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Effects of the Nursing Home System on Subjective Sleep Quality and Bed Climate of Residents

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Bed climate and the subjective sleep quality of the aged in two different nursing homes (NH) were surveyed. Thirty aged volunteers were selected from nursing homes in central Tokyo (T) and in a suburb of Nagano (N). They were divided into four groups depending on their NH and Activity of Daily Living (ADL). The four groups were: subjects with almost no problems in daily life with a high ADL score [T-high, N-high] and subjects who normally stayed in bed all day with a low ADL score [T-low, N-low]. The temperature and humidity of the bedroom and bed climate, the circadian rhythm of subjective sleepiness, vitality and overall feeling, and subjective sleep quality were surveyed. The bedroom temperature was lower and the humidity was higher in the N-high and N-low compared to the T-high and T-low. The bed climate in the daytime was significantly lower in the T-high compared to the other groups. The bed climate at night did not show any significant difference among the groups which were maintained at 32-34℃ and 50-60% RH. The daytime sleepiness was lowest in the T-high compared to the other groups and that of the T-low tended to be lower than in the N-low. The subjective sleep quality was significantly higher in the T-high and T-low compared to the N-high and N-low. These results suggest that subjective sleep quality may differ depending on the nursing home and it has a high possibility of showing improvement by changing the caregiving system.

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Keywords: aged, nursing home, bed climate, ADL, sleeps.

INTRODUCTION

It has been well studied that sleep complaints increase in the aged (Spiegel 1981). The incidence of complaints and poor sleep is higher in nursing home (NH) residents (Cohen *et al.* 1983; Ancoli-Israel *et al.* 1989; Middlekoop *et al.* 1994) than in community-dwelling aged and 75% of the NH residents suffer from poor sleep (Gentili *et al.* 1997). The poor sleep in NH residents may be due to the interaction of various factors such as age-related detoriation in sleep structure (Spiegel. 1981), circadian rhythm disturbances (for example, Monk 1991; Czeisler *et al.* 1992; Ceolim *et al.* 1996), physical and psychiatric disorders, and environment (Cruise *et al.* 1998). Among these factors, the present study focused on the caregiving system of the NH. The objective of this study was to compare subjective sleep quality, bed climate and circadian rhythm of sleepiness and mood between two different NHs, which had different caregiving systems. Considering that reported sleep problems in community-dwelling aged is most strongly related with mortality (Pollak *et al.* 1990), it is extremely important to confirm whether subjective sleep quality differs depending on the caregiving system of the NH. The bed climate was compared as it directly affects thermal comfort during sleep (Candas *et al.* 1979). Furthermore, change in the bed climate temperature, especially in the daytime, can be a good indicator for predicting whether the subjects stayed inside the bed or not (Okamoto *et al.* 1998). The circadian rhythm of sleepiness and mood was compared, as increased daytime sleepiness is associated with disturbed nocturnal sleep (Carskadon *et al.* 1982).

METHOD

Subjects

A survey was conducted in August on 30 subjects who were selected from two different NHs: 22 volunteers from a NH in central Tokyo [T] and 8 volunteers from a NH in a suburb of Nagano [N].

They were informed about the survey in advance and signed consent forms. The physical characteristics of the subjects are shown in Table 1. None of the subjects showed any evidence of psychiatric disease. The subjects were divided into four groups depending on their NH and activity of daily living (ADL). The ADL score was calculated according to Katz's criteria (Katz 1970). One point was scored when the subject did not have difficulty in executing the activities in Katz's criteria and the sum of the six criteria was used as the ADL score. The four groups were: subjects who had no problem in executing most of the Katz's criteria with an ADL score higher than 5 [T-high, N-high] and subjects who normally stayed in bed all day with an ADL score lower than 2 [T-low, N-low].

Features of the NH and schedule of the day

In T, two or four persons shared bedrooms, in contrast to four to six persons in N. All bedrooms had a south facing window both in T and N. The subjects in each group were selected from 3 different bedrooms. In T, a bed, a mattress, a futon and a blanket were supplied by the NH; however the subjects were free to use other bedding and clothing. The bedrooms could be partitioned using a curtain. Air temperature and humidity of each bedroom were separately controlled by an air conditioner. The aged and the caregiver were allowed to change the settings arbitrarily according to their thermal sensations. In N, all the bedding and clothing were supplied by the NH and the residents were not allowed to select their bedding and clothing. There was no air conditioner and bedroom climate was controlled by opening the window.

