An Exercise Program for Women Who Are Caring for Relatives With Dementia

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Objective: This study describes factors related to retention and adherence to an exercise program for women caregivers. **Methods:** One hundred sedentary women (average age = 62 years) caring for relatives with dementia were randomly assigned to an exercise program or an attention control (nutrition education) condition. Participants in the exercise condition received 12 months of home-based exercise counseling to achieve at least four exercise sessions per week, for at least 30 minutes per session. Adherence was tracked through monthly exercise logs, validated in a subsample by ambulatory heart rate and motion monitors. Participants also completed a psychosocial questionnaire battery at baseline and 12 months after randomization. **Results:** Participants achieved a 12-month average exercise adherence rate of 74% (ie, three exercise sessions per week) with an average of 35 minutes per session. At 12 months, the exercise condition demonstrated increased knowledge of the benefits of exercise and increased motivational readiness for exercise compared with the nutrition education condition. Both groups significantly improved in perceived stress, burden, and depression from baseline to posttest. Women who were older, less depressed, and more anxious at baseline showed better program retention, and lower baseline depression was associated with better exercise adherence. **Conclusions:** This study demonstrates the feasibility and success of delivering home-based health promotion counseling for improving physical activity levels in a highly stressed and burdened population. Given the independent risk factors of caregiving and physical inactivity on mortality, programs to improve healthful behaviors are needed to preserve the health of caregivers as they undertake this important familial and societal role. **Key words:** dementia caregivers, health promotion, exercise, retention, adherence.

ADLs = activities of daily living; BDI = Beck Depression Inventory; IADLs = instrumental activities of daily living; ISEL = Interpersonal Social Evaluation List; KR-20 = Kuder-Richardson coefficient; PSS = Cohen Perceived Stress Scale; RPE = Rating of Perceived Exertion; TLC = Teaching Healthy Lifestyles for Caregivers; TMAS = Taylor Manifest Anxiety Scale.

INTRODUCTION

Providing care for a relative with dementia is becoming a common family experience. Today, it is estimated that more than 5 million Americans provide in-home, unpaid care for persons with dementia, typically assisting with activities of daily living (ADLs) such as bathing and ambulating as well as instrumental activities of daily living (IADLs) such as shopping, housework, and financial management (1). Among informal or unpaid dementia caregivers, 91% are family members, 70% are women, and 51% live in the same home with the care recipient (2). Most family caregivers take care of their relatives without assistance from paid providers such as home health aides or respite care workers. On average, family caregivers provide 70 hours of care per week; thus, caregiving often exceeds the commitment of a full-time job (3).

Recent estimates show that each individual family caregiver contributes the equivalent of $34,500 (in 1990 US dollars) worth of care annually (3). Although this unpaid contribution translates to substantial savings for our nation's healthcare economy (eg, by alleviating the burden on Medicare and Medicaid), not surprisingly, unpaid caregiving comes at a great cost to caregivers' health. The deleterious impact of caregiving is well documented. Research shows that, relative to noncaregivers, caregivers are more prone to depression (4, 5), suffer more sleep problems (6), have lowered cellular immunity (4, 7, 8), elevated blood pressure responses (9), more family problems with spouses and children (1), and, for the third of caregivers who maintain paid employment outside the home, complications with employers regarding time off, paid leave, and flexibility in work schedules (10–13). In addition, caregiving involving emotional strain has recently been shown to be an independent risk factor for mortality (14).

The negative impact of caregiving on health is likely due, at least in part, to the reduced probability that caregivers engage in preventive health behaviors such as regular physical activity. It is well known that regular physical activity has many health benefits, including a reduced risk of cardiovascular disease and

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some forms of cancer, reduced stress and depression, and improved sleep (15–17). Despite the well-known benefits of physical activity, less than 25% of older adults exercise at levels necessary to achieve these benefits (18). Although some studies of more advantaged or affluent caregivers have not found differences between caregivers and noncaregivers in rates of physical activity participation (19–21), other studies show that caregivers under strain and caregivers providing a higher level of care are less likely to have time to exercise (22, 23). It has been speculated that the lack of time for exercise may serve as a potential mediator of the relationship between caregiver strain and increased mortality risk (14). Therefore, it is important to investigate the psychological impact of caregiving on caregivers' ability to engage in health behaviors such as physical activity. Likewise, it is equally important to determine if engaging in healthful behaviors can improve caregivers' psychological functioning. To date, depression has been associated with reduced self-care behaviors among caregivers in observational studies (24), but to our knowledge, no controlled study of the effect of health behaviors on improving psychological functioning has been conducted.

In light of the physical and emotional challenges of caregiving, caregivers may particularly benefit from the health-promoting effects of physical activity. Most studies aimed at improving caregiver health and functioning have focused on psychological interventions to manage the emotional impact of caregiving (25). Little is known if caregivers would be willing or able to participate in physical activity to help them cope with caregiving, given the time-consuming and exhausting job of caring for a relative. However, preliminary evidence from a pilot study shows that caregivers are in fact interested in programs to promote physical activity and can successfully adopt more physically active lifestyles, at least on a short-term basis (21).

