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The Course of Subjective Sleep Quality in Middle and Old Adulthood and Its Relation to Physical Health

Sakari Lemola[1] and David Richter[2]

[1]Department of Psychology, University of Basel, Switzerland.
[2]German Institute for Economic Research, Berlin, Germany.

Objectives. Older adults more often complain about sleep disturbances compared with younger adults. However, it is not clear whether there is still a decline of sleep quality after age 60 and whether changes in sleep quality in old age are mere reflections of impaired physical health or whether they represent a normative age-dependent development.

Method. Subjective sleep quality and perceived physical health were assessed in a large sample of 14,179 participants (52.7% women; age range 18–85) from the German Socio-Economic Panel Study across four yearly measurement time points.

Results. Subjective sleep quality linearly declined from young adulthood until age 60. After age 60, a transient increase in subjective sleep quality occurred that coincides with retirement. After age 66, subjective sleep quality appears to decrease again. Physical health prospectively predicted subjective sleep quality and vice versa. These relations were similar for participants aged over and under 60.

Discussion. Around retirement, a transient increase in subjective sleep quality appears to occur, which might reflect a decrease in work-related distress. Perceived physical health appears to be important for subjective sleep quality in old adults but not more important than at younger age.

Key Words: German Socio-Economic Panel Study—Old age—Physical health—Retirement—Sleep quality.

Background

Older adults more often complain about sleep disturbances such as difficulty initiating and maintaining sleep, waking up too early, and excessive daytime tiredness compared with young adults (Bixler, Kales, Soldatos, Kales, & Hedley, 1979; Foley, Ancoli-Israel, Britz, & Walsh, 2004; Foley, Monjan, Simonsick, Wallace, & Blazer, 1999; Foley et al., 1995; Ganguli, Reynolds, & Gilby, 1996; Gíslason, Reynisdóttir, Kristbjarnarson, & Benediktsdóttir, 1993; Middelkoop, Smilde-van den Doel, Neven, Kamphuisen, & Springer, 1996; Newman, Enright, Manolio, Haponik, & Wahl, 1997; Schubert et al., 2002). In a study on three large epidemiological samples of adults aged 65 and older, more than 50% reported that they suffered from at least one of these symptoms most of the time (Foley et al., 1995).

Poor sleep in old adults is often secondary to physical health problems. In their epidemiological study, Foley et al. (1995) could show that sleep complaints were associated with a higher number of respiratory symptoms, physical disabilities, use of nonprescription medications, and poor self-reported health. In the same line, further studies on the comorbidity of sleep complaints suggest that the majority of geriatric sleep complaints are not the result of age per se but rather of medical and psychiatric disorders (Foley et al., 2004; Giron et al., 2002; McCrae et al., 2005; Taylor et al., 2007; Vitiello, Moe, & Prinz, 2002). Thus, the high prevalence in sleep complaints among older persons may partially also reflect the age-related high prevalence in chronic diseases and other health problems during older age.

Although there is high prevalence of sleep complaints in old age, there is, however, debate on the question whether sleep quality further declines after age 60. In support of a further decline of sleep quality after age 60, Phelan, Love, Ryff, Brown, and Heidrich (2010) reported a decrease in reported sleep quality in women aged 67 at baseline across a follow-up period of 10 years. In a related vein, studies by Middelkoop et al. (1996), Schubert et al. (2002), and Newman et al. (1997) reported an increase in night-time awakenings after age 60 based on cross-sectional data.

In contrast to the view that sleep quality continuously declines over the life span, Ohayon, Carskadon, Guilleminault, and Vitiello (2004) put forward that this course is asymptotically shaped with a linear decline between 20 and 60 years of age, which then reaches a low plateau level after the age 60. Their conclusions were based on a meta-analysis of 65 polysomnographic studies of individuals aged between 5 and 102. Polysomnography involves synchronous recording of the electrical activity of the brain (electroencephalogram, EEG), eye movements (electrooculogram, EOG), and muscle activity during sleep (electromyogram, EMG). Analysis of the sleep EEG allows to distinguish between different sleep stages and to determine the amount of slow-wave sleep (SWS), which is most important for the recuperative function of sleep (Borbély & Achermann, 1999). In their meta-analysis, Ohayon and