Table 1. Physical characteristics of the subjects

	T-High	T-Low	N-High	N-Low
N (male/female)	12 (7/5)	10 (5/5)	4 (0/4)	4 (2/2)
Age (Yr)	81.9(7.9)	82.5(6.6)	80.4(4.0)	80.0(8.5)
Weight (Kg)	50.1(11.5)	45.6(6.5)	41.5(8.5)	*
Height (cm)	152.8(10.1)	152.8(9.1)	147.7(2.3)	160.2(4.7)

The main anamnesis were cerebral infection sequela, hypertension, intracerebral bleeding, and sciatica.
*There was no data and it was impossible to measure as they are almost bed ridden.

The schedule of the day is shown in Fig. 1. In T, the residents were woken up at about 6:00. They had their meals at 7:00, 12:00 and 17:00. Afternoon refreshments were served at 15:00. Lights were turned off at 21:00. During the day, T-high generally stayed in their bedrooms. They moved to the meeting room for meals and afternoon refreshments and were able to participate in club activities such as flower arrangement, calligraphy and singing classes which were organized at least three times per week from 13:30. On the other hand, T-low spent their day almost entirely in bed. They were taken to a meeting room by wheel chair for meals, afternoon refreshments and certain club activities such as singing. Their body positions and diapers were changed every 2 h during the day and at night.

In N, the residents were woken up at about 6:00. They had their meals at 7:30, 11:30, and 16:30. Afternoon refreshments were served at 14:00. Lights were turned off at 18:00. During the day, N-high generally stayed in their bedroom. Their meals were served in their bedrooms. There were no club activities. N-low spent their day almost entirely in bed. They were seated on the bed for meals and afternoon refreshments. Their body positions and diapers were changed every 3 h during the day and at night.

Measurements

1. Bedroom and bed climate

The bedroom and bed climate of each subject were measured for 24 h starting at 7:00 in T and 9:00 in N, using a thermometer and a hydrometer (Data stocker, TRH-DM3, Shinei) at 1-min intervals. A sensor for