The purpose of this study was to evaluate the feasibility and success of a long-term health promotion program focused on increasing physical activity in older women caregivers. Program retention, adherence to the 12-month exercise intervention, the impact of psychological factors on caregivers' ability to engage in recommended levels of physical activity, and improvements in psychological functioning as a result of participation in the program were investigated.

METHODS

Data for the current investigation are from women who participated in the Teaching Healthy Lifestyles for Caregivers (TLC) study, a randomized, controlled trial examining the effectiveness of health promotion interventions for women caring for relatives with dementia. Major results have been reported elsewhere, and will not be discussed in detail here (26).

Participants

Participants included 100 women providing unpaid care to a relative with dementia. Participants were recruited through community-wide advertisements for a study examining the benefits of a 12-month exercise program on physical health and functioning. Men were not recruited because of the overwhelming prevalence of women in the dementia caregiver population. Eligibility criteria were 1) postmenopausal status, 2) age 50 years and older (participants could be as young as 46 if they were postmenopausal because of a complete hysterectomy), 3) living with a relative who was diagnosed by a physician with Alzheimer's disease or other dementia, 4) providing a minimum of 10 hours per week of unpaid care to the relative with dementia, 5) not planning to move from the area for 12 months, 6) free from any medical condition that would limit participation in light to moderate intensity exercise (ie, walking), 7) not engaging in regular physical activity in the previous 6 months (ie, exercising less than 3 times per week, for 20 minutes or more), and 8) stable on all medications for at least 6 months.

Procedures

After informed consent was obtained, participants underwent baseline medical, physical, and psychosocial assessment. Following the baseline evaluation, participants were stratified by relationship to care recipient (ie, spouse vs. adult daughter) and care recipient dementia diagnosis (Alzheimer's disease vs. another form of dementia) to control for the possibility that these factors could differentially affect participants' response to the interventions. Participants were then randomly assigned to one of two conditions using a computerized version of the Efron procedure (27): 1) a 12-month moderate-intensity endurance exercise training condition or 2) a 12-month attention control (nutrition education) condition.

Exercise condition. Participants randomly assigned to the exercise program were given an exercise prescription in which exercise intensity was gradually increased over a 6-week period to 60 to 75% of heart rate reserve based on peak heart rate achieved during symptom-limited treadmill testing. Participants were instructed to engage in four 30- to 40-minute exercise sessions per week occurring in a home-based format throughout the 12-month period. Most participants chose to primarily engage in brisk walking. Participants were also encouraged to increase other forms of routine activity throughout the day, such as leisurely walking and gardening.

During a 30- to 40-minute introductory, face-to-face session after randomization, a project health educator provided information on the exercise program to be initiated and instruction on monitoring pulse rate. Written information and activity logs were provided, and the staff member telephoned the participant at home the following week to check on progress. After the introductory session, caregivers were contacted by telephone once per week for 3 weeks, then biweekly for 1 month, and then once every month for the remainder of the year (for a total of 15 scheduled calls throughout the intervention period). Telephone contacts, which lasted an average of 15 minutes, were used to monitor progress, answer questions, and provide individualized feedback. Participants completed brief, daily physical activity logs that were mailed back to the project staff at the end of the month. Home-based physical activities, including type and duration of physical activity, were recorded on the logs.

Attention-control (nutrition education) condition. Participants randomly assigned to this condition received a telephone-based nutrition education program that was matched with the exercise

condition on the amount and type of staff contact received, including a 30- to 40-minute postrandomization introductory session describing the nutrition program and 15 follow-up telephone contacts. The nutrition program was based on recommendations from the American Heart Association and similar organizations for a heart-healthy diet (28–30). Participants completed daily nutrition logs that were mailed back to the project staff monthly.

For both conditions, health educators used counseling strategies based on social cognitive theory to promote behavior change (31). Health promotion counseling strategies included discussion of the benefits associated with behavior changes, specific goal-setting, rewards and reinforcement for behavior changes, development of social supports and environmental changes to enhance behavior changes, regular self-monitoring, provision of ongoing feedback, topic-specific educational materials that were mailed to participants during the intervention, and relapse prevention training (31, 32). Additionally, the health educators provided support and encouragement for participants in their roles as caregivers and provided information for resources (eg, respite care and local Alzheimer's Association services).

Measurement

Caregiving characteristics. Participants completed a survey on various aspects of their caregiving (21), including their relationship to the care recipient, age and diagnosis of the care recipient, years or months spent caregiving, and weekly hours spent in caregiving activities.

