Daughters and Mothers Exercising Together (DAMET): Effects of Home- and University-Based Interventions on Physical Activity Behavior and Family Relations

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ABSTRACT

This study compared two interventions in terms of impact on physical activity participation and mother–daughter relations. Previously sedentary mothers and daughters (N = 34) were randomly assigned to a 12-week university- or home-based physical activity group. Program activities were designed using focus group information, aspects of the social cognitive theory, and information from previously successful interventions. The university-based group met three times a week for fitness building and recreational activities. The home-based group received a packet of information and training to perform activities in or near the home. Changes in physical activity and family bonding were assessed for mothers and daughters separately using a 2 (group)(2 (time) repeated measures analysis of variance. On completing the program, mothers and daughters in each group reported increased participation in physical activity (p=.02 to .000). The majority of mothers (94%) and daughters (88%) agreed that "my relationship with my daughter/mother has improved as a result of participating in physical activity together." On the Parental Bonding Instrument daughters reported no statistically significant changes in their perceptions of "mom's level of caring" (p=.73); however, "mom's level of control" (p ≤ .05) increased. Group byTime interactions were not significant, indicating that there were no differences between results from either program. Both home- and university-based physical activity programs may be viable paradigms in which to improve family relations and increase physical activity.

Adolescence is a period of turbulence due to insecurities, relationship stress, and self-anxiousness (Rice, 1999). Adolescent girls report a greater number of family problems than boys do, and these problems may be complicated by the fact that during adolescence communication with parents deteriorates. In addition to psychological stressors, adolescent girls are at risk for physical inactivity. Regular physical activity can help individuals maintain a healthy body weight, reduce the chance of developing Type II (adult onset) diabetes mellitus, and it can promote psychological health by reducing stress, depression, and anxiety (U.S. Department of Health and Human Services [USDHHS], 1999). Unfortunately, adolescent girls are less likely than boys to engage in vigorous physical activity and, among all youth, as grade in school increases, physical activity participation decreases (USDHHS, 2000). In the 1997 Youth Risk Behavioral Survey, fewer than 54% of adolescent girls reported health-enhancing vigorous activity on at least 3 of the preceding 7 days for at least 20 minutes (Pratt, Macera, & Blanton, 1999).

Several studies have shown that parents' activity level has a strong positive relationship to their child's activity level (Alpert, Field, Goldstein, & Perry, 1990; Anderssen & Wold, 1992; Fogelholm, Nuutinen, Pasanen, Moynahanen, & Saatela, 1999; Kalakanis, Goldfield, Paluch, & Epstein,

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2001; Reynolds et al., 1990; Zakarian, Hovel, Hofsetter, Sallis, & Keating, 1994). Additionally, prior researchers have demonstrated that daughters can positively influence their mothers' physical activity levels (Eyler et al., 1999; Taylor, Baranowski, & Sallis, 1994).

Family support appears to be an important component for increasing physical activity in adolescents and adults. Biddle and Goudas (1996) found that adolescents' intentions to exercise and their participation in strenuous activity was significantly predicted by parent and teacher encouragement. According to Anderssen and Wold (1992), direct parental help in exercising vigorously is the most important determinant of physical activity among adolescent girls. They also reported that for adolescent girls, after friends, support from their mothers was the most significant predictor of exercise. Field, Diego, and Sanders (2001) established that for adolescent girls in their study, absence of social support for exercise was the most common reason for discontinuing exercise. It is likely that if an adolescent perceives that physical activity is important to his or her peers and parents, that adolescent will participate in more physical activity than someone whose parents and peers are less supportive of physical activity or more supportive of other skills and activities.

