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Mechanisms of patient health behavior change in a randomized controlled trial of a spouse-assisted intervention

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Spouse-assisted interventions can improve health behaviors, but mechanisms of action are unknown. This study evaluated mediators of dietary and physical activity outcomes during a spouse-assisted intervention to improve low-density lipoprotein cholesterol. This is a secondary analysis of data from a randomized controlled trial comparing usual care ($n = 128$) to a spouse-assisted lifestyle change intervention ($n = 127$) comprising nine monthly goal setting telephone calls to participants and support planning calls to spouses over 11 months. Structural equation modeling was used to examine if the intervention influenced the putative mediators of participant self-efficacy and perceived spousal support at 6 months (i.e. action test); if changes in putative mediators at 6 months were associated with changes in diet and physical activity outcomes at 11 months (i.e. conceptual test); and if treatment condition effects on outcomes at 11 months were mediated by its effects on the 6-month putative mediators (i.e. indirect effects test). Participants were 94.9% male, 64.9% white and were 61.3 years old on average. The action test showed that the intervention increased dietary self-efficacy ($p < .001$) and perceived spousal support for diet ($p < .001$) and physical activity ($p < .01$) at 6 months. The conceptual test showed that increases in participant physical activity self-efficacy at 6 months were associated with increases in physical activity frequency ($p = .01$) and duration ($p = .04$) at 11 months; other putative mediators were not associated with changes in outcomes at 11 months. The indirect effects tests did not support a mediating role for self-efficacy or perceived spousal support. Intervention-induced changes in spousal support and dietary self-efficacy did not translate into behavior change. Other mechanisms may be driving behavior change.

Keywords: physical activity; diet; cholesterol; mediators; social support

Introduction

Spouses have highly concordant health behaviors (Di Castelnuovo, Quacquaruccio, Donati, de Gaetano, & Iacoviello, 2009; Macken, Yates, & Blancher, 2000), and spousal support has been linked to engagement in healthy behaviors (Franks et al., 2006; Martire et al., 2012). Accordingly, increasing spousal support for healthy behaviors may positively influence health behaviors. Partner- or spouse-assisted lifestyle interventions

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aim to do this by involving a spouse in supporting the patients' behavior change. Partner- and spouse-assisted interventions have contributed to improvements in a variety of patient health behaviors (Martire, Schulz, Helgeson, Small, & Saghafi, 2010), including diet and physical activity (Black, Gleser, & Kooyers, 1990; Burke, Beilin, Cutt, Mansour, & Mori, 2008; Voils et al., 2013). However, the mechanisms by which spouse-assisted interventions improve participant diet and physical activity have not been explored.

Social support is a key mechanism that is believed to contribute to the effectiveness of spouse-assisted interventions. Social support from spouses for diet and physical activity can include a variety of behaviors, for example, providing encouraging words or cooking healthy meals for a spouse (Gallant, 2003). In addition to social support, a spouse-assisted intervention to change health behaviors may be most effective if patients' self-efficacy for the health behaviors is targeted. Social cognitive theory and other health behavior theories posit a prominent causal role for self-efficacy in health behaviors, supported by research findings (Abusabha & Achterberg, 1997; Strecher, DeVellis, Becker, & Rosenstock, 1986).

Couples Partnering for Lipid Enhancing Strategies (CouPLES) was a randomized controlled trial that tested a spouse-assisted health behavior intervention (Voils et al., 2013). CouPLES aimed to reduce low-density lipoprotein cholesterol (LDL-C; primary aim) and to induce health behavior change, including improvements in diet and physical activity (secondary aims) among patients with elevated LDL-C. The intervention was informed by social cognitive theory, which posits a key role for self-efficacy and social support (Bandura, 1997). Thus, the intervention targeted the intermediate constructs of self-efficacy and spousal support for a healthy diet and physical activity. Results showed that LDL-C did not differ between the intervention and usual care groups at the final assessment. However, the intervention resulted in significantly lower intake of calories, total fat, saturated fat, and percent total fat compared to usual care. Further, frequency of physical activity was 20% higher in the intervention group than the control group, a clinically meaningful but statistically insignificant change. Physical activity duration, cholesterol intake, and fiber intake did not change.

In order to evaluate hypotheses about the mechanisms of CouPLES's effects, in the present study, we conducted statistical mediation analyses, which can test whether an intervention changed a targeted intermediate variable (an 'action test'); if change in a targeted intermediate variable was associated with a change in an outcome variable (a 'conceptual test'), and if an intervention's effects on an outcome variable were attributable to its effects on the intermediate variable (an 'indirect effects' or mediation test; Cerin & MacKinnon, 2009). In the current study, the action test tests the hypothesis that the intervention increased four key intermediate variables: diet self-efficacy, physical activity self-efficacy, spousal support for diet, and spousal support for physical activity. The conceptual tests test the hypothesis that change in these intermediate variables is associated with changes in diet and physical activity outcomes. The indirect effects' tests test whether the effects of the intervention on diet and physical activity were mediated through intermediate variables. We included in our analyses both outcomes that were significantly improved and those that did not significantly change during the intervention because mediation can be present even in the absence of a significant relationship between the intervention and outcome (MacKinnon, 2008).