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coworkers (2004) found a marked reduction in SWS between ages 20 and 60 but no evidence for a further decrease after age 60. In line with these conclusions from polysomnographic studies, also several epidemiological survey studies found no further increases in sleep complaints after age 60: In the three epidemiological samples that included adults aged 65 and older studied by Foley and coworkers (1995), only in one sample sleep complaints increased with age. Moreover, this relation of age with sleep complaints disappeared after adjusting for differences in health status. Further, Ganguli and coworkers (1996) and Gíslason and coworkers (1993) found no further increases in sleep complaints with age after 60 years and relatively high persistence of symptom reporting in a 2-year follow-up (Ganguli et al., 1996). A recent study applying polysomnography on a sample of more than 2,600 participants showed no decrease of sleep efficiency after age 60, indicating no further increase of night-time awakenings and sleep onset latency (Redline et al., 2004). Based on the inconsistency in findings regarding the course of sleep quality after age 60, Vitiello (2006) concluded that there is need for further and more differentiated description of the developmental course of sleep quality in old age. A limitation of most of the prior studies on the development of sleep quality after age 60 is that sleep quality was only assessed cross-sectionally.

Although there is a large body of evidence that poor physical health is a reason for sleep disturbances, research is also accumulating that poor or insufficient sleep has negative consequences for physical and mental health as well. Prospective studies show that insufficient and disturbed sleep is related to a variety of physical and psychological health problems such as coronary heart disease (Meisinger, Heier, Löwel, Schneider, & Döring 2007), hypertension (Stranges et al., 2010), premature death (Heslop, Smith, Metcalfe, Macleod, & Hart, 2002), depression and anxiety disorders (John, Meyer, Rumpf, & Hapke 2005; Kaneita et al., 2006; Roth et al., 2006), and lower psychological well-being (Groeger, Zijlstra, & Dijk, 2004; Phelan et al., 2010). Among older adults, insomnia symptoms are predictive of poor cognitive performance (Nebes, Buysse, Halligan, Houck, & Monk, 2009) and related to higher incidence of suicidal ideation (Nadorff, Fiske, Sperry, Petts, & Gregg, in press). Correspondingly, there is a large body of evidence from laboratory-based studies that sleep plays a vital role for many somatic processes including metabolism, immunofunction, thermoregulation, and processes related to respiration and the cardiovascular system (Siegel, 2005). Moreover, many cognitive and psychological processes including memory consolidation, attentional processes, insightfulness, and emotional processing depend on the role of sleep for neuronal plasticity and recuperation (Brand & Kirov, 2011; Diekelmann & Born, 2010).

The present study has three goals: First, we aim at describing the course of subjective sleep quality across the life span in a large nationally representative panel study, that is, the German Socio-Economic Panel (SOEP). The panel design has the advantage that the development of several age groups can be described longitudinally, which allows to figure out whether cross-sectional differences between age groups reflect the longitudinal development. As there is evidence from the meta-analysis by Ohayon and coworkers (2004) that sleep quality decreases until age 60 but does not further decrease thereafter, we specifically test the hypothesis that subjective sleep quality shows a decrease until age 60 but remains on approximately the same level at higher age. Second, we examine the relationship between subjective sleep quality and perceived physical health. There is evidence of both an influence of physical health on sleep, as well as from sleep on physical health. We therefore test their interdependency in a longitudinal cross-lagged path model across four time points of measurement, expecting both significant prediction of subjective sleep quality and perceived physical health by the respective other variable. As there is a large body of evidence on the importance of physical health problems for sleep after age 60, we test the model separately in individuals of more than 60 years and younger individuals. Finally, we explore the association of the transition to retirement with subjective sleep quality as one major event during old age by specifically analyzing the subsample in the SOEP that experienced retirement between the assessment waves in years 2008 and 2011. Generally, the transition to retirement is described as a neutral life event that involves positive and negative effects on personal well-being. Although probably most retirees experience less work-related distress, have more free time for leisure and nonprofessional activities, and relationships with friends and their family, it also involves a loss in structure of the weekdays, less contact with work mates, and also a reduction of income (Luhmann, Hofmann, Eid, & Lucas, 2012). In a similar vein, retirement may be favorably associated with subjective sleep quality as it involves a reduction of work-related stress and offers independence in planning the day and choosing bed and wake times without daytime work-related constraints. On the other hand, retirement may also be negatively associated with subjective sleep quality due to decrease in structure and regularity of weekday activities, which imposed a regular sleep–wake schedule before retirement.

Method

Participants

The data was provided by the SOEP Study (Version 28) of the German Institute for Economic Research, which is an ongoing, nationally representative longitudinal study of private households in Germany (for details see Wagner, Frick, & Schupp, 2007). All members of selected households were asked to participate in the yearly interviews, which were conducted by a professional fieldwork organization (Infratest Social Research, Munich).