Given the potential link between parent and child physical activity, one way to potentially increase the physical activity levels of adolescent girls and decrease the psychological stressors of adolescence is to design and implement a family-based intervention. Several family-based physical activity interventions have been developed, but most have had little success at increasing physical activity. Baronowski and colleagues (1990) focused on increasing physical activity levels in African-American families with children in the fifth through seventh grades. The control group received no intervention, whereas the intervention group participated in a 14-week program of one educational and two fitness activities per week. Due to a number of factors, including a hurricane alert and a bomb scare, participation rates were very low (average 28%). Adult physical activity levels, as measured in weekly Metabolic Equivalents (METS), increased significantly in the experimental and control groups, but no significant differences were found for psychological variables or cardiovascular fitness indicators among any of the participants. Of particular interest in this study is that most families who continued to participate were led by mothers who perceived the program as a means for them to spend quality time with their children.

Nader and colleagues (1989) implemented a family cardiovascular risk reduction intervention that focused on reducing salt and fat intake and increasing physical activity. The intervention group received 3 months of weekly exercise, education, and behavioral management sessions followed by 9 months of maintenance sessions. The control group received no intervention. Intervention participants significantly improved their diets, but physical activity levels showed no significant improvements. The authors noted that the most powerful long-term (e.g., 1 year) behavior changes among Mexican-American families occurred when siblings and mothers were involved with the intervention.

Epstein, Valoski, Wing, and McCurley (1990) recruited families with one obese child (>20% overweight), one obese parent, and one parent willing to attend treatment meetings with his or her child. These families were then randomly assigned to one of three groups: child and parent group that reinforced habit and weight change, child group that reinforced habit and weight change, and nonspecific group that reinforced attendance. All participants were given information on diet, exercise, and behavioral principles, and all were instructed to begin an aerobic exercise program. Results indicated that the only positive significant changes occurred in the group that targeted both the parent and child. Compared to children in the group with their parents, children in the "child target" and "nonspecific target" groups were significantly heavier ($p \leq .05$) 5 and 10 years after the intervention.

Ransdell, Dratt, Kennedy, O'Neill, and DeVoe (2001) used social cognitive theory (SCT) to design a family-based intervention that allowed mothers to spend quality time with their daughters while being active and learning about physical activity. Although physical activity did not increase significantly over time, mothers and daughters experienced significant improvements in perceived sport competence, physical condition, and strength and muscularity. This is important because previous studies have linked high levels of physical self-perception to continued participation in physical activity across the life span (Welk, 1999).

In addition to using family-based physical activity interventions to increase physical activity, it is interesting to consider other psychosocial benefits that might result from such a program. Using qualitative data from a previous study, we concluded that mother–daughter relations typically improve when they participate in physical activity together (Ransdell et al., 2001). Interestingly, only one other study has examined the possible link between exercise and an adolescent's relationships. In a cross-sectional study, Field et al. (2001) questioned 89 high school seniors on their exercise habits and relationships with peers and parents. The "high-exercise group" reported ($p \leq .05$) higher quality relationships and greater intimacy with parents and more family support as compared to the "low-exercise group."

Given the many potential benefits of a physical activity program in terms of increasing physical activity and improving mother–daughter relations, it is important to consider a theoretical background to ensure the development and implementation of a successful program. Bandura's (1986; 2001) SCT has been applied to numerous family-based interventions, and it is useful for explaining the adoption of various health behaviors (Taylor et al., 1994). SCT is an effective means of explaining family behaviors because in this theory, the environment, internal personal factors, and behavior act as bidirectional determinants of each other (Bandura, 1978). If one of these

factors changes, the others are more likely to change. When interventions target all three factors, significant behavior changes are more likely to occur. The socialization aspect of the SCT shows how a parent's and child's behavior can act as reciprocal determinants and create a cycle of physical activity promotion.

Because family relations are often strained during adolescence, it is important to consider ways to decrease stress, increase physical activity, and bring parents closer to their adolescent children. One method of improving family relations that has not been thoroughly examined is the use of physical activity interventions. Physical activity interventions may work to improve mother–daughter relations because mothers and daughters will spend more time than usual socializing as they plan the activities, ride to and from the activities, and exercise together. They could also develop a sense of camaraderie as a result of hard work and setting and reaching physical activity goals together. Lastly, succeeding with an exercise program may lead to increased self-esteem, which can have a significant positive effect on one's relations with others.