Methods

Recruitment and inclusion criteria

The study was approved by the local Institutional Review Board. Electronic medical record queries were conducted to identify Durham VA patients who were married, had LDL-C ≥ 100 mg/dL, and had at least one primary care visit in the previous year. Patients identified via medical record query were mailed a recruitment letter and contacted by telephone for screening followed by an in-person screening. Patients were ineligible if they or their spouse had inconsistent telephone access, impaired cognition or hearing, health problems that interfered with participation, resided in a nursing home, or received long term care. Further details on study methods are available in Voils et al. (2009, 2011, 2013).

Procedures

Consented participants completed baseline measurements and then were randomized at a 1:1 ratio with stratified, block randomization (block size: 2). Randomization was stratified by patient race (White vs. non-White) and CHD risk (high risk vs. moderate/low risk). Participants were informed of randomization assignment by the study interventionist nurse after obtaining baseline labs. The study nurse informed patients of their randomization assignment and delivered the intervention, allowing the other study staff who conducted assessments to remain unaware of treatment assignment. Participants were asked not to divulge randomization assignment to study staff conducting assessments. Assessments of outcome and mediators were conducted in person at 6 months and 11 months post-baseline. Participants and spouses were paid $10–20 for outcome assessments.

Usual care

Participants' lipid disorders were managed by their providers. No contact was made with study staff except for outcome assessments.

CouPLES intervention

The intervention comprised monthly telephone calls to participants and spouses. Calls were delivered by a trained research nurse using custom software developed to guide intervention content according to intervention protocol. The first call educated participants and spouses about hypercholesterolemia and self-management principles. For spouses, this call also included orientation toward strategies for supporting participant's goal attainment. On subsequent monthly calls (months 2–5, 7–10), participants selected the focus of the call from one of four content areas: diet, physical activity, participant–physician communication, or medication adherence. Telephone calls to participants consisted of goal setting and problem-solving focused on the selected content area. Participants made measurable behavioral goals and developed action plans, with an emphasis on guiding participants to set achievable, gradual goals to increase self-efficacy. During spousal phone calls, which occurred within one week of the participant calls, participants' progress with previous goals and the next months' goals and action plans were discussed. Spouses were coached to develop a specific behavior plan to support the participant (e.g. change cooking habits, provide verbal reinforcement).

Two or more intervention calls were completed by 92% of randomized intervention participants and 8 or more calls by 69% of participants (Voils et al., 2013). Average call duration was 13.6 (SD = 6.3) minutes for patients and 8.8 (SD = 4.6) minutes for spouses. Participants selected diet in 51% of calls, physical activity in 49% of calls, patient–provider communication in <1% of calls, and never selected medication management. Spouses were asked if they would make the same behavior changes as participants, and did so for 97% dietary goals and 65% of physical activity goals. Spouse health behavior outcomes are described in King, Jeffreys, McVay, Coffman, and Voils (2014).

Measures

Dietary intake

The Brief Block, 2000 Food Frequency Questionnaire (FFQ; Berkeley Nutrition Services) measured dietary intake (Block, 2000). The FFQ was developed from the National Health and Nutrition Examination Survey (NHANES) III food intake data. Participants indicate foods they have eaten over the past 6 months, including portion size and frequency of intake. Dietary variables examined were those targeted for reduction (calories, percent fat, percent saturated fat, and cholesterol) or increase (fiber) during the intervention in accordance with guidelines from the Adult Treatment Panel III (National Heart Lung and Blood Institute, 2004).

Physical activity

The Community for Healthy Activities Model Program for Seniors (CHAMPS) measure assessed physical activity (Stewart et al., 2001). CHAMPS produces frequency of activity (times per week) and duration of activity (minutes per week) scores. CHAMPS has demonstrated validity, reliability, and sensitivity to change (Stewart et al., 2001). Moderate intensity physical activity was the focus of the current study because of the importance of this level of activity to health (US Department of Health Human Services, 2008).

Dietary self-efficacy

Self-efficacy for dietary intake was measured using the 15-item eating self-efficacy scale which has demonstrated validity (McCann et al., 1995). Participants reported their confidence that they could adhere to a cholesterol lowering diet under a variety of circumstances (e.g. at a party with food) on a scale from 1 (‘not at all confident’) to 10 (‘extremely confident’). The measure’s two subscales (Negative Affect and Socially Acceptable Circumstances) were combined due to high correlations between items across subscales. The internal consistency reliability of the measure in the current study was strong (Baseline: $\alpha = .97$, 6-month: $\alpha = .97$).