Starting in 2008, the measure of subjective sleep quality was administered yearly. In 2008, a total of 19,646 participants (52.4% women) completed them. In the subsequent years 17,620 (89.7% of the original sample; 52.4% women), 15,718 (80.0% of the original sample; 52.6% women), and 14,278 persons (72.7% of the original sample; 52.7% women) provided valid sleep-quality information again. For the present study, only participants with complete data were included. As the sample decreased in very old age, we followed the approach of Specht, Egloff, and Schmukle (2011a) and restricted our analyses to participants not older than 85 years (*Ns* > 40 per year).

Compared with the final longitudinal sample, participants dropping out after the first measurement (noncontinuers) were younger ($p < .001$), slightly less likely to be women ($p < .05$), slightly less educated ($p < .001$), less likely to be married ($p < .001$), separated ($p < .001$), and more likely to be single ($p < .001$). Furthermore, noncontinuers were more likely to be not working ($p < .001$) and less likely to be part-time working ($p < .001$). The main characteristics of the longitudinal sample and the noncontinuers are depicted in Table 1. In terms of the central constructs, noncontinuers reported slightly better health ($M = 3.29$ vs. $M = 3.19$, $p < .01$) and comparable subjective sleep quality ($M = 6.74$ vs. $M = 6.76$, $p = .634$). It can be concluded that the final longitudinal sample only slightly differs from the original sample. Moreover, only slight differences exist in comparison to the average of the adult population of Germany in the year 2011 (http://www.destatis.de; see also Table 1).

The subsample that experienced retirement between the measurement time points in 2008 and 2011 ($n = 385$, age $M = 62.13$ years, standard deviation [*SD*] = 2.61) was slightly less likely to be women (41.3%, chi square [χ^2] (1) = 20.55 $p < .001$) and of slightly higher educational status (28.4% low, 33.7% medium, 32.9% high, and 5.0% other educational status, $\chi^2(3) = 27.60$, $p < .001$).

Table 1. Main Characteristics of the Longitudinal Sample, the Noncontinuers, and the Adult Population of Germany in the Year 2011

	Longitudinal sample	Noncontinuers	Adult population of Germany
N	14,179	5,467	68,624,472
Age (in years)			
M	49.76	46.89	50.05
SD	16.55	18.81	18.53
Sex (% female)	52.7	51.1	50.9
Education[a]			
Low	32.8	33.1	36.3
Medium	36.7	33.1	28.9
High	22.3	20.1	26.6
Other	8.2	13.7	8.2
Marital status			
Single	21.6	30.7	42.3
Married	61.9	54.8	42.4
Seperated or divorced	10.3	8.6	8.2
Widowed	6.2	5.9	7.1
Work status[b]			
Full time	41.8	41.4	56.2
Part time	16.9	14.7	20.8
Not working	41.3	43.9	23.0

Notes. *M* = mean; *SD* = standard deviation.
[a]People with low educational background had graduated from the vocational track of the three-tier German secondary system, medium education refers to the intermediate track, and high education refers to the academic track.
[b]Work status of the adult population of Germany refers to people aged between 15 and 65.

Measures

To keep respondent burden for the participants of the SOEP to a minimum, subjective sleep quality was assessed via the single-item indicator "How satisfied are you with your sleep?" Responses were made on an 11-point scale ranging from 0 (totally unsatisfied) to 10 (totally satisfied). Validity of the assessment of subjective sleep quality with one item regarding sleep satisfaction has been reported by Ohayon and Zulley (2001). Individuals indicating poor sleep satisfaction on this single item were more likely to seek help for sleep problems and to use sleep medication than individuals who only reported insomnia symptoms but no dissatisfaction with sleep. Self-reported health was measured with the item "How would you describe your current health?" Responses were made on a 5-point scale ranging from 1 (bad) to 5 (very good). Validity of the assessment of global self-rated physical health with one item has been described by Idler and Benyamini (1997). In their systematic review of 27 studies, global self-rated health was a strong and independent predictor of mortality. Additionally, participants reported whether specific occupational changes occurred within the past year. For the analyses of the present study, we extracted information according to retirement in the years 2008 to 2011 and coded them dichotomously as 0 (retirement did not occur) or 1 (retirement did occur).

Analytical Strategy

All analyses were conducted with SPSS 19.0 (2011) and Mplus 6.11 (Muthén, L. K. & Muthén, 1998–2011). As the data of the participants of the SOEP are nested in households, we corrected for nonindependence of the data by calculating robust standard errors using the household number as a cluster variable in all analyses (cf. Muthén & Satorra, 1995).

