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Nursing Care Time for Newborns during Hospitalization in a Mixed Hospital Ward with an Obstetrics Department

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Purpose: This study aimed to better understand the nursing care time spent with healthy term newborns from birth to discharge, giving insight into neonatal nursing staff management. **Method:** In total, 30 healthy term newborns in a mixed hospital ward with an Obstetrics Department participated in this study. To measure care time, they had a wireless beacon attached to their cots. This measured how much time the nurses stayed in front of the cot from the time of birth until discharge, 24 hours/day. Collected data were tabulated every 24 hours after birth. **Results:** Seventeen newborns had their data analyzed. The average length of hospital stay for the newborns was 8231.3 minutes. The average nursing care time for the newborns was 533.8 minutes. Nurses provided the highest care time during the first 24 hours after birth (157.6 minutes/24hr). After the first 24, the average nursing care time gradually decreased. The average nursing care time during the first 24 hours after birth was longer than the nursing care time for any other 24-hour periods, with a significant difference ($p = 0.001$ to 0.046). **Conclusion:** The nursing care time for healthy newborns gradually decreased with the passage of time after birth. Healthy newborns should be treated as individuals, and the number of nursing staff should be adjusted according to the number of newborns in the ward to ensure nursing care quality and to prevent life-threatening events during the first 24 hours after birth.

INTRODUCTION

Currently, the rate of aging populations is rising around the world, spreading even into emerging countries. Japan has become the first super-aged society in the world, and Japan's Ministry of Internal Affairs and Communications expects that the nation's aging rate will reach approximately 30% in 2025 [14]. Meanwhile, according to United Nations International Children's Emergency Fund, the Japanese birth rate has been on a gradual decline since 1991, and the total fertility rate in Japan is at 1.43 in 2017 [25]. Further, Japan's population began to decline in 2005 [12]. Given this social background, Japan introduced the Diagnosis Procedure Combination (DPC) in its medical fee reimbursement system in 2003. The DPC is designed to help establish a sustainable social security system, a movement that has affected, among others, the field of obstetrics. Healthy mothers and infants have been struggling to stay in their hospital beds in Japanese maternity wards because there are women with upcoming deliveries that need them more urgently. Maternity-specific wards have therefore turned into mixed wards to achieve higher bed utilization rates [10].

Ninety percent of newborns who are born in Japan are considered low risk and do not require special medical intervention [13, 25]. In Japanese obstetrics, a healthy newborn is not counted as an inpatient, even though they are staying in a medical institution; instead, they are treated as a mere add-on to their mothers. Sato et al. have raised concerns that, since the infants are not counted as patients, nurses are understaffed, and newborns are not receiving sufficient care [23]. In addition, since the government does not mandate the length of a postpartum hospital stay, the mothers' and the newborns' discharge date is determined at each hospital's discretion. Furthermore, since there are also no standards for nursing care provided to mothers and infants during the postpartum hospital stay, it is unknown what type of postpartum care is being given. There are also no standards to help mothers care for their infants successfully at home because there are no interventions targeted at improving their infant care abilities during the hospital stay.

A mixed ward in a Japanese hospital may admits obstetric patients with normal and abnormal deliveries, their infants, and non-obstetric patients. Without government standards of postpartum care for mothers and infants, it is

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believed that the priority in nursing care is almost inevitably given to urgent patients in a day-to-day basis while nursing care for healthy term newborns may be delayed or reduced due to their lack of necessity for urgent care.

Nursing Care Measurement Research

Nursing care measurement research is intricate. When analyzing nursing care, it may be necessary to identify when health concerns are addressed, to whom, and exactly what nursing staff do to provide care. In addition, it proves difficult to measure nurses at once due to the characteristics of their activities, which tend to be flexible because they are contingent on patients' conditions. Furthermore, a previous study has shown that nurses tend to suffer from mental burden when their work is being directly measured, that there is also a considerable burden on the measurer, and that there is a limit to long-time measurement [24]. Regardless of these difficulties exist, studies to measure the ideal amount of nursing care administered to healthy newborns - who are not considered patients in Japan - are still required because understanding how much time is required to provide a healthy and lasting care for these infants.