Psychological measures. Caregivers completed the Screen for Caregiver Burden (33), which is a 25-item questionnaire that measures both the occurrence of potentially negative or upsetting experiences (ie, objective burden) and perceptions of distress over those experiences (ie, subjective burden). The objective burden score is derived by summing the number of caregiving-related situations reported by the respondent (range = 0–25). For each experience endorsed, the caregiver rates level of distress from that experience on a scale of 1 to 4, with higher scores indicating more distress. The subjective burden scores are summed from these distress ratings, with a range of 25 to 100. In the current sample, the Kuder-Richardson coefficient (ie, KR-20, a measure of internal consistency for dichotomous items) for the objective scale was 0.74, and Cronbach's α for the subjective scale was 0.81.

Anxiety was measured with the 20-item short form of the Taylor Manifest Anxiety Scale (TMAS; Ref. 34). Possible scores range from 0 to 20, with higher scores indicating more anxiety. The KR-20 in this sample was 0.83.

Depressive symptoms were measured with the Beck Depression Inventory (BDI; Ref. 35), a widely used, well-validated 21-item self-report inventory that assesses severity of depressive symptoms. Possible scores range from 0 to 63. Cronbach's α for this sample was 0.82.

Self-rated stress was assessed with the Cohen Perceived Stress Scale (PSS; Ref. 36), a 14-item scale that measures the degree to which situations in one's life are perceived as stressful. Possible scores range from 0 to 56, with higher scores indicating greater perceived stress. Cronbach's α was 0.85 in this sample.

Perceived social support was measured with the Interpersonal Social Evaluation List (ISEL; Ref. 37). This 40-item, true/false questionnaire is designed to measure four functions of perceived support (tangible, belonging, self-esteem, and appraisal support) as well as a global index of support. Items are summed and have a possible range of 0 to 40, with higher scores indicating a higher level of perceived support. The KR-20 coefficient for the global support scale for this sample was 0.93.

Exercise knowledge. An eight-item knowledge questionnaire was created for this study based on the American College of Sports Medicine and the US Surgeon General recommendations for safe and effective exercise and physical activity for older adults (17, 18). Examples of questions include, "Is cardiovascular exercise such as brisk walking appropriate for older adults who have hypertension?" and "Which of the following [health risks and benefits] are true of regular cardiovascular exercise?" A multiple-choice format was used. Scores were calculated as the percentage of correctly answered questions out of the total number of questions.

Motivational readiness for physical activity. Participants completed a six-item questionnaire based on the transtheoretical model (38, 39). In this measure, intention and participation in regular physical activity are assessed along a continuum of five stages of change: precontemplation, contemplation, preparation, action, and maintenance (39). Regular physical activity was defined as engaging in any form of exercise that causes an increase in respiration, heart rate, or sweating at least three times per week, for at least 20 minutes. Participants in precontemplation are defined as not engaging in regular activity and having no intentions to become active. Those in contemplation do not exercise but intend to become more active. People in preparation engage in some activity but intend to become more regular. Those in action and maintenance are regularly active, but those in action have been regular exercisers for less than 6 months, whereas those in maintenance have been regularly active for more than 6 months.

Exercise adherence. Exercise adherence rates were calculated for participants randomly assigned to the exercise condition. Participants were instructed to complete monthly activity logs describing the exercise type, frequency, duration, and rating of perceived exertion (RPE) for each session. RPE has been found to be a useful indicator of exercise intensity (40) and was rated in this study on a scale of 6 to 20. Logs were returned monthly by mail for 12 months. If a participant failed to return a log, she was contacted by telephone to obtain the information. Each month, participants were prescribed 4 sessions per week, equaling 16 sessions per month. Average monthly adherence rates were calculated as the percentage of exercise sessions completed at the prescribed intensity out of the number of sessions prescribed. For example, if a participant completed 12 exercise sessions in a month, her adherence rate was 75%.

Approximately 20% of participants (9 exercisers and 11 nutrition education participants) were randomly selected to wear a solid-state two-channel portable microprocessor (41, 42) that recorded heart rate and body movement continuously for a 3-day period during the course of the study. This and similar solid-state portable microprocessors provide a valid and reliable indicator of adherence to prescribed home exercise (43).

Program retention. Participants were asked to participate in a minimum of one telephone-based health promotion counseling call per month and were asked to return one self-monitoring log each month. Therefore, a minimum of two contacts per month was planned for both exercise and nutrition education conditions. If a woman had some form of contact in any given month, either by telephone or by mail, she was considered involved in the program for that month. If she failed to participate in a health promotion counseling phone call that month and did not mail in her log for that month, she was considered "not involved" in the program that month. This resulted in a summary score for every woman in the study from 0 to 12, with higher scores indicating greater retention in the program. In addition, a summary score of all possible telephone and mail contacts was calculated for each participant, with a range of 0 to 24.