To analyze the effects of age on subjective sleep quality, we created 17 four-year age groups on the basis of participants' age in 2008 (cf. Lucas & Donnellan, 2011). The youngest group ranged from 18 to 21 years, and the oldest group ranged from 82 to 85 years (Table 2). Scores of subjective sleep quality across the four measurement time points were fitted to linear growth models within a structural equation modeling framework. We tested whether the 17 age groups differed in their cross-sectional means (intercept), whether longitudinal development (slope) occurred across

Table 2. Sample Sizes of the 17 Four-Year Age Cohorts, Percentage of Women per Cohort, and Comparison of Intercepts and Slopes of Age-Cohort-Specific Growth Curves, and Gaps Between Age Cohorts

Age group	*N*	% Women	Chi-square (df = 1) intercept	*p*	Chi-square (df = 1) slope	*p*	Chi-square (df = 1) gaps	*p*
18–21	724	46.5	164.38	<.001	9.90	.002	-	-
22–25	607	52.9	76.25	<.001	1.30	.254	0.37	.545
26–29	664	56.0	38.41	<.001	1.56	.211	4.20	.040
30–33	683	56.2	30.32	<.001	2.88	.089	0.49	.485
34–37	804	52.9	28.84	<.001	6.06	.014	1.64	.200
38–41	1068	52.6	53.91	<.001	7.02	.008	14.58	<.001
42–45	1258	51.4	17.55	<.001	8.50	.004	1.58	.209
46–49	1196	53.8	20.88	<.001	13.78	<.001	11.85	.001
50–53	1173	53.8	2.37	.124	18.48	<.001	0.50	.480
54–57	1103	55.9	0.65	.420	8.61	.003	4.06	.044
58–61	1021	51.2	Reference	-	0.95	.328	10.53	.001
62–65	876	48.4	11.97	<.001	0.43	.512	7.95	.005
66–69	1104	50.5	3.79	.052	7.97	.005	4.19	.041
70–73	866	51.3	3.19	.074	4.68	.031	6.89	.009
74–77	496	52.6	0.46	.499	0.78	.377	0.30	.582
78–81	350	54.9	1.15	.284	4.17	.041	0.36	.548
82–85	186	69.4	2.05	.153	0.19	.662	1.01	.316

Notes. Chi-square values refer to comparisons of intercepts and slopes of age-group-specific growth curves and for cross-sectional-level differences between age cohorts ("gaps"). Intercepts were tested against the reference group that was 58–61 years old at the first measurement in 2008. "Gaps" refers to the cross-sectional comparison between end and starting points of adjacent age cohorts.

Table 3. Model Fit for Structural Equation Models of Sleep Quality in Relation to Health

	Model fit					Model comparison			
Model	df	χ^2	RMSEA	CFI	SRMR	Model	$\Delta\chi^2$	Model	$\Delta\chi^2$
Model 0	72	1929.99***	0.060	0.961	0.071				
Model 1 (forward)	66	1306.20***	0.051	0.974	0.051	M1 vs. M0	623.79***	M3 vs. M1	555.80***
Model 2 (reverse)	66	1247.92***	0.050	0.975	0.047	M2 vs. M0	682.07***	M3 vs. M2	497.52***
Model 3 (reciprocal)	60	750.40***	0.040	0.986	0.036	M3 vs. M0	1179.59***		

Notes. df = degrees of freedom; CFI = comparative fit index; RMSEA = root mean squared error of approximation; SRMR = standardized root mean residual. Analyses are controlled for sex, age, age², and age³.

Model 0 includes all autoregressions within variables over time (i.e., all paths from sleep quality and health on the respective construct a year later). Model 1 includes all autoregressions and forward paths (i.e., all paths from sleep quality on health a year later).

Model 2 includes all autoregressions and reverse paths (i.e., all paths from health on sleep quality a year later).

Model 3 includes all autoregressions, forward paths, and reverse paths (i.e., reciprocal paths).

***$p < .001$.

the four measurement time points, and whether there were significant differences between the end and the beginning of adjacent growth curves of consecutive age groups. To test the hypothesis that subjective sleep quality decreases until age 60 but does not further decline thereafter, the intercept of the cohort, which was 58–61 years old in 2008, was used as the reference against which all other group intercepts were tested. All model parameters were standardized relative to the overall sleep quality scores at the first measurement in the year 2008 (i.e., the mean of the intercept was set to 0, and its variance was set to 1). Model fit was evaluated with reference to the χ^2 and degrees of freedom, the root-mean-square error of approximation (RMSEA), the comparative fit index (CFI), and the standardized root mean residual (SRMR). We use the common guidelines that well-fitting models will have RMSEAs at or below .05, CFIs at or above .95, and SRMRs at or below .06.

To analyze the interdependence of health and sleep quality, we conducted multigroup cross-lagged path analyses. Competing models are explained and displayed in Table 3. The models all allowed for within-time correlations, and adjusted sex, age, age², and age³. In addition, we compared the model for younger (18–59 years) and older participants (60–85 years) in a multigroup approach. The χ^2 difference test was used to determine the best-fitting model.