Physical activity self-efficacy

Physical activity self-efficacy was measured with the validated self-efficacy for exercise scale (Resnick & Jenkins, 2000). This is a 9-item measure of participants’ confidence that they could exercise three times per week for 20 min under various circumstances (e.g. ‘if the weather were bad’), rated on a scale from 1 (‘not at all confident’) to 10 (‘extremely confident’). Internal consistency reliability was strong in the current sample (Baseline: $\alpha = .96$, 6-month: $\alpha = .96$).

Spousal support for healthy diet

Spousal support for healthy eating was measured with the validated Social Support and Eating Habits Survey (Sallis, Grossman, Pinski, Patterson, & Nader, 1987). Participants rated how often spouses engaged in encouraging and discouraging behaviors over the previous three months on a scale from 1 ('never') to 5 ('very often'). In the current study, we used only the encouragement subscale of this measure (internal consistency reliability, baseline: $\alpha = .84$; 6-month: $\alpha = .83$) due to poor psychometric properties of the discouragement scale.

Spousal support for physical activity

Spousal support for physical activity was measured with the Family Support for Exercise Scale (Sallis et al., 1987). Participants rated how often their spouses engage in certain supportive behaviors over the previous three months on a scale from 1 ('never') to 5 ('very often'). Only the *participation and encouragement* subscale was used because the *reward and punishment* subscale had poor test–retest reliability in the validation study (Sallis et al., 1987) and unacceptable inter-item correlations in the current sample. The subscale used has evidence of validity and had good internal consistency reliability in the current study (baseline: $\alpha = .93$; 6-month: $\alpha = .93$).

Analyses

Analyses were conducted with structural equation modeling using Mplus (version 6.11) (Muthen & Muthen, 2011). Separate models were fit for each of the five dietary intake outcomes and the two physical activity outcomes. Participants were analyzed in the group to which they were randomized. Dietary self-efficacy and spousal support were tested as mediators for dietary outcomes, whereas physical activity self-efficacy and spousal support were tested as mediators for physical activity outcomes. Self-efficacy and spousal support were tested simultaneously in each model in order to determine the unique influence of each putative mediator. All variables were evaluated for normality prior to analyses.

Dietary outcomes

Model specifications are shown in Figure 1. Putative mediators measured at 6 months were regressed on intervention condition (usual care = 0; intervention = 1). Simultaneously, the 11-month outcome variable was regressed on 6-month putative mediators and intervention condition. Six-month mediators and the 11-month outcome variable were all regressed on their baseline values and on the stratification variables (CHD risk group and race). Variables measured at the same time point were free to correlate with one another. Calories, cholesterol, and fiber were log-transformed prior to analyses to address their skewed distribution (Voils et al., 2013). Full information maximum likelihood was used to estimate the models. The χ^2 test indicated absolute model fit. Because χ^2 is sensitive to sample size and model complexity, incremental model fit was assessed with root mean square error of approximation (RMSEA; Steiger & Lind, 1980), comparative fit index (CFI; Bentler, 1990), and Tucker–Lewis Index (TLI; Tucker & Lewis, 1973). Conventional cut-offs for acceptable fit are RMSEA < .06, CFI > .95 and TLI > .95 (Hu & Bentler, 1999). The statistical significance of the indirect pathways was determined using bootstrapping with 95% confidence limits (MacKinnon, 2008). Coefficients were standardized for ease of comparison.

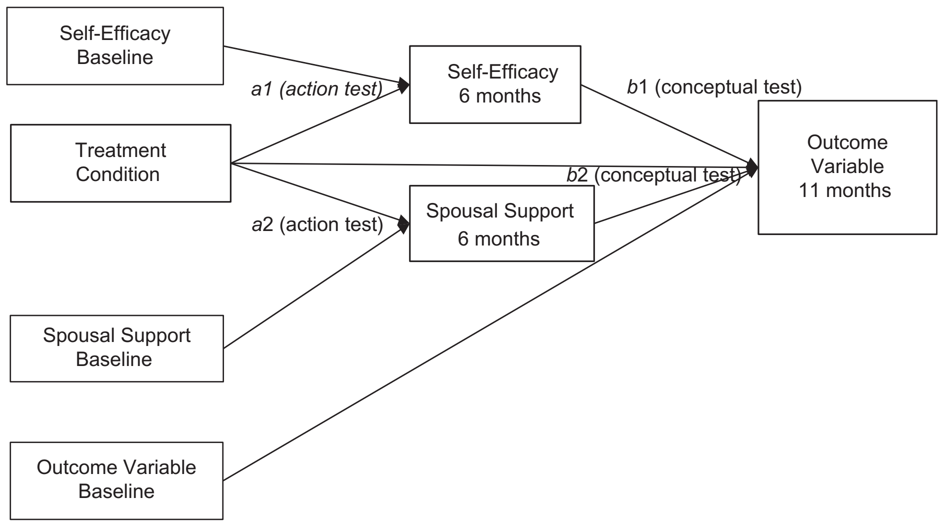

Figure 1. Mediation model for effects of intervention on dietary intake and physical activity. Stratification variables (CHD risk level, race) were included in the model but are omitted from the figure for ease of presentation.

