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Sleep and Circadian Rhythms in Spousally Bereaved Seniors

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Abstract

A laboratory study of sleep and circadian rhythms was undertaken in 28 spousally bereaved seniors (≥60 yrs) at least four months after the loss event. Measures taken included two nights of polysomnography (second night used), ~36 h of continuous core body temperature monitoring, and four assessments of mood and alertness throughout a day. Preceding the laboratory study, two-week diaries were completed, allowing the assessment of lifestyle regularity using the 17-item Social Rhythm Metric (SRM) and the timing of sleep using the Pittsburgh Sleep Diary (PghSD). Also completed were questionnaires assessing level of grief (Texas Revised Inventory of Grief [TRIG] and Index of Complicated Grief [ICG]), subjective sleep quality (Pittsburgh Sleep Quality Index [PSQI]), morningness-eveningness (Composite Scale of Morningness [CSM]), and clinical interview yielding a Hamilton Depression Rating Scale (HDRS) score. Grief was still present, as indicated by an average TRIG score of about 60. On average, the bereaved seniors habitually slept between ~23:00 and ~06:40 h, achieving ~6 h of sleep with a sleep efficiency of ~80%. They took about 30 min to fall asleep, and had their first REM episode after 75 min. About 20% of their sleep was in Stage REM, and about 3% in Stages 3 or 4 (slow wave sleep). Their mean PSQI score was 6.4. Their circadian temperature rhythms showed the usual classic shape with a trough at ~01:00 h, a fairly steep rise through the morning hours, and a more gradual rise to mid-evening, with an amplitude of ~0.8°C. In terms of lifestyle regularity, the mean regularity (SRM) score was 3.65 (slightly lower than that usually seen in seniors). Mood and alertness showed time-of-day variation with peak alertness in the late morning and peak mood in the afternoon. Correlations between outcome sleep/circadian variables and level of grief (TRIG score) were calculated; there was a slight trend for higher grief to be associated with less time spent asleep ($p = 0.07$) and reduced alertness at 20:00 h ($p = 0.05$). Depression score was not correlated with TRIG score ($p > 0.20$). When subjects were divided into groups by the nature of their late spouse's death (expected/after a long-term chronic illness [n = 18] versus unexpected [n = 10]), no differences emerged in any of the variables. In conclusion, when studied at least four months after the loss event, there appears to be some sleep disruption in spousally bereaved seniors. However, this disruption does not appear to be due to bereavement-related disruptions in the circadian system.

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Keywords

Bereavement; Widow; Sleep; Circadian rhythms

Introduction

For most people, spousal bereavement is the most devastating life event that they will ever experience. It happens in the lives of more than 800,000 older Americans every year (Murrell et al., 1984). Apart from the severe emotional strain of the loss of a loved one, there are profound changes in lifestyle and status, often accompanied by a reduction in financial security, perceived personal safety, and freedom of action. As noted by Reynolds et al. (1992), sleep disturbance is a major, persistent, and debilitating aspect of spousal bereavement. Although sleep disturbance is particularly prevalent in the depressed bereaved, even bereaved persons who fail to meet a formal diagnosis of depression have measurable sleep impairment. When a group of spousally bereaved seniors with sub-syndromal symptoms of depression were compared with an age-and gender-matched control group, all of the bereaved subjects scored ≥5 on the Pittsburgh Sleep Quality Index (PSQI), compared to only 4 of the 14 control subjects (Pasternak et al., 1992). More recent, large-scale, epidemiological studies in both Japan (Doi et al., 2000) and Sweden (Valdimarsdottir et al., 2003) have reported that being widowed increases the risk of sleep disorders by up to 90%.

There are, of course, many different possible etiologies to bereavement–related sleep disturbance, and three major (inter-related) pathways can be identified. The first is simply the loss of a loved one who may have been the subject's bed partner for many decades, and whose absence at night can be particularly painful. Second, there are widow(er)s who meet formal research diagnostic criteria for psychiatric disorders. Major Depressive Disorder (MDD) afflicts about 28% of the spousally bereaved (Zisook & Shuchter, 1993). This risk of MDD appears to peak during the first six months of bereavement (Harlow et al., 1991; Mendes de Leon et al., 1994). Reynolds et al. (1992) showed that depressed bereaved subjects were almost identical to non-bereaved depressed unipolar MDD patients of matched age and gender, both in PSQI scores (bereaved = 12.3 vs. non-bereaved = 12.9) and polysomnographic (PSG) measures of sleep continuity, REM sleep measures, and NREM sleep architecture. In analyzing the possible cognitive mechanism of this sleep disruption in the spousally bereaved elderly, Hall et al. (1997) showed that levels of intrusive thoughts and avoidance behaviors reported by depressed bereaved subjects were extremely high, resembling values reported among individuals with post-traumatic stress disorder. A third mechanism by which sleep might be disrupted in the spousally bereaved is through the disruption of the subject's circadian rhythms. Not only does spousal bereavement lead to the loss of a loved one, but it also leads to profound lifestyle changes in the survivor, whose life must often be radically restructured after the event (Holmes & Rahe, 1967). In a paper discussing the effects of rhythm-disturbing life events, Ehlers et al. (1993) addressed the additional role of spousal bereavement as a potent Zeitstőrer, or time disrupter. In the Zeitstőrer model, we posit that spousal bereavement may result in the elimination of many social zeitgebers that had previously served to keep the individual's circadian rhythms properly entrained (either directly or indirectly as a gatekeeper to photic zeitgebers). Thus, the absence of the spouse may, for some people, lead to the absence of a reason to wake up, take meals, and go to bed at particular times of day. We suggest that this may lead to circadian disentrainment, with a consequent impairment of mood, sleep, and daytime functioning resulting from misaligned (and/or low-amplitude) circadian rhythms. There appear to be no studies in the literature regarding circadian rhythms in the spousally bereaved, and one primary aim of the present study was to fill that gap.