To analyze the course of sleep quality during the transition to retirement, the sample was restricted to the 385 respondents, who experienced retirement across the four measurement time points of the study. The data on sleep quality were then centered on the yearly mean of the whole sample to account for average trends over time (cf. Lucas, Clark, Georgellis, & Diener, 2003; Specht, Egloff, & Schmukle, 2011b) and recorded relative to the year in which the retirement occurred. By using an unbalanced panel design and allowing missing data, the 2 years prior and the 2 years following retirement could be modeled by fitting a latent growth model (the data even allows modeling 3 years prior and 3 years following retirement. However, we decided against this because only few respondents provided date for these time points [3 years before retirement: $N = 100$, 3 years after retirement: $N = 107$].). Consequently, our sample size ranged from 186 to 385 respondents per year.

Adaptation of subjective well-being to major life events often occurs in a nonlinear fashion, namely by a large initial change followed by adaption (cf. Luhmann et al., 2012). Moreover, people often also report anticipatory changes in subjective well-being in the years before an event occurs (e.g., Lucas et al., 2003; Specht et al., 2011b). Therefore, we also estimated a quadratic slope in addition to the intercept and the linear slope in order to account for the possible curvilinear nature of the adaptation process.

In the models reported in the present study, error variances of manifest indicators were constrained to be equal across time points. For all tests $p < .01$ was considered criterion for statistical significance.

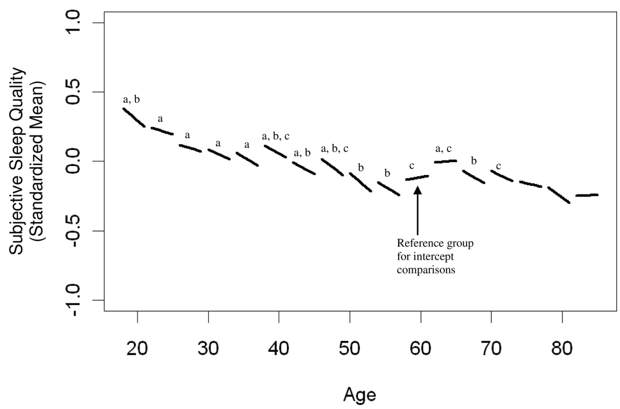

Figure 1. Mean level change in subjective sleep quality for the 17 four-year age cohorts, controlled for sex. [a] = Intercept different from the reference group (age 58–61) as revealed by chi-squared difference test (df = 1; $p < .01$). [b] = Slope different from 0 as revealed by chi-squared difference test (df = 1; $p < 0.01$).[c] = End and starting points of two adjacent age cohorts ("gaps") different as revealed by chi-squared difference test (df = 1; $p < .01$).

Results

Effects of Age and Time on Sleep Quality

Cross-sectional means and longitudinal changes in mean levels were examined by plotting intercepts and slopes from the multigroup latent grow model (see Figure 1). Specifically, each individual line plots the mean for the year 2008 and the longitudinal development over the years 2008–2011 for one of the 17 age cohorts. Consequently, the beginning of each line reflects the cross-sectional results for the year 2008, the end of each line reflects the cross-sectional results for the year 2011, and the slope of each line reflects longitudinal change for each cohort.

Figure 1 shows that the cross-sectional patterns are roughly consistent with the longitudinal development as sleep quality is steadily decreasing across the adult life span until around age 60. At some points, however, the cross-sectional pattern was inconsistent with the longitudinal course such that the end of the course of one cohort was significantly different from the beginning of the course of the subsequent cohort (i.e., at points where vertical gaps between consecutive lines occur in Figure 1). Significant ($p < .01$) cross-sectional gaps with better subjective sleep quality in the respective older cohort were found at 37–38 years, 45–46 years, 57–58 years, 61–62 years, and 69–70 years. The model fit for the unrestricted model (i.e., every age group was allowed to have individual intercept and slope values) was good (χ^2 (186) = 275.29, $p < .001$, RMSEA = 0.02, CFI = 0.99, SRMR = 0.02). Cross-sectional comparison of age group–specific intercepts to the intercept of the reference age group of 58- to 61-year-old participants revealed significantly better subjective sleep quality ($p < .001$) for all age groups between 18 and 49 years. The age groups older than 49 years were not significantly different from the reference group except for the age group of the 62- to 65-year-olds who reported significantly better subjective sleep quality than the younger reference group. This transient (cross-sectional) increase in subjective sleep quality is followed by a further moderate decrease, which is reflected in a significantly negative slope of the 66- to 69-year-old age group ($p = .005$). At age 85, subjective sleep quality arrives at a similar level as at around age 60 in the between-age-cohort comparison (see also Table 2).