The purpose of this study was to determine how effective home- and university-based interventions were at facilitating increased physical activity participation and improved mother–daughter relations. Program design was based on SCT and grew out of focus group input, a prior mother–daughter study that successfully influenced psychological factors (Ransdell et al., 2001), and program components that had previously demonstrated large effect sizes in physical activity interventions (Dishman & Buckworth, 1996). The proposed hypothesis for this study was that both home- and university-based interventions would facilitate increased physical activity and improved mother–daughter relations.

METHODS

Study Participants

Prior to the onset of this study, approval was obtained from the University of Utah Institutional Review Board for Human Research. Twenty mother–daughter pairs (N=40) were recruited for the intervention using newspaper articles and local girl scout troop announcements. Both mothers and daughters were required to be apparently healthy (as defined by the American College of Sports Medicine, 2000) and irregularly active or inactive as defined by their answer to one question on the Behavioral Risk Factor Surveillance System (Behavioral Risk Factor Surveillance System, 1995). This question asked about their participation in physical activity for the 3 months prior to the study. Participants were considered sedentary or irregularly active if they engaged in physical activity less than 3 days per week during the past 3 months.

Intervention Description

One month prior to the start of the intervention a subset of mothers and daughters (N=16) was selected and asked to participate in a 2-hour focus group session. During this session participants were asked to discuss the types of activities in which they wanted to participate and desired meeting times and dates. They were also asked to review the home-based participant manual and provide feedback regarding ease of use and quality of recommended activities. Intervention activities were planned using feedback from the focus group meeting, aspects of SCT, and information from previously successful physical activity intervention programs (Dishman & Buckworth, 1996; Ransdell et al., 2001).

Once eligibility was confirmed, participants were randomly assigned to either the university-based or home-based intervention. After assignment to a group, participants met for two classroom sessions. Topics of the classroom sessions for both groups included appropriate amounts of physical activity, components of health-related fitness, calculating energy expenditure of various activities, and using self-monitoring techniques such as goal setting and positive self-talk. The home-based group also received instructions about how to complete various exercises and stretches at home.

To facilitate mother–daughter bonding, specific activities were included in the initial training sessions and emphasized throughout both programs with activities, phone calls, and e-mail messages. Some examples of these activities include the use of a female only environment (which may be perceived as more friendly than a co-ed environment), the emphasis on our study "community," the promotion of the philosophy that exercise is fun, the use of reinforcement for reaching physical activity goals, and the use of positive self-talk to boost confidence. We also played a game called "Get to Know your Mother/Daughter," which included questions about "your daughter's top goal in life right now," or "your mother's biggest success to date."

Participants in the university-based group met three times per week and participated in fitness activities twice a week and lifetime activities or sports once a week. Table 1 presents the university-based physical activity schedule. Fitness activity days typically consisted of a 5-minute warm-up, 30 minutes of aerobic activity, 30 minutes of weight training, and 5–10 minutes of stretching and abdominal exercises. Lifetime activities included cross-country skiing, indoor rock climbing, and hiking. Sports consisted of basketball, soccer, and volleyball. To track program compliance, attendance of the university-based group was taken at each session. To facilitate optimal attendance in the university-based group, weekly prizes such as tickets to athletic events, water bottle holders, hiking books, and gift certificates to sporting goods stores were awarded via a University of Utah women's sports trivia question contest.

The home-based group received a detailed packet containing a calendar of recommended activities, pictures of various stretches and strength training activities (using household items), and tips for overcoming barriers to physical activity. They were asked to participate in a physical activity program very similar to that provided for the university-based group (e.g., 3 days per week emphasizing flexibility, strength training/calisthenics, and aerobic activities), but they were not specifically asked to participate in physical activity sessions together.

