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Improvements in Sleep Problems Among the Chronic Disease Self-Management Program Participants

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Sleep is increasingly important in public health because sleep problems are associated with multiple negative health and quality-of-life outcomes, especially among those with chronic conditions. While evidence-based self-management programs have been widely studied, little is known about their specific impacts on sleep. Using data from the National Study of Chronic Disease Self-Management Program (n = 1168), improvements in sleep problems were observed for all subgroups except men. More sleep problem reductions were observed among younger participants compared with their older counterparts. This study confirmed the value of self-management programs for ameliorating sleep problems across diverse participant groups.

Sleep is increasingly recognized as an important element for maintaining healthy lives, with sleep insufficiency seen as a major public health issue.[1] Despite recommendations for adults to get 7 to 9 hours of sleep per night,2 35.5% of American adults reported getting less than 7 hours of sleep on average, and 4.7% reported nodding off or falling asleep while driving in the last 30 days.[3] Changing lifestyles and work demands are associated with sleep deprivation and a variety of unhealthy conditions including hypertension, obesity, and diabetes.[4]

Poor sleep quality can affect and be affected by lifestyle changes and disease profiles. A previous study documented that people with chronic conditions struggle to achieve deep, sound sleep when they suffer from disease-related symptoms (eg, depression, pain).[5] Simultaneously, sleep problems can contribute to or exacerbate chronic conditions. Lack of sleep is related to metabolic syndrome,[6] obesity,[7] cardiopulmonary disease,[8] coronary heart disorder and stroke,[9] hypertension,[10] and type 2 diabetes.[11] Furthermore, sleep deprivation is closely related to stress[12] and negative mental health outcomes.[13]

The importance of investigating the relationship between sleep problems and chronic conditions is heightened when considering the rapidly aging and booming rates of people living with chronic conditions.[14] While it has been demonstrated that there are more sleep disturbances15 and more chronic conditions among older adults,[14] the relationship between these problems is still being investigated. Meanwhile, the number of Americans suffering from chronic conditions is projected to increase by 37% from 2000 to 2030.[14] And, on average, 68% of middle-aged adults and 91% of older adults have at least 1 chronic condition, which is substantially higher than their younger counterparts.[14] Such statistics warrant additional examination of the underlying factors contributing to sleep problems in people with chronic conditions and an exploration of effective solutions.

There is a pressing need to identify effective interventions to help older adults improve their sleep and manage co-occurring somatic conditions, and self-management programs aimed at improving sleep in elderly populations have been found effective.[16–18] Chronic Disease Self-Management Program (CDSMP) is one such effort that empowers people with chronic conditions to deal with their conditions and related symptoms including sleep problems, pain, fatigue, and depression.[19,20] As an evidence-based program, which is defined as a program undergoing extensive randomized control testing to show health benefits for participants and being translated into programs in community settings, CDSMP is a peer-led intervention consisting of 6 highly participative classes held for 2.5 hours each, once a week, for 6 consecutive weeks.[21-23] This program has resulted in better health, better health care, and better value.[21,24,25] While a recent study suggested that CDSMP can generally improve sleep over a 6-month period,[24] little is known about whether the program can result in sustained effects over time and which participants benefit from the CDSMP workshops. Thus, the objectives of the study were to (1) identify changes in sleep problems among CDSMP participants over a 12-month study period and (2) examine to what extent CDSMP reduced sleep problems occurred among participant subgroups based on their sociodemographic factors, number of chronic conditions, and CDSMP completion rates.

METHODS

Design issues

This study was designed as translational research study of adults enrolled in CDSMP delivered throughout the United States by 22 licensed sites in 17 states between August 2010 and April 2011. This study utilized a pre-post longitudinal study design to examine intervention effects among participants enrolled in CDSMP workshops. Each CDSMP delivery site recruited workshop participants by obtaining referrals from organizations serving older adults. Participant eligibility criteria included (1) having at least 1 chronic condition; (2) enrolling in a CDSMP workshop delivered in either English or Spanish; (3) attending at least 1 of the first 2 class sessions; (4) not having taken CDSMP previously; (5) completing a baseline assessment; and (6) consenting to the study. To boost fidelity, CDSMP has an intensive training occurring centrally by Stanford staff or in local communities by certified master trainers. Additional information about sampling, recruiting, training, and fidelity assessment can be found in prior studies.[21,24]

Study participants

Data used in these analyses were collected at baseline, 6-month follow-up, and 12-month follow-up as part of the National Study of CDSMP. In this initiative, data were collected from 1170 community-dwelling participants. Approximately 77% (n = 903) and 71% (n = 825) of the 1170 participants completed the 6-month and 12-month assessments, respectively.[21] Participants who completed assessments at both follow-up time points tended to be older, and completers of the 6-month assessment were likely to be non-Hispanic white.[21] Because this study focuses specifically on the sleep problem outcome, we excluded respondents who did not answer the sleep-related question as our dependent variable (n = 2), leaving the final analytic sample size of 1168.[21,24]