Statistical Analysis

Pearson product-moment correlations and *t* tests of continuous variables and chi-square analyses of categorical variables were performed to identify demographics (age, income, employment, dementia diagnosis, relationship between caregiver and care recipient, etc.) that may be covariates of the psychological, retention, and adherence variables. Simultaneous multiple regression analyses were performed to assess the effect of initial psychological status on program retention and exercise adherence rates: baseline depression, anxiety, stress, subjective burden, and objective burden were entered as independent variables, and average exercise adherence, months of program participation, and total number of telephone and mail contacts were entered as separate dependent variables. In the regression equation for exercise adherence, the motivational readiness/stage of change measure was also added as an independent variable to test its contribution as a predictor of exercise participation during the trial. Two-way (group condition by time) repeated-measures multivariate analyses of variance were performed to assess change over time in psychological functioning, exercise knowledge, and motivational readiness between the exercise and nutrition education conditions. Finally, repeated-measures analyses of variance were performed within the exercise group to assess changes in exercise knowledge and motivational readiness as a function of participation and adherence to the exercise program. Casewise deletion of missing data were used in all analyses.

RESULTS

A total of 574 women were initially screened for eligibility. Of this number, 331 were excluded on the basis of study criteria: 46% of this group did not meet caregiving criteria (eg, caregiver was not a relative, provided care <10 hours/week, or did not live with the care recipient), 18% of caregivers were too physically active, 18% were excluded because they did not meet the gender or age requirements, and 7% had health or medical problems that prohibited participation. An additional 143 caregivers were no longer interested in participating after the study was described more thoroughly. Therefore, a total of 100 women were randomized (51 to the exercise condition, and 49 to the nutrition education condition). Fifteen of these participants (6 exercisers and 9 nutrition participants) dropped out of the study before completion of the 12-month evaluation. All 6 exercisers and 6 of the nutrition education participants dropped out because of increased familial obligations (eg, decline in care recipient functioning and subsequent increase in caregiving responsibilities), and 3 women in the nutrition education condition dropped from the study because of medical complications that were unrelated to the study. This resulted in an attrition rate of 15%, which is reasonably good relative to other exercise studies, particularly given the complicated circumstances of the targeted population (44). Caregivers who did not complete the trial had significantly higher scores on baseline depression (mean BDI = 16.2, SD = 8.2) and stress (mean PSS = 22.5, SD = 4.8), and they spent more hours at baseline in caregiving duties (mean = 100.5, SD = 41.7) than the rest of the sample. There were no differences between participants who completed the trial and those who did not based on the randomization condition, relationship to care recipient, or type of dementia.

Demographics

Demographic characteristics of the sample are displayed in Table 1. There were no significant differences between the two conditions on any demographic variable. The sample was similar in age, ethnicity, and weekly hours of caregiving compared with samples in previous studies (1, 3). Overall, the sample was well educated, white, and in their early 60s. The sample was almost evenly split between wives caring for spouses and daughters caring for parents. A slight majority of women (64%) cared for a relative with a diagnosis of Alzheimer's disease, and the remaining 36% cared for a relative with dementia related to Parkinson's disease, stroke, or another form of dementia. The caregivers provided approximately 71 hours of care to their relative per week and, on average, had been caring for their relative for 4.7 years.

At baseline, the psychological profile for this sample was similar to other samples documented in the caregiver literature (45–47). On average, caregivers scored in the mildly depressed range on the BDI; 78% of the sample scored within the range for mild depression (48). Additionally, the sample reported elevated levels of anxiety and stress and less social support than the general population (34, 36, 37). There were no differences in psychological functioning based on caregiver status: wives and adult daughters were similar on all measures with the exception of social support, in which wives seemed to have less support than adult daughters ($t(1,94) = 2.20$, $p < .03$). However, this difference seemed to be a function of age; caregiver relationship status and age were highly correlated ($r_s = 0.61$, $p < .0001$), with spousal caregivers being older, and age and perceived social support were also correlated ($r = -0.20$, $p < .04$), with older caregivers having less social support. Age was included as a covariate in all analyses.

Retention

As was stated earlier, 85% of participants completed the 12 month posttest assessment. The exercise group was successfully maintained in the program for an average of 10.73 months (SD = 2.50), whereas the nutrition education group was maintained in the pro-

TABLE 1. Demographic Characteristics of Sample (N = 100)

