Preventive Medicine Reports 11 (2018) 7–14

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

Effect of a culturally-tailored mother-daughter physical activity intervention on pre-adolescent African-American girls' physical activity levels

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ARTICLE INFO

Keywords:
Physical activity
Intervention
Mother-daughter
African-American
After-school program
Accelerometers

ABSTRACT

Positive parent-child attachment can be determined by opportunities for the child to interact with his/her parent and can influence a child's physical activity (PA) behavior. Therefore, an intervention that provides children and their parent more time to interact positively could impact children's PA. We examined the efficacy of a 12-week mother-daughter intervention on African-American girls' PA levels. In Spring of 2013 and 2014, mother-daughter dyads (n = 76) from Springfield, MA, were randomly assigned to one of three groups [child-mother (CH-M, n = 28), child alone (CH, n = 25), or control (CON, n = 23)] that participated in an afterschool culturally-tailored dance intervention (60 min/day, 3 days/week, 12 weeks). Girls in the CH-M group participated in the intervention with their maternal figure, while girls in the CH group participated in the intervention alone. CON group participants received weekly health-related newsletters. PA was assessed with accelerometers for seven days at baseline, 6-weeks, and 12-weeks. Hierarchical linear modeling was used to examine rates of change in PA. During the afterschool intervention time, girls in the CH-M group displayed a significantly steeper rate of increase in their percent time spent in vigorous PA compared to both the CON ($\gamma = 0.80, p < 0.001$) and the CH group (χ^2 (1) = 13.01, $p < 0.001$). Mothers in the CH-M group displayed a significantly steeper rate of increase in their percent time spent in total daily moderate-to-vigorous PA compared to CH group's mothers ($\gamma = 0.07$, $p = 0.01$). This culturally-tailored mother-daughter afterschool intervention influenced African-American girls' afterschool hour PA levels, but not total daily PA.

Trial Registration: Study is registered at www.clinicaltrials.gov NCT01588379.

1. Introduction

African-American girls in the U.S. suffer disproportionately from obesity (Ogden et al., 2016), representing a health disparity that worsens with age as African-American women have the highest rates of obesity (Flegal et al., 2016). One factor associated with increased obesity prevalence in children is decreased physical activity (PA) (Baranowski et al., 1992; Goran et al., 1999; USDHHS, 2008). Current data indicate that African-American girls are more likely than Caucasian girls to report not participating in any bouts of PA during a typical week (Kann et al., 2016).

Maternal health behaviors and attitudes have been shown to guide the development of children's health behavior practices (Lazarou et al., 2008; Birch and Fisher, 2000; Arredondo et al., 2006; Bauer et al., 2008). The risk and resilience framework posits that a child's development is shaped by risk factors (e.g., poor parent-child bonding) and resilience factors (e.g., attachment to parent, positive attitude) (Hawkins et al., 1992; Catalano and Hawkins, 1996). Increased presence of resilience factors have been shown to alter a child's behavior, which can be attributed to positive parent-child attachment (Hawkins et al., 1992; Catalano and Hawkins, 1996). A child's level of attachment to their parent is determined by opportunities for the child to interact with his/her parent (Hawkins et al., 1992; Catalano and Hawkins, 1996; Hawkins and Weise, 1985; Hawkins et al., 1999). Therefore, interventions that provide children and their parent more time to interact in a positive manner can enhance the quality of the parent-child relationship.

In the African-American culture, mothers are thought to be the primary influence on their daughters' PA behavior through late adolescence by creating and supporting PA opportunities and modeling PA behavior (Davison et al., 2011; Raudsepp, 2006; Baldwin and Hopkins, 1990). Despite the key role that maternal figures play in girls' PA

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https://doi.org/10.1016/j.pmedr.2018.05.009
Received 2 November 2017; Received in revised form 24 April 2018; Accepted 5 May 2018
Available online 09 May 2018

behavior, previous PA interventions have minimally involved mothers (Olvera et al., 2010; Olvera et al., 2008; Ransdell et al., 2003; Corning et al., 2010; Beech et al., 2003; Robinson et al., 2003; Robinson et al., 2010). In previous studies, maternal involvement was limited to providing informational newsletters (Olvera et al., 2010; Olvera et al., 2008; Beech et al., 2003), progress reports (Ransdell et al., 2003), family homework/projects (Corning et al., 2010), or family fun night activities (Beech et al., 2003; Robinson et al., 2003; Robinson et al., 2010). However, to date there have been limited studies in which mothers and daughters participated jointly in the intervention activities (Barr-Anderson et al., 2014). Therefore, the purpose of this study was to examine the feasibility and efficacy of a 12-week culturally-tailored mother-daughter PA intervention on the PA levels of pre-adolescent African-American girls.