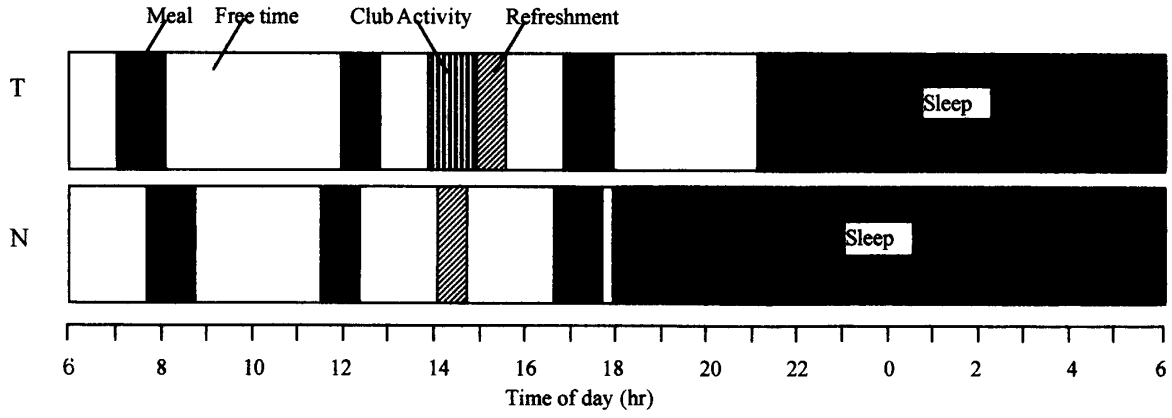

Fig. 1. Schedule of the day in two NHs

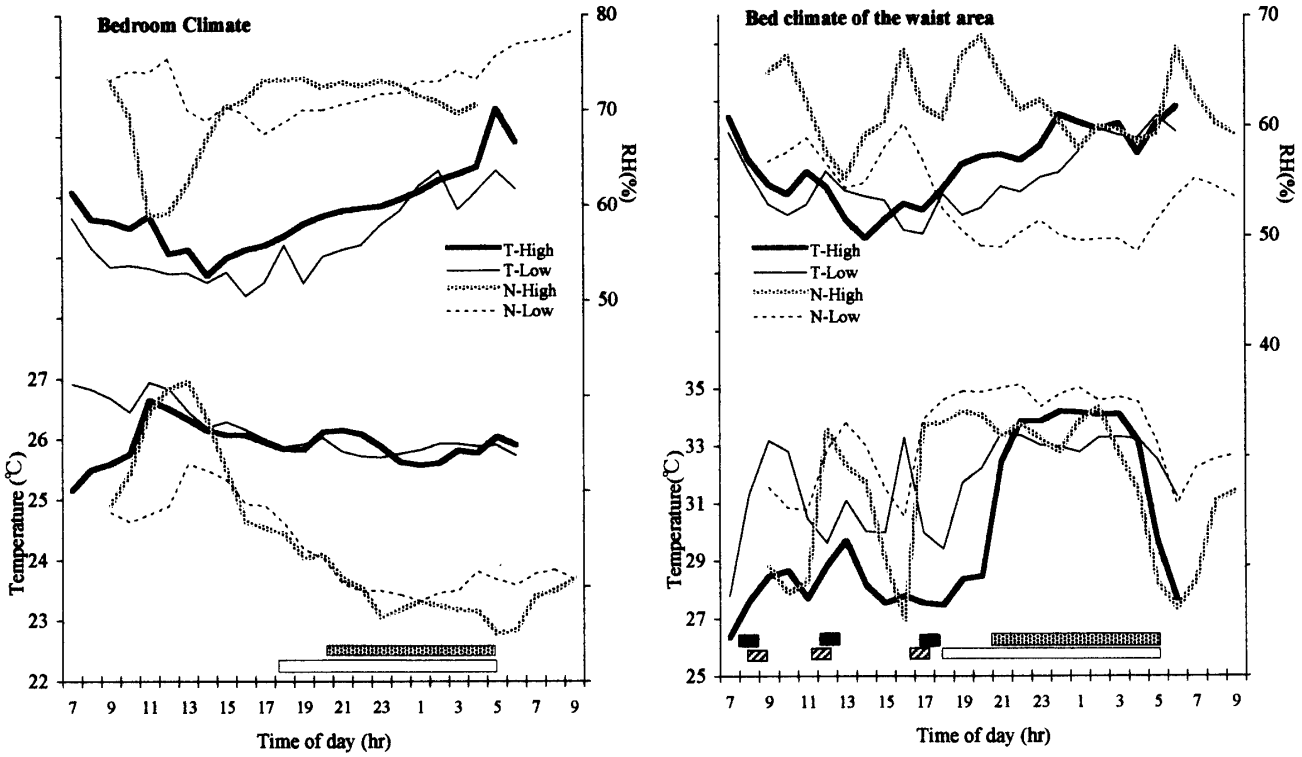

Fig. 2. Changes of bedroom and bed climate of the waist area

Average of each group. □, sleep time in N; ▩, sleep time in T; ▨, meal time in N; ■, meal time in T.

measuring the bedroom climate was placed on the wall near each subject's bed. The measuring areas of the bed climate were the back and foot areas beneath the bed sheet. The bedroom and bed climates of three to four subjects per day in T and two subjects per day in N were measured for 6 days. The subjects were selected from each group.

2. Survey of bedding condition

The number and types of bedding and clothing were surveyed before and after sleep continuously for 6 days.

3. Subjective sleep quality and subjective sleepiness

Subjective sleep quality was surveyed after sleep continuously for 6 days using a scale from −3 to +3 on the following four factors: sleep depth, sleep onset, refreshed state in the morning and satisfaction of sleep time. Subjects were asked to mark their evaluation on the scale. Zero indicated the medium score. Subjective sleepiness, vitality, and overall feeling were also checked continuously for 6 days in time intervals of 4 h starting from 6:00 during the day using a VAS (Visual Analogue Scale). The subjects were asked to mark or indicate the level on a 10-cm vertical line. The percentage was calculated and 100 % showed that they were very sleepy, full of vitality and had a very good overall feeling. Circadian rhythm of sleepiness, vitality and overall feeling was calculated by using least square multivariate cosine analysis to determine the theoretical 24-h best-fit cosine curve. Three characteristics of the cosiner wave, 1) mesor (mean of 24 h value), 2) amplitude (peak to trough value), and 3) acrophase (the time of maximum value occurrence) were calculated.

