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Psychosocial Predictors of Changing Sleep Patterns in Aging Women: A Multiple Pathway Approach

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The authors of this investigation sought to examine changes in the sleep quality of older women over time and to determine whether dimensions of psychological well-being, health (subjective health and number of illnesses), and psychological distress (depression and anxiety) predict these changes. A secondary analysis was conducted with a longitudinal sample of aging women (Kwan, Love, Ryff, & Essex, 2003). Of 518 community-dwelling older women in the parent study, 115 women (baseline *M* age = 67 years, *SD* = 7.18) with data at baseline, 8 years, and 10 years were used for this investigation. Participants completed self-administered questionnaires and participated in in-home interviews and observations. Growth curve modeling was used to examine the overall linear trajectories of sleep quality. Growth mixture modeling was used to examine whether there were different patterns of change in sleep quality over time and to examine baseline predictors of each pattern. Sleep quality declined over time but not for all women. Two distinctly different sleep patterns emerged: good but declining sleep quality and disrupted sleep quality. Higher psychological well-being (positive relations with others, environmental mastery, personal growth, purpose in life, and self-acceptance), fewer illnesses, and lower depression scores at baseline predicted reduced odds for membership in the disrupted sleep group. Future research is needed to examine whether interventions focused on maintaining or enhancing psychological well-being could minimize later life declines in sleep quality.

Keywords: sleep, older women, psychological well-being, depression, health

Declines in sleep quality are a significant problem in community-dwelling older adults, particularly women. The study of women is important because women report higher rates of sleep problems, have a wider variety of sleep complaints, and are more likely to report multiple sleep complaints than men (Foley et al., 1995; Maggi et al., 1998; Middelkoop, Smilde-van den Doel, Neven, Kamphuisen, & Springer, 1996). Our aim in this investigation was to examine the relationship between sleep quality and health (physical and psychological) in older women and to identify factors that might predict changes in sleep quality with aging. Unique to this investigation is whether positive psychological functioning, conceptualized as psychological well-being (Ryff, 1989) in this study, may have an impact on sleep quality in aging. According to Ryff (Ryff, Singer, & Love, 2004), there is an interplay between biopsychosocial processes such that positive psychological well-being will be accompanied by positively functioning physiologic processes. This approach may help explain why some older adults experience less disrupted sleep than others.

The most common sleep disorders in older adults include insomnia, sleep-related breathing disorders, and limb movement disorders (Ancoli-Israel, 2009). The study of sleep has included both subjective (self-report) and objective (polysomnography) measures. The gold standard for the diagnosis and management of sleep-related breathing disorders and limb movement disorders is polysomnography (PSG). However, PSG has drawbacks and is not recommended for use in all sleep investigations. For example, underlying etiologies for insomnia may not be detectable with PSG, and consequently PSG is not recommended in the routine diagnosis and treatment of insomnia (Littner et al., 2003). There are limitations in the use of self-report methods as well. Individuals with significant sleep disorders may experience little or no night time distress. Also, evidence suggests that some individuals have sleep state misperceptions, and use of self-report measures tend to underestimate sleep time and overestimate disruptions in sleep. Sleep complaints are not sleep disorders in and of themselves. Our intent in this investigation is not to diagnose sleep disorders but to describe changes in sleep quality. As such, self-report methods were used.

In the National Institute on Aging's multicenter study, Established Populations for Epidemiologic Studies of the Elderly

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(EPESE), more than 50% of older adults reported at least one of four sleep complaints "most of the time" (as cited in Foley et al.,1995). These complaints included (a) difficulty initiating sleep, (b) difficulty maintaining sleep, (c) waking too early, or (d) waking not feeling restored. In a longitudinal study of 1,050 community-dwelling older adults, 37% reported difficulty falling asleep, 29% reported fragmented sleep, and 19% reported early rising. Two years later, the percentages increased substantially (75%, 69%, and 47%, respectively; Ganguli, Reynolds, & Gilby, 1996).