Physical activity outcomes

Physical activity frequency and duration are count variables that followed a Poisson-type process and thus required a different modeling approach (Voils et al., 2013). The models were estimated in Mplus with maximum likelihood with numerical integration using Monte Carlo method, specifying a negative binomial model (Muthen & Muthen, 2011). Model specification was otherwise the same as for dietary outcomes (Figure 1). Model fit statistics are not available for models with endogenous count variables (Muthen & Muthen, 2011); therefore, we compared this model to a model without parameter estimates for the mediation pathways. Because these models were nested, fit was evaluated using the difference in −2 log likelihood, which followed a χ^2 distribution. Standardized coefficients cannot be produced for physical activity variables because count variables do not have residual variance parameters.

Results

Descriptive data

The initial sample included 255 participants (127 intervention and 128 usual care; see Figure 2). The sample was 94.9% male, 64.9% White, and the average age was 61.3 (SD = 12.3) years. Table 1 provides descriptive statistics on all putative mediators and outcome variables. Tables 2 and 3 provide correlation coefficients for all dietary and physical activity variables, respectively.

Mediation models for dietary outcomes

The dietary models had marginally acceptable fit (Table 4). Results from the action tests (*a* pathways) showed that the intervention led to improvements in dietary self-efficacy and participant perception of spousal support for healthy eating at 6 months. The

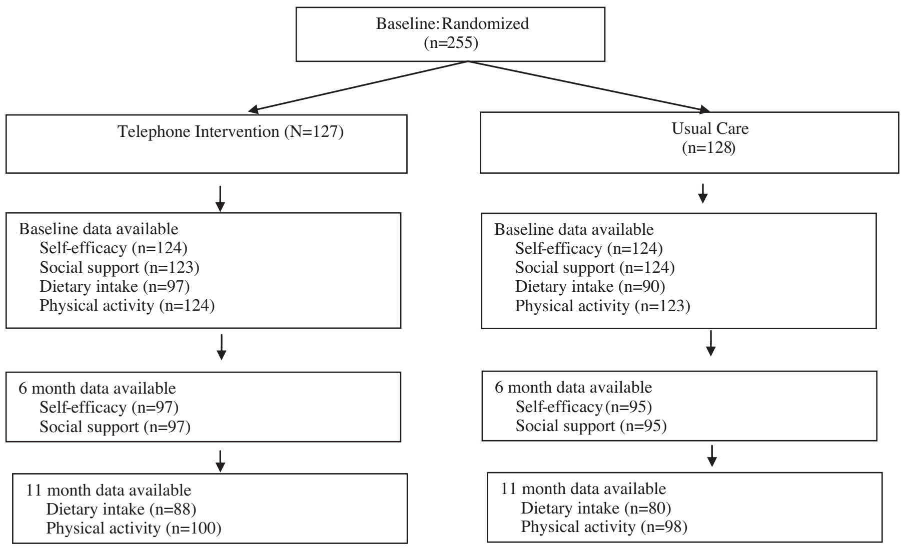

Figure 2. Participant flow diagram.

conceptual tests (*b* pathways) showed that increases in dietary self-efficacy and spousal support from baseline to 6 months were not associated with changes in dietary outcomes at 11 months. The indirect effects test (*a***b*) did not support a mediating effect of dietary self-efficacy or social support.

Mediation models for physical activity outcomes

The inclusion of the mediation pathways for both moderate intensity physical activity frequency (−2 log likelihood difference test: χ^2 (4) = 19.302, $p < .001$) and duration (χ^2 (4) = 12.884, $p = .01$) improved model fit over the model without mediation pathways. The action tests (*a* pathways) revealed that the intervention led to increases in spousal support but not self-efficacy for physical activity at 6 months (Table 5). The conceptual tests (*b* pathways) showed that increases in 6-month physical activity self-efficacy were associated with increases in 11-month physical activity duration and frequency outcomes. The conceptual test did not support an influence of changes in spousal support for physical activity at 6 months on changes in physical activity outcomes. The indirect effects test (*a***b*) indicated an absence of mediation effects for both spousal support and self-efficacy.