2. Methods

2.1. Participant recruitment and eligibility

This study was a three-arm, parallel group, pilot randomized controlled trial. African-American girls and their mothers were recruited from the Springfield, MA, area. Girls were eligible for the study if they were between the ages of 7–10 years and identified as African-American or Black by their mothers (Robinson et al., 2003; Robinson et al., 2010). Mothers self-identified themselves as African-American or Black and were broadly defined as the primary maternal figure that resided with the girls. Participants were not eligible if they had any condition limiting their participation in the PA intervention or in the assessment of PA, or were unable to read/complete the informed consent in English. Girls provided assent, and mothers provided informed consent for themselves and for their daughter to participate in this study. The University of Massachusetts Amherst institutional review board approved this study.

After completion of all baseline measures, mother-daughter dyads were randomly assigned by block randomization to one of three [child and mother (CH-M), child alone (CH), or control (CON)] groups. Randomization was stratified by girls' BMI percentile ($\geq$85th percentile or $<$ 85th percentile) to ensure an equal distribution of overweight and non-overweight girls across all groups. A trained member of the research staff performed all randomization procedures. Data was collected in the spring of 2013 and 2014.

2.2. Intervention

2.2.1. Theoretical framework

This intervention was based on the social cognitive theory, which supports that behavior is developed and altered through the interplay of personal (interest in the dance program, self-efficacy); behavioral (knowledge and skills needed to participate in dance); and environmental (inclusion of the mother, safe environment) factors (Bandura, 1986; Bandura, 1997). The intervention also incorporated the African-American culture by emphasizing both surface (e.g., selected dance style and music, utilizing an African-American dance instructor) and deep (e.g., social and historical influences, the importance of the maternal figure) structure cultural influences (Resnicow et al., 1999; Gaines Jr et al., 1997; Resnicow et al., 1997).

2.2.2. Intervention development

Results from a focus group study in African-American dyads were used to develop the intervention components (Alhassan et al., 2014). The data indicated that a dance intervention (African, Jazz, and Hip-Hop) was the preferred PA format. For the dance intervention, two routines were developed for each dance style by professional dancers. Each routine consisted of a warm-up (2-minutes), moderate-to-vigorous dance movements (8-minutes) and cool-down (1-minute). Each routine was recorded on DVDs for the instructors to learn the choreography. Experienced African-American female dance instructors were hired and trained to teach the classes. Each dance style was also accompanied by an educational curriculum, which highlighted the history of the dance style, and its impact on the African-American culture. The education curriculum was taught by the research staff. Additionally, 12 weekly health newsletters were developed utilizing educational materials from federal health agencies on topics (generated from focus group data) relevant to African-American communities in Springfield, MA (Alhassan et al., 2014). Separate newsletters covering the same content were developed for mothers and daughters. The daughters' newsletters also contained activities for them to complete and highlighted historical African-American female figures and their influence on society.

2.2.3. Implementation of intervention

Afterschool dance classes were held at a centrally located elementary school in Springfield, MA. Mothers and daughters assigned to the CH-M group and daughters assigned to the CH group underwent the same PA intervention on the same days, but at different times. The intervention was held three days/week (based on focus group data) for 12 weeks (Alhassan et al., 2014). Each intervention session included 2 h of a healthy snack and homework tutoring and 1 h of the dance intervention. Participants arrived at the intervention site and were offered healthy snacks from 3:30–4:00 pm. During the focus group, mothers indicated that a later start time would better accommodate their work schedules. Therefore, the CH group danced from 4:20–5:20 pm followed by homework tutoring. The CH-M group danced from 5:30–6:30 pm, preceded by homework tutoring. Mothers and daughters in all groups received a weekly newsletter. The CON girls were asked to attend the intervention sessions, during which girls received a healthy snack and homework tutoring for 2 h. After the completion of the 12-week study, girls in the CON and CH group were offered the dance curriculum with their mothers.

2.3. Assessments and measures

Data were collected at baseline, 6-weeks, and 12-weeks by trained data collectors. Girls' and mothers' PA levels were assessed using the Actigraph accelerometer (Actigraph, LLC, Pensacola, FL). Accelerometers have been validated for PA assessment in children and adults (Sirard and Pate, 2001; Trost et al., 2005; Troiano et al., 2008; Freedson et al., 1998). Accelerometers were attached to an adjustable elastic belt worn on the participant's right hip and programmed to store data in 60-second epochs. Participants were asked to wear the accelerometers during all waking hours for seven consecutive days and to remove it only when sleeping or when it would get completely wet. Accelerometer data were reduced using Actilife software (version 6.9.1). Wear time was determined using the Choi (2011) algorithm (Choi et al., 2011). A valid wear day consisted of at least 480 min of wear time on at least three days (including one weekend day). Percent time spent in sedentary behavior and all activity intensities for total day (8 am–10 pm) and afterschool intervention time (3:30 pm–6:30 pm) were determined using the Troiano (2008) cut points for adults (mothers) and Evenson (2008) cut points for children (daughters) (Troiano et al., 2008; Evenson et al., 2008).