In studies of changes in sleep physiology using PSG, researchers have noted a reduction in total sleep time and sleep efficiency (i.e., ratio of time asleep to time in bed), lighter sleep, and increases in nighttime awakenings with advancing age (Feinsilver, 2003; Ohayon, Carskadon, Guilleminault, & Vitiello, 2004). Findings from several cross-sectional studies in which self-report measures were used indicate that there are increases in fragmented sleep (Middelkoop et al., 1996; Newman, Enright, Manolio, Haponik, & Wahl, 1997; Schubert et al., 2002) and in difficulty falling asleep with increasing age, particularly in women (Middelkoop et al., 1996; Newman et al., 1997). Results from other cross-sectional studies indicate there are no overall differences in sleep between young adults and older adults (Gislason, Reynisdottir, Kristbjarnarson, & Benediktsdottir, 1993). Mood disorders and health problems have been implicated as possible explanations for the conflicting findings (Giron et al., 2002; McCrae et al., 2005; Vitiello, Moe, & Prinz, 2002).

A strong link exists between poor psychological health and poor sleep (Ohayon & Vecchierini, 2005). Self-reported anxiety and worry have been associated with difficulty initiating sleep (Maggi et al., 1998). Depression has been associated with reports of difficulty falling asleep, fragmented sleep, early morning awakening, and waking feeling unrefreshed (Foley, Ancoli-Israel, Britz, & Walsh, 2004; Newman et al., 1997). Poor sleep has been implicated as a risk factor for depression, a consequence of depression, a potential result of medication management for depression, and a common refractory symptom of depression (Benca, 2005).

The relationship between poor physical health and poor sleep has been well studied. Poor self-rated health and the number of health problems are strongly related to poor sleep (Foley et al., 2004). Reports of night time urination, gastrointestinal problems, respiratory disease, and cardiovascular problems have been consistently associated with poor sleep quality as measured by self-report (Taylor et al., 2007). However, in studies in which participants were carefully screened for health conditions or in which health and well-being factors were controlled in analyses, age-related differences were no longer found (Foley et al., 1995; Newman et al., 1997; Vitiello et al., 2002). The general consensus among sleep scientists is that there are age-related changes in sleep-related physiology. However, the negative impact of psychological and physical health conditions on sleep far outweighs that of normal physiologic age-related change (Lesage & Scharf, 2007).

Hamilton, Catly, and Karlson (2007) in a study of adults with rheumatoid arthritis and fibromyalgia posited that sleep buffered the relationship between stress and negative affect, suggesting that while poor sleep may increase the risk of anxiety and depressive symptoms, restorative sleep may serve to manage them. Yet, the potential restorative effects of sleep, including the relationship between sleep and positive psychological functioning, have been examined in only a few studies. Hamilton, Nelson, Stevens, and Kitzman (2007) found that adults who reported sleeping 6.0–8.5 hr per night had lower levels of anxiety and depression and higher levels of psychological well-being (positive relations with others, purpose in life, and self-acceptance) than those reporting less than 6.0 hr or more than 8.5 hours per night. Plasma interleukin-6 (IL-6) levels (known inflammatory biomarkers in older women) were found to be lower in women scoring higher in psychological well-being (i.e., positive relations with others; Friedman, Hayney, Love, Singer, & Ryff, 2007). Lower plasma IL-6 levels predicted greater sleep efficiency, while high plasma IL-6 levels were found in women who had lower psychological well-being and reported lower sleep quality (Friedman et al., 2005). In summary, there are overall declines in sleep quality with age. There is little consensus about whether a decline in sleep quality is a normative developmental change in old age (National Heart, Lung, and Blood Institute, National Center on Sleep Disorders Research, 2003). The declines may be due to normal age-related physiologic changes as well increasing psychological and physical health changes. Also, poor sleep may contribute to declines in physical and psychological health. Clearly, longitudinal investigations to clarify the relationship between sleep quality and health and well-being factors in older adults are needed. In addition, there have been no examinations of inter- or intraindividual age-related changes in sleep quality to determine whether sleep quality varies for subgroups of older adults. Factors that might differentiate these subgroups include psychological distress, psychological well-being, and varying degrees of health. The use of growth models in longitudinal aging research emphasizes *interindividual* differences in *intraindividual* change and does not assume that all individuals follow the same pattern of change over time. The use of growth modeling is expanding exponentially, particularly among those who study psychological factors. This approach is important because the "average" aging adult may not be informative if there is a great deal of variability in health and well-being across adults as they age.

Also neglected in prior research has been the question of whether positive psychological functioning may predict changes in sleep quality over time. The literature is clear that anxiety, worry, and depression may be important antecedents of poor sleep, but the role of positive psychological functioning may also be important. Recent research suggests that positive psychological factors may have protective influences. It is unclear whether positive psychological factors may influence declines in sleep quality seen with age. In this investigation, we examined the intraindividual changes in sleep over time and focused on both the positive and negative predictors of changes in sleep in a unique longitudinal study that allows for assessment of the links between psychosocial factors and longitudinal change in sleep over a decade.

