Twelve-month outcomes of a father-child lifestyle intervention delivered by trained local facilitators in under-served communities: The Healthy Dads Healthy Kids dissemination trial

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Abstract

Background: Healthy Dads Healthy Kids (HDHK) was the first program internationally to specifically target overweight and obese fathers to improve their children's health. In previous RCTs, HDHK generated meaningful short-term improvements in the adiposity, physical activity and eating behaviors of both fathers and children.

Purpose: To evaluate the 12-month impact of HDHK when delivered by trained facilitators across four low socio-economic and regional communities in the Hunter Region, Australia.

Methods: Non-randomized, prospective trial with minimal eligibility criteria (i.e., father body mass index (BMI) ≥ 25 kg/m^2 and children aged 4-12 years). HDHK included eight weekly practical and theoretical sessions. Assessments were baseline, 3-month (post-intervention), 6-month and 12-month. The primary outcome was fathers' weight. Secondary outcomes included child BMI-z and validated lifestyle behavior measures (e.g., physical activity, diet).

Results: Overall, 189 fathers (mean age:40.2 years, BMI:32.6 kg/m^2) and 306 children (mean age:8.1 years) participated in one of 10 HDHK programs in four areas. Intention-to-treat linear mixed models revealed a significant mean reduction in fathers' weight at post-intervention (-3.6 kg, 95%CI -4.3,-2.9), which was maintained at 12 months (71% retention). Corresponding improvements were also detected in children's BMI z-score and a range of lifestyle behaviors for both fathers and children. Attendance and satisfaction levels were high.

Conclusions: Positive intervention effects observed in previous RCTs were largely replicated and sustained for 12 months when HDHK was delivered by trained local facilitators in under-served communities. Further investigation into the key systems, processes and contextual factors required to deliver HDHK at scale appears warranted.

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Increasing obesity rates in adults and children are international health concerns [1]. In Australia, the prevalence of overweight and obesity has now reached 71% in men, 56% in women and 27% in children [2]. Within a broader, systems-based approach, behavior-change programs can help individuals and families reduce their risk of obesity by providing them with the knowledge, skills and motivation required to manage their weight in the modern obesogenic environment. However, as these programs have only been modestly successful to date for both children [3, 4] and adults [5], the field requires innovation.

Although men typically face greater health risks from obesity than women [6], they are less likely to attempt weight loss, consider their weight a concern, or participate in weight loss research [7]. As such, the evidence-base for which weight loss strategies are particularly engaging or appealing to men is lacking [8]. A similar trend is evident in childhood obesity interventions, where fathers represent only 6% of parents in family-based programs [9]. Given the profound influence of fathers on children's well-being [10], particularly in relation to health behaviors such as physical activity and healthy eating [11], this is a key limitation of the evidence-base that is almost certainly limiting the effectiveness of current interventions.

The broader evidence-base for obesity treatment and prevention programs has also been limited by a lack of translational research [12]. With reference to a recent evidence-building framework for public health interventions [13], it is clear that most studies have contributed evidence towards *solution generation* (program development) and *intervention testing* (efficacy and effectiveness trials) [14], with few focusing on the translational research goals of *intervention replication* (i.e., reproducing outcomes in diverse settings or populations) and *intervention dissemination* (i.e., testing if programs can be scaled to achieve meaningful population impact).

According to a recent systematic review [9], *Healthy Dads, Healthy Kids* was the first lifestyle program to target fathers. The program assisted overweight and obese fathers to lose weight, improve their lifestyle behaviors and optimize their parenting practices as a novel strategy to improve the health of their children [9]. In previous efficacy [15] and effectiveness [16] randomized controlled trials, fathers and children who participated in HDHK achieved a range of short-term health benefits including reduced weight status, increased physical activity and improved dietary behaviors [15, 16]. However, these promising results were assessed in the short-term only and the majority of participating families were recruited from socio-economically advantaged communities. As these are common limitations of the field, researchers are now calling for studies to examine the long-term effectiveness of obesity treatment and prevention programs, particularly in underserved and disadvantaged areas [17].

Thus, to progress the evidence-base for HDHK from *intervention testing* to *intervention replication* (i.e., the first phase of translation research), the current study investigated whether the positive outcomes for families established in the previous RCTs could be achieved and sustained for up to 12 months when the program was delivered by trained local facilitators to families living in four low socio-economic and regional communities.