	Exercise Group[a] (N = 51)	Nutrition Group[a] (N = 49)	Total Sample (N = 100)
Age, y			
Mean (SD)	62.16 (9.33)	63.33 (9.03)	62.73 (9.16)
Range	49–82	49–82	49–82
Education, y			
Mean (SD)	15.41 (2.24)	14.61 (2.79)	15.02 (2.54)
Range	10–20	6–20	6–20
Annual income, $US			
Mean (SD)	44,343 (23,404)	54,592 (50,609)	49,468 (39,552)
Range	7200–120,000	6828–300,000	6828–300,000
Weekly hours of caregiving			
Mean (SD)	72.11 (49.19)	70.04 (43.45)	71.10 (46.23)
Range	10–168	10–154	10–168
Years of caregiving			
Mean (SD)	4.51 (2.90)	4.82 (3.04)	4.66 (2.95)
Range	1–13	1–13	1–13
Care recipient age, y			
Mean (SD)	79.85 (9.12)	80.30 (8.24)	80.10 (8.64)
Range	49–93	58–96	49–96
Employed, %	39	27	33
Married, %	73	77	75
Relation to care recipient, %			
Spouse	55	51	53
Adult child	45	49	47
Dementia diagnosis			
Alzheimer's	65	63	64
Other dementia	35	37	36
Ethnicity, %			
White	90	82	86
Black	4	6	5
Hispanic	0	8	4
Asian/Pacific Islander	4	2	3
Cuban/white	2	2	2

[a] No differences between conditions.

gram for 9.43 months (SD = 3.70). Overall, the exercise group had more monthly contacts than the nutrition education group over the year ($t(2,100) = 2.04$, $p < .04$). The exercise group participated in 9.28 of a minimum of 12 monthly telephone contacts (SD = 2.67) and mailed 8.81 of a possible 12 exercise logs (SD = 4.39) across the year, whereas the nutrition group participated in 9.02 telephone calls (SD = 3.02) and mailed 7.35 nutrition tracking logs (SD = 4.75).

Exercise Adherence

Figure 1 displays the pattern of adherence for the exercise condition across the year of the intervention. On average, the exercise group adhered to 74% of their prescribed exercise sessions. This equates to approximately three exercise sessions per week. The average duration of the sessions was 35.77 minutes (SD = 22.97). As seen in Figure 2, the duration of moderate or more vigorous intensity exercise increased over the year. Thus, the exercisers averaged approximately 106 minutes of exercise per week. Average rate of perceived exertion during the exercise sessions was 12.96 (SD = 1.57), which equates to ratings of working "somewhat hard" (the moderate intensity range for the scale). As seen in Figure 1, adherence was quite high during the first month of the intervention, dipped slightly in months 2 and 3, remained stable around 80% in months 4 through 7, and then slightly declined in months 8 through 12. However, adherence rates remained above 70% across the entire year, which is significant given participants' initial sedentary status (ie, exercising <60 minutes/week).

The increase in physical activity in the exercise condition was reflected in the ambulatory heart rate and monitoring data. For the nine exercise participants randomly selected to wear the 3-day ambulatory heart rate and activity monitor, there was an 87.5% agreement rate between continuous bouts of physical activity within the moderate intensity target heart rate

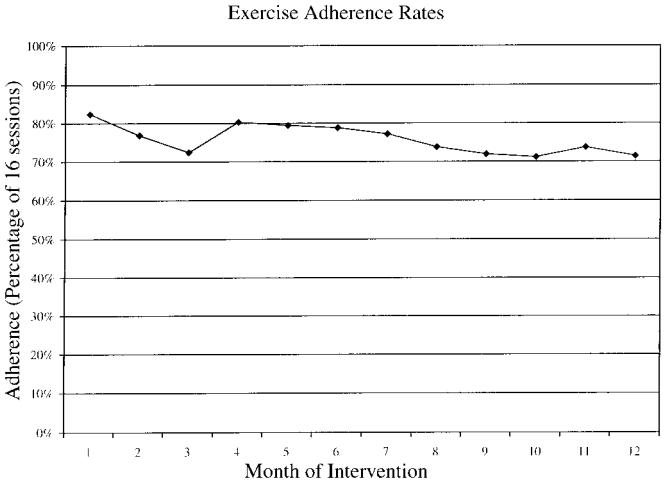

Fig. 1. Average exercise adherence rates across the year of the intervention for participants randomly assigned to the exercise condition.

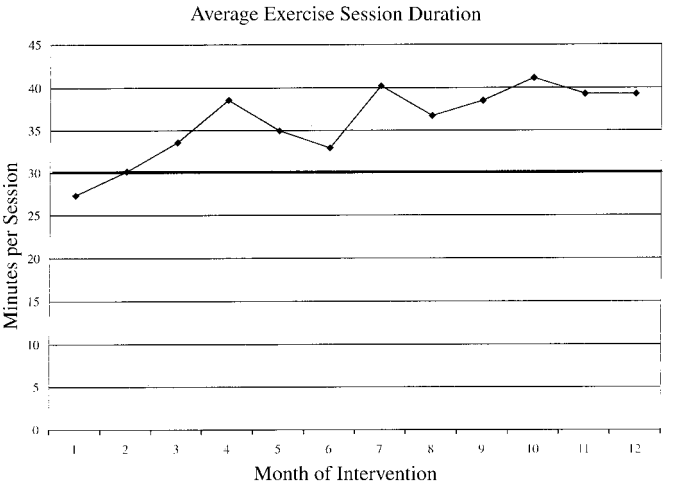

Fig. 2. Average duration of exercise sessions across the year of the intervention for participants randomly assigned to the exercise condition.

range as recorded by the monitor and the participants' logs. In addition, two of the participants reported physical activity bouts of sufficiently long duration but that failed to reach the targeted exercise heart rate range. Exercise session duration in the prescribed heart rate range as measured by the heart rate and activity monitor averaged 32.8 minutes (SD = 20.34 minutes).