Discussion

Identifying the mechanisms by which successful spouse-assisted health behavior interventions exert their effects or reasons they fail to influence outcomes should lead to intervention refinement and design of more effective interventions. To our knowledge, this is the first study to examine mediators of a spouse-assisted intervention to improve physical activity or diet.

Table 1. Descriptive data on putative psychosocial mediators and outcomes.

	Intervention	Usual care
Mediators		
Dietary self-efficacy, M(SD)		
Baseline	6.4 (1.9)	6.7 (2.0)
6 months	7.1 (1.8)	6.5 (1.9)
Dietary spousal support		
Baseline	2.9 (1.0)	3.1 (1.0)
6 months	3.6 (.8)	3.3 (1.0)
Physical activity self-efficacy		
Baseline	6.4 (2.2)	6.8 (2.3)
6 months	6.7 (2.1)	6.4 (2.2)
Physical activity spousal support		
Baseline	2.5 (1.0)	2.6 (1.0)
6 months	2.8 (.9)	2.6 (1.0)
Outcomes		
Energy (Kcals/day), M(SD)		
Baseline	1596 (827)	1475 (735)
11 months	1175 (579)	1253 (575)
Total fat (%), M(SD)		
Baseline	38.2 (7.8)	38.4 (7.5)
11 months	35.4 (7.3)	38.2 (9.1)
Saturated fat (%), M(SD)		
Baseline	12.3 (2.9)	12.6 (2.7)
11 months	12.6 (2.7)	12.3 (2.9)
Cholesterol (mg/day), M(SD)		
Baseline	210.5 (145.5)	211.0 (140.6)
11 months	152.1 (97.4)	175.5 (117.1)
Fiber (g/day) (M, SD)		
Baseline	14.8 (6.8)	13.9 (6.7)
11 months	13.2 (6.3)	11.9 (5.7)
Physical activity frequency, Times/week, Median (IQ1, IQ3)		
Baseline	7 (3.5, 12)	9 (5,15)
11 months	10 (6,14)	10 (4,16)
Physical activity frequency, min/week, Median (IQ1, IQ3)		
Baseline	322.5 (135, 667.5)	435 (225, 840)
11 months	435 (217.5, 667.5)	465 (210, 735)

Notes: M: means, SD: standard deviation, and IQ1: 1st interquartile value, IQ3: 3rd interquartile value. Participants were outpatients from the Durham Veterans Affairs Medical Center during 2007–2010. Data are unadjusted raw data with no imputations. From an initial randomized sample of 127 for the intervention condition and 128 for usual care condition, sample size for baseline and 6 months, respectively, were as follows: Self-efficacy, intervention: 124 and 97; self-efficacy, usual care: 124 and 95; spousal support, intervention: 123 and 97; spousal support, usual care: 124 and 95; Sample size for baseline and 11 months, respectively, were as follows: dietary intake variables, intervention: 97 and 88; dietary intake variables, usual care: 90 and 80; physical activity variables, intervention: 124 and 100, physical activity variables, usual care: 123 and 98.

The *action tests* presented herein showed that the intervention increased dietary self-efficacy, spousal support for physical activity, and spousal support for a healthy diet. These results support the effectiveness of a low-intensity, remotely delivered intervention for influencing key constructs for improving health behavior. However, the intervention did not significantly increase physical activity self-efficacy. Although previous studies of low-intensity interventions have reported increases in physical activity self-efficacy (Dutton et al., 2009; Lewis, Williams, Martinson, Dunsiger, & Marcus, 2012), the population in the present study differs in that it was a Veteran population and thus

Table 2. Correlations for measured dietary variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Dietary self-efficacy, baseline													
2. Dietary self-efficacy, 6 months	.60***												
3. Dietary spousal support, baseline	.22	.25											
4. Dietary spousal support, 6 months	.04	.29	.59***										
5. Energy intake, baseline	−.18*	−.27***	−.11	−.14									
6. Energy intake, 11 months	−.10	−.25**	−.09	−.19*	.65***								
7. Total fat (%), baseline	−.16*	−.21*	−.17*	−.12	.18*	.00							
8. Total fat (%), 11 months	−.12	−.26**	−.04	−.17*	.17*	.10	.62***						
9. Saturated fat (%), baseline	−.21**	−.24**	−.13	−.11	.20**	.09	.86***	.52***					
10. Saturated fat (%), 11 months	−.11	−.26*	−.05	−.14	.16	.11	.52***	.85***	.58***				
11. Cholesterol (mg/day), baseline	−.22**	−.22**	−.12	−.09	.79***	.42 ***	.46***	.36***	.52***	.43***			
12. Cholesterol (mg/day), 11 months	−.15	−.15	−.06	−.13	.54***	.68***	.29***	.41***	.37***	.51***	.63***		
13. Fiber (g/day), baseline	.02	.02	.01	−.10	.71***	.47***	−.12	−.07	−.18*	−.18*	.40***	.23**	
14. Fiber (g/day), 11 months	.02	.02	−.04	−.10	.43***	.74***	−.20*	−.23**	−.21*	−.30***	.12	.33***	.59***

*$p < .05$; **$p < .01$; ***$p < .001$.
Note: Calories, cholesterol, and fiber were log-transformed prior to analyses to address their skewed distribution.

