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# Study on Work Load of Matrons under Shift Work in a Special Nursing Home for the Elderly

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**Abstract: In order to find out the work load of matrons under shift work in a special nursing home for the elderly (SNH), six healthy female matrons volunteered to participate in the present study. For each subject, care working time, heart rate, walking steps, estimated energy expenditure and working time in different postures were determined during day shift work (540 min) and night shift work (960 min). Although the time on duty, working and recess were significantly longer in night shift work than day shift work, the percentages of working and recess time to duty time were nearly the same regardless of shift work. The longest care work in each shift work was individual care of residents in the SNH. The maximum, minimum and mean heart rate and percentages to estimated maximal heart rate were similar in each shift work. Although total walking steps in night shift work were significantly larger than those in day shift work, steps per hour did not differ between them. The estimated total energy expenditure (kcal) was significantly higher in night shift work than in day shift work; however, the work intensity (kcal/kg/min) was significantly higher in day shift work. The longest length and larger percentage of working time were observed in standing posture in each shift work. These findings suggest that physical activity and energy expenditure of matrons under either shift work in the SNH seem to be high. Further studies are needed to clarify the work load of matrons engaged in SNH to formulate countermeasures.**

**Key words:** Special nursing home for the elderly, Matron, Work load, Shift work, Heart rate, Energy expenditure, Posture, Care work

## Introduction

After the World War II, the average life span in Japan has increased remarkably, and the elderly population is increasing rapidly. Bedridden elderly or senile elderly is also increasing. As the results, demands for health care, medical care and welfare services by the increasing number of elderly are growing. Security of sufficient number of facility and matrons to provide long-term care services for the elderly is an important problem of the day in Japan[1].

Under the existing conditions, "Ten-Year Strategy to Promote Health Care and Welfare for the Elderly (so-called the "Gold Plan")" was formulated in Japan in December 1989[1]. In the "Gold Plan", the goals were to provide in-home services, facility services, training and securing of manpower and so forth until 1999. Subsequently, this plan was reviewed again in December 1994 and the revised version is called the "New Gold Plan"[1]. In the "New Gold Plan", provision of special nursing home for the elderly (SNH) is raised for 290,000 people, and the number of matrons and long-term care staffs is increased up to 200,000 people.

Studies concerning work load of matrons engaged in SNH from the viewpoint of work physiology are very few until now. Matsumoto *et al.*[2] reported that physical and mental fatigue of matrons engaged in SNH during shift work was high. Wakui[3] reported that physical activity and energy expenditure of matrons engaged in SNH during day shift work were larger than those of other types of workers. Yokozeki *et al.*[4] also reported that energy expenditure and work intensity of each care work during day shift work of matrons engaged in SNH were high.

Care work by providers requires frequent manual lifting,

transferring residents and half-sitting posture that makes severe burden for the waist[5–9]. Low back pain is prevalent in matrons and care staffs with long-term experience. Furthermore, increasing number of the elderly and severe disability of residents in SNH will intensify the work load of matrons. In fact, Fujimura *et al.*[5] reported that low back pain of matrons engaged in SNH is associated with residents care needs.

In recent years, social demands for the matrons are enhanced. It is speculated that the work load of matrons is very high. If so, reduction of the work load of matrons and improvement of working conditions for them are needed. However, studies regarding the work load, work intensity and energy expenditure during shift work of matrons engaged in SNH are not enough. The purpose of this study is to clarify the work load during shift work of matrons engaged in SNH from the view point of work physiology.

## Subjects and Methods

Six healthy female matrons from a SNH volunteered to participate in the present study. Table 1 shows the general characteristics of the subjects.

In order to find out the work load of matrons under shift work in the SNH, we measured for the same subjects in day shift work (early attendance; 7:30–16:30, late attendance; 9:00–18:00) and night shift work (16:30–8:30). Working form consisted of two-shift systems (day shift work and night shift work). The usual number of matrons in day shift work and night shift work in the SNH were thirteen and three, respectively.