Methods

Study Design and Participants

Details on study methods have been published elsewhere [18]. While previous studies have assessed the impact of the HDHK program under controlled conditions [15, 16], the current study used a non-randomized, prospective design to align with the translational research aim and employed minimal selection criteria to increase the generalizability of the findings. To participate, fathers were only required to: i) have a Body Mass Index (BMI)

greater than 25 kg/m^2, ii) have at least one 4-12 year old child, and iii) pass a pre-exercise screening questionnaire or provide a doctor's clearance. Fathers were not required to co-reside with their children. The study was approved by the University of Newcastle Human Research Ethics Committee and was registered with the Australia New Zealand Clinical Trials Registry (ACTRN12613000067774). Prior to enrolment, all fathers provided written, informed consent.

Families were recruited from four regional local government areas (LGAs; Cessnock, Singleton, Maitland, Muswellbrook) in New South Wales, Australia between 2011 and 2012. These LGAs are characterized by high levels of shift work employment and increased rates of overweight and obesity in adults and children compared to state averages [19]. Recruitment methods encompassed the use of local media releases (print, TV and radio), paid newspaper and radio advertisements, school-based strategies including assembly presentations, newsletter items and take-home fliers. Parents were also recruited by being approached and handed HDHK fliers at school pick-up zones while waiting to collect their children at the end of the school day. The data for this dissemination trial were collected throughout 10 HDHK programs that were delivered by trained facilitators in these LGAs between 2011 and 2012 (Cessnock x2, Singleton x2, Maitland x4, Muswellbrook x2). While the program did not vary between iterations, the first program delivered in the current trial included 19 fathers and 27 children from the wait-list control group from the previous community RCT [16]. These participants had not received any intervention prior to their 'baseline' assessment in the current trial. Only objectively measured data from wait-list participants were included in the current analysis.

The HDHK Intervention

Program content. Details of the specific program content delivered in each session of the HDHK program have been described elsewhere [18]. Briefly, the program aims to help

fathers achieve their weight loss goals, become healthy role models, and promote healthy behaviors for their children. By including the children in the HDHK sessions, their natural enthusiasm for father-child activity provides an important behavioral reinforcement. In the current trial, fathers attended eight face-to-face HDHK group sessions over 3 months (90 minutes each), four of which included children. All sessions were delivered by local facilitators who were trained by the research team. See Supplementary Table 1 for specific details on the content covered in each of the eight HDHK sessions. This table also includes the self-reported fidelity checklist recorded by the co-facilitator. This provides an indication as to whether the lead facilitator covered each core session component as intended.

In the father-only sessions, fathers are taught how to spend quality time with their children using healthy eating and physical activity as the engagement mediums. They are given evidence-based parenting strategies to facilitate better dietary and activity choices for all family members at home [20]. The program promotes a 'do as I do' and not a 'do as I say' philosophy and encourages fathers to make small changes, build on initial success and create a home environment where healthy dietary and physical activity patterns are the usual experience. The dietary advice to fathers focuses on various aspects of parental influence on children's dietary intake and incorporates Satter's 'trust' paradigm [21], which advocates that parents supply healthy foods and a supportive eating environment and allow their children to decide when and how much to eat. In addition, father-child sessions include a practical session where fathers are shown how to engage their children in positive and enjoyable physical activity experiences. These sessions focus on: i) rough and tumble play, ii) health related fitness, and iii) fundamental movement skills, and capitalize on the 'masculine interaction style', (i.e., bonding through stimulating and unpredictable physical play) which is common to fathers [22]. Although mothers do not attend sessions, they receive a handbook with program information and fathers are encouraged to include them in some home tasks.

Facilitator recruitment and training: For this dissemination trial, experienced physical education (PE) teachers were targeted to deliver the program due to their expertise in teaching children, communicating with families, and delivering practical sessions safely and effectively. Further, recruiting PE teachers often provided access to school settings where the program could be delivered after hours. The primary strategies to recruit facilitators were articles in school sector newsletters and emails to head teachers or principals.

Prior to delivering the program, potential facilitators attended a one-day face-to-face training workshop at the University campus, which covered the program rationale, session-by-session content knowledge, program mechanics (e.g., group sessions, role playing, and home activities) and advice on delivering informative, engaging and safe physical activity sessions. Training time ranged from 10 hours to 15 hours and depending on time of year and facilitator availability, occurred over 2 days or 3 days.