Participants' height and weight were measured using a stadiometer and a digital scale, respectively. BMI was calculated as weight (kilograms) divided by height (meters) squared. For girls, BMI percentiles were calculated using the Centers for Disease Control and Prevention Growth Charts (Ogden et al., 2002). Demographic information was collected from mothers at baseline using a structured questionnaire. Sexual maturation (reported by mothers) was measured at baseline using the Peterson development scale (Morris and Udry, 1980; Wilson et al., 1991). Girls and mothers were asked to report their PA preference using a validated self-report instrument (Robinson et al., 2003). Girls' PA self-efficacy was assessed using the Child Self-Perception of Adequacy and Predilection for PA Scale (CSAPPA, test-retest reliability,

r = 0.84–0.90) (Cairney et al., 2005; Hay, 1992). Mothers' PA self-efficacy was assessed with the PA Self-Efficacy scale (test-retest reliability, r = 0.68; internal consistency, r = 0.84) (Sallis et al., 1988; Garcia and King, 1991; Oman and King, 1998).

2.4. Study process evaluation

Detailed information of study process evaluation procedures and data are reported elsewhere (Burkart et al., 2017). Study process evaluation was assessed during each intervention day by trained staff using a semi-structured questionnaire. The intensity of the dance intervention was assessed one randomly selected day/week using accelerometers. Accelerometers were placed on the participants at the start of intervention day and removed before going home. Attendance was monitored with daily sign-in sheets. At the completion of the study, mothers' perception of the intervention and the effects they observed on their daughters' behavior was assessed with an open-ended questionnaire.

2.5. Data analyses

Baseline descriptive statistics examining the frequency and distribution of variables between the groups were assessed. The distributions of all study variables were examined to see if any transformations were necessary. Most of the study variables were normally distributed, and those that were not required basic linear transformations to center time at zero for necessary hierarchical linear modeling (HLM) interpretation. Baseline group differences were examined using ANOVA and χ^2 for scaled and categorical variables, respectively using SAS (version 9.3, SAS Inc., Cary, NC). Primary and secondary analyses were conducted in the fall of 2014 using HLM software (version 7.26b, Scientific Software International, Inc., Skokie, IL). HLM was used to consider rates and patterns of change between treatment groups on a series of continuous outcome variables for daughters and mothers separately. HLM is appropriate for analyzing longitudinal data, as it is a methodology capable of accounting for dependency between repeated observations and more accurately estimates standard errors than ordinary least squares regression (Raudenbush and Bryk, 2002). It is also useful for a design such as this intervention since HLM accommodates for missing data, retaining participants who contribute data for at least one-time point on the dependent variable. Analyses followed intention-to-treat principles. For the daughters' continuous dependent PA outcomes (baseline PA levels), age and sexual maturation were included as model covariates, as it was reasonably believed that these factors could contribute to daughters' willingness to fully engage in the dance intervention, beyond assigned group membership. For mothers' PA outcomes, marital status and education were included as model covariates.

The sample size and power calculation were based on a three-group model in which we examined differences in rate-of-change in percent of time spent in MVPA between any two groups over 12 weeks. The sample size calculation was based on work from the Stanford GEMS pilot study (Robinson et al., 2003) and baseline data from their two-year intervention (Robinson et al., 2008; Alhassan and Robinson, 2008). Using these values and an alpha = 0.05, with a sample size of 60 daughter-mother dyads (20 dyads/group), we had 80% power to detect a difference between 20 and 50 min/day of MVPA between any two groups.

3. Results

3.1. Baseline characteristics

Participants' recruitment and enrollment information are presented in Fig. 1. Participants' baseline characteristics and comparisons are reported in Table 1. Of the 76 dyads (CH-M, n = 28, CH, n = 25; CON, n = 23) randomized, complete data was available in 32 dyads (CH-M, n = 14, CH, n = 12; CON, n = 6) used in the analysis. Significant differences were observed in mothers' BMI ($p = 0.04$), income ($p = 0.008$), and marital status ($p < 0.001$) between those that dropped out of the study and those that were used in the analysis. Average BMI percentile and BMI for girls and mothers placed them in the normal weight and obese category, respectively. Daughters participating in this study were from single-parent (60.9%), low-income (57.1%) households. On average, girls and mothers spent 60.2% and 71.2% of their day engaged in sedentary activity, respectively. Significant between-group baseline differences were observed for girls' age and mothers' marital status and education level.