In the characteristics of the SNH, bed capacity was 110 and mean age of residents was 80.7 yr. In activities of daily living (ADL) of the residents, proportions of total care or partial care demanded by the residents of the SNH for feeding, excretion, bathing, ambulating and dressing were 25.5%, 60.0%, 79.1%, 56.4% and 70.0%, respectively.

Each care work, care working time and working time in different postures (sitting, standing, walking and running) were measured by means of time study method. Care work was classified with the use of care work classification code developed by the National Council of Social Welfare in Japan[10]. Heart rate was measured every minute using memory checker (VAM1-001, VINE, Japan); however, heart rate during recess time was excluded from the data for analysis. For calculating percentage to maximal heart rate, maximal heart rate was estimated using formula of maximal heart rate equal to 220 minus age[11]. Walking steps were measured using calorie counter (SUZUKEN, Japan) and walking steps during recess time were not included for analysis. Energy expenditure was estimated from relative metabolic rate (RMR) by means of time study method.

**Table 1. General characteristics of subjects (n=6)**

| Age (yr) | Experience (yr) | Height (cm) | Weight (kg) | %fat |
|---|---|---|---|---|
| 41.1 ± 16.0 | 8.3 ± 6.7 | 155.8 ± 4.2 | 54.5 ± 8.2 | 27.8 ± 6.4 |

Values are Mean ± SD.

Values were expressed as the mean ± standard deviation. Statistical analysis was performed using the paired *t*-test. Results were considered statistically significant with $p<0.05$. This study was conducted during the period from August to September in 1992.

## Results

Table 2 shows the means and standard deviations of the lengths of time on working and recess and percentage to the total time on duty in each shift work. Duty times in day shift work and night shift work were 540 min and 960 min, respectively. The length of time on working and recess in night shift work were significantly longer than those in day shift work ($p<0.05$, $p<0.001$); however, the percentages of time on working and recess in both shifts were the same, respectively.

Table 3 shows the lengths of care work and percentages to the total working time on duty in each shift work classified according to the code of National Counsil of Social Welfare in Japan[10] (the first-level classification). The longest length of care work in each shift work was for individual care of residents in the SNH. The length of individual care of residents in night shift work was significantly longer than that in day shift work ($p<0.01$); however, the percentage to the total working time was significantly lower than in day shift work ($p<0.05$). Care work within the top 5 in each shift work were the same except for management work in day shift work and others (including waiting time in ward) in night shift work. The percentages for care work within the top 5 were more than 90% of the total in each shift work, respectively.

Table 4 shows the care working time of matrons on duty in each shift work classified according to the code of National Council of Social Welfare in Japan[10] (the second-level classification). The longest care work according to the second-level classification code in day shift and night shift was bathing (107 min, 01-11) and excretion (226 min, 01-

**Table 2. Length of time on working and recess and percentage to total time on duty**

| | Duty (min) | Working | | Recess | |
|---|---|---|---|---|---|
| | | min | % | min | % |
| Day shift | 540 | 465 ± 34 *** | 86.1 ± 6.2 | 75 ± 34 * | 13.9 ± 6.2 |
| Night shift | 960 | 827 ± 24 | 86.2 ± 2.4 | 133 ± 24 | 13.8 ± 2.4 |

Values are Mean ± SD. *:p<0.05, ***:p<0.001.

**Table 3. Length of care work and percentage to total working time on duty (the first-level classification)**

| | Care work | min | % |
|---|---|---|---|
| Day shift | 1. Individual care of residents | 331 ± 64 ** | 71.4 ± 15.4 * |
| | 2. Administration of the institution | 57 ± 46 | 12.1 ± 8.9 |
| | 3. Communication with residents | 21 ± 15 ** | 4.7 ± 3.3 * |
| | 4. Ambulation of residents | 18 ± 11 | 3.8 ± 2.0 |
| | 5. Management of the institution | 14 ± 12 | 2.9 ± 2.3 |
| Night shift | 1. Individual care of residents | 433 ± 49 | 52.3 ± 5.5 |
| | 2. Others (including waiting time in ward) | 156 ± 58 | 19.0 ± 7.3 |
| | 3. Communication with residents | 89 ± 29 | 10.8 ± 3.3 |
| | 4. Administration of the institution | 50 ± 18 | 6.0 ± 2.2 |
| | 5. Ambulation of residents | 27 ± 9 | 3.2 ± 1.1 |

Values are Mean ± SD. *:p<0.05, **:p<0.01.