Each program was delivered by a lead facilitator, who presented all theoretical content to the fathers and lead the delivery of the practical sessions, and a co-facilitator who assisted with equipment management, concept explanations, and pre- and post-session support. On occasions where both fathers and children were present, the co-facilitator engaged the children in games and activities during the fathers' information session. Facilitators did not receive structured support after the initial training workshop, but could contact the research team to discuss specific issues or questions during the program. Program delivery was standardized using PowerPoint slides, a handbook for facilitators with key talking points and answers to frequently asked questions, a summary of all practical activities and a sports equipment pack.

Outcomes

Assessments for the 10 HDHK programs in this trial took place between October 2011 and October 2013. All trials included baseline, 3-month (post-intervention), 6-month,

and 12-month assessments. Measures were collected by trained research assistants at the local school where each program was being conducted.

The primary outcome for the trial was fathers' weight at 12 months. For both fathers and children, weight was assessed in light clothing, without shoes on a digital scale to 0.01 kg (model CH – 150kp, A&D Mercury Pty Ltd, Australia). Weight was measured twice and the average of the two measures was used for analysis.

Participants also completed a range of secondary outcomes, which are described in Table 1. Demographic information included participants' age, fathers' marital status, country of birth, and Aboriginal or Torres Strait Islander heritage. Socioeconomic status was determined using the Australian postal area index of relative socio-economic advantage and disadvantage [23]. Process outcomes included participant retention, attendance and satisfaction. In addition to an overall program evaluation at post-intervention, fathers and facilitators also completed brief evaluations of each session during the program. To assess fidelity, co-facilitators reported how much of the required content the lead facilitator had delivered during each session.

Statistical analysis

Intention-to-treat linear mixed models were conducted in SPSS 17 (IMB Corp., Armonk: NY), to identify changes in the primary and secondary outcomes over time ($p < 0.05$). Linear mixed models are considered one of the best practice methods for analyzing weight loss trials [24]. Although the current trial included only one study arm, the intention-to-treat approach was considered appropriate as it allows for all available data from non-completers to be included in the analyses. In weight loss trials, this is considered a more conservative approach than completers-only analyses, which may bias the results towards more engaged or successful participants who may be less likely to withdraw. Analyses were adjusted for age, socio-economic status, baseline score, sex (children's models only), and

included a random intercept to account for clustering effects at the program level. Cohen's *d* was calculated by dividing the mean change by the standard deviation of change. As multiple children could participate from one family, the BMI z-score analyses also included a random intercept for family to account for clustering at this level. This term was not required for the children's' behavioral outcomes, which were reported by fathers in relation to their eldest participating child only. Missing data, assumed to be missing at random (MAR), were statistically modeled using a likelihood-based analysis that included all available data.

Results

Participant flow

In total, 189 fathers and 306 children participated across the 10 HDHK programs. As demonstrated in Figure 1, primary outcome data were obtained from 81% of fathers at post-intervention (3 months), 65% at 6 months, and 71% at 12 months. Compared to those who attended the 12-month assessment (n = 134), those who did not (n = 55) had a greater mean baseline weight (105.8 kg vs. 99.7 kg), but were comparable in all other characteristics (all $p>0.05$).

Demographic characteristics

The mean (SD) ages of fathers and children at baseline were 40.2 (6.3) years and 8.1 (2.2) years, respectively. Overall, 93% of families were recruited from areas of low-to-middle socio-economic status. Most fathers were married or in a de-facto relationship (86%) and born in Australia (84%). Four percent identified as Aboriginal or Torres Strait Islander. Thirty-four percent of fathers were overweight and 66% were obese. Based on waist circumference, 92% and 67% of fathers were at an increased risk (≥94 cm) or greatly increased risk (≥102 cm) of cardiovascular disease, respectively. In total, 24% of children were overweight and 9% were obese. Importantly, the participants were broadly representative of the population of the Upper Hunter Region. Additional detail on participant

demographic characteristics is reported in Supplementary Table 2.

Primary outcome

The adjusted mean difference in weight for fathers at post-intervention was -3.6 kg (95% CI -4.3, -2.9, $d = 0.7$). This weight loss was maintained at 12 months (adjusted mean difference: -3.8 kg, 95% CI -4.6, -3.1, $p < 0.001$, $d = 0.7$) (Table 2)

Secondary outcomes

Tables 2 and 3 highlight the significant and sustained improvements in a range of secondary outcomes for both fathers and children at 12 months. For fathers, these improvements included reductions in BMI (d = 0.8), waist circumference at the umbilicus (d = 0.5) and widest point (d = 0.6), MVPA (d = 0.5), workday sitting time (d = 0.2), and portion size (d = 0.4). Fathers also reported improvements in a range of indicators of dietary intake including fruit, takeaway/fast food consumption and SSB consumption (d = 0.1-0.5). Improvements were not observed for fathers' intake of vegetables with the main meal or sitting time on non-work days.