3.2. Process evaluation

The mean attendance rate (days/week) for the intervention was 1.21, 1.24, and 0.56 for girls in the CH-M, CH, and CON group, respectively. Mean attendance rate for mothers in the CH-M group was 0.97 days/week. The average duration of the dance classes was 54.4 ± 5.5 and 58.2 ± 3.5 min for the CH-M and CH group, respectively. Overall, girls (CH-M, 95.3%; CH, 96.9%) enjoyed the dance classes. During the dance class, a significant portion of the girls in both the CH-M (95.3%) and CH (100%) group spent their time engaged in the dance routine. All elements of the intervention were implemented as designed except the integration of concepts of African-American cultural heritage due to lack of time. According to the end of the study survey, participants were very satisfied with the program (96.2%). Mothers in the CH-M group reported that spending time with their daughters was the most satisfying part of the program. One mother stated, "*I love the bonding time between my daughter and I.*" The most frequently reported barrier to the program was transportation and time commitment due to study assessment.

3.3. Dance intervention time PA

We analyzed at level-2 the effect of experimental group (0 = CH, 1 = CH-M) on rates of PA intensities percent change over time with age and sexual maturation as covariates in the model. Daughters in the CH-M group had a significantly steeper rate of increase in percent time spent in vigorous PA (VPA) during the intervention period compared to daughters in the CH group ($\gamma = 1.05$, $p = 0.002$). Additionally, CH-M daughters had a significantly steeper rate of increase in percent time spent in MVPA during the intervention period compared to CH daughters ($\gamma = 1.57$, $p = 0.007$).

3.4. Total afterschool intervention time

Group differences between all three groups were assessed across the entirety of the afterschool intervention period. Changes in PA, controlling for baseline PA during the afterschool time, are presented in Table 2. Daughters in the CH-M group displayed significantly steeper rates of increase over time in percent time spent in VPA compared to the CON group ($\gamma = 0.80$, $p < 0.001$) and the CH group (χ^2 (1) $= 13.01$, $p < 0.001$). Changes in VPA during the afterschool time are depicted in Fig. 2. Daughters in the CH group showed a significantly steeper rate of decrease in percent time spent in MVPA compared to the CON group ($\gamma = -1.29$, $p = 0.002$) and the CH-M group (χ^2 (1) $= 26.40$, $p < 0.001$), while the CH-M and CON group slopes revealed no significant differences.

3.5. Total daily PA

Changes in total daily PA are presented in Table 2. No significant between group rates of change differences were observed in daughters' total daily PA to support the change trajectories found during the intervention time or total afterschool time. However, significant changes were observed in the mothers' total PA data. Controlling for baseline PA, mothers in the CH-M group displayed a significantly steeper rate of