Our overall purpose in this investigation was to examine changes in the sleep quality of older women over time and to determine whether psychological well-being (positive relations with others, environmental mastery, personal growth, purpose in life, and self-acceptance), psychological distress (depression and anxiety) or health factors (subjective health and number of illnesses) predict these changes. There were three specific research questions:

1. Does the sleep quality of older women change over time?

2. Are there different patterns of change in sleep quality over time?

3. Do psychological well-being (positive relations with others, environmental mastery, personal growth, purpose in life, and self-acceptance), psychological distress (depression and anxiety) or physical health (subjective health, number of illnesses) predict different patterns of change in sleep quality over time?

Method

Design

This was a secondary analysis of data from a longitudinal study of aging women (Kling, Seltzer, & Ryff, 1997; Kwan, Love, Ryff, & Essex, 2003). The sample was first recruited for the purpose of studying a major transition of aging (community relocation), then additional funding was obtained to do further longitudinal follow-up of a subsample of respondents for whom contact information was still available. (See Figure 1.)

Sample

Eligibility criteria for the parent studies included being an English-speaking, community-dwelling woman, 55 years or older, with sufficient cognitive and physical health to complete study interviews, questionnaires, and examinations. At baseline, participants were between 55 and 84 years old ($M = 67$ years, $SD = 7.2$). At 10 years, participants were between 63 and 93 years old ($M = 76$ years, $SD = 7.2$).

Differences between completers ($N = 115$) and noncompleters ($N = 403$) in baseline demographics, sleep quality, and health and well-being variables were examined (see Table 1). Completers were younger, $t(516) = 4.91$, $p > .0001$, and more educated, $t(515) = -2.67$, $p > .01$, with higher levels of personal growth, $t(514) = -4.02$, $p > .001$, subjective health, $t(516) = -3.30$, $p > .001$, and fewer illnesses, $t(510) = 3.43$, $p > .001$, suggesting completers may be positively biased. No significant differences were found between groups in sleep quality, anxiety, depression, or other dimensions of psychological well-being.

Measures

Sleep quality. Sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The PSQI is a 19-item scale that produces a global sleep quality score; it has demonstrated utility in the assessment of sleep quality and sleep disturbances in older adults (Carpenter & Andrykowski, 1998; Smith, 1999). A global score greater than 5 yielded a diagnostic sensitivity of 89.6% and specificity of 86.5% ($\kappa = 0.75$, $p < .001$), indicating poor subjective sleep quality (e.g., more sleep disturbances, daytime dysfunction, lower sleep duration, and lower habitual sleep efficiency; Buysse et al., 1989). The PSQI has overall high internal consistency (Cronbach's alpha), ranging from .80 to .87 for community samples (Backhaus, Junghanns, Broocks, Riemann, & Hohagen, 2002) and was .70 in this study. Higher numbers indicate poorer sleep quality.

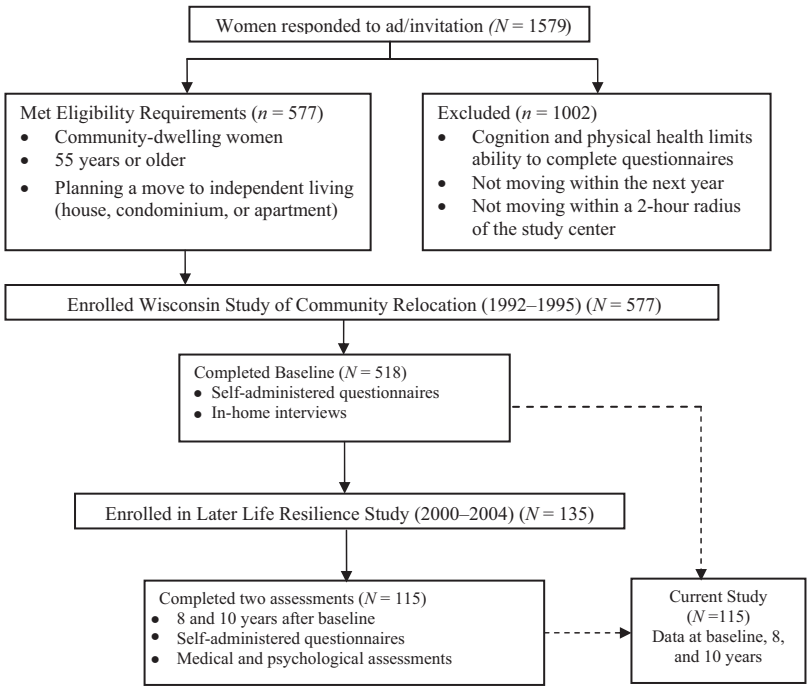

Figure 1. Study design. (Wisconsin Study of Community Relocation; Kling, Seltzer, & Ryff, 1997. Later Life Resilience Study; Kwan, Love, Ryff, & Essex, 2003.)