Weekly calendar pages and preaddressed stamped envelopes were also included so that home-based participants could circle the physical activity sessions they completed and send their logs to the first author on a bimonthly basis. Those who failed to submit their calendars in a timely fashion were phoned repeatedly until 100% of the calendars were obtained.

To facilitate the initiation and maintenance of physical activity, all participants were asked to participate in additional moderate physical activity 1 to 2 additional days during the week (e.g., taking the stairs instead of the elevator, parking farther away and walking, etc).

Data Collection Procedures

Measurements for this 12-week study were collected at baseline and after completion of the intervention. Because both groups were conducted concurrently, baseline data were collected in late January of 2000 and postintervention data were collected 12-weeks later in late April of 2000. For pre- and posttesting, participants were asked to schedule a 1-hour data collection session during which they completed all questionnaires. A summary of all assessments conducted during the testing sessions is contained in the paragraphs below.

The Fitnessgram Physical Activity Questionnaire was used to detect any changes in physical activity level that resulted from the intervention. This questionnaire, developed using questions from the Youth Risk Behavioral Surveillance Survey, has been deemed reliable and valid (Cooper Institute for Aerobics Research, 1999). Specifically, it asks participants about the number of days per week that they participate in aerobic, resistance training, and flexibility exercises.

The Parental Bonding Instrument (Parker, Tupling, & Brown, 1979), used frequently in family counseling literature with children and adolescents, was used to assess daughters' perceived changes in mother–daughter relations as a result of participating in the intervention. Mothers did not complete this scale. The scale contains 25 questions, which are answered according to a 3-point Likert-type scale (*disagree*, *neutral*, and *agree*). Questions are divided into two subscale areas: caring and control. The caring scale, which consists of 12 questions, measured the daughters' perception of mom's level of caring. Sample questions on this subscale include: "My mom speaks to me with a warm and friendly voice"; "My mom appears to understand my problems and worries"; "My mom is affectionate toward me"; and "My mom enjoys talking things over with me." The range of scores on this subscale is 12 to 48, and higher scores indicate that daughters think that mom "cares" more. The control scale, which consists of 13 questions, measured the daughters' perception of mom's level of over-protectiveness. Sample questions on this subscale include: "My mom lets me do those things I like doing"; "My mom likes me to make my own decisions"; "My mom invades my privacy"; and "My mom is overprotective of me." The range of scores on this subscale is 13 to 52, and higher scores indicate that mom is more controlling. Optimal bonding is characterized by high care and low control scores (Gamsa, 1987). Parker et al. (1979) assessed 3-week test-retest reliability and reported a Pearson correlation coefficient of .76 for the caring scale and .63 for the overprotectiveness scale. Concurrent validity of the scale was assessed by comparing raters' scores of caring and overprotection obtained at interviews to questionnaire scores (r=.77 for caring and .48 for overprotection). Since the initial paper by Parker and colleagues (1979), several other researchers have deemed this scale reliable and valid (Canetti, Bachar, Galili-Weisstub, De-Nour, & Shalev, 1997; Enns, Cox, & Larsen, 2000; Parker, 1990).

Family and Physical Activity Participation Scale

In addition to the questions described above, three questions were developed in an attempt to ascertain the impact of the family on physical activity participation and whether mothers and daughters felt their relationships with each other improved as a result of participating in physical activity together. Participants were asked to answer the following questions using a 4-point Likert-type scale (*strongly disagree*, *disagree*, *agree*, *strongly agree*): "My mother/daughter helps me feel confident about my physical abilities"; "My mother/daughter encourages me to be more active than others in my family"; and "My relationship with my mother/daughter has improved through participation together in physical activities." These questions demonstrated superior 1-week test-retest reliability (r=.95) and content validity was established through an extensive literature review and evaluation by a panel of experts as recommended by McKenzie, Wood, Kotecki, Clark, and Brey (1999).