03), respectively.

Table 5 shows the heart rate and percentages to the estimated maximal heart rate on duty. The differences between the two-shift work in maximum, minimum and mean heart rate, and their percentages to the estimated maximal heart rate were not significant.

Figure 1 shows the change of heart rate of individual matron on duty and the classification code of care work. Except for classification codes of 13-04, standing by and taking a nap, and 13-02, recess, heart rate of matrons was higher than 80 beats/min during most of the working time and two matrons among them indicated higher heart rate than 100 beats/min continuously.

Table 6 shows the percentage to the estimated maximal heart rate of matrons on duty in each shift work classified according to the code of National Council of Social Welfare in Japan[10] (the second-level classification). Most of the percentages to the estimated maximal heart rate of care work in day shift and night shift were more than 50 percent.

Table 7 shows the number of walking steps on duty. The number of total walking steps in night shift work was significantly higher than that in day shift work ($p$<0.01); however, the walking steps per hour were similar to each other.

Table 8 shows the estimated energy expenditure on duty. The total energy expenditure in night shift work was significantly higher than that in day shift work ($p$<0.001); however, the work intensity (kcal/kg/min) was significantly lower than in day shift work ($p$<0.05).

Table 9 shows the length of working time in different postures and percentage to the total working time on duty. The length and percentage of working time were larger in standing followed by walking and sitting postures in each shift work. The total of percentages of working time in standing and walking were more than 95% in day shift work. On the other hand, the percentage of working time in sitting was more than 20% (the waiting time in ward was included) in night shift work.

## Discussion

The purpose of this study was to clarify the work load of matrons under shift work in the SNH. We observed that the lengths of time on working and recess in night shift work were significantly longer than those in day shift work. However, the percentages of time on working and recess in both shifts were the same, respectively (Table 2).