The present report is concerned with a group of 28 spousally bereaved seniors who were recruited for a randomized clinical trial of a behavioral intervention designed to improve their sleep. In order to avoid the major acute effects of bereavement (and to avoid burdening subjects with laboratory studies at an extremely difficult time in their lives), sleep and circadian rhythm studies were performed at least four months after the loss event. This report focuses upon the baseline measures that were acquired from subjects before therapy was started. Assessments include subjective measures of grief severity, sleep, circadian rhythms, and lifestyle regularity, as well as objective laboratory measures of sleep (by polysomnography) and circadian rhythmicity (of core body temperature).

Method

Subjects

Subjects were recruited by word of mouth and advertisements. The usual procedure of having a single project coordinator (JRZ) being involved with the subject's entire experience of the study—from initial recruitment through signed informed consent, introduction to therapists and laboratory staff, and follow-up and debrief—was followed. This allowed the development of a very close relationship between subject and project coordinator, which assisted greatly in subject compliance and retention. The laboratory supervisor (BDB) introduced the subject to the laboratory procedures and ensured that she or he was comfortable and well looked after (and that complete data were obtained), using a team of trained technicians. All were well experienced and certified appropriately for running clinical studies. The completion of self-report questionnaires and diaries was supervised by the project coordinator, who addressed any concerns of the subject regarding those instruments. Evaluations of depression were conducted by qualified masters or doctorate level therapists, who were not the subject's own therapist for the study. Any medical or psychiatric issues were addressed by one of the team physicians (DEM, MKS).

The present study concerns 28 subjects (24F, 4M, age = 60–84 yrs, mean = 72.3 yrs, SD = 6.4 yrs) who had provided full sleep and circadian variables at the time of writing. All subjects were spousally bereaved and studied in the laboratory between 4 and 19 months after the loss event (mean 8.3 months, SD = 3.4 months). Potential subjects who were on antidepressant medication were not recruited, but subjects remained in the study if they were later put on such. Following baseline assessments, subjects took part in a study involving a potentially therapeutic intervention as well as assessments of sleep, physical health, mental health, and functioning. Intervention sessions were provided at no cost to the subject, and subjects were compensated for their time. The protocol complied with the University of Pittsburgh Biomedical Internal Review Board (IRB) and with the ethical standards of this journal (Touitou et al., 2006). Full informed consent was obtained.

Subjects were required to be free of clinical unstable medical or psychiatric conditions that warranted immediate intervention (i.e., they were clinically stable and on a fixed treatment regimen), but otherwise exclusion criteria allowed for fairly inclusive recruitment. In particular, subjects were included even if they coded for major depressive disorder (MDD). Inclusion criteria also included the requirement of having some sleep problems (PSQI ≥ 5 or percent sleep efficiency <90%), but no potential subjects were excluded by these criteria. For those who passed the screening processes, the intervention consisted of either Social Rhythm Therapy (SRT), which is designed to induce an active and regular lifestyle, or Emotion-Focused Therapy (EFT), which is designed to explore the triggers of grief. Each therapy lasted six months and involved ten one-on-one sessions. All of the data to be described here, however, were collected before any therapy had been given. The only contact with the therapist had been a “meet and greet” session during which the subject was introduced to the diary instruments and a baseline 25-item Hamilton Rating Scale for Depression (HRSD) was obtained.

For their data to be included in this analysis for this report, subjects were required to have provided informed consent and to have given a medical history, undergone a physical exam, provided a standardized psychiatric history, and have completed all the sleep and circadian rhythm measures. Before the laboratory study, all subjects had a screening night of polysomnography (PSG) with full oximetry at their habitual bed timings. To be included in the protocol, subjects were required to have an Apnea-Hypopnea Index (AHI) score <35 and Periodic Limb Movements with Arousal (PLMA) score <20.

Procedures

All studies took place in a one-bedroom apartment with living room, bathroom, and kitchenette area that comprised part of the Biological Rhythm Laboratory (BRL) of the University of Pittsburgh Neuroscience Clinical & Translational Research Center (N-CTRC). The BRL allows the complete monitoring of subjects while they live in a comfortable apartment. There were no windows, but time isolation was not enforced. Subjects were studied singly. Technicians (who continually monitored the subject using closed-circuit TV and audio monitoring) often entered the apartment and chatted with the subject, trying to keep the topics of conversation neutral (when possible).