Calculation of Program Adherence

Adherence to the university-based program was calculated as follows. First, the total number of possible classes (N=36) was calculated and multiplied by the number of university-based participants (N=20) for a total of 720 possible classes. This total number of possible classes (N=720) was used as the denominator in the university-based adherence rate formula. Then, the total number of classes attended by all university-based participants (N=554) was calculated from the attendance records and used as the numerator. Adherence to the university-based program was 77% (554/720).

Adherence to the home-based program was calculated by counting the total number of recommended exercise sessions (N=36) on the weekly calendars and multiplying that number by the number of home-based participants (N=14) for a total of 504 recommended exercise sessions. This total number of recommended exercise sessions (N=504) was used as the denominator in the home-based adherence rate formula. Then, the total number of sessions completed by all home-based participants (as ascertained from weekly calendars mailed in every 2 weeks) (N=353) was used as the numerator. Adherence to the home-based program was 70% (353/504).

Data Analysis

All data were analyzed using SPSS for Windows (version 10.1). At baseline and postintervention, researchers assessed physical activity participation scores (aerobic, muscular strength, and flexibility activi-

Table 1. Summary of University-Based Physical Activities During 12-Week Intervention

Week of Intervention	Physical Activities
1	Classroom topics (discussed in detail in text)
2	Weight circuit (self-testing of strength and development of programs) (2 days) Racquetball
3	Weight circuit (2 days) Cross-country skiing
4	Aerobic and weight circuit (30 minutes each) Box aerobics Volleyball clinic with University of Utah athletes
5	Weight and aerobic circuit (30 minutes each) Box aerobics Hike in Red Butte Canyon
6	Weight and aerobic circuit (30 minutes each) 3 days)
7	Indoor cycling (spin) and weight circuit (30 minutes each) (2 days) Indoor rock climbing
8	Indoor cycling (spin) and weight circuit (30 minutes each) (2 days) Soccer clinic
9	Weight Circuit and indoor soccer (30 minutes each) Box aerobics Day hike in Mill Creek Canyon
10	Frisbee golf/ultimate frisbee Weight and aerobic circuit (30 minutes each) Orienteering (map reading skills and activities)
11	Self-Defense Aerobic and weight circuit (30 minutes each) Basketball clinic with University of Utah athletes
12	Weight and aerobic circuit (30 minutes each) (2 days) Posttesting of both university- and home-based groups

ties), and subscale scores for the Parental Bonding Instrument (caring and overprotectiveness). Two (group)(two (time) repeated measures analyses of variance were used to examine changes in the aforementioned variables, and data for mothers and daughters were analyzed separately. Group by Time interactions were examined to detect differences between the effects of the university-based and home-based programs. Homogeneity of variance and sphericity assumptions were checked prior to analysis and all met the standard criteria. Effect sizes (eta-squared) were computed to detect the magnitude of the treatment effect. Data from the Family and Physical Activity Participation Scale questions, collected before and after the intervention, are presented descriptively.

RESULTS

One hundred percent of the university-based participants (N=20) finished the study and 70% of the home-based group (N=14) finished the study. Three pairs (N=6) from the home-based group dropped out within the first 3 weeks of the study due to illness and time constraints. When baseline data from the dropouts were compared with data from those who finished the study, dropouts were not significantly different from participants in terms of physical activity, age, ethnicity, marital status of mothers, income, education, or self-rated health status.

Participant health, lifestyle, and demographics characteristics are listed in Table 2. For the most part, randomization yielded groups with similar characteristics. Daughters were between 14 and 17 years of age (M=15.41±1.33 years) and mothers were between 31 and 60 years of age (M= 45.18±7.49 years). The majority of participants were White with household incomes above $50,000. Most mothers were well-educated (at least some college) and married/living in a committed relationship. Interestingly, mothers in the home-based group had slightly more education than those in the university-based group, and mothers and daughters in the university-based group were more likely to rate their health as good or excellent compared to mothers and daughters in the home-based group.