At 12 months, children's BMI-z score across the whole sample had decreased by 0.12 units (d = 0.2). In children who were classified as overweight or obese at baseline, a significant 12-month reduction of 0.17 units was observed. Significant 12-month improvements were also observed for children's MVPA on weekdays and weekend days (both d = 0.2), and consumption of SSBs, takeaway/fast food, juice and snacks (d = 0.2-0.5), but not screen-time, fruit, or intake of vegetables with the main meal.

Process outcomes

Fathers: The median number of sessions attended by fathers was 6 of 8 (75%). Only 5 of the 189 fathers did not attend any sessions (3%). As seen in Supplementary Table 3, fathers provided a range of positive evaluations about the program. For example, on a scale of 1 (Strongly Disagree) to 5 (Strongly Agree), fathers mean (SD) scores indicated that they

found the program enjoyable (4.4 (0.6)) and relevant (4.2 (0.7)) and they would recommend it to their friends (Mean (SD) = 4.4 (0.6)). On a scale of 1 (Poor) to 5 (Excellent), fathers mean (SD) satisfaction with the trained local facilitators was 4.7 (0.5). Extended data on fathers' and facilitators' perceptions of each program session are available in Supplementary Table 4.

Facilitators: The trained facilitators successfully delivered all program sessions in each of the 10 programs. As seen in Supplementary Table 1, each program included 46 distinct course components over the eight sessions. Across the 10 programs, the facilitators confirmed delivering 428 of the 460 components in the appropriate session (93%) and reported that all outstanding components were covered in subsequent sessions.

Discussion

The primary aim of the current study was to determine whether the positive impact of HDHK could be replicated and maintained long-term when delivered by trained facilitators in low socio-economic and regional areas. Encouragingly, the results were broadly consistent with previous RCTs [15, 16] and included significant intervention effects for fathers' weight, BMI, waist circumference, physical activity, and a range of dietary behaviors. For children, intervention effects were observed for adiposity, physical activity, and some dietary behaviors including SSB and takeaway/fast food consumption. Further, this study provided novel insights into the long-term impact of the program, with most significant post-test effects maintained for up to 12 months. Notably, the study used very minimal eligibility criteria compared to previous RCTs, which enhances the external validity of the results.

The trial achieved its goal of predominantly recruiting families from low-to-middle socio-economic communities, who represented 93% of families overall. In contrast, only 53% of families in the pilot RCT [15] and 39% in the community RCT [16] were recruited from these areas. This is particularly important as areas of low socio-economic status have the highest rates of obesity in Australia [25] and internationally [26]. Further, while childhood

obesity rates appear to have plateaud in Australia [1], this has not been the case in disadvantaged areas [27]. Despite multiple studies indicating that socio-economic disadvantage is associated with reduced parental engagement in childhood obesity prevention interventions [28, 29], 58% of fathers in the current study attended at least 75% of program sessions, which is comparable to other recent obesity prevention scale-up research in the state [14]. In addition, while fathers are substantially less likely than mothers to participate in family-based lifestyle programs [9], the current participants provided very positive evaluations of the program and the facilitators and over 70% were retained at 12 months.

At post-intervention assessment, fathers achieved a mean weight loss of 3.6 kg, which had further reduced to 3.8 kg by 12 months. This is an important finding as systematic reviews indicate that most adults who lose weight generally regain approximately 50% in the first year after treatment [30]. Notably, a 3-4 kg weight loss has been linked to a range of clinically meaningful health benefits including a reduction in the risk of hypertension [31] and type II diabetes [32]. Although this effect is smaller than was observed in the HDHK pilot (-7.6 kg) [15], it was comparable to the weight outcomes from the community RCT [16] when the program was delivered by trained facilitators rather than highly-experienced research staff. The improvements in fathers' weight observed in the current study were also supported by sustained reductions in BMI and waist circumference over 12 months.