Table 1
Comparison of Noncompleters and Completers at Baseline

Variable	Noncompleters ($N = 403$)		Completers ($N = 115$)	
	M	*SD*	*M*	*SD*
Age***	71.01	8.15	66.89	7.18
Years of education**	13.48	2.72	14.26	2.93
Sleep quality	5.12	3.05	4.88	2.73
Psychological well-being				
Positive relations with others	68.19	10.14	68.12	10.36
Autonomy	62.06	9.41	62.32	9.98
Environmental mastery	64.38	9.62	65.34	9.50
Personal growth***	66.26	9.04	70.17	9.70
Purpose in life	64.23	9.71	65.98	10.30
Self-acceptance	62.65	11.16	64.02	11.23
Psychological distress				
Depression	12.01	8.45	10.57	7.46
Anxiety	19.38	5.63	19.04	5.48
Health				
Subjective health***	5.11	1.16	5.50	0.92
Number of illnesses***	2.74	2.0	2.03	1.73

** $p < .01$. *** $p < .001$.

Psychological well-being. Ryff's six scales of psychological well-being (Ryff & Keyes, 1995) were used to measure psychological well-being: The Positive Relations With Others (PR) scale emphasizes the achievement of intimacy and indicates satisfying relationships with others. The Autonomy (AU) scale measures the extent to which one is self-determined and free of the opinions of others. The Environmental Mastery (EM) scale reflects a sense of competence in managing one's environment. The Personal Growth (PG) scale measures one's view of himself or herself as continually growing and changing in ways that reflect self-knowledge. The Purpose in Life (PIL) scale refers to a feeling that life is meaningful. The Self-Acceptance (SA) scale reflects a positive attitude toward oneself and acknowledgment of one's good and bad qualities. Each scale consists of 14 items with responses ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Higher scores indicate greater psychological well-being. Cronbach's alphas ranged from .82 to .88.

Psychological distress. The Center for Epidemiological Studies Depression (CES-D) inventory (Radloff, 1977) and the State–Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) were used to measure psychological distress. The CES-D is a 20-item self-report scale designed to measure depressive symptomatology. Respondents were asked to answer each item on a scale ranging from 0 (*rare or none*) to 3 (*most or all of the time*) on the basis of how often they had felt each symptom during the past week. Scores greater than 15 are suggestive of clinical depression. For this study, total scores were adjusted to account for the elimination of a sleep item; the highest possible CES-D score was 57. The Cronbach's alpha was .83. The 10-item State Anxiety component of the STAI (Spielberger, Sydeman, Owen, & Marsh, 1999) measures anxiety-related feelings experienced on an average day. Higher scores reflect greater state anxiety. The alpha coefficient for the STAI was .85.

Physical health. There were two measures of physical health. *Subjective health* was assessed with a single question, "How would you describe your overall health at the present time?" Participants were asked to rate their health on a 7-point scale, ranging from 1 (*poor*) to 7 (*excellent*). Higher scores indicate better health. This measure was selected because self-rated health status has been found to be one of the best predictors of mortality and morbidity among older adults and an important predictor of functional ability and health-related quality of life (Idler & Kasl, 1991; Wilson & Cleary, 1995). The *number of illnesses* was assessed with the Older Americans Resources Survey (OARS; Duke University Center for the Study of Aging and Human Development, 1978). It is a self-report checklist of illnesses common in mid-life and older adults. Participants indicated whether they had experienced each of the 19 illnesses listed (e.g., asthma or wheezing, kidney disease, high blood pressure, and so forth). The total number of illnesses was summed to yield an illness score. Higher scores indicate poorer health.