Each subject arrived for the 36 h study at ~20:00 h and body temperature monitoring started immediately. The subject was then prepared for PSG recording. A snack was made available. All lights were extinguished at the subject's habitual bedtime (as determined by a prior two-week sleep diary). At the subject's habitual wake time, the lights were turned on, and the subject was required to get up and get dressed (but was not allowed to get up before then, except for brief visits to the toilet). Breakfast was provided 1 h after habitual wake-time, with lunch at noon and dinner at 18:00 h. If requested, exercise (on a stationary bicycle) and a shower were allowed only between 10:30 and 12:00 h. Some cognitive tests and questionnaires (in addition to four mood and alertness tests) were given during the day, but otherwise the subject was free to read, pursue hobbies, or watch TV. An evening snack was again available, the subject again prepared for PSG recording, and the second night sleep again studied at the subject's habitual bedtime. This second sleep provided the PSG variables that are reported here. On the second morning, PSG and temperature monitoring was concluded, breakfast given, and the subject offered taxi transportation home. Normal daytime illumination levels in the apartment, from fluorescent and incandescent bulbs, averaged 450 lux (everywhere < 1000 lux). Only incandescent bulbs were used (<300 lux) between 18:00 h and bedtime. Sleep was in darkness, although infra-red camera monitoring was in place to assure subject safety.

Measures

Level of grief was measured using the Texas Revised Inventory of Grief [TRIG] insrument (Thompson et al., 1991) using the total score (the sum of both past and present symptoms). Also given was the Index of Complicated Grief (ICG), which was used to assess which of the subjects were experiencing complicated (or traumatic) grief, as defined by an ICG score >25 at more than six months post-loss (Prigerson et al., 1995). The date of these and other evaluations was sometimes different from the date of the sleep study.

Each subject also completed the Composite Scale of Morningness (CSM; Smith et al., 1989) and Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). The CSM yields a numerical score showing where an individual lies on the “morning lark” versus “night owl” continuum; the PSQI yields a measure of subjective sleep quality, with higher numbers indicating more problems. Subjects also completed diaries at home for two weeks: a modified form of the Pittsburgh Sleep Diary (PghSD; Monk et al., 1994) and the 17-item Social Rhythm Metric (SRM; Monk et al., 1990). The SRM requires the subject to note the timing and other details of 17 events during their day. The instrument yields the SRM score itself, as well as the Activity

Level Index (ALI), which comprises a simple count of the number of events (of the 17 specified ones) done per week. ALI scores thus range up to 119 (7 × 17). The SRM score is calculated for each full week and comprises a metric of lifestyle regularity ranging on a continuum between 0 and 7, with higher numbers indicating greater lifestyle regularity (Monk et al., 1990). The present analysis was based on the average SRM and ALI scores from the two weeks. Concurrent with the two-week SRM, the wake-time section of the PghSD (Monk et al., 1994) was completed, from which the habitual bed and wake-time of each subject was determined using a standard algorithm on the 14 nights. Additionally, wrist actigraphy was applied during the two-week study span; these findings will be reported elsewhere.

PSG recordings included one channel of EEG ($C_3 - (A_1 + A_2)$), two referential electro-oculograms (EOG), and submental electromyogram (EMG). All electrode impedances were <5,000 ohms, and the EEG band pass was 0.3–30 Hz. PSG recordings were directed onto a computer with sampling at a rate of 256 Hz. Following standard conventions of the University of Pittsburgh N-CTRC, all nocturnal polygraph records (stored on the computer) were scored visually by PSG technicians into 20 sec epochs according to modified Rechtschaffen and Kales (1968) criteria. The PSG variables used in the present study were: sleep efficiency (percent of night actually spent asleep), sleep latency (min between lights out and sleep onset); min of wakefulness after sleep onset (WASO), sleep duration (total min of PSG sleep obtained after subtraction of sleep latency and WASO); percent sleep spent in stage of rapid eye movement (%REM), percent sleep spent in stages 3 and 4 (%SWS), and REM latency (min between sleep onset and first REM period).

Core body temperatures were recorded continuously, sampling every min around the clock, either using an online system with a rectal thermistor (n = 6) or an ingestible pill-based system (n = 22). The rectal system comprised our standard system, as described earlier (Monk et al., 1995). The ingestible pill-based system (VitalSense®, Minimitter Corp., Bend, Oregon, USA) is based on a radio pill that is swallowed and broadcasts the internal temperature to a receiver in a belt-pack device worn by the subject. The pill passes through the subject undigested and is then discarded with a bowel movement. At the completion of the 36 h study, data from the belt-pack are downloaded onto a computer for subsequent analysis. The initial (non-biological and unreliable) values obtained during the first 40–100 min after swallowing the sensor were discarded.

Cosinor analyses were used to examine the temperature time series of each subject. A mixed model repeated measures ANOVA was used to fit 12 and 24 h sine and cosine curves to each individual's 10 min mean time series data. These analyses use an adaptation of SAS Proc Mixed (details of which can be found at http://www.stat.cmu.edu/~hseltman/SASMixed/primer.pdf). Each individual's fitted curve was then used to estimate the subject's amplitude (maximum value minus minimum value [T_{range}]) and phase (time of the minimum value [T_{min}]). Fitted curves that failed to account for ≥25% of the variance ($R^2 < 0.25$) were not used in the calculation of amplitude and phase estimates. This led to the data of five subjects being excluded. For the purpose of illustration, the temperature data of each subject were presented as the deviation from the temperature mean of that subject for the ~36 h span.

At four times throughout the day (i.e., at ~07:30, 10:00, 16:00, and 20:00 h), the subject was required to complete computerized evaluations of alertness (global vigor) and mood (global affect) using visual analogue scale techniques reported elsewhere (Monk, 1989). These scales yield a number between 0 and 100, with higher values indicating greater alertness and better mood. Also, during the day there were evaluations of cognition and the completion of other pencil-and-paper questionnaires, the findings of which will be published elsewhere.