The Relationship Between Health and Sleep Quality

In Table 3, fit statistics and model comparisons are presented for the competing models of sleep quality and health. According to the RMSEA, CFI, and SRMR fit statistics, all models provided a good fit to the data. The χ^2 difference test of the competing models showed that Model 3 (with reciprocal paths) fitted the data significantly better than the null Model, Model 1 (with forward paths), and Model 2 (with reverse paths).

Figure 2 presents the cross-lagged path analyses of self-reported health and subjective sleep quality. A table with all model parameters is provided as Supplementary Table A. The evaluation of the autoregressive pathways revealed moderate stability of subjective sleep quality and perceived health for the 1-year measurement intervals. Cross-lagged associations revealed that higher levels of subjective sleep quality in preceding years were significantly associated with higher self-reported health later on. Thus, individuals who were higher in the distribution of subjective sleep quality in preceding years tended also to be higher in the distribution of self-reported health later on. In turn, the cross-lagged associations of self-reported health on subjective sleep quality were also significant. That is, individuals who were higher in the distribution of self-reported health in preceding years tended also to be higher in the distribution of subjective sleep quality later on. Comparison of a model constraining paths to be equal between younger (<60 years old) and

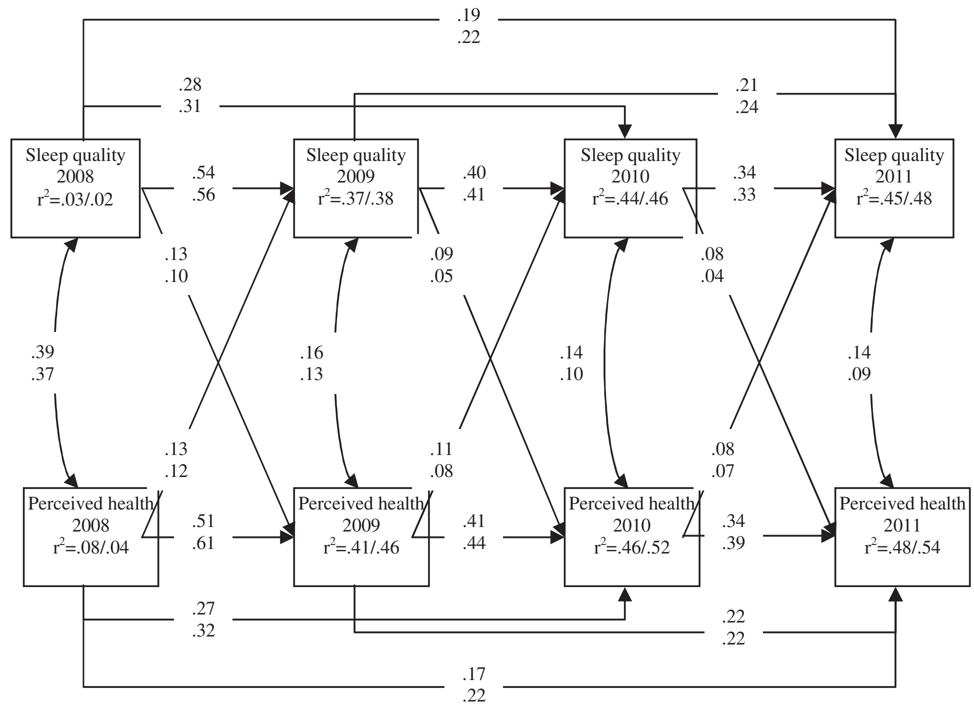

Figure 2. Cross-lagged path analyses of self-reported health and subjective sleep quality. Note. Values in upper rows represent coefficients for younger participants (18–59 years; *n* = 9,812), values in the lower rows represent coefficients for older participants (60–85 years; *n* = 4,367). Participant's gender, age, age², and age³ are controlled; the model including the coefficients for the control variables is presented in Supplementary Table A. All coefficients are significant at $p < .001$.

older participants (60 years and above) with a model without equality constraints between the two age groups showed a significant difference in model fit ($\chi^2(30) = 355.36$, $p < .001$; model without equality constraints: $\chi^2(60) = 750.40$, $p < .001$, RMSEA = 0.04, CFI = 0.99, SRMR = 0.04; model with equality constraints: $\chi^2(30) = 1105.76$, $p < .001$, RMSEA = 0.05, CFI = 0.98, SRMR = 0.04), although the model fit according to RMSEA, CFI, and SRMR was quite similar in both models. However, inspection of the path coefficients of the model without equality constraints reveals that the size of the coefficients was approximately similar for the younger and older group. To conclude, the analyses revealed that subjective sleep quality and self-reported health were bidirectionally interrelated. These relations were approximately similar for the younger and older age group.