Data analysis

In order to analyze the statistical significance, two-way ANOVA was used for subjective sleepiness, mood and bed condition. The factors were groups (T-high, T-low, N-high, and N-low) and subjects. The bedroom and bed climate data was calculated separately in the day and at night by using two-way ANOVA for repeated measures. The factors were groups and time. After the significance of ANOVA was confirmed, a post hoc test (Fisher's PLSD) was organized in order to compare the intergroup differences. The level of significance was assumed to be $p<0.05$.

RESULTS

Bedroom and bed climate

Figure 2 shows the results of the bedroom climate and waist area of the bed climate. The bedroom temperature in the day ($F_{3,\ 26}=4.30$; $p<0.05$) and at

Table 2. Mesor, amplitude and acrophase of subjective vitality, overall feeling and sleepiness

		T-High	T-Low	N-High	N-Low
Feeling	Mensor (%)	76.4±11.7	66.3± 15.8	72.1± 8.7	54.7± 4.1[a]
	Amplitude (%)	10.0± 7.3	8.3± 2.8	5.4± 1.2	8.5± 4.0
	Acrophase (ϕ)	-232.2±66.4	-185.4±111.3	-138.8±120.3	-142.6±101.2
Power	Mensor (%)	73.2±10.9	55.1± 19.7	59.1± 17.5	40.9± 8.3[a]
	Amplitude (%)	11.4± 6.2	10.9± 7.7	8.1± 1.9	14.8± 5.9
	Acrophase (ϕ)	-199.0±56.4	-147.4± 93.3	-184.4± 82.6	-220.4± 69.3
Sleepiness	Mensor (%)	20.2± 8.9	41.0± 10.7[a]	41.9± 19.1[a]	57.2± 6.7[a]
	Amplitude (%)	10.0± 4.7	13.6± 6.1	16.4± 7.5	18.3± 10.3
	Acrophase (ϕ)	-288.6±74.8	-272.6± 47.4	-228.5±110.6	-222.6±106.7

[a] Indicates significant difference between T-high.

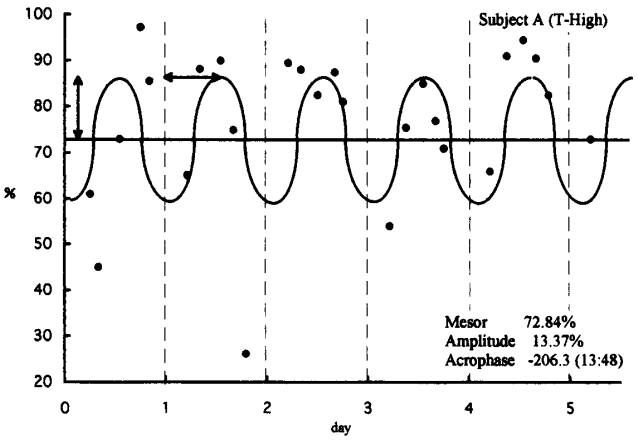

Fig. 3. Circadian rhythm of subjective overall feeling of subject A (T-high)

—— (parallel line), mesor (mean of 24 h value); ↕, amplitude (peak or trough value from mesor level); ↔, acrophase (the time of maximum value occurrence measured from 0:00.); ---, each line indicates 0:00; ●, indicates measured data.

night ($F_{3,\ 26}=11.63$; $p<0.001$) differed significantly among the groups. The relative humidity also differed among the groups in the day ($F_{3,\ 26}=16.7$; $p<0.001$) and at night ($F_{3,\ 26}=9.22$; $p<0.001$). The temperature in the day was higher in the T-low compared to the N-low and humidity was lower in the T-high and T-low compared to the N-high and N-low. At night, the temperature was higher and humidity was lower in the T-high and T-low compared to the N-high and N-low. In the T-high and T-low, temperature and humidity were stable, while in the N-high and N-low the temperature increased toward 12:00 and decreased about 4℃ at night. Regarding bed climate temperature of the waist area, the temperature ($F_{3,\ 26}=6.88$; $p<0.01$) and humidity ($F_{3,\ 26}=3.24$; $p<0.05$) differed among the groups in the day. The temperature was lower in the T-high compared to other groups. In the T-low, N-high, and N-low the bed climate temperature showed a clear decrease at meal, club activity and refreshment times. In these groups, the bed climate temperature at night started to increase before the lights were turned off. In the T-high, the temperature increased significantly only at night. The relative humidity was significantly lower in the T-high than the N-high. No significant difference was observed between the T-low and N-low. At night, no significant difference was observed in the bed climate of the waist area. In the foot area of the bed climate temperature, interaction was observed in the daytime ($F_{3,\ 26}=5.18$; $p<0.01$) which showed a significantly lower temperature in the T-high compared to the other groups. No significant difference among the groups was observed at night and the temperature and humidity were maintained around 29-32℃ and 50-65% RH, respectively.