Procedure

Study participants were women who responded to newspaper advertisements and informational brochures as well as to invitations to participate from housing facility managers. Eligibility was determined via telephone screening. Baseline in-home assessments of independence in physical functioning and in-depth personal interviews were conducted by trained interviewers. At baseline, 518 women completed self-administered questionnaires of psychological well-being. At the end of the initial investigation, letters were sent to 369 women who had expressed interest in participation in future studies. Participation was contingent on completion of the previous waves of data collection. Women were contacted until a final sample size of 135 was obtained. Reasons for nonparticipation included death (11.5%), poor health of the participant or of a family member (26%), feeling that the study was too demanding (11.5%), inability to contact the participant or the participant's moving out of the area (16.3%), and refusal for other reasons (34.6%). The 135 women participated in interviews and in psychological and laboratory testing, including the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975), and completed questionnaires during a 2-night stay at the University of Wisconsin–Madison's General Clinical Research Center as part of the parent study. Testing was repeated 2 years later. This investigation included the 115 women with data at baseline, 8 years, and 10 years (see Figure 1.) The research proposals were approved by the university's institutional review board.

Data Analysis

SPSS Version 12.0 was used for descriptive statistics. Mplus Version 5 (Muthén & Muthén, 2007) was used for growth curve modeling (GCM) and growth mixture modeling (GMM). This approach models a "change trajectory" that reflects the relationship between time and changes in outcome variables within an individual subject. Latent variables representing the intercept (e.g., estimated baseline scores) and slope (e.g., estimated change over time) are then used to model the expectancy of growth across subjects. Individual growth modeling is well suited for this analysis because older adults are more heterogeneous than alike. GMM allows the examination of subgroups within the larger GCM (Wu, Clopper, & Woolridge, 1999).

Results

Sample Characteristics

Most participants were White, well educated, and unemployed and lived alone (Table 2). In general, women had high levels of psychological well-being, low mean levels of depressive symptomatology and anxiety, good subjective health, and few illnesses. The most common illnesses reported at baseline were arthritis, hypertension, glaucoma or cataracts, thyroid problems, and heart disease.

Does the Sleep Quality of Older Women Change Over Time?

Overall, sleep quality declined over time from a mean score of 5.0 ($SD = 2.72$) to 6.29 ($SD = 3.65$); nearly half of the women reported the use of sleep aids at Time 3 assessment. To identify the general form of change in sleep quality over time, we tested a linear growth curve. Fit statistics indicate that a linear growth curve model was a good fit, $\chi^2(1) = 0.46$, $p = .5$; comparative fit index = 1.00, Tucker–Lewis Index = 1.02, root-mean-square error of approximation = .00, and standardized root-mean-square residual = 0.01. The overall growth curve of sleep quality in community-dwelling older women increased significantly over time, indicating reduced sleep quality over time ($\beta_0 = 4.97$, $SE = 0.24$; $\beta_1 = 0.14$, $SE = 0.03$; $p < .001$). Note that higher numbers reflect declining sleep quality.

Are There Different Patterns of Change in Sleep Quality Over Time?

We found the most parsimonious model (a one-class model) by sequentially increasing the number of growth model classes to three latent class models, with the choice of best fitting model based on the following criteria: the Akaike's information criterion (AIC) statistic (Akaike, 1974), the Bayesian information criterion (BIC), the adjusted BIC statistical fit index (Schwarz, 1978), and the consistent AIC (CAIC). Lower AIC, BIC, adjusted BIC, and CAIC values indicate better model fit and a significant Lo–Mendell–Rubin likelihood ratio demonstrating a significant improvement in fit for the inclusion of one more class (Li & Nyholt, 2001). While adjusted BIC has been found to identify the number of classes better than other fit statistics, it is not perfect. Since no single parameter demonstrates a best fit, examining across the parameters provides the best estimate of fit (Nylund, Asparouhov, & Muthén, 2007).

Table 2
Baseline Demographic Characteristics of 115 Community-Dwelling Older Women

Characteristic	*n*	%
White	112	97
More than a high school education	40	45
Married or living with partner	32	28
Living alone	66	57
Employed	45	39
Annual income less than $20,000	48	42

The three-category model demonstrated the best fit of the three models tested (Table 3). Group 1 ($n = 23$) had an estimated mean sleep quality score that did not change significantly over time ($\beta_0 = 7.34$, $SD = 0.47$; $\beta_1 = 0.24$, $SD = 0.13$; $p < .058$). Group 2 ($n = 4$) had the worse mean sleep quality score at baseline that became significantly worse over time ($\beta_0 = 10.62$, $SD = 2.74$; $\beta_1 = 0.61$, $SD = 0.21$; $p < .004$). Group 3 ($n = 88$) had the best mean sleep quality score at baseline, but it significantly worsened over time ($\beta_0 = 4.06$, $SD = 0.29$; $\beta_1 = 0.09$, $SD = 0.04$; $p < .009$).