The improvements in fathers' adiposity outcomes were likely due to sustained changes in several key health behaviors. At 12 months, fathers reported increasing their mean daily MVPA by approximately 13 minutes/day and decreasing their mean workday sitting time by ~75 minutes/day, though non-work day sitting time was unaffected. Recent studies have indicated that while men's physical activity typically decreases during fatherhood [33], a desire to be a healthy role model for their children and a newfound enjoyment from being active with their children are key motivators for those who remain active [34]. The HDHK

program may have helped fathers tap into these motivating factors, which is supported by the sustained increases in father-child co-physical activity at 12 months.

In addition to increased physical activity, fathers also reported several improved dietary behaviors. Of note, sustained decreases in portion size and takeaway/fast food consumption were identified, which were recently highlighted as key mediators of weight loss in a recent male-only weight loss trial [35], explaining almost 30% of the overall group-by-time weight loss effect at 6 months [35]. Initial improvements were identified for vegetable intake in the current study, but these were not maintained at 12 months. While this finding may reflect issues with the item used to measure vegetable intake, which only assessed the number of occasions per week where vegetables were eaten with the main meal, it is consistent with findings from the HDHK RCTs [36, 37]. Given only 4% of men in Australia report sufficient intake of vegetables [2], novel strategies are required to target this important outcome in the longer-term in future versions of the program.

Positive and sustained adiposity improvements were also observed in participating children. At 12 months, the children's mean BMI-z score had decreased by 0.12 units for the whole sample (d = 0.3) and 0.17 units in the subgroup of children who were overweight or obese at baseline (d = 0.4). While modest, BMI z-score reductions as small as 0.10 have been associated with clinically meaningful reductions in health outcomes including insulin and insulin resistance [38], provided they are sustained for up to one year. It is also encouraging that these improvements are comparable to meta-analyzed effect sizes reported in several reviews of childhood obesity treatment [3, 39] and prevention [4] interventions, which mostly included short-term, highly controlled efficacy studies.

As few childhood weight management studies have included long-term post-intervention follow-up [3, 4, 39], it is unclear whether short-term improvements in health behaviors are actually maintained over time. In the current study, long-term improvements

were detected in several key dietary behaviors including consumption of takeaway/fast food consumption and SSBs. This is important, as these behaviors are leading risk factors for weight gain in children and adolescents [40, 41] and appear to be more common in families of lower socio-economic position [42, 43]. However, while the HDHK intervention encourages fathers to increase their children's exposure to fruits and vegetables, no long-term intervention effects were observed for these outcomes. While unexpected, this is consistent with several recent reviews of school and family-based interventions [44, 45], highlighting the difficulty in generating meaningful, long-term improvements in these outcomes.

A significant improvement was detected in children's MVPA, though it was not evident until the 12 month assessment. It is unclear why this effect was not observed at post-intervention, but may be due to seasonality. Importantly, the 12-month assessment timeframe minimizes error due to season effects and the efficacy of the HDHK program to improve children's physical activity levels was established in both previous RCTs with objective measures. The current findings are also corroborated by the sustained improvements in father-child co-physical activity at 12 months. In contrast, no effects were detected for children's screen time or the number of nights per week they watched television while eating dinner, which was also consistent with previous HDHK research. Most other behavioral interventions have also had limited success in reducing children's screen time [46], and have expressed concerns with the quality of measure used. Regardless, identifying novel strategies to reduce children's screen time is a priority for future research.

This study has again demonstrated the potential to address family health through the targeting of fathers. While beyond the scope of the current paper, we have recently published a series of practical suggestions for researchers and practitioners to recruit, engage and design programs for fathers [11]. This study had several strengths including: long-term participant follow-up (12 months post-baseline, 9 months post-intervention), strong retention rates at 12

months (71%), extensive process evaluation and an intention-to-treat analysis of outcome effects. However, there were also some limitations. As this dissemination trial did not include a control group, the intervention effects should be interpreted with some caution. For example, improvements in adiposity could be partially attributed to regression to the mean [47]. In addition, due to the translational nature of the trial, brief self-report instruments were used to assess behavior change in place of objective measures. However, we chose measures which have been validated, and also have used these in previous studies (in conjunction with objective measures). It is also important to note that this trial was preceded by two RCTs [15,16], which established the efficacy and effectiveness of the program with extensive measures and a comparison group.

Another limitation was that intervention fidelity was self-reported by co-facilitators rather than members of the research team. However, it is important to note this study was focused on external rather than internal validity and aligned with our 'hand-off' approach to implementation. Finally, men with a greater mean baseline weight were more likely to drop out at 12-months, despite being comparable in all other measures. This suggests that these fathers may require more intensive support either during and/or after the program, though this trend was not evident in previous HDHK trials [15,16].