Data Analysis

The primary analysis comprised a descriptive summary of the sleep and circadian rhythm findings from the 28 spousally bereaved subjects. These descriptive statistics are compared with published findings from seniors not spousally bereaved. Repeated measures mixed model analysis of variance (ANOVA) was used to test for significant time-of-day effects in alertness and mood. Time was used as a class variable to compare discrete time points. There were two secondary analyses. In the first, correlations between TRIG score and endpoints of the sleep/circadian variables were calculated using the Spearman's rho statistic. The second concerned the nature of the late spouse's death. The division, which was completed by the project coordinator (JRZ, who was blind to the sleep/circadian results), was into two groups, namely expected (after a long-term chronic illness) versus unexpected (sudden or after a very short illness). Non-parametric Wilcoxon rank-sum exact tests were then used to determine whether the two groups differed in the considered sleep and circadian measures.

Results

Primary Analysis

Although the study deliberately sought to avoid the most acute effects of the spousal bereavement, the subjects appeared to be still quite distressed by their loss. Overall, the mean TRIG score was 59.46 (SD = 14.12). The distribution of the TRIG scores is illustrated in Figure 1. There appeared to be only a very weak relation between TRIG score and time since loss event, but in the expected direction (rho = −0.32, $p = 0.10$). Only four subjects (F 61 yrs, F 81yrs, F 74 yrs, & M 69 yrs) could be categorized as suffering from complicated or traumatic grief using the criterion of ICG >25 and time since loss >6 months. Mean Hamilton ratings of depression were 9.32 (SD = 6.32), indicating some depression symptoms. A total of 11 subjects (39.3%) exceeded the HRSD criterion value of 10, often used to indicate possible MDD. However, the HRSD score was not correlated with TRIG score (rho = 0.24, $p > 0.20$).

Figure 2 illustrates the mean circadian temperature rhythm of the group of 28 subjects. The rhythm showed the usual classic shape, with a trough at ~01:00 h, a fairly steep rise through the morning hours, and a more gradual rise to mid-evening. The peak at 11:30h reflected the time at which showers and exercise were permitted (thus temporarily increasing body temperature). The 24 h + 12 h cosinor model analysis (see above) explained more than 25% of the variance in all but 5 subjects. Thus, estimates of phase (i.e., time of T_{min}) and amplitude (i.e., T_{range}) were available for 23 of the 28 subjects. The resulting group mean estimate for T_{min} was 02:57 h and for T_{range} was 0.80°C (see Table 1).

Table 1 also presents the values of variables related to grief (TRIG), depression (HRSD), lifestyle regularity (SRM, ALI), subjective sleep (PSQI), habitual bed and wake-up times, plus objective PSG sleep (%sleep efficiency, sleep duration, sleep latency, WASO, %REM, %SWS, and REM latency). The sample of 28 bereaved seniors habitually slept between ~23:00 and 06:40 h; they achieved ~6 h of sleep with a sleep efficiency of about 80%. They took about 30 min to fall sleep and had their first REM episode after 75 min. About 20% of their sleep was in stage REM, and ~3% in stages 3 or 4 (slow wave sleep). Their PSQI score was 6.4. In terms of lifestyle regularity, the mean regularity (SRM) score was 3.65, and the activity level (ALI) score was 88.64.

The time-of-day function in alertness (global vigor) and mood (global affect) showed the usual pattern. Alertness peaked ~10:00 h, with the usual decline as the subjects approached bedtime. Mood peaked at ~16:00 h, with a decline thereafter. Repeated measures ANOVA showed a trend in time-of-day effect in both alertness ($F(3,81) = 2.64$, $p = 0.055$) and mood ($F(3,81) = 2.29$, $p = 0.085$).

Correlations between TRIG Score and Sleep/Circadian Variables

Despite the observed broad range of TRIG scores (see Figure 1), there were no significant correlations with any of the circadian variables ($p > 0.30$, all correlations). In particular, there was no relation between TRIG and SRM (rho = 0.11, $p > 0.5$). Of the sleep variables, only sleep duration even approached significance (rho = −0.346, $p = 0.07$), with more grief being associated with less sleep. Alertness (global vigor) at 20:00 h was correlated with TRIG score, with more grief being associated with lower alertness (rho = −0.37, $p < 0.05$). To illustrate this graphically, the TRIG score was used to divide the sample into high-grief (≥60) and low-grief (<60) bereaved groups. There were 11 women and 1 man (mean age 70 yrs, SD = 7.25 yrs) in the high-grief group, and 13 women and 3 men (mean age 73.4 yrs, SD = 5.8 yrs) in the low-grief group. The two groups did not differ in terms of morningness-eveningness score; mean CSM scores were 43.07 for the low-grief group and 44.08 for the high-grief group, putting means of both groups on the boundary between “intermediate type” and “morning type.” For most sleep/circadian variables, there was a remarkable similarity in values between the two groups, with only sleep duration showing a significant difference (low-grief group = 383 min vs. high-grief group = 328 min, Wilcoxon exact $p = 0.012$). The time-of-day effect in alertness and mood (see Figure 3) seemed to differ between the two groups. In particular, while subjective alertness levels were very similar for the two groups at the first three times of day, the high-grief group showed a precipitous decline, with the 20:00 h testing time showing a marked difference between the two groups. A mixed model ANOVA revealed a significant time-of-day effect ($F(3,78) = 3.55$, $p = 0.018$) and no main effect of group ($F(1,26) < 1$, $p > 0.50$), but a significant time × group interaction ($F(3,78) = 3.43$, $p = 0.021$). A post-hoc group test at 20:00 h revealed a significant difference between the groups in alertness at that testing time ($T(78) = 2.18$, $p = 0.033$). With respect to mood, the apparent (and expected) better values for the low-grief group did not achieve statistical significance ($F(1,26) = 1.70$, $p = 0.20$), and neither was there a significant group × time interaction ($F(3,78) = 1.97$, $p = 0.13$), although the main effect of time almost reached significance ($F(3,78) = 2.45$, $p = 0.07$). However, there was a greater apparent decline at 20:00 h, although this was not tested because of the absence of significant effects.