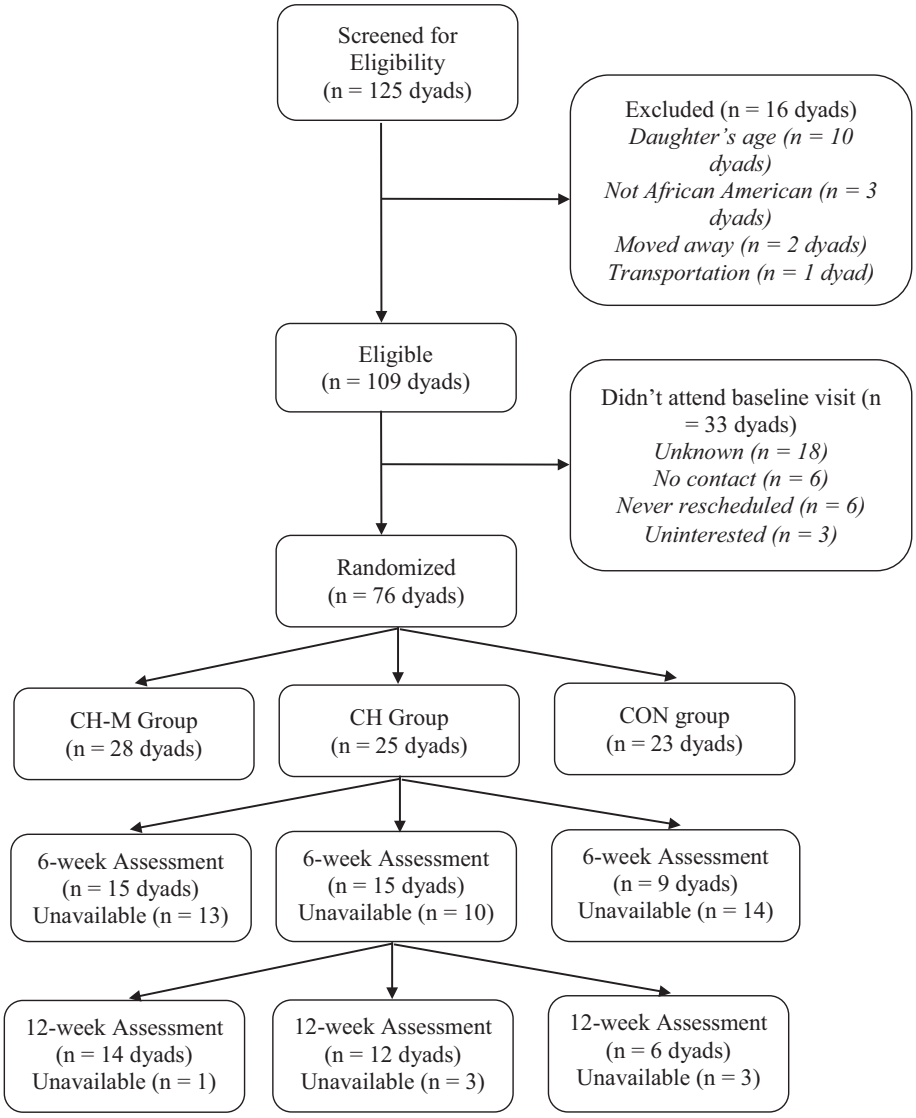

Fig. 1. Participant recruitment, randomization, and follow-up.
CH-M = child-mother group; CH = child alone group; CON = control group.

increase over time in percent time spent in MVPA compared to the CH group (χ^2 (1) = 6.46, p = 0.01), and neither treatment groups' slope differed significantly from the CON group.

4. Discussion

Previous PA studies in pre-adolescent African-American girls rarely directly involved the maternal figure in the intervention activities, nor did they examine the impact of the intervention on maternal PA behavior. The aim of this pilot study was to examine the feasibility and efficacy of a 12-week joint mother-daughter afterschool intervention on the PA levels of pre-adolescent African-American girls. The intervention led to a significant improvement in the rate of change in the percent time that girls in the treatment groups spent in VPA and MVPA during the afterschool hours, respectively. We also observed significant improvements in total daily percent time spent in MVPA for the mothers in the CH-M group.

Since 2000, there have been eight culturally-tailored PA interventions in pre-adolescent African-American girls (Beech et al., 2003; Robinson et al., 2003; Robinson et al., 2010; Baranowski et al., 2003; Klesges et al., 2010; Barbeau et al., 2007; Story et al., 2003; Burnet et al., 2011). PA levels were usually assessed with accelerometers (Beech et al., 2003; Robinson et al., 2003; Robinson et al., 2010; Baranowski et al., 2003; Klesges et al., 2010; Story et al., 2003) or self-report (Barbeau et al., 2007; Burnet et al., 2011). Of the studies that used self-reported measures of PA, both reported significant changes in girls' PA levels. However, a common theme in the studies where PA was objectively assessed, was that intervention activities did not lead to significant changes in total daily PA levels, which is similar to the current study. Some of these studies did observe non-significant improvements in MVPA during the afterschool hours when the intervention would have been taking place (Beech et al., 2003; Robinson et al., 2003; Robinson et al., 2010; Story et al., 2003). In three different 12-week pilot studies (Beech et al., 2003; Robinson et al., 2003; Story et al., 2003) and a two-year intervention (Robinson et al., 2010), researchers reported non-significant increases in objectively measured MVPA between 12 pm–6 pm.

The lack of a significant change in total daily MVPA was discouraging, as focus group data were utilized to inform the study design (Alhassan et al., 2014). The lack of change in total daily MVPA could be attributed to not targeting the home environment (strategies to change dyads' PA home environment), impact of the active placebo group, or implementation challenges. One of the main underlying concepts of the intervention design was that the direct inclusion of the girls' mothers

Table 1
Participant's baseline characteristics.