The longest length of care work in each shift work was

**Table 4. Care working time of matrons on duty (the second-level classification)**

| Care work | Day shift | Night shift |
|---|---|---|
| 01 Individual care of residents | | |
| -01 Personal cleanliness | 14 (6–22, n=5) | 15 (4–42, n=6) |
| -02 Posture change | 2 (1–3, n=4) | 4 (2–8, n=4) |
| -03 Excretion | 95 (18–195, n=5) | 226 (199–247, n=6) |
| -04 Feeding | 92 (59–119, n=6) | 88 (75–102, n=6) |
| -05 Arrangement of surroundings | 69 (2–162, n=3) | 39 (32–49, n=6) |
| -06 Safety and comfort | 11 (4–30, n=6) | 8 (2–11, n=6) |
| -07 Management of resident's articles | 2 (1–3, n=2) | 2 (1–3, n=4) |
| -08 Sanitary care | 41 (5–76, n=2) | — |
| -09 Dressing | 4 (3–4, n=4) | 12 (3–17, n=4) |
| -10 Drinking | 10 (1–19, n=4) | 37 (9–83, n=6) |
| -11 Bathing | 107 (29–183, n=4) | — |
| -12 Social life | — | 2 (1–4, n=4) |
| -13 Transfer | 6 (1–13, n=6) | 3 (1–5, n=6) |
| -14 Coping with senile dementia | 1 (n=1) | 7 (2–15, n=4) |
| 02 Communication with residents | | |
| -01 Communication with residents | 21 (8–47, n=6) | 89 (60–125, n=6) |
| 03 Management of health care | | |
| -01 Medication | 1 (n=1) | 6 (3–11, n=5) |
| -02 Treatment of illness | 2 (n=1) | 2 (1–4, n=3) |
| -03 Examination of vital signs | — | 4 (2–7, n=4) |
| -04 Physical activity | 1 (n=1) | 4 (n=1) |
| 04 Ambulation of residents | | |
| -01 Room change | — | — |
| -02 Admission and discharge | — | 1 (n=1) |
| -03 Attending clinic and hospital | — | — |
| -04 Ambulation inside the institution | 18 (8–36, n=6) | 27 (11–36, n=6) |
| 05 Recording | | |
| -01 Recording of treatment | 7 (1–18, n=4) | 23 (10–36, n=6) |
| -02 Recording of management | — | — |
| 06 Liaison | | |
| -01 Contact and reporting | 5 (1–12, n=5) | 9 (2–20, n=5) |
| -02 Shift reporting | 6 (n=1) | 7 (6–7, n=6) |
| 07 Guidance and orientation for residents | | |
| -01 Orientation of admission and discharge | — | — |
| -02 Orientation of treatment | — | — |
| 08 Meeting and conference | | |
| -01 Meeting for discussion about treatment | — | — |
| -02 Conference | — | — |
| 09 Management of the institution | | |
| -01 Indoor arrangement | 14 (2–22, n=4) | 16 (7–29, n=6) |
| -02 Management of medicines | 2 (n=1) | 4 (2–9, n=5) |
| -03 Management of equipment | 7 (6–10, n=3) | 5 (2–9, n=6) |
| -04 Businesslike work | — | — |
| -05 Management of an article | 2 (1–2, n=4) | — |
| 10 Staff training | | |
| -01 Orientation at admission and employment | — | — |
| -02 Staff training | — | — |
| 11 Management of resident's recreation | | |
| -01 Events | — | — |
| -02 Club activities | 7 (n=1) | — |
| 12 Administration of the institution | | |
| -01 Cleaning | 43 (2–91, n=6) | 16 (6–30, n=6) |
| -02 Laundry | 13 (2–51, n=6) | 26 (9–44, n=6) |
| -03 Disaster prevention | 5 (n=1) | 5 (2–12, n=6) |
| -04 Maintenance of equipments | 3 (n=1) | 5 (5–6, n=3) |
| 13 Others | | |
| -01 Private | 13 (3–22, n=6) | 19 (6–44, n=6) |
| -02 Recess | 75 (11–99, n=6) | 128 (89–145, n=6) |
| -03 Community activity | — | 5 (n=1) |
| -04 Standing by and taking a nap | — | 131 (60–236, n=6) |
| -05 Others | 2 (n=1) | 6 (2–17, n=5) |

Values are min (minimum–maximum, number).

**Table 5. Heart rate and percentage to estimated maximal heart rate on duty**

| | Maximum | | Minimum | | Mean | |
|---|---|---|---|---|---|---|
| | beats/min | % | beats/min | % | beats/min | % |
| Day shift | 121 ± 18 | 67.7 ± 9.5 | 77 ± 11 | 44.3 ± 7.0 | 98 ± 14 | 54.7 ± 7.8 |
| Night shift | 123 ± 18 | 68.9 ± 7.5 | 72 ± 12 | 40.3 ± 6.4 | 93 ± 13 | 52.0 ± 6.1 |

Values are Mean ± SD.

for individual care of residents in the SNH; however, the percentage to the total working time in night shift work was significantly lower than that in day shift work. This reason may be that the length of working time for others including waiting time in ward was longer in night shift work, and the time for communication with residents in the SNH was significantly longer in night shift work than that in day shift work (Tables 3, 4).

In each shift work, the percentage to the total working time for individual care of residents in the SNH in the present study was similar to the report of the National Council of Social Welfare in Japan analyzing care work of matrons in SNH[10]. Matsumoto *et al.*[2] reported that almost all of care work of matrons in SNH were connected with individual care of residents in each shift work, such as excretion (changing diaper), feeding and bathing, and in particular, excretion (changing diaper) was frequently carried out in night shift work. Their results are also similar to ours; almost all of care work of matrons during each shift work was excretion, feeding and bathing in the present study (Table 4).