Conclusions

This study has shown that training local facilitators to deliver the HDHK program may be an effective strategy to engage and assist families from low socio-economic and regional areas to improve their health and well-being. Importantly, the program results and process evaluation data indicate that, despite receiving only one day of training, the facilitators largely delivered the program as intended and were able to motivate the participants to change their health behaviors in sustainable ways, resulting in important health benefits over 12 months. To build on this intervention replication data, further investigation

into the key systems, processes and contextual factors required to sustainably deliver the HDHK program at scale in these under-serviced communities appears warranted.

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Table 1. Secondary outcomes assessed in the HDHK dissemination trial.

Body mass index	To calculate BMI, height was measured using the stretch stature method on an electronic stadiometer to 0.1 cm (Harpenden/Holtain, Mentone Education Centre, Morrabin, Victoria). BMI-z scores for children were calculated using the LMS method (World Health Organization growth reference centiles) [48].
Waist circumference	Waist circumference was measured using a non-extensible steel tape (KDSF10-02, KDS Corporation, Osaka, Japan). In addition to a measure that was level with the umbilicus, an additional measure was taken at the greatest (fathers) or narrowest (children) circumference between the lower costal border and the iliac crest.
Physical activity	Fathers' weekly participation in moderate-to-vigorous physical activity (MVPA) was measured with a modified version of the validated Godin Leisure-Time Exercise Questionnaire [49]. Fathers also reported how many days per week they engaged in co-physical activity with their children [50] and completed a proxy-measure of their children's MVPA using the validated Children's Leisure Activities Study Survey (CLASS) [51]. To reduce skewness, extreme outliers were truncated to score within 3.29 SD of the sample mean at each time point.
Sedentary behavior	Fathers' sitting time was assessed with a adaptation of the validated Sitting Questionnaire [52]. For the current study, the weekday and weekend categories were changed to workday and non-workday categories to account for the high rates of non-traditional shift work employment in the targeted regions. Children's screen-time was assessed using the small-screen recreation items from the CLASS [51], which was completed by fathers. Extreme screen time and sedentary behavior values at each time point were also truncated to reduce skewness.
Dietary behaviors	The dietary behaviors were assessed using a brief sub-set of questions from the Australian Eating Survey (AES) food frequency questionnaire (FFQ) for fathers, and the Australian Child and Adolescent Eating Survey FFQ for children (father-proxy), which have been validated [53, 54]. Six questions corresponding to key nutrition messages delivered in the HDHK program were evaluated in relation to frequency of behaviors related to fruit intake, vegetables consumed with the evening meal, take-away food consumption, meals eaten whilst watching television, drinking sugar sweetened beverages (SSBs) (soft-drink and cordial), fruit juice intake, and snacking. Prior to analysis categorical responses were converted into a continuous daily frequency outcome using standardized methods described in the AES Manual (e.g., once per day = 1, 2-3 per day = 2.5).
Portion size	Fathers' usual portion size were measured using photographs from the Dietary Questionnaire for Epidemiological Studies Version 2.
Family mealtime frequency	Fathers self-reported the usual number of times per week they usually ate breakfast, lunch and dinner with their families using three items developed for this study

Table 2. HDHK dissemination trial outcomes for fathers (n = 189) [a].