Nature of Late Spouse's Death

As can be seen from Table 2, there was remarkable similarity in all of the variables in terms of the two types of subjects categorized by the expected versus unexpected death of the spouse. No significant differences emerged in any of the variables.

Discussion

For both ethical and scientific reasons, the study sought to avoid the most acute effects of bereavement, but waited a minimum of four months post-loss before data collection. Even so, there was still considerable grief present in the subjects of the sample. The overall mean TRIG score of 59.46 was within the range found by Thompson et al. (1991), who reported total TRIG scores of 63.76 and 58.17 in bereaved seniors at 2 and 12 months post-loss, respectively (as compared to values of about 40 in age-matched controls). Similarly, we found depressive symptoms present as measured by the HRSD, with a mean score of 9.3, which is very comparable to that of 11.7 observed by Reynolds et al. (1992) in a comparable group of 31 bereaved seniors. This is also in accord with the epidemiological study of Turvey et al. (1999), who showed reliable increases in depressive symptoms up to 2 yrs after late-life spousal bereavement.

It is notable that only four subjects met the formal definition for Complicated Grief (CG), sometimes referred to as Traumatic Grief, despite the fact that 18 of the 28 subjects were more than six months post-loss and thus eligible for a possible CG diagnosis. Therefore, even when

CG is not present, spousal bereavement in late life may have profound consequences for sleep and mood that can last beyond a year. When we examined the sleep and circadian measures of the four CG subjects, they were about one standard deviation worse than the whole sample mean in circadian temperature rhythm amplitude; half a standard deviation worse in sleep duration, sleep efficiency, and sleep latency; and half an hour earlier in circadian temperature rhythm phase. They were just over one standard deviation worse in TRIG score (77.25), but very similar in HRSD score (8.50). The sleep findings confirm some of those found in a much larger group of CG patients (Germain et al., 2006). Paradoxically, though, the four CG subjects were slightly *higher* (i.e., more regular) than the whole sample mean in SRM score and about the same in ALI score. In an earlier study of 64 CG subjects, Monk et al. (2006b) found that ALI scores were, on average, lower than those of controls. The instrument used in that study precluded the calculation of SRM score. Clearly, many more CG subjects need to be studied before the circadian or SRM results can be confirmed for that disorder.

Although the presence of sleep disruption was a formal inclusion criterion (PSQI ≥5 or percent sleep efficiency <90%), no potential subjects were so excluded; thus, one can be reasonably sure that the sleep findings are broadly representative, albeit with the caveat that they had volunteered for a fairly intense research study. This is supported by a comparison with the earlier study of the sleep of 31 bereaved seniors conducted by Reynolds et al. (1992), who found a mean sleep efficiency of 77.8% compared to the present study's average of 79.3%. This is in contrast to the mean sleep efficiency of Reynolds's control group of 15 non-bereaved seniors who had a mean sleep efficiency of 84%. This disruption was also reflected in other sleep stage measures. It would thus appear that the conventional wisdom that bereavement is associated with sleep disruption is confirmed by the present study. Interestingly, of all the sleep variables, only sleep duration showed a correlation with TRIG score that even approached significance (rho = −0.346, $p = 0.07$). The weak correlation with TRIG may, however, have resulted from the time lag between the TRIG evaluation and the sleep study, which sometimes amounted to several months. Thus, while the amount of actual sleep obtained by a bereaved senior is indeed related to grief from the loss event, it would appear that by >4 months post-loss, the *architecture* of the sleep stages would seem to be relatively normal. This is in line with the findings of Pasternak et al. (1992), who also reported no correlation between PSG sleep stage measures and time since loss in subsyndromally depressed widow(er)s. Such effects have been found, however, when analyses are limited to those formally diagnosed with MDD (Reynolds et al., 1992).

With respect to circadian temperature variables, there was little evidence of any circadian dysfunction related to the loss. Thus, the overall mean T_{min} of 02:57 h was very similar to those of 03:27 (women) and 02:45 h (men) observed by us in an extremely healthy non-bereaved sample of 48 seniors (Monk et al., 1995) who were slightly older (83 yrs in that sample versus 72 yrs in the present one). In a similar vein, the measures of circadian temperature rhythm amplitude were also very similar between this study (0.80°C) and the earlier one (women = 0.82°C, men = 0.70°C). Thus, at least when studied at least four months after the loss event, late-life spousal bereavement appears to have little impact on the phase or amplitude of the circadian temperature rhythm, and that possible pathway to disrupted sleep appears to not be a major one. Therapeutic strategies might thus better concentrate on homeostatic, rather than rhythmic, substrates of sleep disturbance. It remains possible, though, that the rhythmic pathway to disrupted sleep might be more active closer to the loss event.