The differences between day shift work and night shift work in maximum, minimum and mean heart rate, and percentage to the estimated maximal heart rate of matrons, were not significant (Tables 5, 6). Heart rate of matrons was higher than 80 beats/min during the most of working time except for standing by and taking a nap, and recess. Furthermore two of six matrons indicated higher heart rate than 100 beats/min continuously (Fig. 1). The mean heart rate of matrons in the present study in each shift work was nearly the same as those of some previous studies investigating the work load of matrons in SNH[3, 4].

Shimaoka *et al.*[12] reported that the mean heart rate of nursery teachers (aged 29.0 ± 6.1 yr) was 90 ± 6 beats/min. Fujiwara[13] reported that the mean heart rate of hospital nurses (aged 21.5 ± 2.3 yr) during day, evening and night shift work were 93.6 ± 9.5, 82.5 ± 15.0 and 80.1 ± 6.1 beats/min, respectively. In the present study, the mean heart rate of matrons in each shift work was nearly similar or slightly higher than those in the above studies on nursery teachers and hospital nurses[12, 13]. The percentage to the estimated maximal heart rate of matrons was about 10% higher than those in the above studies when considered the difference in age. In comparison with several other women's job, the mean heart rate of matrons in the present study was higher than those of market worker (mean 90 beats/min) and mechanic (mean 89 beats/min); however, the mean heart rate of matrons in each shift work was lower than that of workers engaged in rice-planting without mechanization (mean 119 beats/min)[14].

The maximum permissible mean heart rate of 8-hour work in women aged from 30 to 39 and from 40 to 49 is similar and estimated at 110 beats/min[15]. The mean heart rate of matrons in the present study is more similar to the estimated maximum permissible level than the results of Shimaoka *et al.*[12] for nursery teachers and Fujiwara[13] for hospital nurses. They suggested that a reduction in working time, reconsideration of arrangements, maintenance of a daily schedule and improvement of working conditions are necessary.

The number of total walking steps of matrons in night shift work was significantly larger than that in day shift work; however, the walking steps per hour were similar to each other (Table 7). The reason is considered that the working time in night shift work was lengthy. Furthermore, the total walking steps of matrons in each shift work in this study were larger than those of nursery teachers[12] and hospital nurses[13] (we calculated the total walking steps in evening and night shifts for the nurses in the referral to have comparison with the total walking steps of matrons in night shift work in the present study as because the working form in the nurse work consisted of the three-shift system, each of 8-hour) (data not shown).

The total energy expenditure of matrons in night shift work was significantly higher than that in day shift work; however, the work intensity (kcal/kg/min) was significantly lower than in day shift work (Table 8). In night shift work, residents in SNH usually sleep and care work of matrons are mainly excretion (changing diaper), a tour of inspection and waiting in ward. Therefore, the physical activity and