	ALL (n = 76 dyads)	CH-M (n = 28 dyads)	CH (n = 25 dyads)	CON (n = 23 dyads)	*p* value
Daughter					
Age (years)	8.3 ± 1.3	8.8 ± 1.4	7.8 ± 1.0	8.1 ± 1.1	0.02
BMI percentile	68.2 ± 29.1	73.3 ± 28.9	60.1 ± 30.9	70.7 ± 26.8	0.26
TD SED (%)	60.2 ± 10.0	60.5 ± 9.2	63.1 ± 8.2	57.3 ± 12.1	0.38
TD LPA (%)	36.8 ± 8.9	36.5 ± 7.7	34.3 ± 7.2	39.4 ± 11.1	0.42
TD MVPA (%)	2.9 ± 2.0	2.9 ± 2.0	2.5 ± 2.0	3.3 ± 2.1	0.26
AS SED (%)	48.8 ± 12.9	45.7 ± 12.2	52.6 ± 12.8	48.1 ± 13.8	0.31
AS LPA (%)	45.8 ± 11.3	47.9 ± 10.3	43.7 ± 11.2	45.8 ± 12.3	0.55
AS MVPA (%)	5.4 ± 5.5	6.4 ± 5.5	3.6 ± 3.4	6.2 ± 7.5	0.36
PA self-efficacy[a]	56.5 ± 15.6	57.5 ± 14.4	59.0 ± 12.2	52.3 ± 19.8	0.48
PA preference (active)	85.8 ± 11.3	86.5 ± 11.2	84.5 ± 10.3	85.9 ± 12.7	0.88
PA preference (sedentary)	31.6 ± 3.5	31.3 ± 3.8	31.1 ± 3.0	32.5 ± 3.5	0.44
Mother					
Age (years)	37.4 ± 7.7	35.5 ± 8.2	36.8 ± 7.3	39.8 ± 7.7	0.26
BMI (kg/m^2)	31.9 ± 7.2	34.0 ± 7.4	29.9 ± 7.3	31.4 ± 6.4	0.13
TD SED (%)	71.2 ± 7.0	71.3 ± 7.3	69.8 ± 5.9	72.3 ± 7.5	0.59
TD LPA (%)	27.2 ± 6.3	27.1 ± 6.9	28.8 ± 5.4	26.1 ± 6.3	0.50
TD MVPA (%)	1.6 ± 1.1	1.6 ± 0.9	1.5 ± 0.8	1.6 ± 1.5	0.92
PA self-efficacy[b]	3.9 ± 0.7	3.8 ± 0.6	3.9 ± 0.8	3.9 ± 0.9	0.82
PA preference (active)	60.5 ± 10.7	60.1 ± 12.9	58.3 ± 9.7	63.6 ± 8.6	0.29
PA preference (sedentary)	19.7 ± 1.8	19.5 ± 1.9	20.3 ± 1.4	19.3 ± 1.9	0.17
Parent marital status, n (%)					0.002
Single-never married	45 (61.6%)	19 (70.4%)	14 (60.9%)	12 (52.2%)	
Married	21 (28.8%)	6 (22.2%)	6 (26.1%)	9 (39.1%)	
Divorced/separated/widowed	7 (9.6%)	2 (7.4%)	3 (13.0%)	2 (8.7%)	
Max household education, n (%)					0.04
High school or less	18 (25.7%)	6 (23.1%)	8 (38.1%)	4 (17.4%)	
Some college/technical school	24 (34.3%)	14 (53.8%)	4 (19.0%)	6 (26.1%)	
College graduate	28 (40.0%)	6 (23.1%)	9 (42.9%)	13 (56.5%)	
Annual household income, n (%)					0.37
Less than $20,000	19 (27.1%)	8 (29.6%)	8 (36.4%)	3 (14.3%)	
$20,000–$39,000	25 (35.7%)	10 (37.0%)	6 (27.3%)	9 (42.9%)	
$40,000–$59,000	17 (24.3%)	4 (14.8%)	7 (31.8%)	6 (28.6%)	
> $59,000	9 (12.9%)	5 (18.5%)	1 (4.6%)	3 (14.3%)	

Unless otherwise noted, variables are presented as mean ± sd. CH-M = child-mother group; CH = child alone group; CON = control group, TD = total day, AS = afterschool hours, SED = time spent in sedentary behavior, LPA = time spent in light physical activity, MVPA = time spent in moderate to vigorous physical activity, BMI = body mass index, cm = centimeters, PA = physical activity. Average accelerometer wear time for daughter and mother were 1027.0 ± 220.5 min/day and 999.7 ± 206.1 min/day respectively.

[a] Daughters' PA self-efficacy scores range from 19 to 76, with higher scores indicating greater self-efficacy.

[b] Mothers' PA self-efficacy is based on a scale of 1–5, with higher scores indicating greater self-efficacy.

into the afterschool intervention activities would energize the dyads to start enjoying PA and therefore, to incorporate PA into other parts of their lives. For example, CH-M participants were encouraged to practice their dance routines at home. However, there were no direct activities or behavior change strategies that were implemented to specifically target the dyads' home environment. It is possible that simply encouraging participants to practice their dance routines at home was not enough to elicit changes in the girls' total daily MVPA. It should be noted that during the post-intervention interview some of the mothers indicated that they did practice their dance steps at home but without

Table 2
Impact of intervention on physical activity variables (mean ± sd).