The Association of Sleep Quality With Retirement

The linear latent growth model showed good model fit ($\chi^2(13) = 22.56$, $p = .05$, RMSEA = 0.04, CFI = 0.97, SRMR = 0.07; intercept: $\beta = -.216$, $p < .01$, slope: $\beta = .128$, $p < .001$) and was not inferior to the more complex quadratic model ($\chi^2\text{diff}(4) = 4.93$, $p = .18$). On average, an overall increase in subjective sleep quality of 0.51 points between sleep quality at the baseline level (2 years before retirement) and sleep quality 2 years after retirement occurred. This increase corresponds to an effect size of $d = 0.21$ ($p < .001$). (The effect size was calculated using the standard deviation of sleep quality at the baseline level of 2.47 (cf. Specht et al., 2011b) and reflects the change of sleep quality relative to the variability in the respective population 2 years before retirement.)

Discussion

This study on a large panel sample aged between 18 and 85 years shows a linearly declining course of subjective sleep quality from young adulthood until age 60, which was derived from a combination of longitudinal growth curves across 3 years and cross-sectional modeling across 11 age cohorts between 18 and 60 years. After age 60, a transient increase in subjective sleep quality occurs that coincides with retirement. For individuals who experienced retirement within the time span of our study (i.e., between 2008 and 2011), an increase of subjective sleep quality occurred that already started before retirement. After the age of 66, subjective sleep quality shows again a decrease. Moreover, analyses revealed that subjective sleep quality can be predicted by the perception of physical health 1 year before while subjective sleep quality is also predictive of physical health. Thus, individuals who tended to be higher in the distribution of subjective sleep quality tended also to be higher in the distribution of perceived health in the following year and vice versa. The predictive power of physical health was approximately similar in young as in old adults.

Our findings are consistent with a meta-analysis, which shows that objectively assessed sleep indices such as sleep efficiency and the amount of SWS pronouncedly decrease between ages 20 and 60 but do not further decrease thereafter, thus resembling an asymptotic rather than a linear course (Ohayon et al., 2004). However, the findings are in contrast to the notion that sleep quality further deteriorates after age 60 as for instance assumed by epidemiological studies by Schubert et al. (2002) and Newman et al. (1997). According to Vitiello (2006), the conflicting evidence from polysomnographic research as summarized by Ohayon et al. (2004) on the one hand and from some of the epidemiological studies on the other hand (e.g., Newman et al., 1997; Schubert et al., 2002) may be reconciled by the point that the range in physical health is larger in the epidemiological studies. Thus, in samples with a larger range in physical health, it is more probable to find further deterioration of sleep quality after age 60 due to decreasing physical health. The findings of the present study, however, are rather consistent with the view that subjective sleep quality is overall relatively stable after age 60 also in population-based samples as the SOEP—although there is short period of increase after age 60, there is also a decrease after around age 66 compensating for the transient rise. A possible reason for the difference in our findings to the ones reported by Schubert et al. (2002) and Newman et al. (1997) is that the SOEP participants reported their sleep quality on a one-item global score of sleep quality, which taps perceived satisfaction with sleep, whereas Schubert et al. (2002) and Newman et al. (1997) relied on questionnaires on sleep quality that mainly assess insomnia symptoms. Although the one-item assessment of sleep quality proved valid in several regards (see e.g., Ohayon & Zulley, 2001), it is possible that it is more strongly affected by cognitive accommodation processes in older individuals, who may adjust their evaluation of sleep quality in reference to their age.

Our findings are further in line with the notion that physical health is predictive of subjective sleep quality (Foley et al., 1995; Vitiello, 2006). Poor health status may affect sleep; patients who suffer from obesity, cardiovascular disease, respiratory problems, physical disabilities, or chronic pain are known to report lower sleep quality than healthy individuals (Foley et al., 1995; Taylor et al., 2007). On the other hand, our findings are also consistent with a large body of evidence that indices of sleep quality are predictive of physical health (e.g., Heslop et al., 2002; Meisinger et al., 2007; Stranges et al., 2010). Good night sleep is beneficial for metabolism, thermoregulation, immunofunction, and processes related to respiration and the cardiovascular system (Siegel, 2005). Moreover, sleep plays a crucial role for psychosocial adjustment and cognitive function—in particular, SWS is involved in learning and memory consolidation processes (Diekelmann & Born, 2010). Maintaining an adequate sleep quality may therefore play a crucial role for successful aging. However, our results are not in line with the expectation that physical health becomes more important for sleep quality during older age compared with how important it already was during younger adulthood.