Although there were few differences in the circadian temperature rhythm, there was slight evidence of a reduction in lifestyle regularity in this bereaved sample of seniors. The mean SRM score here was 3.65, compared to 4.3 (women) and 4.4 (men) found in an earlier study involving 45 healthy seniors (Monk et al., 1992). Thus, the bereaved seniors in the present study had an SRM score that was about one standard deviation lower (more irregular) than

those of the earlier study. Some of this difference, however, may be explained by the fact that the earlier study involved a slightly older sample (80 yrs versus 72 yrs), as SRM does increase with age (Monk et al., 2006a). Thus, there may be room for lifestyle regularity to be increased in bereaved seniors, which was the aim of one of the therapies given to half of the subjects after these baseline data had been collected. The lack of any positive correlation between SRM and sleep duration or between TRIG and SRM does, however, suggest that there is no simple link between SRM disruption and sleep disruption in late-life spousal bereavement.

There are three possible pathways to the correlation between TRIG and alertness at 20:00 h and the time-of-day × grief group interaction (see Figure 3). First, alertness at 20:00 h might be impaired by the shorter sleep durations seen in those more acutely bereaved, leading to a stronger build up in sleepiness during the waking day. Second, there may have been a dissociation between the normally parallel circadian rhythms in alertness and body temperature. Thus, the lower alertness values at 20:00 h may have been due to an earlier phasing of the circadian alertness rhythm. In other research, Monk and Kupfer (2000) demonstrated that circadian alertness rhythms can show age-related differences that are not present in circadian temperature rhythms. Third, there may have been a “reverse halo” effect, whereby the more grief-stricken widow(er) dreaded going to bed and thus had lower ratings in *all* subjective measures as bedtime approached. Further, more sophisticated, circadian studies (e.g., using circadian unmasking or forced desynchrony protocols) would be needed to resolve the issue.

Conclusions

When studied for at least four months after the loss event, there appears to be some sleep disruption in spousally bereaved seniors. However, this disruption does not appear to be due to bereavement-related disruptions in the circadian system, although grief-related differences in the time-of-day effect in alertness were apparent. Lifestyle regularity (SRM score) was slightly reduced in the bereaved relative to non-bereaved seniors, but SRM scores did not differ by grief severity.

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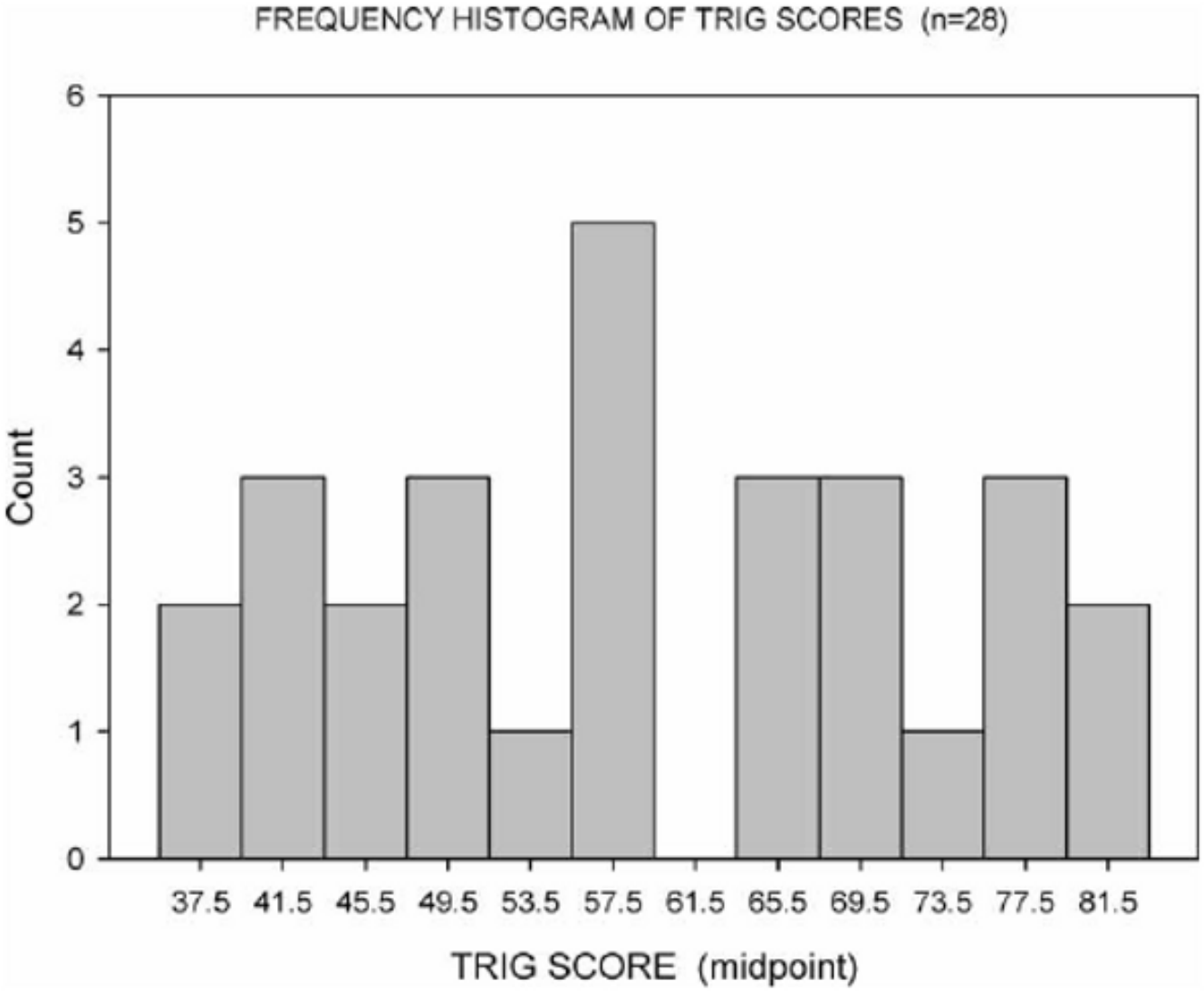

FIGURE 1.
Frequency histogram showing the distribution of TRIG scores from the 28 subjects.