Table 3. Correlations for measured physical activity variables.

	1	2	3	4	5	6	7
1. Physical activity self-efficacy, baseline							
2. Physical activity self-efficacy, 6 months	.61***						
3. Physical activity spousal support, baseline	.26***	.32***					
4. Physical activity spousal support, 6 months	.21***	.38***	.64***				
5. Physical activity frequency, baseline	.34***	.31***	.22***	.12			
6. Physical activity frequency, 11 months	.29***	.37***	.16*	.27***	.58***		
7. Physical activity duration, baseline	.33***	.31***	.20**	.17*	.80***	.46***	
8. Physical activity duration, 11 months	.30***	.29***	.15*	.16*	.49***	.70***	.57***

*$p < .05$; **$p < .01$; ***$p < .001$.
Note: Spearman correlations were conducted when one or more of the variables were physical activity frequency or physical activity duration.

predominantly male, older, and likely to suffer from greater levels of pain, disability, and osteoarthritis (Dominick, Golightly, & Jackson, 2006).

The *conceptual test* showed that change in physical activity self-efficacy from baseline to six months was positively associated with later physical activity frequency and duration. In contrast, for the other putative mediators examined, we did not find that six-month changes were associated with later health behavior changes. The *indirect effects tests* did not support the hypothesis that self-efficacy or spousal support mediated intervention effects. In past studies of interventions targeting social support, mixed findings for its role as a mediator of diet and physical activity have been reported (Papandonatos et al., 2012; Rhodes & Pfaeffli, 2010; Van Dyck et al., 2011). The current intervention differed from these previous studies in that it included direct coaching of the social support system and focused specifically on support from spouses.

These results provide information on why the intervention did not have a greater impact on participants' physical activity intensity and duration. In particular, the action tests show that the intervention was unable to produce an increase in physical activity self-efficacy, which was hypothesized to be a key intermediate variable. Populations similar to our sample may require a higher dose of intervention or different strategies to increase exercise self-efficacy. For example, patients may benefit from scheduled group exercise training sessions tailored to their disability/chronic pain issues. Such sessions would provide behavior modeling and vicarious experience, both strategies that enhance self-efficacy (Bandura, 1997). The conceptual test revealed that the increase in spousal support for physical activity during the intervention did not influence physical activity. Different types of spousal support may be more effective at affecting physical activity levels. For example, an emphasis on decreasing discouraging behaviors, rather than increasing encouraging behaviors, could be effective. Although we encouraged spouses to increase supportive behaviors and decrease unsupportive behaviors, the social support for physical activity measure may not have been sensitive enough to detect changes in these constructs, or social support alone may be insufficient to meaningfully increase

Table 4. Estimates from the mediator models for dietary outcomes.

	Path coefficient[a] (treatment to mediator)			Coefficient[b] (mediator to outcome)			Coefficient (indirect effect)			Model fit indices			
	Beta[a]	SE	p-value	Beta	SE	p-value	Coefficent	95% CI		$\chi^{2,b}$	RMSEA	CFI	TLI
Energy (Kcals/day)										31.4**	.066	.941	.917
Spousal support-diet	.236	.054	<.001	−.102	.066	.12	−.024	−.057	.003				
Self-efficacy-diet	.190	.054	<.001	−.057	.062	.36	−.011	−.035	.013				
Total Fat (%)										26.1*	.054	.956	.939
Spousal support-diet	.237	.054	<.001	.033	.074	.65	.008	−.027	.012				
Self-efficacy-diet	.191	.054	<.001	−.080	.069	.25	−.015	−.027	.043				
Saturated Fat (%)										28.2*	.059	.946	.924
Spousal support-diet	.237	.054	<.001	.050	.076	.51	.012	−.024	.048				
Self-efficacy-diet	.191	.054	<.001	−.082	.073	.26	−.016	−.044	.013				
Cholesterol (mg/day)										33.0**	.069	.934	.907
Spousal support-diet	.237	.054	<.001	−.044	.070	.53	−.011	−.043	.022				
Self-efficacy-diet	.189	.054	<.001	−.121	.066	.07	−.050	−.046	.005				
Fiber (g/day)										31.0**	.065	.937	.912
Spousal support-diet	.236	.054	<.001	−.071	.073	.33	−.017	−.051	.023				
Self-efficacy-diet	.190	.054	<.001	−.011	.067	.88	−.002	−.027	.018				

[a]All coefficient values are standardized.
[b]Degrees of freedom for all chi-squared analyses is 15.
*$p < .05$; **$p < .01$; ***$p < .001$.