Adherence to the prescribed exercise program was significantly correlated with retention, in that participants who had more contact with the program by telephone calls or mailed logs also had higher exercise adherence rates ($r = 0.40$, $p < .004$).

Effect of Initial Psychological Functioning on Retention and Exercise Adherence

Across all participants, baseline psychological variables accounted for 17% of the variance in total months of program involvement ($F(8,83) = 2.08$, $p < .04$), and 18% of the variance in total number of successfully completed telephone and mail contacts ($F(8,76) = 2.10$, $p < .04$). See Table 2 for the results of the regression equations. Baseline depression was the only significant predictor of program retention across the sample as a whole, with higher baseline depression scores associated with fewer successful program contacts over the 12-month intervention. This association between baseline depression and program retention was also consistent within the exercise condition alone ($F(7,45) = 4.32$, $p < .001$). Additionally, within the exercise condition alone, the overall model of baseline psychological variables accounted for 43% of the variance in exercise adherence across the 12-month intervention ($F(8,35) = 3.25$, $p < .007$), with lower baseline depression, greater baseline anxiety, and older age emerging as significant predictors of better exercise adherence rates.

Changes in Psychological Functioning Across the Intervention

Baseline and 12-month psychological functioning variables are summarized in Table 3. For participants in both the exercise and nutrition education conditions, depression decreased significantly from an average baseline BDI score of 12.22 to a 12-month postrandomization score of 8.44 ($F(1,74) = 26.56$, $p < .0001$). The decrease did not differ as a function of condition assignment ($F(1,74) = 3.03$, $p > .08$). Likewise, all participants demonstrated reductions from baseline to 12 months in perceived stress ($F(1,74) = 7.71$, $p < .007$) (baseline PSS = 28.70, 12 months = 25.84). There were no significant improvements in self-reported social support ($p > .30$), anxiety ($p > .09$), or objective burden ($p > .07$), but subjective burden significantly decreased for both groups from baseline to 12 months ($F(1,69) = 8.01$, $p < .006$) (baseline subjective burden score = 41.64, 12 months = 38.20). Assignment to the exercise condition did not result in differential improvements in any of the psychological variables (p values $> .06$).

Exercise Knowledge and Motivational Readiness for Physical Activity

Participants in the exercise group demonstrated improved knowledge of physical activity relative to the nutrition education group from baseline to 12 months

TABLE 2. Summary of Simultaneous Multiple Regression Analyses for Psychological Variables, Program Retention, and Exercise Adherence

Variable	Months of Program Contact (N = 92)			Total Phone and Mail Contacts (N = 85)			Exercise Adherence (exercise group only: N = 44)		
	β	SE	p	β	SE	p	β	SE	p
Age	0.06	0.04	.12	−0.01	0.08	.87	0.01[a]	0.005[a]	.03[a]
Group condition	−1.06	0.66	.11	−0.52	1.36	.70			
Depression	−0.15[a]	0.07[a]	.03[a]	−0.31[a]	0.14[a]	.03[a]	−0.03[a]	0.01[a]	.007[a]
Stress	−0.02	0.06	.75	−0.08	0.12	.51	−0.01	0.01	.22
Social support	0.01	0.04	.73	0.07	0.09	.43	0.01	0.01	.14
Objective burden	.024	0.13	.06	0.37	0.26	.16	0.001	0.02	.99
Subjective burden	−0.05	0.05	.34	0.07	0.11	.53	0.001	0.01	.97
Anxiety	0.13	0.10	.22	0.02	0.21	.94	0.04[a]	0.01[a]	.006[a]
Motivational readiness							−0.03	0.03	.39
R^2	0.17 ($p < .04$)			0.18 ($p < .04$)			0.43 ($p < .007$)		

[a] Significant predictor of program retention.

($F(1,43) = 7.34$, $p < .01$). On average, scores for the exercise group improved from 51% at baseline to 72% at 12 months, compared with 55% baseline and 58% 12-month scores for the nutrition education group.

There was also a significant difference in motivational readiness for physical activity between the exercise and nutrition education conditions over time. At baseline, both groups were in similar stages of readiness (on average, in the preparation stage). However, the exercise group was at a significantly more advanced stage of readiness for physical activity than the nutrition education group at a 6-month interim evaluation ($t(1,74) = 2.94$, $p < .004$) and the 12-month posttest evaluation ($t(1,76) = 2.39$, $p < .02$). On average, the nutrition education condition ended the program in the preparation stage, whereas the participants in the exercise condition were in the action stage of motivational readiness.