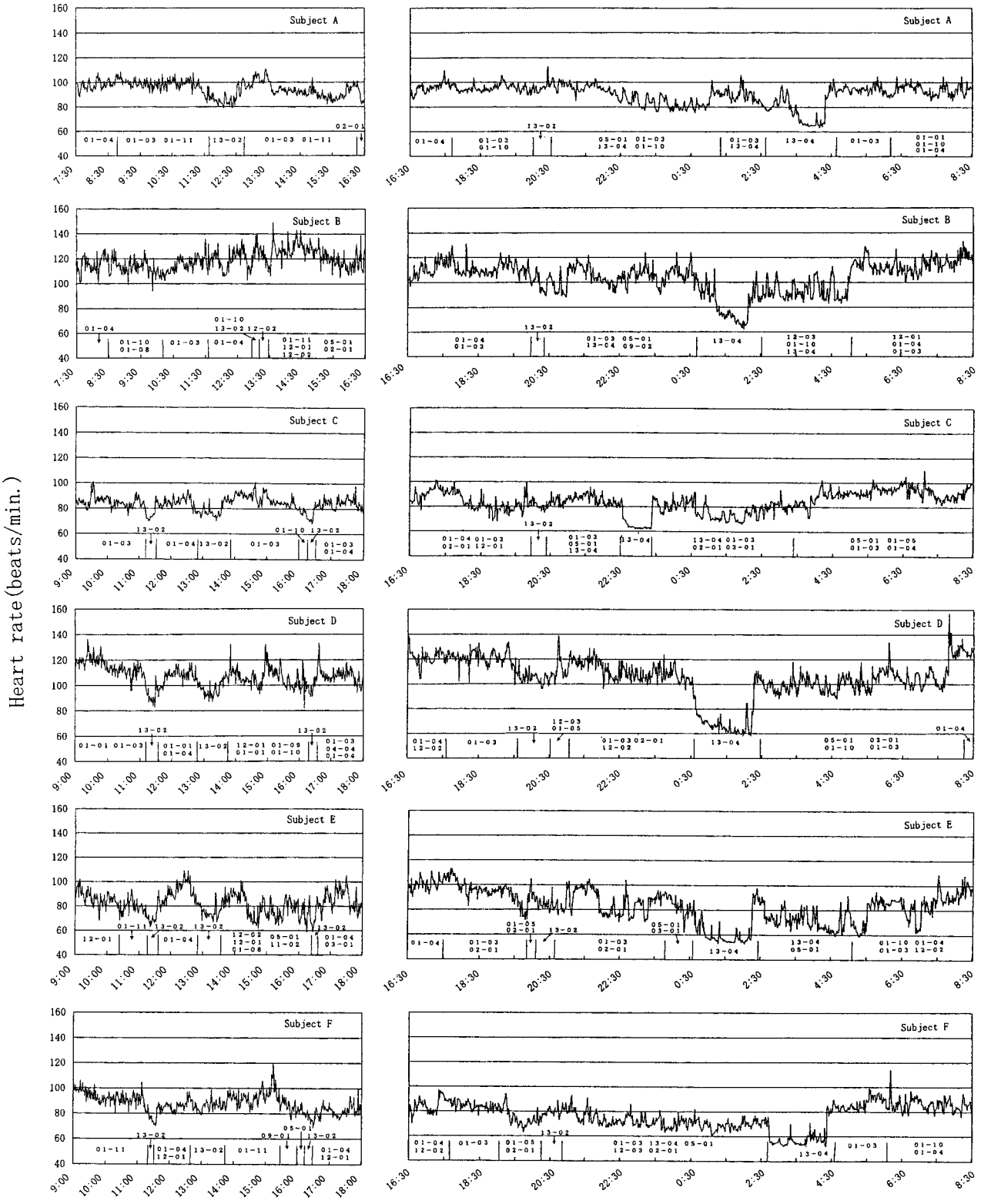


**Fig. 1. Change of heart rate of individual matron on duty and classification code of care work in day shift (left) and night shift (right).**
Explanation of classification code (e.g. 01-04) in this figure is shown in Table 4.