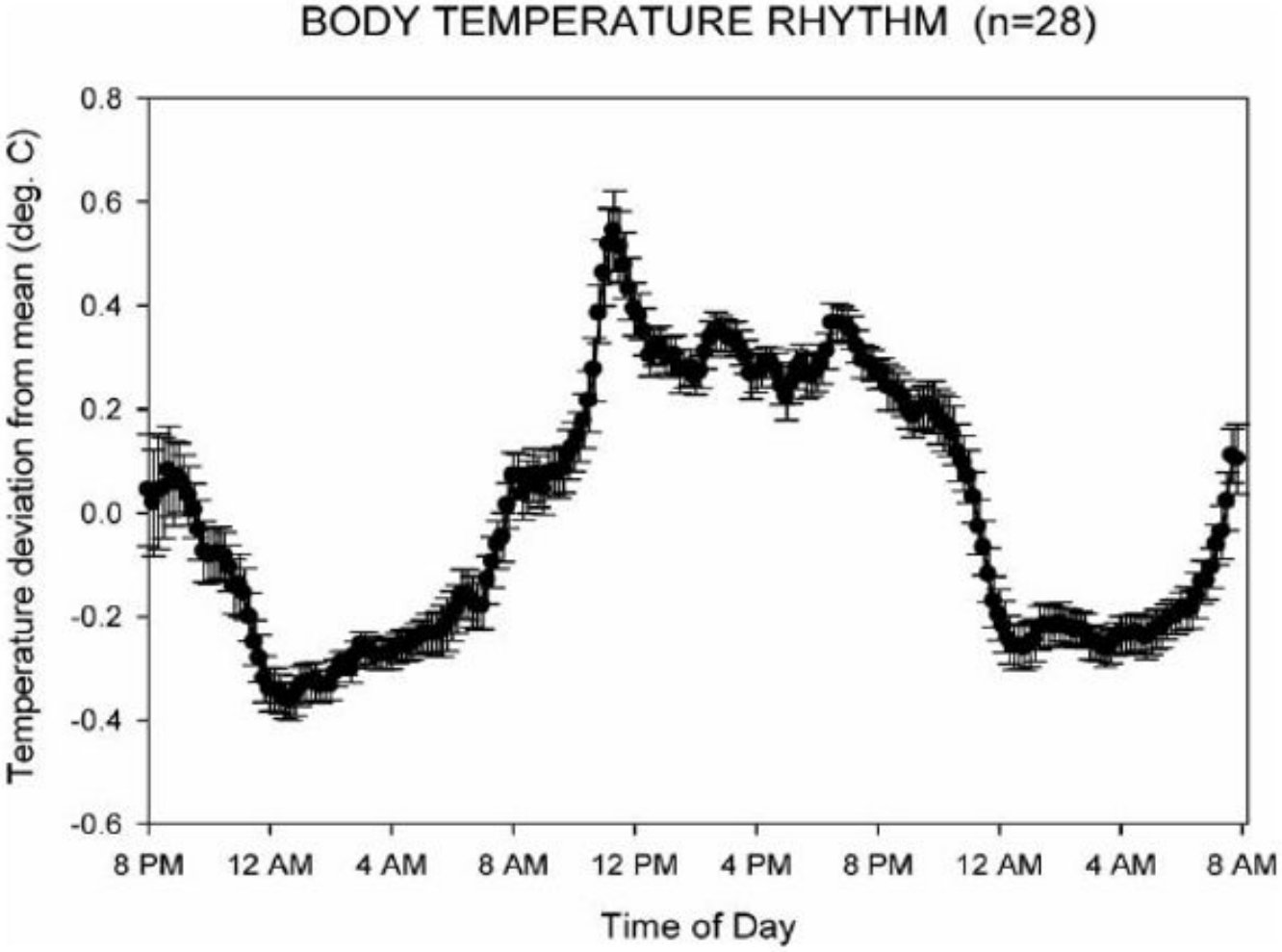

FIGURE 2.

Core body temperature rhythm of the sample of 28 subjects. Plotted is the mean (±1 SEM) of the temperature values standardized to the mean level by the subtraction of each subject's own ~36h mean temperature from his/her time series (see text).