Among participants randomly assigned to the exercise condition, the total number of telephone and mail contacts was positively associated with increased exercise knowledge ($F(2,20) = 3.62$, $p < .04$), accounting for 28% of the variance in improved knowledge. Similarly, total program contacts were also positively associated with change in motivational readiness ($F(2,32) = 3.63$, $p < .04$), accounting for 19% of the variance in change. Post hoc follow-up analyses revealed that the telephone contacts were more strongly

TABLE 3. Psychological Functioning Variables at Baseline and 12 Months (N = 85)

Psychological Variable	Exercise Group (N = 45)		Nutrition Group (N = 40)		Total Sample (N = 85)	
	Baseline	12 Months	Baseline	12 Months	Baseline	12 Months
Depression (BDI)						
Mean (SD)	10.72 (6.54)	7.60 (4.89)	13.73 (6.26)	9.44 (7.15)	12.22 (6.54)	8.44 (6.06)[a]
Range	0–34	0–21	1–32	0–37	0–34	0–38
Stress (PSS)						
Mean (SD)	28.06 (8.33)	25.23 (8.39)	29.34 (6.80)	26.56 (8.48)	28.70 (7.59)	25.84 (7.32)[a]
Range	11–45	9–45	11–45	6–43	11–45	6–45
Subjective burden						
Mean (SD)	39.61 (9.39)	36.10 (7.86)	43.68 (9.83)	40.97 (12.79)	41.64 (9.78)	38.20 (10.49)[a]
Range	25–67	24–61	26–65	24–86	25–67	24–86
Objective burden						
Mean (SD)	11.49 (3.70)	11.07 (3.78)	12.64 (4.02)	11.84 (4.81)	12.06 (3.89)	11.41 (4.25)
Range	6–18	5–23	2–19	2–24	2–19	2–24
Social support (ISEL)						
Mean (SD)	28.79 (8.80)	29.35 (8.05)	26.57 (7.66)	28.19 (7.03)	27.68 (8.28)	28.82 (7.58)
Range	6–38	7–38	6–37	14–38	6–38	7–38
Anxiety (TMAS)						
Mean (SD)	6.38 (4.31)	6.33 (4.33)	8.94 (4.51)	7.19 (4.92)	7.68 (4.57)	6.73 (4.60)
Range	0–15	0–15	2–20	0–17	0–20	0–17

[a] $p < .007$ (significant improvement from baseline to 12 months in the total sample).

associated with changes in exercise knowledge and motivational readiness (p values $< .03$), whereas the number of mail contacts did not have as strong a relationship (p values $> .08$). As expected, exercise adherence rates were positively associated with the increase in motivational readiness within the exercise group ($F(2,32) = 4.65$, $p < .04$).

DISCUSSION

The results of this randomized, controlled trial confirm that long-term health promotion programs are feasible for a highly stressed and burdened population such as dementia family caregivers. Despite the heavy amount of reported caregiving per week (approximately 70 hours), the majority of women caregivers in our sample were actively involved in their home-based health promotion program for a minimum of 9 of 12 months, with relatively few dropouts compared with other community-based physical activity intervention trials (32, 44). Furthermore, the substantial exercise adherence rates obtained by the caregivers in the exercise condition demonstrate that exercise counseling programs such as the one described can successfully encourage a stressed and burdened population to engage in physical activity at levels sufficient to produce health benefits. The adherence results support the notion that caregivers are capable of adopting more active lifestyles for an extended length of time (ie, 1 year). This extends findings from a previous study that investigated shorter-term, 4-month outcomes (21).

Caregivers who were more depressed at the beginning of the trial had fewer contacts with their health counselors by telephone and mail relative to women who were less depressed. Additionally, women randomly assigned to the exercise condition who were more depressed at baseline also demonstrated poorer adherence to their exercise prescription. Therefore, depression among family dementia caregivers seems to be a consistent and strong barrier to participation in such health promotion programs. Previous literature suggests that depression among caregivers is causally related to poorer physical health (49). Some researchers have investigated perceived control or sense of mastery as moderating source of influence on health behaviors (23). However, exploratory analysis of sense of mastery and self-efficacy in this sample showed they were unrelated to program retention, exercise adherence, or psychological outcomes.

The finding that older women and women who were initially more anxious demonstrated better exercise adherence is intriguing. The differential performance of older women cannot be explained by differences in exercise prescriptions: Whereas prescribed exercise intensity was based on treadmill performance, the absolute number of prescribed sessions was held constant for all participants. It is more likely that the age effects masked the influence of employment status, because younger women were more likely to be employed outside the home. It is conceivable that younger women may have had more difficulty adhering to their exercise prescription while managing multiple roles at home and at work. The finding that initially more anxious women demonstrated better adherence suggests that initial distress may have served as an impetus or motivation for joining a caregiver-focused program, as has been reported in other caregiver studies (50). Additionally, participants with anxiety may have experienced the anxiolytic effects of exercise, which could motivate them toward maintaining their exercise adherence.

