 (4, 125)**	**0.010 [0.40]**
Daughters sport competence								
Object control score (TGMD) [f]	Treatment	20.2 (0.6)	**+9.5 (8.1, 11.0)**			**+9.7 (8.3, 11.1)**		
	Control	20.4 (0.6)	**+1.8 (0.4, 3.2)**	**+7.8 (5.7, 9.8)**	**<0.001 [1.23]**	**+3.4 (2.0, 4.7)**	**+6.4 (4.4, 8.3)**	**<0.001 [1.05]**
Perceived FMS competence	Treatment	3.0 (0.1)	**+0.4 (0.3, 0.5)**			**+0.4 (0.2, 0.5)**		
	Control	3.1 (0.1)	**+0.1 (0.0, 0.2)**	**+0.3 (0.1, 0.4)**	**<0.001 [0.58]**	**+0.2 (0.1, 0.3)**	**+0.2 (0.0, 0.4)**	**0.002 [0.39]**
Perceived sports competence	Treatment	4.4 (0.1)	**+0.3 (0.1, 0.5)**			**+0.4 (0.2, 0.6)**		
	Control	4.6 (0.1)	-0.1 (-0.3, 0.1)	**+0.4 (0.1, 0.7)**	**0.006 [0.45]**	+0.1 (-0.1, 0.3)	**+0.3 (0.0, 0.6)**	**0.02 [0.33]**
Screen time (weekday)								
Daughters (min/day)	Treatment	107 (7.0)	-48 (-59, -37)			-45 (-57, -32)		
	Control	84 (7.0)	-17 (-27, -6)	**-31 (-47, -16)**	**<0.001 [0.77]**	-14 (-27, -2)	**-30 (-48, -13)**	**<0.001 [0.64]**
Fathers (min/day)	Treatment	121 (7)	**-36 (-48, -25)**			**-38 (-51, -25)**		
	Control	110 (7)	**-19 (-30, -7)**	**-18 (-34, -1)**	**0.03 [0.40]**	**-31 (-44, -18)**	-7 (-26, 11)	0.10 [0.14]
Screen time (weekend)								
Daughter (min/day) [f]	Treatment	198 (12)	-71 (-89, -52)			-79 (-101, -58)		
	Control	166 (12)	-39 (-57, -21)	**-32 (-57, -6)**	**0.02 [0.46]**	-42 (-63, -21)	**-38 (-67, -8)**	**0.03 [0.47]**

Table 3. Changes in Primary and Secondary Outcomes for Study Participants.