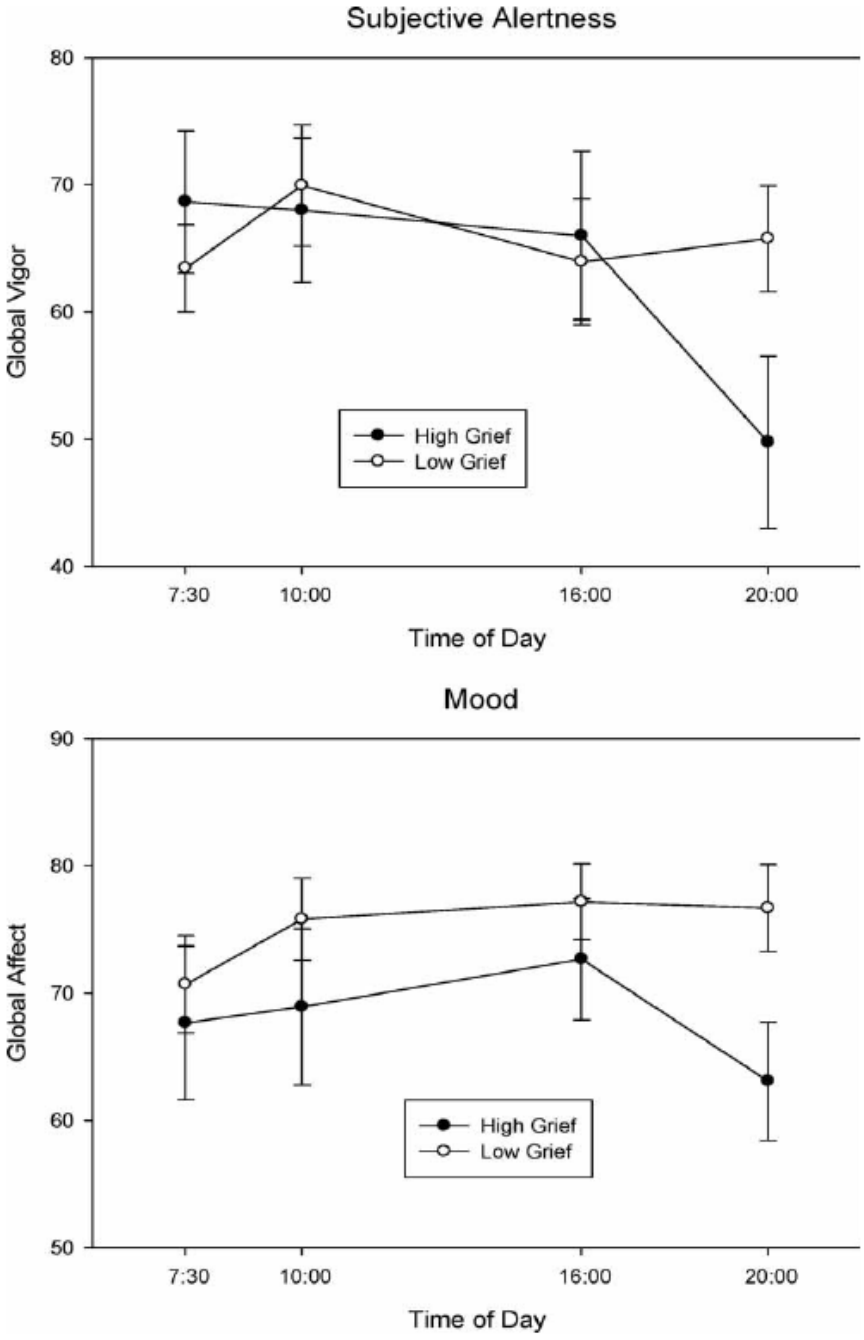

FIGURE 3.

Time-of-day effects in subjective alertness as measured by global vigor and mood as measured by global affect. Plotted is the mean (±1 SEM) from 16 low-grief and 12 high-grief subjects.

TABLE 1

Results of Primary Analysis

Variable	Mean	SD	n
TRIG score (grief)	59.46	14.12	28
HRSD score (depression)	9.32	6.32	28
SRM core (regularity)	3.65	0.63	28
ALI (activity level)	88.64	12.39	28
T_{range} (amplitude, °C)	0.80	0.23	23
T_{min} (phase, clock time, h)	02:57	106 min	23
PSQI Score (subject sleep)	6.36	3.41	28
Bedtime (clock time, h)	23:01	31 min	28
Wake-up (clock time, h)	06:39	34 min	28
%Sleep efficiency	79.28	11.58	28
Sleep duration (min)	359.33	53.67	28
Sleep latency (min)	30.19	34.40	28
WASO (min)	65.02	41.95	28
%REM	21.50	6.39	28
%SWS	3.22	4.66	28
REM latency (min)	76.58	61.37	28

TABLE 2

Comparison of Findings According to Type (Expected or Unexpected) of Spousal Death

	Expected death			Unexpected death		
Variable	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
TRIG score (grief)	59.00	16.52	18	60.30	9.01	10
HRSD score (depression)	9.72	6.90	18	8.60	5.38	10
SRM score (regularity)	3.66	0.71	18	3.65	0.51	10
ALI (activity level)	91.17	10.77	18	84.10	14.33	10
T_{range} (amplitude, °C)	0.80	0.24	16	0.80	0.22	7
T_{min} (phase, clock time, h)	03:05	117.08	16	02:37	80.56	7
PSQI score (subj. sleep)	6.72	2.97	18	5.70	4.19	10
Bedtime (clock time, h)	23:08	17.24	18	22:48	45.17	10
Wake-up (clock time, h)	06:45	21.21	18	06:27	47.85	10
%Sleep efficiency	79.52	11.46	18	78.86	12.41	10
Sleep duration (min.)	361.57	52.98	18	355.30	57.53	10
Sleep latency (min.)	29.52	31.40	18	31.40	41.04	10
WASO (min.)	64.48	49.22	18	66.00	26.48	10
%REM	22.37	6.76	18	19.92	5.63	10
%SWS	2.38	3.18	18	4.71	6.49	10
REM latency (min.)	69.54	47.59	18	89.27	82.12	10