Contrary to our hypothesis, participation in the exercise condition did not lead to differentially greater psychological improvements relative to the nutrition education condition. Participation in both types of health promotion programs was related to decreased levels of depression, stress, and perceived burden from baseline to posttest. It is possible that involvement in some type of health promotion program that incorporates consistent contact with health professionals may have provided sufficient stress reduction and mental health benefits for the women in the trial. The project health educators were committed to providing frequent, regular, and reliable contact with all participants; therefore, the additional social support and reduced isolation were possibly sufficient to produce the improvements noted in depression and stress across interventions. Likewise, given that baseline depression was in the mild range, it is possible that a restricted range of depressive symptoms and the moderate intensity of reported physical activity may not have provided a sufficient physiological stimulus to see differential improvements with exercise. However, the majority of the literature in this field supports the notion that it is the frequency of the exercise program, as opposed to the intensity or fitness-related effects, that is most strongly associated with psychological improvements (16).

Frequent contact with health educators (especially by telephone) was associated with better exercise adherence. These results are encouraging, given the trend away from class-based exercise instruction, and the general public's preference (including middle- and older-aged women) for exercising on one's own with minimal instruction (32, 51). A home-based model of exercise program delivery is optimal for a population such as caregivers, given that they may typically have less flexibility to attend programs outside the home because of family obligations.

Limitations

Our sample was mostly white and of more advantaged socioeconomic status; although this closely reflects the composition of the San Francisco Bay mid-peninsula region, caution should be taken in generalizing these results to a larger caregiver population. Additionally, recruitment methods (community-wide advertisements in which interested parties contacted the program) may have captured more motivated caregivers in the community or caregivers with sufficient resources to allow them to participate in a program focused on themselves rather than the relative. As has been argued by others (45), we must continue to reach caregivers who are potentially more isolated or less advantaged to see if the results of caregiver health studies can be successfully replicated in a more heterogeneous population.

Rather than institute a wait-list condition for the 1-year trial, the attention-control condition evolved into a unique nutrition education program for the caregivers. This alternative intervention may have increased interest and motivation to stay enrolled in the project, and the interaction with staff in the nutrition program could have been sufficient to influence targeted outcomes, especially psychological improvements. Clearly, an attention-control condition needs to be carefully designed so it does not influence expected outcomes, but to date few alternative "placebo" conditions have been developed specifically for caregiver intervention studies, and wait-list conditions have been demonstrated to be extremely difficult to maintain among caregivers, even for relatively short time periods (52). Although an attention-control condition, as opposed to a wait-list condition, was a more ethical and pragmatic choice for this trial, it also limits our ability to determine the extent to which the psychological changes were a product of health behavior changes vs. the beneficial effect of attention or support from program staff.

Bivariate correlations revealed that baseline depression was associated with other psychological measures. Therefore, the model was also tested with the depression variable removed from the equation. After doing so, the overall model was no longer statistically significant, and other psychological variables did not emerge as correlates of program retention or exercise adherence. Therefore, we can confidently assert that depression was consistently driving the relationship between initial psychological status, program retention, and adherence.

Future Directions

On the basis of these results, depression seems to be a strong barrier for caregivers. Therefore, future health promotion programs for caregivers should incorporate components to more directly address depression. Furthermore, researchers and public health professionals should be encouraged to consider a telephone-supervised, home-based program as a useful model, because it was successful for sustaining contact and encouraging healthy behavior change in the current sample. Classes or other structured programs may not be necessary to help caregivers adopt healthier lifestyles, and the flexibility and convenience of a home-based program is compatible with caregivers' complicated lifestyles. The telephone-mediated, home-based model may similarly benefit other aging populations that are hard to reach, such as other types of caregivers (eg, grandparents raising grandchildren) or persons in communities where traditional venues for exercise are less accessible or available (eg, rural communities).

As the American population ages and the proportion of older adults in the United States continues to increase rapidly, it is expected that the prevalence of dementia will also increase. Thus, we can predict that the demand for family caregiving will grow accordingly. Although treatments for Alzheimer's disease and other forms of dementia are making gradual progress, a substantial number of Americans should prepare to assume a caregiving role at some point in their lifetime. An important task for health research is to find effective ways to prepare caregivers both psychologically and physically for the demands of this role. Given the known independent risk factors of caregiving, physical inactivity, and other health behaviors on mortality, it is imperative that more studies test effective methods to preserve or improve caregivers' mental and physical well-being as they assume this long-term familial and societal role.

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