Table 5. Estimates from the mediator models for physical activity outcomes.

	Path coefficient (treatment to mediator)			Coefficient (mediator to outcome)			Coefficient (indirect effect)	
	Beta	SE	*p*-value	Beta	SE	*p*-value	Coeff.	95% CI
Physical activity frequency (times/week)								
Spousal support-physical activity	.313	.107	<.01	.070	.052	.18	.022	−.014, .057
Self-efficacy-physical activity	.386	.245	.12	.065	.026	.01	.025	−.012, .062
Physical activity duration (min/week)								
Spousal support-physical activity	.314	.107	<.01	−.005	.077	.95	−.002	−.049, .046
Self-efficacy-physical activity	.386	.245	.12	.072	.036	.04	.028	−.016, .072

Note: SE: Standard error. Model fit statistics are not able to be produced for models with endogenous count variable.

physical activity. The absence of mediation by the proposed intermediate constructs also suggests the need to identify other factors that may be accounting for the intervention's effects (e.g. patient motivation).

Study limitations include use of self-report measures and marginally acceptable model fit. Generalizability of results may be limited, as the inferential population is predominantly male, middle-aged veterans. Our study also had several strengths. There is growing interest in designing interventions that include participants' social network; however, few of these interventions have been subject to analyses to determine intervention mechanisms. The study intervention was theoretically based, and the analyses conducted were designed to rigorously examine the theory in the context of an intervention with high potential for dissemination.

In conclusion, the results of the current study demonstrated that the CouPLES intervention increased several of the putative mediators targeted; however, increases in spousal support and dietary self-efficacy did not mediate intervention outcomes. Other potential mediators of spouse-assisted interventions should be identified in order to inform intervention refinement.

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References

Abusabha, R., & Achterberg, C. (1997). Review of self-efficacy and locus of control for nutrition- and health-related behavior. *Journal of the American Dietetic Association, 97*, 1122–1132.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*, 238–246.

Black, D. R., Gleser, L. J., & Kooyers, K. J. (1990). A meta-analytic evaluation of couples weight-loss programs. *Health Psychology, 9*, 330–347.

Block, G. (2000). *Nutrition Quest Block Brief 2000 Food Frequency Questionnaire*. Retrieved from http://www.nutritionquest.com

Burke, V., Beilin, L. J., Cutt, H. E., Mansour, J., & Mori, T. A. (2008). Moderators and mediators of behaviour change in a lifestyle program for treated hypertensives: A randomized controlled trial (ADAPT). *Health Education Research, 23*, 583–591.

Cerin, E., & MacKinnon, D. P. (2009). A commentary on current practice in mediating variable analyses in behavioural nutrition and physical activity. *Public Health Nutrition, 12*, 1 182–1188.

Di Castelnuovo, A., Quacquaruccio, G., Donati, M. B., de Gaetano, G., & Iacoviello, L. (2009). Spousal concordance for major coronary risk factors: A systematic review and meta-analysis. *American Journal of Epidemiology, 169*(1), 1–8.

Dominick, K. L., Golightly, Y. M., & Jackson, G. L. (2006). Arthritis prevalence and symptoms among US non-veterans, veterans, and veterans receiving Department of Veterans Affairs Healthcare. *The Journal of Rheumatology, 33*, 348–354.

Dutton, G. R., Tan, F., Provost, B. C., Sorenson, J. L., Allen, B., & Smith, D. (2009). Relationship between self-efficacy and physical activity among patients with type 2 diabetes. *Journal of Behavioral Medicine, 32*, 270–277.

Franks, M. M., Stephens, M. A. P., Rook, K. S., Franklin, B. A., Keteyian, S. J., & Artinian, N. T. (2006). Spouses' provision of health-related support and control to patients participating in cardiac rehabilitation. *Journal of Family Psychology, 20*, 311–318.

Gallant, M. P. (2003). The influence of social support on chronic illness self-management: A review and directions for research. *Health Education and Behavior, 30*, 170–195.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55.

King, H. A., Jeffreys, A. S., McVay, M. A., Coffman, C. J., & Voils, C. I. (2014). Spouse health behavior outcomes from a randomized controlled trial of a spouse-assisted lifestyle change intervention to improve patient low-density lipoprotein cholesterol. *Journal of Behavioral Medicine, 37*, 1102–1107.

Lewis, B. A., Williams, D. M., Martinson, B. C., Dunsiger, S., & Marcus, B. H. (2012). Healthy for life: A randomized trial examining physical activity outcomes and psychosocial mediators. *Annals of Behavioral Medicine, 45*, 1–10.