Outcomes	**Baseline**	**Change at 3 months** [e]		**Change at 6 months** [e]		**Change at 12 months** [e]		
	Mean (SE)	**Mean (95% CI)**	**Cohen's *d***	**Mean (95% CI)**	**Cohen's *d***	**Mean (95% CI)**	**Cohen's *d***	***p*-value**
Weight (kg)	100.8 (0.4)	**-3.6 (-4.3, -2.9)**	**0.71**	**-4.4 (-5.2, -3.6)**	**0.80**	**-3.8 (-4.6, -3.1)**	**0.71**	**<0.001**
BMI (kg/m^2)	32.5 (0.1)	**-1.2 (-1.4, -1.0)**	**0.70**	**-1.4 (-1.7, -1.2)**	**0.78**	**-1.2 (-1.5, -1.0)**	**0.75**	**<0.001**
Waist circumference [b]								
Umbilicus (cm)	108.6 (0.4)	**-3.5 (-4.2, -2.8)**	**0.69**	**-3.8 (-4.6, -3.0)**	**0.66**	**-2.5 (-3.3, -1.7)**	**0.47**	**<0.001**
Greatest circumference (cm)	109.3 (0.3)	**-3.8 (-4.5, -3.1)**	**0.75**	**-4.2 (-5.0, -3.4)**	**0.77**	**-3.0 (-3.8, -2.2)**	**0.55**	**<0.001**
MVPA (mins/week) [c]	93.05 (12.61)	**+73.3 (33.2, 113.5)**	**0.37**	**+54.3 (13.5, 95.1)**	**0.27**	**+93.2 (51.8, 134.6)**	**0.46**	**<0.001**
Sitting time [c]								
Workday (mins/day)	580.6 (20.1)	-32.7 (-79.4, 14.0)	0.11	**-77.2 (-125.3, -29.1)**	**0.24**	**-75.4 (-124.9, -26.0)**	**0.23**	**0.003**
Non-workday (mins/day)	450.7 (14.4)	-36.9 (-77.6, 3.8)	0.14	**-47.2 (-89.1, -5.3)**	**0.17**	-12.8 (-55.5, 29.9)	0.05	0.56
Co-physical activity (days/week) [c]	1.7 (0.12)	**+1.2 (0.9, 1.5)**	**0.63**	**+1.0 (0.7, 1.3)**	**0.49**	**+0.9 (0.6, 1.2)**	**0.42**	**<0.001**
Dietary behaviors [c]								
Fruit (pieces/day)	0.94 (0.06)	**+0.51 (0.34, 0.68)**	**0.44**	**+0.48 (0.31, 0.66)**	**0.41**	**+0.36 (0.18, 0.54)**	**0.31**	**<0.001**
Vegetables eaten with nightly meal (times/week)	4.69 (0.10)	**+0.35 (0.12, 0.58)**	**0.19**	**+0.29 (0.05, 0.53)**	**0.15**	+0.23 (-0.02, 0.48)	0.12	0.07
Takeaway/fast food (meals/week)	1.53 (0.07)	**-0.53 (-0.71, -0.36)**	**0.62**	**-0.35 (-0.54, -0.17)**	**0.39**	**-0.45 (-0.64, -0.27)**	**0.46**	**<0.001**
Dinner eaten in front of TV (times/week)	2.31 (0.12)	**-0.58 (-0.90, -0.25)**	**0.31**	**-0.56 (-0.90, -0.22)**	**0.31**	**-0.35 (-0.70, -0.01)**	**0.13**	**0.04**
Sugar-sweetened drinks (glasses/day)	1.44 (0.06)	**-0.65 (-0.84, -0.47)**	**0.56**	**-0.52 (-0.71, -0.33)**	**0.40**	**-0.50 (-0.69, -0.30)**	**0.39**	**<0.001**
Juice (glasses/day)	0.33 (0.03)	**-0.13 (-0.20, -0.05)**	**0.25**	**-0.13 (-0.21, -0.05)**	**0.25**	**-0.14 (-0.22, -0.06)**	**0.27**	**<0.001**

Table 2. HDHK dissemination trial outcomes for fathers (n = 189) [a].

Outcomes	**Baseline**	**Change at 3 months** [e]		**Change at 6 months** [e]		**Change at 12 months** [e]		
	Mean (SE)	**Mean (95% CI)**	**Cohen's *d***	**Mean (95% CI)**	**Cohen's *d***	**Mean (95% CI)**	**Cohen's *d***	***p*-value**
Snacks (number/day)	1.80 (0.06)	**-0.49 (-0.67, -0.30)**	**0.42**	**-0.32 (-0.51, -0.13)**	**0.25**	**-0.45 (-0.64, -0.25)**	**0.35**	**<0.001**
Portion size factor [c d]	1.16 (0.01)	**-0.10 (-0.14, -0.07)**	**0.39**	**-0.12 (-0.15, -0.09)**	**0.46**	**-0.10 (-0.13, -0.07)**	**0.39**	**<0.001**
Family meals [c]								
Breakfast (times/week)	1.9 (0.1)	+0.3 (-0.0, 0.6)	0.14	+0.3 (-0.0, 0.7)	0.14	+0.2 (-0.2, 0.5)	0.07	0.36
Lunch (times/week)	1.4 (0.1)	**+0.3 (0.1, 0.6)**	**0.20**	**+0.3 (0.1, 0.6)**	**0.22**	+0.2 (-0.1, 0.4)	0.11	0.13
Dinner (times/week)	5.4 (0.1)	+0.3 (-0.0, 0.5)	0.15	+0.3 (-0.0, 0.5)	0.14	**+0.4 (0.1, 0.7)**	**0.20**	**0.01**