	CH-M group		CH group		CON group	
	6-Week	12-Week	6-Week	12-Week	6-Week	12-Week
Daughter						
TD SED (%)	60.3 ± 10.5	63.7 ± 8.2	59.9 ± 8.1	57.9 ± 8.2	61.7 ± 14.3	55.2 ± 11.7
TD LPA (%)	36.8 ± 9.7	33.6 ± 7.1	37.1 ± 6.5	39.1 ± 7.1	35.7 ± 13.0	37.1 ± 8.5
TD MVPA (%)	2.8 ± 1.3	2.8 ± 1.3	3.0 ± 2.7	3.1 ± 1.6	2.6 ± 1.6	3.5 ± 1.9
AS SED (%)	41.2 ± 12.5	44.8 ± 10.9	40.2 ± 13.3	36.5 ± 11.2	49.8 ± 17.5	41.7 ± 15.9
AS LPA (%)	50.7 ± 9.7	45.7 ± 7.2	52.2 ± 12.0	53.2 ± 8.1	44.2 ± 13.0	47.3 ± 10.8
AS MVPA (%)	8.2 ± 3.9	9.5 ± 4.6	7.6 ± 6.3	10.2 ± 6.3	6.0 ± 6.5	11.0 ± 8.8
Mother						
TD SED (%)	70.0 ± 10.8	70.0 ± 8.2	69.8 ± 5.9	72.3 ± 6.5	68.0 ± 3.3	65.1 ± 7.7
TD LPA (%)	28.2 ± 10.6	28.0 ± 6.8	28.8 ± 5.4	26.2 ± 5.4	30.8 ± 2.8	33.4 ± 7.1
TD MVPA (%)	1.8 ± 1.3	2.0 ± 1.9	1.5 ± 0.8	1.5 ± 1.4	1.2 ± 0.8	1.6 ± 1.2

CH-M = child-mother group; CH = child alone group; CON = control group, TD = total day, AS = afterschool hours, SED = time spent in sedentary behavior, LPA = time spent in light activity, MVPA = time spent in moderate to vigorous physical activity. Average accelerometer wear time for daughters at 6-week and 12-weeks were 1008.8 ± 203.8 min/day and 1061.6 ± 244.5 min/day, respectively. Average accelerometer wear time for mothers at 6-week and 12-week were 1005.7 ± 218.7 min/day and 989.6 ± 170.3 min/day, respectively.

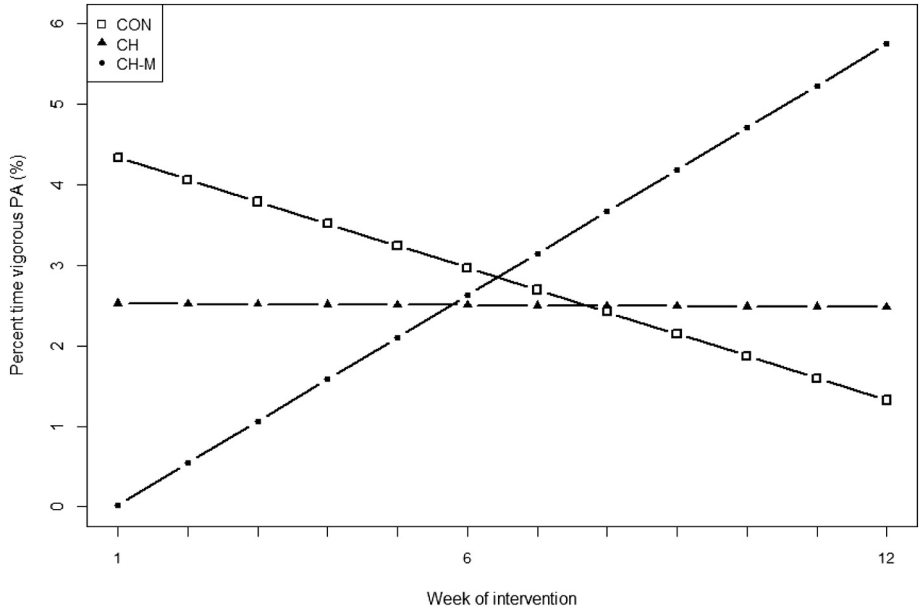

Fig. 2. Rate of change in vigorous physical activity.
PA = physical activity; CH-M = child-mother group; CH = child alone group; CON = control group.

their daughters because "*I wanted to make sure I knew the steps and didn't want to embarrass my daughter during the dance class.*" The lack of change in total daily MVPA would suggest that to effectively alter total daily PA in African-American girls living in low-income urban environments, multilevel interventions may be needed that address not only the girls' behaviors during the afterschool hours, but also address the home environment (Sallis and Glanz, 2006).