Macken, L. C., Yates, B., & Blancher, S. (2000). Concordance of risk factors in female spouses of male patients with coronary heart disease. *Journal of Cardiopulmonary Rehabilitation and Prevention, 20*, 361–368.

MacKinnon, D. (2008). *Introduction to statistical mediation analysis*. New York, NY: Erlbaum.

Martire, L. M., Schulz, R., Helgeson, V. S., Small, B. J., & Saghafi, E. M. (2010). Review and meta-analyses of couple-oriented interventions for chronic illness. *Annals of Behavioral Medicine, 40*, 325–342.

Martire, L. M., Stephens, M. A. P., Mogle, J., Schulz, R., Brach, J., & Keefe, F. J. (2012). Daily spousal influence on physical activity in knee osteoarthritis. *Annals of Behavioral Medicine, 45*, 1–11.

McCann, B. S., Bovbjerg, V. E., Brief, D. J., Turner, C., Follette, W. C., Fitzpatrick, V., … Knopp, R. H. (1995). Relationship of self-efficacy to cholesterol lowering and dietary change in hyperlipidemia. *Annals of Behavioral Medicine, 17*, 221–226.

Muthen, L. K., & Muthen, B. O. (2011). *Mplus User's Guide* (6th ed.). Los Angeles, CA: Author.

National Heart Lung and Blood Institute. (2004). Third report of the national cholesterol education program expert panel on detection, evaluation, and treatment of high blood cholesterol in adults. National Heart, Lung, and Blood Institute.

Papandonatos, G. D., Williams, D. M., Jennings, E. G., Napolitano, M. A., Bock, B. C., Dunsiger, S., & Marcus, B. H. (2012). Mediators of physical activity behavior change: Findings from a 12-month randomized controlled trial. *Health Psychology, 31*, 512–520.

Resnick, B., & Jenkins, L. S. (2000). Testing the reliability and validity of the self-efficacy for exercise scale. *Nursing Research, 49*, 154–159.

Rhodes, R. E., & Pfaeffli, L. A. (2010). Mediators of physical activity behaviour change among adult non-clinical populations: A review update. *International Journal of Behavioral Nutrition and Physical Activity, 7*, 37–48.

Sallis, J., Grossman, R., Pinski, R., Patterson, T., & Nader, P. (1987). The development of scales to measure social support for diet and exercise behaviors. *Preventive Medicine, 16*, 825–836.

Steiger, J. H., & Lind, J. C. (1980). *Statistically based tests for the number of common factors*. Paper presented at the annual meeting of the Psychometric Society, Iowa City, IA.

Stewart, A. L., Mills, K. M., King, A. C., Haskell, W. L., Gillis, D., & Ritter, P. L. (2001). CHAMPS physical activity questionnaire for older adults: Outcomes for interventions. *Medicine and Science in Sports and Exercise, 33*, 1126–1141.

Strecher, V. J., DeVellis, B. M., Becker, M. H., & Rosenstock, I. M. (1986). The role of self-efficacy in achieving health behavior change. *Health Education and Behavior, 13*, 73–92.

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika, 38*(1), 1–10.

US Department of Health Human Services. (2008). US Department of Health Human Services Physical Activity Guidelines for Americans. Hyattsville, MD: US Department of Health and Human Services. Retrieved from http://www.health.gov/paguidelines

Van Dyck, D., De Greef, K., Deforche, B., Ruige, J., Tudor-Locke, C. E., Kaufman, J.-M., & De Bourdeaudhuij, I. (2011). Mediators of physical activity change in a behavioral modification program for type 2 diabetes patients. *International Journal of Behavioral Nutrition and Physical Activity, 8*(1), 1–13.

Voils, C. I., Coffman, C. J., Yancy Jr., W. S., Weinberger, M., Jeffreys, A. S., Datta, S., & Bosworth, H. B. (2013). A randomized controlled trial to evaluate the effectiveness of CouPLES: A spouse-assisted lifestyle change intervention to improve low-density lipoprotein cholesterol. *Preventive Medicine, 56*, 46–52.

Voils, C. I., Yancy, W. S., Jr, Kovac, S., Coffman, C. J., Weinberger, M., Oddone, E. Z., … Bosworth, H. B. (2009). Study protocol: Couples partnering for lipid enhancing strategies (CouPLES) – A randomized, controlled trial. *Trials, 10*, 10.

Voils, C. I., Yancy, W. S., Weinberger, M., Bolton, J., Coffman, C. J., Jeffreys, A., … Bosworth, H. B. (2011). The trials and tribulations of enrolling couples in a randomized, controlled trial: A self-management program for hyperlipidemia as a model. *Patient Education and Counseling, 84*, 33–40.