Preliminary to performing the analysis for Question 3, we conducted GCM for each of the health and well-being variables. Fit statistics were examined to ensure that each predictor variable met the assumptions of a linear model. For physical health, number of illnesses was dropped from this step of the analysis because of poor fit (Table 4). For psychological well-being, positive relations, personal growth, and purpose in life did not change, but, autonomy, environmental mastery, and self-acceptance had significant increases. For psychological distress, anxiety, and depression scores improved significantly over time. Subjective health declined significantly over time. (See Table 5).

Does Psychological Well-Being, Psychological Distress, or Subjective Physical Health Predict Different Patterns of Change in Sleep Quality Over Time?

The three-category model could not be used in these analyses because the smallest group ($n = 4$) was too small for statistical comparisons. The four women in this group were removed from analysis. We conducted GCM and GMM modeling with the remaining 111 women. A sequential testing of one-, two-, and three-category models indicated that a two-category model was the best fit and a better fit than the previous two- and three-category models in which all 115 women were used (see Table 3). In this model, Group 1 ($n = 87$) had relatively good sleep quality scores at baseline but worsened significantly over time ($\beta_0 = 3.95$, $SE = 0.39$; $\beta_1 = 0.10$, $SE = 0.10$; $p < .01$). Group 2 ($n = 24$) had worse sleep quality scores at baseline that remained poor ($\beta_0 = 7.38$, $SE = 0.42$; $\beta_1 = 0.20$, $SE = 0.14$; $p > .05$). A binary classification of sleep quality was created from these distinctly different groups. The larger group ($n = 87$) had low sleep quality scores at baseline, and scores increased significantly over time indicating good but diminished sleep quality over time. This group was classified as having "good sleep" (GS) in that while sleep worsened significantly overtime, overall sleep scores remained within a good range. The smaller group ($n = 24$) had poor sleep quality scores at baseline and no change in the level of sleep quality over time, indicating disrupted sleep that persisted over time. This group was classified as having "disrupted sleep" (DS).

We conducted GMM to identify whether any psychological well-being, psychological distress, or physical health variables at baseline predicted membership in the GS or DS group. We modeled the growth class membership, based on posterior probabilities, using logistic regression. Predictors were modeled one at a time. The results indicate that baseline levels of five dimensions of psychological well-being (positive relations with others, environmental mastery, personal growth, purpose in life, and self-acceptance) predicted membership in the DS group of women, that is, higher levels of psychological well-being were associated with

Table 3
Growth Mixture Model Fit Statistics For One-, Two-, and Three-Category Sleep Quality Models

Sample/Model/Group	*N*	AIC	BIC	Adjusted BIC	CAIC	LMR 2LL	LMR *p*
Original sample ($N = 115$)							
One-category model: Group 1	115	1719.69	1741.65	1716.27	1720.93		
Two-category model							
Group 1	106	1704.83	1735.03	1700.26	1720.93	19.49	0.01
Group 2	9						
Three-category model							
Group 1	23	1705.64	1744.07	1699.82	1700.06	4.85	0.69
Group 2	4						
Group 3	88						
Retested sample ($N = 111$)							
One-category model: Group 1	111	1614.83	1639.51	1611.22	1626.07		
Two-category model							
Group 1	87	1609.34	1639.15	1604.22	1616.07	10.73	0.24
Group 2	24						
Three-category model							
Group 1	86	1611.30	1649.23	1604.99	1589.57	3.77	0.14
Group 2	13						
Group 3	12						

Note. AIC = Akaike's information criterion; BIC = Bayesian information criterion; Adjusted BIC = BIC adjusted for sample size; CAIC = consistent AIC; LMR = Lo–Mendell–Rubin likelihood ratio; 2LL = 2 log likelihood.

lower odds of disrupted sleep (see Table 6). Higher depression and more illnesses at baseline were associated with greater odds of having disrupted sleep. Baseline autonomy, anxiety, and subjective health were not significant.