Bedding condition

Bedding and clothing condition did not show any change during the 6 days in either T or N. The number of bedding items over the body was 1.19± 0.27 and no significant difference was observed among the groups. The number of bedding items under the body significantly increased in the T-low, compared with the N-low. There was no significant difference between T-high and T-low. The outerwear was 2.04±0.08 and underwear was 2.64±0.61 and was not affected by group.

Subjective sleep quality and circadian rhythm of subjective sleepiness and mood

The results of circadian rhythm of subjective sleepiness, overall feeling and vitality and one example of the circadian rhythm of the subjective overall feeling of subject A are shown in Table 2 and Fig. 3. The amplitude and acrophase did not differ among the groups. A significant effect of group was observed in mesor of overall feeling ($F_{3,\ 31}=2.92$; $p<0.05$), vitality ($F_{3,\ 31}=3.95$; $p<0.05$) and sleepiness ($F_{3,\ 31}=8.76$; $p<0.001$). The overall feeling and vitality was significantly higher in the T-high compared to the N-low. The subjective sleepiness was significantly lower in the T-high compared to the N-high. Although there was no significant difference, the T-low tended to show lower sleepiness compared to the N-low. For subjective sleep evaluation, a significant difference among the groups was observed in the refreshed state in the morning ($F_{3,\ 26}=4.49$; $p<0.05$), profoundness ($F_{3,\ 26}=22.68$; $p<0.001$), satisfaction in sleep time ($F_{3,\ 26}=4.31$; $p<0.05$) and total sleep score ($F_{3,\ 26}=8.49$; $P<0.001$) (Fig. 4). Sleep profoundness was significantly higher in the T-high than in the N-high. The T-low also showed a significantly higher score than the N-low. Of the other three factors, the T-low

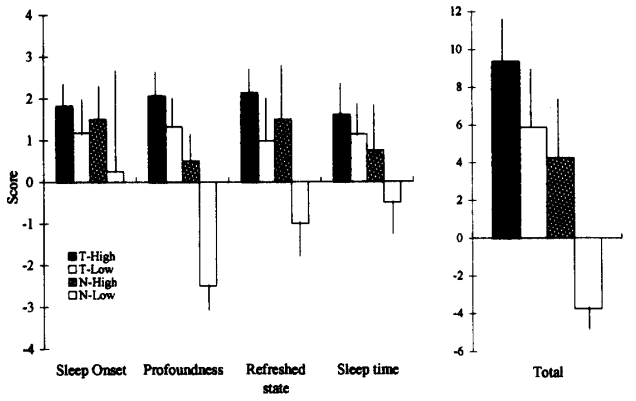

Fig. 4. The average of subjective sleep quality in each group

The vertical line indicates standard deviation. The asterisk indicates the level of significance among the group ($*p<0.05$, $***p<0.001$).

showed a higher score than the N-low. In addition, these factors showed higher scores in the N-high than N-low, while the T-high and T-low did not show any significant difference.

DISCUSSION

The most interesting result of this study was that subjective sleep quality was significantly higher in the T-high and T-low compared to the N-high and N-low. In a previous study, the most common sleep disturbance caused by an environmental factor was noise related to changing diapers at night (Gentili *et al.* 1997). We did not measure noise at night; however, the fact that there were less frequent diaper changes in N than T suggests that there are other factors relating to poor subjective sleep quality in N.