Measurement

Dependent variable

Measures were collected at baseline, 6 months, and 12 months. The dependent variable in this study was sleep problems. A visual numeric scale (ie, 0-10) was used to measure self-reported sleep problems. Study participants were asked, "We are interested in learning whether or not you are affected by sleep problems. Please circle the number below that describes your sleep in the past week." This sleep visual numeric has been tested in prior studies,24,26 and further information about this variable can be found on the Stanford Patient Education Research Center Web site (http://patienteducation.stanford.edu/research/vnssleep.html).

Sociodemographic factors

Personal characteristics served as covariates including gender (ie, male, female), age (ie, <65 years old, >65 years old), race (non-Hispanic white, other), and education (high school graduate or less, >high school graduate).

Number of chronic conditions

Health status was assessed by the number of chronic conditions with which study participants had been diagnosed (eg, diabetes, heart disease, asthma and other lung-related diseases, cancer, arthritis). We also documented CDSMP workshop attendance rates (eg, those who attended 4 or more of the 6 classes were considered to have "successfully completed" the program).

Statistical analysis

ANOVA tests were used to compare the equality of average sleep problem scores at baseline, 6-month, and 12-month time points among all CDSMP participants and by subgroups. To assess the changes in sleep problems across time, a linear mixed model with a discrete time covariate (ie, a 3-category variable for the 3 time points) and participant-level random intercepts were fitted controlling for age, gender, race, education, and number of chronic conditions. To evaluate the magnitude of improvements in sleep problems among different subgroups, we added the interaction terms between time and each group variable into the linear mixed model. A significant interaction term indicates the improvements in sleep problems differ significantly between subgroups. We then estimated the adjusted changes in sleep problems from baseline to each follow-up assessment using the lsmeans statement of SAS Proc Mixed procedure (SAS version 9.3, SAS Institute Inc, Cary, North Carolina). The mixed-effects models are likelihood-based approaches that use all available data in model estimation and provide unbiased estimates of the intervention effects under the assumption of missing at random.

An effect size (d = [posttest mean – pretest mean]/pretest standard deviation) using estimates of adjusted changes from the mixed-effects models was computed for each subgroup. Effect sizes of d = 0.2 were considered small; d = 0.5 medium; and d = 0.8 large.[27]

RESULTS

Table 1 illustrates that the CDSMP participants reported an average sleep problem score of 4.6, 3.8, and 3.7 at baseline, 6 months, and 12 months, respectively. Significant differences in the mean scores existed among the 3 time points ($P < .001$). Similarly, the average sleep problem scores had significant differences across the 3 time points for all participants by sociodemographic factors, health status, and CDSMP completion included in this study, with the exception of male participants.

Table 2 presents results from the mixed-effects models. Overall, CDSMP participants' average sleep problems significantly reduced from baseline to 6-month follow-up ($P<.001$) and from baseline to 12-month follow-up ($P < .001$). Sleep problem reductions were also observed from 6-month to 12-month follow-up, which was not significant. The effect sizes of sleep problem improvements between 2 points (eg, from baseline to 6 month; from baseline to 12 month) were each about 0.2. During these 2 time points, the average sleep problem scores also significantly decreased for most of the subgroups groups investigated. The only exception was the male participants at 6-month follow-up. We then compared differences in sleep problem score reductions between subgroup categories, and a few significant interactions were identified. The difference between male and female participant scores was marginally significant at 6 month ($P = .074$). The younger group (age < 65 years old) had the largest effect size (0.31) among all the subgroups. The difference of sleep problem reductions between younger and older participants was statistically significant at 6-month follow-up ($P = .010$), suggesting younger participants benefited more from the intervention than their older participant counterparts. From 6-month and 12-month follow-ups, improvements in sleep problems were significant only among older adults ($P = .046$). The difference of sleep problem reductions between younger and older participants was statistically significant during this period ($P = .006$).