Discussion

Overall Findings

We believe that we are the first to examine individual differences in intraindividual change in sleep among older women, focusing on both positive and negative predictors, in a unique longitudinal study that allows for assessment of links between psychosocial factors and longitudinal change in sleep over a decade. We found a significant decline in the sleep quality of older women over time. Yet not all women experienced the same pattern of decline over time. Three distinctly different patterns of sleep emerged: women with good but declining sleep quality over time, women with poor sleep quality that remained poor over time, and a small number of women with poor sleep that continued to decline over time. While the first group of women had declines in their sleep, their overall sleep quality could still be categorized as good.

In previous studies, depression has been strongly linked to disrupted sleep. In this investigation, depression did not predict membership in the DS group. However, baseline depression was a significant predictor of declining sleep quality overall, which suggests that depression has a role in declining sleep quality but

Table 4
Linear Growth Curve Model Fit Statistics for Each Health and Well-Being Variable

Variable	χ^2	*p*	CFI	TLI	RMSEA	SRMR
Psychological well-being						
Positive relations with others	0.65	.42	1.00	1.00	.00	0.01
Autonomy	0.55	.46	1.00	1.01	.00	0.01
Environmental mastery	2.93	.09	0.99	0.97	.13	0.03
Personal growth	0.97	.33	1.00	1.00	.00	0.02
Purpose in life	1.74	.19	1.00	0.99	.08	0.02
Self-acceptance	0.14	.71	1.00	1.01	.00	0.01
Psychological distress						
Depression	0.02	.89	1.00	1.05	.00	0.003
Anxiety	1.76	.18	0.99	0.98	.08	0.02
Physical health						
Subjective health	2.95	.09	0.98	0.95	.13	0.03
No. of illnesses	7.76	.005**	0.94	0.83	.24	0.06

Note. $N = 115$. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual.
** $p < .01$.

Table 5
Linear Growth Curve Model for Each Health and Well-Being Variable

Variable	Intercept		Slope	
	β_0	*SE*	β_1	*SE*
Psychological well-being				
Positive relations with others	68.26	0.96	0.10	0.07
Autonomy	62.25	0.96	0.18**	0.07
Environmental mastery	65.64	0.91	0.22*	0.9
Personal growth	70.28	0.88	−0.06	0.07
Purpose in life	65.84	0.98	0.06	0.07
Self-acceptance	64.59	1.04	0.23**	0.80
Psychological distress				
Depression	9.42	0.66	−0.26***	0.07
Anxiety	18.92	0.52	−0.32***	0.05
Subjective health	5.57	0.09	−0.04***	0.01

Note. $N = 111$.
* $p < .05$. ** $p < .01$. *** $p < .001$.

perhaps not for all aging women. For example, it may be beneficial to examine differences between women with and without significant depressive symptoms or with concomitant depression and poor physical health. Anxiety has also been associated with poor quality sleep—in particular, difficulty falling asleep, reduced total sleep time, and difficulty returning to sleep once aroused (Spira, Stone, Beaudreau, Ancoli-Israel, & Yaffe, 2009). Indeed, sleep problems are included in the diagnostic criteria for generalized anxiety disorder, and anxiety is included in the diagnostic criteria for insomnia (American Academy of Sleep Medicine, 2005; American Psychiatric Association, 2000). In this investigation, anxiety was not found to predict changes in sleep quality with aging, and, in fact, an overall decline in anxiety was demonstrated. However, the overall level of anxiety in this sample was low. It is not clear what contributes to either decreases or increases in anxiety with age, and the levels of anxiety at which sleep quality may begin to decline are unknown.

The findings specific to psychological well-being suggest that interplay between well-being and sleep exists (Ryff et al., 2004). Previous research in aging has focused on the negative aspects of psychosocial health—that is, how psychological adversity increases biological risk. While this is an important area of investigation, it ignores the potential benefits of positive health. A key hypothesis of positive health is that there is interplay between biopsychosocial processes such that positive psychological well-being will be accompanied by positively functioning physiologic processes. This interplay has been demonstrated in studies of psychological well-being and health, that is, lower plasma IL-6 levels (Friedman et al., 2007) and lower glycosylated hemoglobin (Tsenkova, Love, Singer, & Ryff, 2007) in individuals with higher psychological well-being. If the psychological well-being findings of this investigation were interpreted from a positive health perspective, findings from this investigation indicate that higher levels of baseline positive relations with others, environmental mastery, purpose in life, and self-acceptance predicted membership in the GS class. The nature of the relationships between psychological well-being and sleep needs further examination in larger, longitudinal studies and in more heterogeneous samples.