Parental Bonding Instrument

Table 3 presents data related to daughter's perception of "mom's caring" and "mom's control." Daughters' perceptions of mothers' caring did not change significantly from pre- to posttest, nor were Group by Time interactions significant. Daughters' perceived mothers as being more controlling ($p \leq .05$) after participating together in this physical activity program regardless of where the program was administered.

Family and Physical Activity Participation Scale

Results from the Family and Physical Activity Participation Scale questions are presented in Table 4. At posttest most daughters (88%) and mothers (94%) reported that "my relationship with my mother/daughter has improved through participating in physical activity together." Increases, from pre- to posttest, in the proportion of participants who strongly agreed or agreed with that statement ranged from 23 to 35%.

Physical Activity Participation

Tables 5 and 6 present changes in physical activity behavior ($d \cdot wk^{-1}$) of university-based and home-based mothers and daughters. Mothers and daughters in both the university- and home-based groups re-

Table 2. Characteristics of Mothers and Daughters by Group Assignment

Lifestyle, Demographic, or Health Characteristic	University-Based Moms (M±SD)	Home-Based Moms (M±SD)	University-Based Daughters (M±SD)	Home-Based Daughters (M±SD)
Age (years)	46.0±8.54	44.0±6.11	15.20±1.23	15.71±1.50
Ethnicity (% participants)				
White	100%	86%	100%	86%
Pacific Islander		14%		14%
Marital Status (% participants)				
Married or living in a committed relationship	70%	100%	N/A	N/A
Divorced, separated, or widowed	30%	0%		
Yearly Household Income (% participants)				
< $10,000	10%	0%	N/A	N/A
$35,000–49,999	10%	14%		
$50,000–74,999	30%	57%		
$75,000 & above	50%	29%		
Education level of moms (% participants)				
Some college	40%	71%	N/A	
College graduate	60%	29%	N/A	
Currently smoke (% participants)	10%	0%	N/A	N/A
Overall health rating (% participants)				
Poor or fair	10%	50%	40%	57%
Good or excellent	90%	50%	60%	43%

ported significant increases in aerobic activity, muscular strength building activity, and flexibility activities across time. Group by Time interactions were not significant, indicating that there were no differences between increases in physical activity participation for university- and home-based groups.

DISCUSSION

The purpose of this study was to determine the effects of 12-week university- and home-based programs on physical activity participation and mother–daughter relations. To our knowledge no previous studies have examined changes in relationships between mothers and daughters as a result of participating in a physical activity intervention. The most important findings of this study were that (a) both university- and home-based physical activity interventions facilitated increased participation in physical activity in mothers and daughters; and (b) most mothers and daughters reported feeling increased support for physical activity and improved mother–daughter relations. Interestingly, no differences were reported between the university-based and home-based programs.

It has been determined that parental encouragement is an important correlate of an adolescent's physical activity (Anderssen & Wold, 1992). Taylor and colleagues (1994) suggested that a child's encouragement can also positively effect a parent's physical activity. These important findings add to the evidence that physical activity with family members at home and within a university setting can be beneficial for mother–daughter relations.

An interesting finding is that the university- and home-based daughter's perception of mother's control increased significantly during the intervention, whereas perceived caring did not change. Parker (1983) explains that excessive contact is one of the manifestations of maternal control or overprotection. It is likely that this study allowed the mother and daughter to spend more time than normal together, traveling to and from the intervention and while exercising together. This increased contact time may lead to the daughters' perception of increased maternal control. It is also possible that physiological and psychological changes resulting from adolescence alone could facilitate increased perceived

Table 3. Changes in Daughters Scores on Parental Bonding Instrument as a Result of 12-Week DAMET Project