One reason for the poor subjective sleep quality in N may be related to the circadian rhythm of sleepiness. The mesor of subjective sleepiness was lower in the T-high compared to the N-high. The T-low also showed a tendency to be lower than the N-low. The increased daytime sleepiness is associated with nocturnal sleep disturbance (Carskadon *et al.* 1982). This is due to a diminished difference between night and day, with wakefulness intruding into the night and sleep intruding into the day (Czeisler *et al.* 1992). The subjective alertness rhythms of elderly are less robust than in the young, even in elderly whose body temperature rhythm is quite robust (Monk *et al.* 1996). The low subjective sleep quality and high daytime sleepiness in the N-high and N-low compared to the T-high and T-low may indicate that day and night difference is more diminished in the N-high and N-low. This difference between N and T may be attributable to at least two causes. First, bed climate during the daytime showed a significantly lower and stable temperature in the T-high compared to the N-high. This indicates that the T-high did not remain in bed, while the N-high spent more time in bed during the daytime. In the T-low and N-low, there was no significant difference in temperature, and the time spent in bed was longer in the N-low as the subjects received meals in bed and did not have special events, while the T-low moved to another room for meals and club activities. It has been pointed out that daytime physical or mental activity (Horne and Minard 1985) and social rhythms (Brown *et al.* 1996) have an effect on sleep quality and quantity. Boredom and loneliness can lead to an unstructured day, worsening the circadian function and sleep problems (Monk *et al.* 1992). The stereotyped daytime routine and low activity in N may be associated with an increased daytime sleepiness and decreased subjective sleep quality. Second, this can be related to a longer sleep time in N compared to T: subjects stayed in bed for 12 h in N, and 8 h in T. A common strategy that is adopted for poor sleepers among elderly is to lengthen the amount of time they spend in bed (Carskadon *et al.* 1982). However, an excessive time in bed promotes insomnia and mid-sleep wakening. The extended times in bed and increased sleep fragmentation were remarkable in NH patients (Ancoli-Israel *et al.* 1989). Considering that the earlier sleep hours often kept by older individuals accompany complaints of poor sleep quality (Buysee *et al.* 1991), the sleep time in N can be too early and too long. Furthermore, the N-high and N-low retired to bed after dinner before the lights were off. In order to avoid excessively long and early sleep hours, it is important to keep the subjects away from bed and maintain alertness as well as to delay the time of retiring to bed.

Although the subjective sleep quality differed among the groups, no relation was observed with bed climate at night. The bed climate was maintained at 32-34℃ and 50-60% RH in all groups, which was near the comfort bed climate zone (Miyazawa *et al.* 1974). There were many factors that modified bed climate at night. The bedroom temperature was lower and humidity was higher in the N-high and N-low, which was lower than the optimal temperature recommended for the elderly (Iwashige *et al.* 1995). The bedding under the body increased more in T-low than in other groups. The physical condition was different between

the high ADL groups (T-high and N-high) and low ADL groups (T-low and N-low). T-high and N-high got out of bed to go to the toilet after sleep, while the T-low and N-low had body posture and diaper changes every 2 or 3 h. The fact that there was no significant difference among the groups suggests the possibility that the aged can maintain a certain level of bed climate during sleep independently of these various factors, and subjective sleep quality.

In conclusion, these results suggest that, although ADL is the same, subjective sleep quality differs depending on the caregiving system of the NH and that there is a high possibility of showing improvement by changing the caregiving system of the NH.

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Effects of the Nursing Home System on Subjective Sleep Quality and Bed Climate of Residents

特別養護老人ホームの施設差が入所者の睡眠感および寝床内気候に及ぼす影響

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二つの異なる特別養護老人ホーム入所者の寝床内気候，睡眠感，主観的気分と眠気の日内変動を比較した．調査対象は，介護体制の異なる東京都心（T）と長野県郊外（N）にある特別養護老人ホーム入所者計 30 名（東京 22 名，長野 8 名）とし，さらに ADL（日常生活活動）が自立している群（T-high，N-high）と自立していないねたきりの群（T-low，N-low）にわけて比較した．測定項目は寝室内，寝床内温湿度，起床時の睡眠感，主観的眠気，活力，気分のリズムとした．夜間の室内温湿度は，N で有意に温度が低く，湿度が高かった．日中の背部の寝床内温度は，T-high で N-high よりも有意に低かった．夜間の寝床内気候に群による差はみられず，32～34℃，50～60% RH の間に保たれていた．日中の眠気は T-high で N-high より有意に低く，T-low でも N-low より低い傾向であった．睡眠感は T-high，T-low で N-high，N-low よりも有意に高かった．ADL は同じでも，ホームにより睡眠感は差がみられ，介護体制を改善していくことで睡眠感が改善する可能性が示唆された．

キーワード：高齢者，養護老人ホーム，寝床内気候，ADL，睡眠．