It has been assumed that older adults follow the same pattern of sleep with age, except for variances due to specific health problems. In this study, we examined two measures of physical health in relation to sleep quality. A decline in subjective health did not predict declines in the sleep quality of older women. Because of sample size limitations, we were not able to examine whether health at baseline or declines in health over time predict changes in sleep quality for some groups and not others. The small group of women with very poor sleep quality may represent a group of women with poorer health, and investigation of this group is indicated. It would be interesting to examine whether positive health factors, such as exercise or lower body mass index, might protect women from disrupted sleep over time. Exercise, cognitive–behavioral therapies, and weight reduction are interventions shown to improve disrupted sleep. It is not clear whether use of these techniques prior to declines in sleep quality might serve a protective role. Another ideal question for future inquiry is whether restorative sleep may serve to buffer the relationship between stress and negative affect.

The women in this sample were generally well-functioning and healthy and yet still experienced declines in sleep quality. This finding seems to support the view that the shift toward lower quality sleep with aging is normal. On the other hand, if diminishing health and well-being are largely responsible for the changes in sleep observed with age, it would seem likely that a group of healthy women with consistently high sleep quality would emerge. When conducting a meta-analysis of age-related changes in sleep, Ohayon et al. (2004) found that the effect size was considerably smaller when participants with psychological or physical illness were excluded but that poor health did not obscure the overall significant declines in sleep quality with age. These findings are consistent with those of this study, which suggests that age-related changes in sleep quality are normative and are independent of diminished health and well-being. What is not known is whether the findings of this investigation reflect changes in sleep in aging men or even in women who are not so healthy or socioeconomically advantaged.

In this investigation, statistical methods were employed that have not been used in past sleep quality research; consequently,

Table 6
Baseline Health and Well-Being Variables Predicting Membership in the Disrupted Sleep Group

Variable	Estimated logit	*SE*	Odds ratio
Psychological well-being			
Positive relations with others***	−.11	.03	0.90
Autonomy	−.02	.03	0.98
Environmental mastery**	−.07	.02	0.94
Personal growth*	−.06	.02	0.94
Purpose in life**	−.07	.02	0.93
Self-acceptance**	−.07	.02	0.94
Psychological distress			
Depression*	.07	.03	1.08
Anxiety	.01	.04	1.01
Physical health			
Subjective health	−.14	.25	0.87
No. of illnesses*	−.27	.12	0.77

Note. $N = 111$.
* $p < .05$. ** $p < .01$. *** $p < .001$.

they provide another perspective for examining potential changes in sleep quality over time. The use of GCM and GMM allowed the sleep quality of individual women to be followed over time and their rates of change in sleep quality to be analyzed. Following intraindividual and interindividual change over time provides insights into the reasons that previous research findings regarding sleep changes with age were conflicting. Also, we used a community-based sample of older adults. Research on community groups provides a different picture than research on clinical samples, expanding previous sleep research of healthy older adults. Finally, the relationship between sleep and positive psychological functioning has been examined in only a few studies. The findings of this investigation suggest that psychological well-being may serve as a resource that deserves more attention.

There are several limitations to this investigation. As a secondary data analysis, the design and measures used in the study could not be changed. Having data at four intervals, rather than three, may have allowed for testing for curvilinear changes over time. This study relied on self-report measures (PSQI), which have limitations. There is a tendency for some participants to underestimate sleep time because of fragmented sleep, a problem for many older adults. However, study of sleep disruption often relies on self-report because the cost of PSG can be prohibitive for research not involving sleep staging or the diagnosis and management of sleep disorders. Also, PSG findings have been found to be at variance with subjective sleep complaints (Pressman & Fry, 1988). Taking the limitations of both methods into consideration, self-report findings must be interpreted with caution. Future studies may benefit from combining self report with PSG measures.

We were able to examine predictors of different sleep patterns, but we were not able to test the relative contribution of different dimensions of psychological well-being to sleep quality because of sample size limitations. We also did not examine the potential bidirectional influence of disrupted sleep on health and well-being. Both would be important directions for future studies. And finally, the sample for this investigation was skewed toward positive health and well-being. The women in the sample had few illnesses and were economically secure, and most were White. Cultural differences in sleep quality have been reported in a multiethnic sample of middle-aged women (Jean-Louis et al., 2008). Conducting similar analyses with a more culturally or economically heterogeneous group and in women with poorer health is important as it may produce different outcomes. However, in this sample of relatively healthy women, higher levels of several dimensions of psychological well-being at baseline predicted reduced odds for DS group membership, perhaps protecting women from disrupted sleep over time.

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