Variable	University-Based (N=10) M±SD	Home-Based (N=7) M±SD	F-Value	p-Value	Eta-Squared
Parental Bonding Instrument (caring)					
Pre	28.22±5.26	24.86±4.95			
Post	27.56±5.22	26.57±4.47			
Group			0.91	.36	.06
Time			0.23	.64	.02
Interaction			1.16	.30	.08
Parental Bonding Instrument (PBI) (control)					
Pre	15.11±6.85	14.86±4.85			
Post	18.00±4.74	16.29±4.46			
Group			0.15	.70	.01
Time			4.93	.04*	.26
Interaction			0.56	.47	.04

Notes: PBI scale consists of 25 items: 12 "caring" items and 13 "control" items. Scores on the caring scale range from 12 to 48 and scores on the control scale range from 13 to 52. "Optimal parenting range" for the PBI is defined as a high caring score (above 25) and a low control score (below 20). The internal consistency (coefficient alpha) for each scale was acceptable (r=.90 for the caring scale and r=.83 for the control scale). Effect sizes (eta-squared) from Cohen (1969): 0.01=small, 0.06=medium, and 0.14=large.
*$p \leq .05$

Table 4. Percentage of Participants Who Experienced Changes in Mother/Daughter Relations Before and After Participation in a 12-Week University- or Home-Based Physical Activity Intervention

Question	Mom (% Who Strongly Agree or Agree with Statement at Pretest)	Mom (% Who Strongly Agree or Agree with Statement at Posttest) (Percentage Change from Pre- to Posttest in Parentheses)	Daughter (% Who Strongly Agree or Agree with Statement at Pretest)	Daughter (% Who Strongly Agree or Agree with Statement at Posttest) (Percentage Change from Pre- to Posttest in Parentheses)
My mother/daughter helps me feel more confident about physical abilities	41	65 (+24)	53	94 (+41)
My mother/daughter encourages me to be more active	41	65 (+24)	88	94 (+6)
My relationship with my mother/daughter has improved through participation in physical activity together	71	94 (+23)	53	88 (+35)

Table 5. Changes in Physical Activity Behavior of Daughters in 12-week DAMET Project

Variable	University-Based (N=10) M±SD	Home-Based (N=7) M±SD	F-Value	p-Value	Eta-Squared
Aerobic activity (d•wk^{-1})					
Pre	2.25±1.62	2.00±1.82			
Post	4.30±1.16	2.71±1.88			
Group			2.27	.15	.13
Time			7.53	.02*	.33
Interaction			1.76	.21	.11
Muscular strength building activity (d•wk^{-1})					
Pre	0.95±1.12	1.29±1.80			
Post	2.40±1.27	3.21 ± 1.86			
Group			.90	.36	.06
Time			17.01	.001**	.53
Interaction			.34	.57	.02
Flexibility activities (d•wk^{-1})					
Pre	2.15±2.33	1.00±1.15			
Post	4.00±1.76	4.86±1.22			
Group			.06	.81	.00
Time			20.98	.000***	.58
Interaction			2.60	.12	.15

Notes: Effect sizes (eta-squared) from Cohen (1969) using *F*-values: 0.01=small, 0.06=medium, 0.14=large.
*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

control of mothers over daughters. Although perceived control did increase, the pre- and posttest means for both university- and home-based daughters are within Parker's (1983) "optimal parenting" range, indicating positive relations between mothers and daughters before and after the interventions.

Results from the Family and Physical Activity Participation Scale consistently supported the notion that the family provides powerful support for physical activity participation, and that participation in physical activity together can potentially enhance relations between mothers and daughters. It is likely that the Family and Physical Activity Participation Scale measured different or more general aspects of family relations than the Parental Bonding Instrument, which was limited to perceived maternal caring and control.

At baseline, physical activity participation levels of daughters were higher than those of mothers. This finding is fairly typical in that younger individuals are often more active than older individuals (USDHHS, 2000). It was also noteworthy that posttest values for physical activity behavior were fairly similar for mothers and daughters in the university-based group, validating their consistent group participation in activity throughout the 12 weeks of the study. In contrast, compared to mothers from the home-based group, daughters from the home-based group participated in more d•wk^{-1} of muscular strength and flexibility activity after completion of the study. Slight discrepancies in reported physical activity participation upon completion of the study are likely the result of home-based mothers and daughters participating in activities separately or participating in physical activity outside of the intervention.