Table 1. Average Sleep Problem Scores at Baseline and Follow-up

	Baseline		6 mo		12 mo		
	N	Mean (±SD)	N	Mean (±SD)	N	Mean (±SD)	ANOVA *P* Value
All	1168	4.6 (±3.3)	902	3.8 (±3.1)	825	3.7 (±3.1)	<.001
Gender							
Male	202	4.2 (±3.2)	154	3.7 (±3.0)	147	3.5 (±3.0)	.113
Female	966	4.6 (±3.3)	748	3.8 (±3.2)	678	3.8 (±3.2)	<.001
Age group, y							
<65	482	5.2 (±3.4)	330	4.1 (±3.4)	313	4.5 (±3.4)	<.001
>65	686	4.1 (±3.2)	572	3.6 (±3.0)	512	3.3 (±2.9)	<.001
Race							
Non-Hispanic white	644	4.7 (±3.1)	520	4.0 (±3.0)	475	3.9 (±3.0)	<.001
Other	524	4.3 (±3.5)	382	3.4 (±3.4)	350	3.5 (±3.3)	<.001
Education							
High-school graduate or less	598	4.4 (±3.4)	458	3.8 (±3.3)	409	3.6 (±3.2)	<.001
>High-school graduate	567	4.7 (±3.2)	441	3.8 (±3.0)	414	3.9 (±3.1)	<.001
Chronic conditions							
≤2 conditions	547	3.8 (±3.2)	403	3.1 (±3.0)	369	3.1 (±2.9)	<.001
>3 conditions	621	5.2 (±3.3)	500	4.4 (±3.2)	456	4.3 (±3.2)	<.001
Session completion							
Session noncompleters	245	4.5 (±3.4)	142	3.7 (±3.2)	130	3.6 (±3.1)	.015
Session completers	923	4.6 (±3.3)	760	3.8 (±3.1)	695	3.8 (±3.2)	<.001

Table 2. Adjusted Changes[a] and Effect Sizes Between Baseline and Follow-up Sleep Problems

	Adjusted Change of Sleep Problems (From 0-10)								
	From Baseline to 6 mo			From Baseline to 12 mo			From 6 mo to 12 mo		
	Adjusted Change[b]	*P*	Effect Size *d*	Adjusted Change[c]	*P*	Effect Size *d*	Adjusted Change[c]	*P*	Effect Size *d*
All (n = 1170)	−0.70	<.001	0.21	−0.74	<.001	0.22	−0.05	.674	0.01
Gender									
Male	−0.30	.211	0.09	−0.51	.038	0.16	−0.21	.417	0.06
Female	−0.78	<.001	0.24	−0.79	<.001	0.24	−0.01	.918	0.00
Difference between gender groups	0.48	.074		0.28	.304		−0.20	.488	
Age group, y									
<65 old	−1.04	<.001	0.31	−0.70	<.001	0.21	0.35	.052	0.10
>65	−0.51	<.001	0.16	−0.78	<.001	0.24	−0.27	.046	0.09
Difference between age groups	−0.53	.010		0.08	.696		0.62	.006	
Race									
Non-Hispanic white	−0.63	<.001	0.20	−0.67	<.001	0.21	−0.03	.820	0.01
Other	−0.78	<.001	0.22	−0.85	<.001	0.24	−0.07	.694	0.02
Difference between race groups	0.15	.460		0.18	.382		0.03	.880	
Education									
High school graduate or less	−0.61	<.001	0.18	−0.77	<.001	0.23	−0.16	.297	0.05
>High school graduate	−0.80	<.001	0.25	−0.73	<.001	0.23	0.07	.645	0.02
Difference between education groups	0.19	.343		−0.04	.845		−0.23	.288	
Chronic Conditions (CC)									
≤2	−0.70	<.001	0.22	−0.73	<.001	0.23	−0.03	.840	0.01
>3	−0.69	<.001	0.21	−0.75	<.001	0.23	−0.06	.678	0.02
Difference between CC groups	−0.01	.966		0.02	.928		0.03	.899	
Session completion									
Session noncompleters	−0.62	.012	0.18	−0.72	.005	0.21	−0.10	.724	0.03
Session completers	−0.72	<.001	0.22	−0.75	<.001	0.23	−0.04	.758	0.01
Difference between completion groups	0.10	.711		0.03	.892		−0.06	.837	

[a]All changes and *P* values are adjusted for gender, age, race, education, and number of chronic conditions.
[b]Adjusted changes between 6 months and baseline from linear mixed regression models.
[c]Adjusted changes between 12 months and baseline from linear mixed regression models.

DISCUSSION

This study affirms the potential of community-based self-management interventions rooted in behavior change theories to improve sleep problems among participants living with chronic conditions over time. On average, study participants significantly reduced sleep problems from 4.6 at baseline to 3.8 at 6-month follow-up, and these effects were sustained at 12-month follow up (ie, mean = 3.7). This study is unique in that it identified subgroup-specific sleep problem improvements by those participating in CDSMP workshops. Interestingly, with the exception of men, sleep problem improvements were observed for all subgroups. More sleep problem reductions were observed among younger participants when compared with their older counterparts. Conversely, the changes in sleep problem scores did not differ significantly by race, education, number of chronic conditions, or workshop completion status, which indicates the improvements were similar across these subgroups. The potential of CDSMP to improve sleep problems is supported by another recent study (using the same visual numeric scale to measure sleep problems) among 139 CDSMP participants from community mental health settings.[26] Among their study participants with disproportionately high proportions of mental health problems (eg, 54.6% with depression, 45.3% with bipolar, 16.5% with schizophrenia), researchers reported that participants reduced their sleep problem scores from 6.2 at baseline to 5.2 at 6-month follow-up with an effect size of 0.3.26