[a] All outcomes are adjusted for age, socio-economic status, and baseline values, [b] n = 186; [c] n = 167, [d] Indicates whether a person eats median size serves (PSF = 1), more than the median (PSF > 1) or less than the median (PSF < 1), [e] Change scores are in relation to the baseline score,

Table 3. HDHK dissemination trial outcomes for children (n = 306) [a]

Outcomes	**Baseline**	**Change at 3 months** [f]		**Change at 6 months** [f]		**Change at 12 months** [f]		
	Mean (SE)	**Mean (95% CI)**	**Cohen's *d***	**Mean (95% CI)**	**Cohen's *d***	**Mean (95% CI)**	**Cohen's *d***	***p*-value**
BMI-z								
All children [b]	0.81 (0.03)	**-0.10 (-0.15, -0.05)**	**0.29**	**-0.12 (-0.18, -0.07)**	**0.23**	**-0.12 (-0.17, -0.07)**	**0.23**	**<0.001**
Overweight/obese only [c]	1.96 (0.03)	**-0.16 (-0.24, -0.08)**	**0.38**	**-0.13 (-0.22, -0.04)**	**0.29**	**-0.17 (-0.26, -0.09)**	**0.39**	**<0.001**
MVPA (mins/day) [d]								
Weekday [e]	105.7 (4.4)	-0.8 (-14.5, 12.8)	0.01	+2.1 (-12.1. 16.3)	0.02	**+20.7 (6.3, 35.2)**	**0.22**	**0.005**
Weekend [e]	141.0 (7.9)	-3.3 (-27.5, 20.8)	0.02	+19.1 (-6.0, 44.2)	0.12	**+30.2 (4.8, 55.6)**	**0.18**	**0.02**
Screen time (mins/day) [d]								
Weekday [e]	129.0 (7.0)	-11.42 (-24.28, 1.45)	0.14	-12.2 (-25.7, 1.2)	0.14	+0.1 (-13.6, 13.7)	0.00	0.99
Weekend [e]	230.4 (9.7)	**-30.82 (-52.34, -9.31)**	**0.22**	**-29.9 (-52.3, -7.5)**	**0.20**	-16.6 (-39.4, 6.1)	0.11	0.15
Dietary behaviors [d e]								
Fruit (pieces/day)	1.64 (0.09)	-0.01 (-0.21, 0.20)	0.01	-0.13 (-0.34, 0.18)	0.09	-0.05 (-0.27, 0.16)	0.04	0.62
Vegetables (times eaten with main meal/week)	4.54 (0.11)	**+0.23 (-0.01, 0.46)**	**0.12**	**+0.33 (0.08, 0.57)**	**0.19**	+0.12 (-0.13, 0.36)	0.08	0.41
Takeaway/fast food (meals/week)	1.18 (0.04)	**-0.18 (-0.31, -0.05)**	**0.23**	**-0.27 (-0.40, -0.13)**	**0.31**	**-0.20 (-0.34, -0.07)**	**0.23**	**0.004**
Dinner eaten in front of TV (times/week)	1.84 (0.12)	**-0.38 (-0.71, -0.04)**	**0.19**	-0.11 (-0.47, 0.24)	0.05	-0.09 (-0.44, 0.27)	0.03	0.62
Sugar-sweetened drinks (glasses/day)	0.90 (0.06)	**-0.25 (-0.42, -0.07)**	**0.21**	**-0.18 (-0.36, -0.01)**	**0.15**	**-0.30 (-0.48, -0.12)**	**0.26**	**<0.001**
Juice (glasses/day)	0.67 (0.03)	**-0.21 (-0.31, -0.11)**	**0.33**	**-0.18 (-0.29, -0.08)**	**0.28**	**-0.29 (-0.39, -0.19)**	**0.45**	**<0.001**
Snacks (number/day)	2.00 (0.06)	**-0.33 (-0.52, -0.14)**	**0.28**	**-0.28 (-0.48, -0.09)**	**0.22**	**-0.34 (-0.53, -0.14)**	**0.26**	**<0.001**

[a] All outcomes are adjusted for age, socio-economic status, sex and baseline values, [b] n = 295, [c] n = 101, [d] Reported by fathers regarding eldest enrolled child, [e] n = 167, [f] Change scores are in relation to the baseline score.

Figure 1. Participant flow during the Healthy Dads Healthy Kids dissemination trial.