Outcome	Group	Baseline	2-month change from baseline (Mean, 95%CI)			9-month change from baseline (Mean, 95%CI)		
		Mean (SE)	Within-group [a]	Mean difference between groups [b]	p-value [Cohen's d]	Within-group [c]	Mean difference between groups [b]	p-value [Cohen's d]
Fathers (min/day)	Treatment	172 (11)	**-50 (-67, -33)**			**-52 (-73, -31)**		
	Control	148 (10)	-11 (-28, 6)	**-39 (-63, -15)**	**0.002 [0.61]**	**-42 (-63, -22)**	**-10 (-39, 19)**	**0.002 [0.13]**
Physical activity parenting practices								
Co-PA (days/week) [f]	Treatment	2.1 (0.2)	**+0.7 (0.4, 1.1)**			**+0.6 (0.2, 1.0)**		
	Control	1.9 (0.2)	-0.2 (-0.6, 0.2)	**+0.9 (0.4, 1.5)**	**<0.001 [0.65]**	**-0.2 (-0.6, 0.2)**	**+0.8 (0.2, 1.4)**	**0.003 [0.51]**
Modelling [f]	Treatment	2.8 (0.1)	**+0.4 (0.3, 0.5)**			**+0.3 (0.1, 0.4)**		
	Control	2.8 (0.1)	+0.1 (-0.1, 0.2)	**+0.3 (0.2, 0.5)**	**<0.001 [0.66]**	+0.0 (-0.1, 0.2)	**+0.3 (0.0, 0.5)**	**0.003 [0.43]**
Limit setting	Treatment	3.6 (0.1)	**+0.4 (0.3, 0.6)**			**+0.4 (0.2, 0.6)**		
	Control	3.8 (0.1)	+0.1 (-0.1, 0.3)	**+0.3 (0.1, 0.6)**	**0.011 [0.48]**	+0.1 (-0.1, 0.3)	**+0.3 (0.0, 0.6)**	**0.04 [0.34]**
Monitoring	Treatment	3.2 (0.1)	**+0.6 (0.4, 0.8)**			**+0.6 (0.4, 0.8)**		
	Control	3.4 (0.1)	**+0.2 (0.0, 0.4)**	**+0.5 (0.2, 0.7)**	**<0.001 [0.62]**	-0.1 (-0.3, 0.2)	**+0.6 (0.3, 0.9)**	**<0.001 [0.77]**
Disciplining	Treatment	2.7 (0.2)	-0.3 (-0.6, 0.1)			-0.4 (-0.7, 0.0)		
	Control	2.9 (0.2)	**-0.5 (-0.9, -0.2)**	+0.3 (-0.2, 0.7)	0.23 [0.23]	**-0.6 (-1.0, -0.2)**	+0.2 (-0.3, 0.7)	0.47 [0.18]
Control	Treatment	2.7 (0.1)	**-0.6 (-0.9, -0.3)**			**-0.5 (-0.7, -0.2)**		
	Control	3.0 (0.1)	**-0.5 (-0.8, -0.2)**	-0.1 (-0.5, 0.3)	0.66 [0.08]	**-0.4 (-0.7, -0.1)**	-0.1 (-0.5, 0.3)	0.89 [0.06]
Weight status								
Daughters (BMI-z)	Treatment	0.48 (0.11)	**-0.06 (-0.10, -0.02)**			**-0.41 (-0.48, -0.33)**		
	Control	0.60 (0.11)	**-0.05 (-0.09, -0.01)**	-0.01 (-0.07, 0.05)	0.74 [0.05]	**-0.38 (-0.45, -0.32)**	-0.02 (-0.12, 0.08)	0.91 [0.06]
Fathers (BMI)	Treatment	27.9 (0.5)	-0.2 (-0.3, 0.0)			**+0.2 (0.0, 0.5)**		
	Control	27.3 (0.5)	-0.2 (-0.3, 0.0)	+0.0 (-0.2, 0.2)	0.82 [0.04]	+0.1 (-0.1, 0.3)	+0.2 (-0.1, 0.5)	0.57 [0.20]
Resting pulse								
Daughters (bpm) [f]	Treatment	98.4 (1.4)	**-5.3 (-8.1, -2.5)**			**-4.3 (-7.2, -1.3)**		
	Control	95.5 (1.3)	**-3.7 (-6.4, -1.0)**	-1.6 (-5.5, 2.2)	0.41 [0.13]	**-4.0 (-6.8, -1.3)**	-0.2 (-4.3, 3.8)	0.67 [0.02]
Fathers (bpm) [f]	Treatment	67.2 (1.3)	-0.5 (-2.3, 1.4)			-1.2 (-3.4, 1.1)		
	Control	68.6 (1.3)	-1.8 (-3.6, 0.1)	+1.3 (-1.3, 4.0)	0.32 [0.19]	-0.8 (-3.0, 1.5)	-0.4 (-3.5, 2.8)	0.45 [0.05]

[a] 2-month value minus baseline. [b] Within-group difference (intervention) minus within-group difference (control). [c] 9-month value minus baseline. [d] Adjusted for SES. [e] Adjusted to include additional activity completed without wearing pedometer (e.g., swimming). [f] Adjusted for age. Bold denotes a significant difference.