Although this study did not directly assess why CDSMP participants were able to improve sleep problems, our experience with the program allows for informed speculation. First, prior studies have shown longitudinal improvements in symptoms related to chronic conditions (eg, depression, pain, fatigue)[21,24] and increased physical activity levels[24] among CDSMP participants. Because physical activity has been related to reduced levels of depression and chronic condition-related pain and fatigue,[28,29] and these symptoms are attributed to sleeplessness and sleep disruption,[5] it is intuitive that participants who improve other health outcomes would also improve their sleep. Second, and more directly, CDSMP participants' reduced sleep problems could have resulted from the sleep-specific aspects of the CDSMP curriculum. This part of the curriculum highlights that sleep problems are one of the common symptoms of chronic conditions and provides 3 common-sensical but practical tips to help participants get better sleep.30 Recommendations provided to CDSMP participants include (1) before going to bed, find a comfortable sleeping position, elevate the head of the bed, and keep the room at a comfortable, warm temperature; (2) avoid the following behaviors before bedtime including eating food, drinking alcohol or caffeine late in the day, smoking cigarettes, and taking diuretics; and (3) develop routine behaviors such as setting up and maintaining a regular rest and sleep schedule, exercising at regular times each day, and getting out in the sun every afternoon.[30] Future studies are warranted to investigate the underlying mechanisms influencing sleep problems among CDSMP participants, including other intervention effects on health outcomes and sleep-specific CDSMP curriculum aspects.

In addition, this study attempted to identify who benefited most from CDSMP in terms of improving sleep problems. Although significant reductions in sleep problems were prevalent among almost all participants, the younger participants reported larger reductions than their older

counterparts especially between baseline and 6-month follow-up. One probable reasoning would be that younger adults reported higher sleep problem scores at baseline than their older adult counterparts (ie, younger adults = 5.2 vs older adults = 4.1). This possible floor effect might have given younger participants more chances to reduce sleep problems over time after taking CDSMP workshops. While behavioral factors and CDSMP-related benefits may differ between age groups in this study, effects of improving sleep problems seem more sustainable among older participants than younger participants. Although it was not significant, sleep problems among younger participants increased between 6-month (4.1) and 12-month (4.5) follow-ups, whereas older adults continued to experience significant improvements in sleep problems between 6-month (3.6) and 12-month (3.3) follow-ups. All in all, this study demonstrates significant improvement among both younger and older adult participants while revealing larger effects in the younger group. Future studies should investigate if changes in behaviors and health outcomes associated with CDSMP attendance were related to improvements in sleep problems, and if these improvements differed by age groups.

There were study limitations that should be acknowledged. First, responses were self-reported, which may have resulted in recall and social desirability biases. Nevertheless, we were not able to identify problematic patterns related to these concerns. Second, sleep problems in this study relied on a single-item visual numeric scale. Although this scale has been tested in previous studies,[24,26] it could lack the capability of capturing diverse dimensions of sleep problems. Future studies may benefit from including additional and more robust measures of sleep duration, quality, and consistency. Third, this study was unable to provide a deeper understanding about how changes in behaviors and health outcomes attributed to CDSMP participation specifically improved sleep problems by subgroups. Instead, we aimed to identify how sleep problems among CDSMP participants were changed on the basis of their sociodemographic factors and health status and recommend future studies to understand mechanisms behind observed findings. Fourth, there might be confounding impacts of external factors (eg, social and family supports) on changes in sleep problems over time. As such, we were limited in our ability to directly link changes in behaviors and health outcomes to improvement in sleep problems. The lack of control group in this study made it difficult to detangle this issue. However, the widespread availability of CDSMP nationwide makes the use of control groups virtually impossible in pragmatic, translational delivery efforts in community settings. In addition, the differential attrition rates at 6-month and 12-month follow-up based on participants' race/ethnicity could have potentially confounded changes in sleep problems (eg, non-Hispanic white participants were more likely to complete the study). Therefore, linear mixed models, which permit unbiased estimation for model parameters when missing at random assumption is met, were used to address this problem.[31] Because the missing at random assumption is difficult to evaluate, a sensitivity analysis (not shown in Tables) among completers only was performed and shows the potential robustness of our results.

CONCLUSION

This study demonstrated significant reductions in sleep problems among CDSMP participants. This benefit was prevalent among diverse participants, and younger CDSMP participants benefited more than their older counterparts. These findings stress the importance of encouraging patients living with chronic conditions and sleep problems to attend this evidence-based intervention.

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