**Table 6. Percentage to estimated maximal heart rate of matrons on duty (the second-level classification)**

| Care work | Day shift | Night shift |
|---|---|---|
| 01 Individual care of residents | | |
| -01 Personal cleanliness | 52.9 (44.9–63.6, n=5) | 54.6 (43.2–65.0, n=6) |
| -02 Posture change | 54.5 (50.9–59.1, n=4) | 52.6 (40.8–65.4, n=4) |
| -03 Excretion | 55.1 (43.7–64.8, n=5) | 54.5 (47.8–62.0, n=6) |
| -04 Feeding | 54.2 (45.7–65.4, n=6) | 55.6 (48.5–63.8, n=6) |
| -05 Arrangement of surroundings | 56.9 (53.6–61.5, n=3) | 53.4 (44.8–61.8, n=6) |
| -06 Safety and comfort | 55.1 (43.7–67.0, n=6) | 53.1 (38.0–64.9, n=6) |
| -07 Management of resident's articles | 43.8 (39.4–48.1, n=2) | 54.2 (46.5–59.9, n=4) |
| -08 Sanitary care | 52.9 (37.2–68.5, n=2) | — |
| -09 Dressing | 56.5 (38.4–73.4, n=4) | 58.6 (55.2–65.7, n=4) |
| -10 Drinking | 51.4 (43.3–63.2, n=4) | 51.7 (43.7–60.0, n=6) |
| -11 Bathing | 54.6 (39.8–64.2, n=4) | — |
| -12 Social life | — | 52.3 (50.3–53.6, n=4) |
| -13 Transfer | 54.1 (41.9–63.4, n=6) | 53.9 (45.9–61.2, n=6) |
| -14 Coping with senile dementia | 56.7 (n=1) | 51.7 (47.8–56.7, n=4) |
| 02 Communication with residents | | |
| -01 Communication with residents | 51.8 (39.7–66.0, n=6) | 50.0 (43.1–59.2, n=6) |
| 03 Management of health care | | |
| -01 Medication | 52.5 (n=1) | 50.4 (42.4–64.2, n=5) |
| -02 Treatment of illness | 50.3 (n=1) | 56.1 (54.8–58.7, n=3) |
| -03 Examination of vital signs | — | 54.6 (43.0–60.3, n=4) |
| -04 Physical activity | 55.8 (n=1) | 40.7 (n=1) |
| 04 Ambulation of residents | | |
| -01 Room change | — | — |
| -02 Admission and discharge | — | 50.0 (n=1) |
| -03 Attending clinic and hospital | — | — |
| -04 Ambulation inside the institution | 53.9 (42.9–67.4, n=6) | 52.1 (44.0–61.8, n=6) |
| 05 Recording | | |
| -01 Recording of treatment | 52.0 (39.2–64.3, n=4) | 49.1 (40.0–56.0, n=6) |
| -02 Recording of management | — | — |
| 06 Liaison | | |
| -01 Contact and reporting | 55.9 (35.4–68.4, n=5) | 50.8 (44.2–60.1, n=5) |
| -02 Shift reporting | 63.3 (n=1) | 53.6 (46.2-65.3, n=6) |
| 07 Guidance and orientation for residents | | |
| -01 Orientation of admission and discharge | — | — |
| -02 Orientation of treatment | — | — |
| 08 Meeting and conference | | |
| -01 Meeting for discussion about treatment | — | — |
| -02 Conference | — | — |
| 09 Management of the institution | | |
| -01 Indoor arrangement | 54.3 (43.9–66.7, n=4) | 52.6 (43.4–62.3, n=6) |
| -02 Management of medicines | 59.4 (n=1) | 50.9 (42.2–57.0, n=5) |
| -03 Management of equipment | 55.9 (50.3–66.5, n=3) | 52.6 (45.5–61.8, n=6) |
| -04 Businesslike work | — | — |
| -05 Management of an article | 59.8 (51.9–66.3, n=4) | — |
| 10 Staff training | | |
| -01 Orientation at inspection and employment | — | — |
| -02 Staff training | — | — |
| 11 Management of resident's recreation | | |
| -01 Events | — | — |
| -02 Club activities | 37.0 (n=1) | — |
| 12 Administration of the institution | | |
| -01 Cleaning | 56.9 (45.4–71.8, n=6) | 55.7 (45.0–62.5, n=6) |
| -02 Laundry | 55.0 (47.6–69.3, n=6) | 57.5 (46.1–66.1, n=6) |
| -03 Disaster prevention | 66.4 (n=1) | 55.3 (47.2–60.3, n=6) |
| -04 Maintenance of equipments | 61.5 (n=1) | 54.1 (42.0–63.8, n=3) |
| 13 Others | | |
| -01 Private | 53.9 (42.7–66.0, n=6) | 50.9 (43.6–62.0, n=6) |
| -02 Recess | 49.8 (37.4–65.7, n=6) | 41.7 (34.1–48.0, n=6) |
| -03 Community activity | — | 50.2 (n=1) |
| -04 Standing by and taking a nap | — | 45.5 (36.5–51.4, n=6) |
| -05 Others | 71.3 (n=1) | 51.4 (43.1–60.1, n=5) |

Values are % (minimum–maximum, number).