Another important finding is that attendance and participation in these interventions was high for both groups (70–77%), especially compared to other family-based interventions (Baranowski et al., 1990; Epstein et al., 1990; Nader et al., 1989; Ransdell et al., 2001). Some of the components that may have contributed to our high adherence rate were (a) targeting mothers and daughters together; (b) using focus group activity recommendations; (c) selecting desirable and age-appropriate modes of physical activity (e.g., hiking, rock climbing, cross-country skiing, etc.); (d) using previously successful physical activity intervention characteristics; and (e) hiring enthusiastic and outgoing activity leaders.

There were no significant differences

Table 6. Changes in Physical Activity Behavior of Mothers in 12-Week DAMET Project

Variable	University-Based (N=10) M±SD	Home-Based (N=7) M±SD	F-Value	p-Value	Eta-Squared
Aerobic activity (d•wk^{-1})					
Pre	1.00±1.05	.57±.79			
Post	4.40±.97	3.0±2.0			
Group			3.96	.07	.21
Time			52.31	.000***	.78
Interaction			1.45	.25	.09
Muscular strength building activity (d•wk^{-1})					
Pre	0.60±1.58	.28±.76			
Post	2.00±1.33	2.00±1.60			
Group			.08	.79	.01
Time			16.72	.001***	.53
Interaction			.17	.69	.01
Flexibility activities (d•wk^{-1})					
Pre	.80±1.55	.14±.38			
Post	3.20±1.69	2.57±1.81			
Group			1.09	..31	.07
Time			34.19	.000***	.70
Interaction			.00	.97	.00

Notes: Effect sizes (eta-squared) from Cohen (1969) using *F*-values: 0.01=small, 0.06=medium, 0.14=large.
***$p \leq .001$.

between changes in physical activity participation or changes in family relations based on group assignment (home- or university-based). This has important implications for the cost-effectiveness of program development. If it is true that home-based programs are as effective as university-based programs in terms of facilitating changes in health-enhancing physical activity and family relations, then individuals interested in health promotion could save significant amounts of money developing home-based programs.

Although results of this study were positive, certain limitations should be mentioned. Because we used a small sample size, and the participants were mostly White and highly educated with a relatively high household income, the results may not be generalizable to some of the American public. Clearly, replication studies are warranted. Another limitation of this study was the failure to use a true control group. We used university- and home-based groups with the belief that the failure to provide the opportunity for physical activity for any group—especially sedentary populations—is unethical (Abrams, Emmons, & Linnan, 1997). Furthermore, the comparison of home-based and clinical settings without a true control group has occurred before in large, federally funded research projects (Dunn et al., 1997, 1998; Kohl, Dunn, Marcus, & Blair, 1998). A third limitation of the study is that participants volunteered to participate in the study. They were probably more interested in physical activity than individuals who did not volunteer to participate.

In the future, the successful aspects of this intervention should be replicated with other mother–daughter pairs. Researchers might consider using the adolescent validated Parental Bonding Instrument-Brief Current form (Klimidis, Minas, & Ata, 1992; Klimidis, Minas, Ata, & Steward, 1992) which is an eight-item version of the long form Parental Bonding Instrument developed by Parker and colleagues (1979). Additionally, examining the effects of physical activity interventions on families who are dysfunctional prior to the study (e.g., low parental caring and high parental control) is another important direction that might have significant implications for physical activity intervention research.

CONCLUSION

This intervention was designed to expose sedentary mothers and daughters to home- and university-based physical activity programs with the hope of increasing physical

activity and improving family relations. With very little research done in this area, this program provides a promising model for improving family relations through physical activity.

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