The lack of significant between-group differences observed in MVPA could also be related to the CON's intervention. It is possible that the active placebo control intervention produced greater effects than anticipated, which could be attributed to the group's presence at the intervention site. A key recruitment component of this study was that all girls would be provided with ≥60 min of homework tutoring during each intervention day. Due to limited resources, girls in all three groups were present at the same intervention site. We observed that although the CON group girls did not officially participate in the dance intervention after they finished their homework, they spent some of the remaining time being active (i.e., playing tag, running around). Therefore, it is possible that the CON intervention led to unintended PA behavior change. Researchers have indicated that active placebo interventions have many important practical and conceptual benefits, however; if it produces behavior change it could make it more difficult to detect treatment effects (Robinson et al., 2010).

Finally, the lack of change in MVPA could be related to difficulties experienced in study implementation (i.e., dance class attendance and duration), resulting in lower-than projected intervention doses. In previous PA studies involving African-American girls, although the intervention activities included a family member, the intervention activities were held separately for mothers and daughters (Barr-Anderson et al., 2014). The key difference between the current pilot study and previous studies is that our intervention consisted of joint PA sessions between the girls and their mothers. Based on our focus group data, 5:30 pm was identified as the best time that would provide mothers sufficient time after work to meet their daughters for the dance intervention. Unfortunately, the CH-M dance class usually did not start until 5:40 pm. The late arrival of the mothers resulted in more time needed by the interventionist to get the daughters back on task; resulting in less intervention time for the CH-M group.

Due to limited resources, we did not provide transportation to and from the intervention site. The lack of transportation meant that parents had to plan to get their daughters to and from the study site. This created an undue burden that significantly impacted the study attrition rate. As part of the study process evaluation, when participants stopped showing up to the intervention, research staff contacted them to ascertain the reason why. The main reason listed by parents/guardians for dropping out of the study was transportation.

5. Limitations

Our study had limitations worth noting. The first limitation is that the overall high attrition rate resulted in a small sample size included in the analysis, which may have impacted our findings and thereby reducing the generalizability. The second limitation is the non-unified attrition rate observed between the groups (highest in CON). This could be because CON girls were asked to come to the intervention site for the homework tutoring, which may not have been enough to maintain their interest in the program. Other limitations were that we did not offer transportation and did not directly target the home environment.

Despite these limitations, our study had several strengths. For example, we objectively assessed PA in both the girls and their mothers. Past studies that did incorporate a family member usually just reported the impact of the intervention on the child. We observed a significant increase in the total daily percent time that the mothers in the CH-M group spent in MVPA, a group that has also been reported to not meet PA guidelines (Tucker et al., 2011). This pilot study is an important first step in designing culturally-tailored interventions to impact the PA of pre-adolescent African-American girls that includes the direct involvement of the girls' mothers. It is possible that behavioral change strategies that target changing PA barriers within the home environment are needed to help the girls incorporate PA into their daily life. Therefore, future studies should focus on implementing intervention strategies that target the home environment and also enhance mother-daughter relationships with limited time demands from the mother.

Acknowledgments

We thank the mother-daughter dyads and Pediatric Physical Activity Lab staff who made this study possible. We thank the Center for Research on Families Statistical Methodology Consultant for completing the HLM analysis.

The findings and conclusion of this article are that of the authors and does not reflect the official policy of the NIH. This study was funded by National Institutes of Health, National Institutes of Diabetes and Digestive and Kidney Diseases (K01 DK087812-01A1).

Conflicts of interest

Alhassan was supported by an NIH K award. Authors have no conflict of interest to report. The study sponsor did not have any role in the study design; collection, analysis, and interpretation of the data; writing the manuscript, or the decision to submit the paper for publication.

Financial disclosure

The authors have no financial disclosures to report.

Author contributions

Dr. Alhassan (principal investigator) had full access to all the data in the study and took responsibility for the integrity of the data and the accuracy of the data analysis. Alhassan was responsible for study design and concept. Alhassan, Nwaokelemeh, Greever, Burkart, and Ahmadi were responsible for the acquisition of data. Alhassan, Greever, and Burkart were involved in data analysis. All authors were involved in the interpretation of the data, drafting, and revision of the manuscript for important intellectual content. Study is registered at www.clinicaltrials.gov NCT01588379. The material contained in this manuscript has not been published elsewhere and is not currently under consideration by any other journal. Authors have no financial disclosures to report for this paper.

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