**Table 7. Number of walking steps on duty**

| | Number of walking steps | |
|---|---|---|
| | total steps | steps/hr |
| Day shift | 12927 ± 286 ** | 1657 ± 265 |
| Night shift | 22370 ± 2149 | 1622 ± 139 |

Values are Mean ± SD. **:p<0.01.

**Table 8. Estimated energy expenditure on duty**

| | Estimated energy expenditure | |
|---|---|---|
| | kcal | kcal/kg/min |
| Day shift | 1041 ± 249 *** | 0.041 ± 0.004 * |
| Night shift | 1663 ± 355 | 0.036 ± 0.003 |

Values are Mean ± SD. *:p<0.05, ***:p<0.001.

**Table 9. Length of working time in different postures and percentage to total working time on duty**

| | Sitting | | Standing | | Walking | | Running | |
|---|---|---|---|---|---|---|---|---|
| | min | % | min | % | min | % | min | % |
| Day shift | 16 ± 8 *** | 3.4 ± 1.6 *** | 300 ± 47 ** | 64.8 ± 12.4 ** | 148 ± 58 ** | 30.3 ± 10.0 | 1 ± 2 | 0.2 ± 0.3 |
| Night shift | 172 ± 46 | 20.8 ± 5.9 | 367 ± 48 | 44.4 ± 6.0 | 285 ± 49 | 34.4 ± 4.9 | 3 ± 3 | 0.4 ± 0.4 |

Values are Mean ± SD. **:p<0.01, ***:p<0.001.

work intensity of matrons in night shift work must be lower than those in day shift work. It is speculated that the work intensity in night shift work was influenced by the waiting time in ward. In the present study, the total energy expenditure of matrons in each shift work was higher than that of nursery teachers[12] and hospital nurses[13].

Yokozeki *et al.*[4] reported that the total energy expenditure of matrons (aged 33 ± 5 yr) in day shift work was 1787 ± 534 kcal which is larger than in the present study. The reason may be that the measurement tools for the energy expenditure were not the same. In the present study, the energy expenditure was estimated from relative metabolic rate (RMR) by means of time study. However, Yokozeki *et al.*[4] used the heart rate-oxygen uptake relationship method. Usutani[16] pointed out that the RMR method underestimates the actual energy expenditure. Therefore, the actual total energy expenditure may be higher than the value estimated in this study.

Working posture is one of the major factors of low back pain among matrons in SNH. In the present study, the longest length of working time and higher percentage to the total working time on duty in different postures were in standing posture in each shift work (Table 9). The percentages to the total working time on duty in working postures including standing, walking and running in day shift work and night shift work were 96.6% and 79.2%, respectively. The value in day shift work was larger than that in night shift work. The reason was that the waiting time in ward was longer in night shift work than in day shift work.

The work load, work intensity and energy expenditure of matrons in the SNH seem to be high in the present study. In order to reduce work load of matrons, an introduction of care instruments may be effective. Tokuda *et al.*[17] reported that use of care instruments can reduce work load of matrons, although there are so many limitations concerning structure of instruments, easiness of movement and operation of instruments. Advancement of care work skill may reduce work load of matrons in SNH. Necessities to increase the number of matrons[2, 4, 5] and to decrease working time[2] are also pointed out for health maintenance and reduction of work load of matrons. These countermeasures must also be important for maintaining high quality care for residents in SNH.

In the present study, the work load of matrons in the SNH is assumed to be high and appropriate countermeasures are to be formulated to reduce the work load of the concerned. Further studies are needed to clarify the influence of the work load on health condition of matrons in SNH.

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