The finding that subjective sleep quality is rising around the transition to retirement might reflect a decrease in work-related distress or the increase in flexibility to organize the day according to one's circadian preferences. Due to lack of an appropriately comparable control group of individuals who did not experience retirement at the same age, causal interpretations of the increasing level of subjective sleep quality around retirement are not possible.

Limitations

As subjective sleep quality was only assessed across four measurement time points, the analyses reported in this study have to rely in part on the assumption that the within-subject course is reflected in the pattern found between subjects. At some points between ages 18 and 85, between-age-group differences occurred that were in contrast to the within-subject growth curves (e.g., differences between age cohorts that indicate better subjective sleep quality in the older age cohort, whereas the slopes of subjective sleep quality in both cohorts were indicative of a decline in subjective sleep quality during this age period). It is possible that these inconsistencies between longitudinal and cross-sectional findings reflect sample attrition forces that act during these age periods. In a related vein (and although the SOEP is generally considered to be a representative study of the German population), it is acknowledged that the sample attrition of individuals after age 60 is selective regarding health status. Participants who are in less good condition at age 60 are less likely to participate 10 years later. Thus, it cannot be ruled out that selective drop out of participants with compromised health status and selective selection into the study due to good health status are driving forces behind the transient rise/asymptotic course of subjective sleep quality in older age.

Furthermore, one has to bear in mind that the cross-sectional findings are also confounded with age-cohort effects. For example, individuals who reached age 65 in the year 2008 were born during World War II. One may assume that their developmental patterns differ in many regards from individuals who were born 20 years later. The cohort-sequential approach is the method of choice to disentangle effects of aging and cohort differences (see, e.g., Schaie, 1965), which, however, would need a longer follow-up time. Formal tests of convergence of within-person change and between-person age differences in age heterogenous longitudinal studies have recently been suggested (Sliwinski, Hoffman, & Hofer, 2010).

A further limitation is the use of analytical approaches that are based on the analysis of interindividual variation. According to the study by Molenaar, Sinclair, Rovine, Ram, and Corneal (2009), conclusions that are derived from analyses of interindividual variation may often not be generalized to processes that operate on an intraindividual level. Future studies on longitudinal development of subjective sleep quality might apply multilevel modeling approaches that separately analyze within-person development and between-person variation as for instance suggested by Hertzog and Nesselroade (2003). Moreover, it is of note that also the presented longitudinal growth curves only reflect average courses of age cohorts. These average courses are most probably not representative for the development of every single member of the respective age cohort.

The present study relies on panel data that were collected at 1-year intervals. We assume that the measurement interval of 1 year is a meaningful choice for the study of some of the possible processes that link sleep and health—in particular, processes that operate on a time scale of years such as the relationship of sleep indices with changes in BMI (see e.g., Hasler et al., 2004) or with increases in risk factors of myocardial infarction (Meisinger et al., 2007). Future studies that are interested in the relationship of sleep with other health indices that fluctuate on a shorter timescale—such as the intensity of chronic pain—might use shorter time intervals to study the interdependence with sleep. Also the study of the course of subjective sleep satisfaction across the transition to retirement might benefit from applying shorter time intervals as this would provide the opportunity to study the adaptation process in a more fine-grained manner.

In the SOEP, subjective sleep quality and perceived health were only assessed with single items. It is possible that subjective sleep quality in older age does not reflect sleep disturbances as closely as in younger age groups because older individuals may adjust their evaluation in reference to their age. Therefore, it is possible that older persons can be quite satisfied with their sleep although they may have more sleep disturbances than younger individuals. In a similar line, it is a limitation that no objective measures of sleep and health were applied (e.g., actigraphy to assess sleep and a physician's examination of health status). As both subjective sleep quality and perceived physical health are assessed with self-report measures, it is possible that their relationship is partly due to same-method variance.

Conclusion

The decline in subjective sleep quality across the life span appears not to be linear. Around retirement, subjective sleep quality is temporally on the rise again before a second decline occurs. Subjective sleep quality and perception of physical health are bidirectionally related.

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Conflicts of Interest

The authors report no potential conflicts of interest.

Supplementary Material

Supplementary material can be found at: http://psychsocgerontology.oxfordjournals.org/

Correspondence

Correspondence should be addressed to Sakari Lemola, PhD, Department of Psychology, University of Basel, Missionsstrasse 62a, 4055 Basel, Switzerland. E-mail: Sakari.Lemola@unibas.ch.

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