When analyzing studies on the matter, we see that Guo et al. automatically measured clinical activities in the intensive care unit (ICU) using the Clinical Activity Tracking System (CATS), but this study was not performed with Japanese newborns [9]. To this date, based on our literature review, Nakai et al. was the only study to measure nursing care time for healthy newborns, but they only measured nursing care during the eight dayshift hours, and the measurement was based on a time and motion study [17]. The time and motion study has the advantage of accurately measuring the status quo, but it is a large-scale study that requires many people to take measurements, which proves difficult to achieve. Further, it did not measure nursing care during the nightshift hours, so the result of the study does not fairly represent the entire duration of the newborns' hospital stay, and it did not indicate any specific numerical value as to what would be an appropriate number of nurses to care for these newborns.

Based on these facts, with the intention to present a study that analyses the whole process of Japanese nursing care for newborns (from birth to hospital discharge) over a medium to long period of time and that builds up on previous knowledge, we chose to use telecommunication devices to collect data. This provokes little physical and/or psychological burden on the subjects and/or researchers and enables a 24-hour measurement of this process.

Aim

The present study was conducted to clarify the nursing care time spent with newborns throughout their hospital stay from birth to discharge. This will provide data that may be used as part of a comprehensive set of information for proper management of nursing staff, to support safe and comfortable hospital stays, to prepare the hospital environment, and to provide high-quality care for newborns in Japan.

MATERIALS AND METHODS

Design

Prospective observational study

Subjects of the Study

Thirty healthy term newborns who were born during the period of the study in the hospital study site.

Study Site

This study was conducted in a private Japanese hospital with a mixed (maternity/non-maternity) ward. The study site had 42 beds aimed primarily at attending obstetrics/gynecology female patients, but it was also utilized by other departments including breast surgery, gastroenterology, and ophthalmology. The site had 218 deliveries in 2017-, 26.5% of these deliveries were performed by c-section.

Study Period

February 1, 2017 to March 17, 2017 (45 days)

Data Collection

In total, 98 wireless beacons (Stick-N-Find) were installed in the mixed ward. Further, there were nine newborn cots (called "cots" going forward) that were installed with two of the same wireless beacons. During the study period, nurses carried smartphones (Android 5.1) and worked as usual. When a nurse approached a newborn cot, the approach information was recorded and sent to the cloud data storage software.

To better explain this procedure, for 24 hours a day, from birth to discharge, whenever a nurse got within close proximity of the beacon, it automatically started measuring the duration of what we considered to be "*nursing care time for newborns.*" The smartphone captured radio waves from the beacons whenever the nurse was in close

proximity. Further, although the proximity distance required for data to be recorded was set to one meter, there was a possibility of smartphones responding to beacons up to two or three meters away owing to variations in radio strength. Data were collected in such a way that radio wave information from two different beacons did not overlap. The present study only began collecting data after newborns were placed in their respective cots.

Information on gestational age, birth weight, newborn gender, maternal age, Apgar-score, and the frequency of vital sign measurements were obtained from patients' electronic medical records.

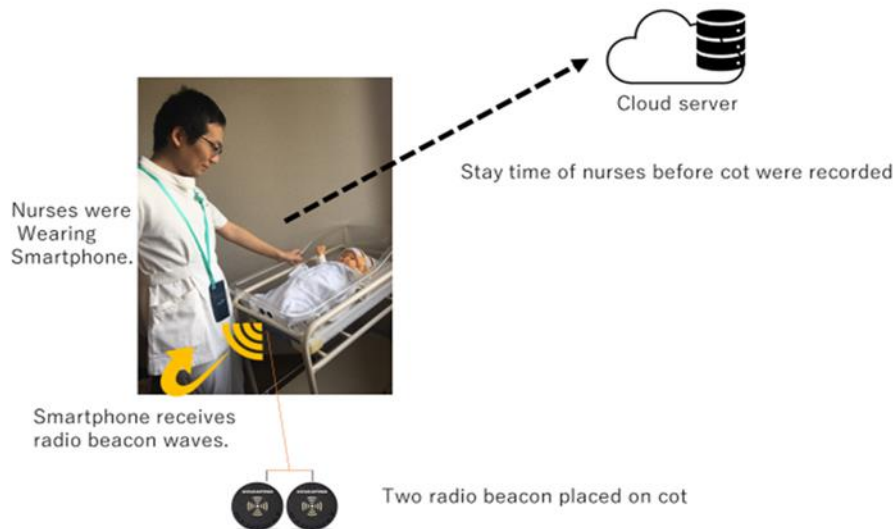


Figure 1. Measurement method for nurses' time spent near newborn cots

Definition of Terms

Healthy newborns: Infants born between 37 weeks and 0 days and 41 weeks and 6 days of pregnancy.

Nursing care time for newborns: Time spent by nurses providing nursing care in front of a newborn cot. This measure also included nursing time spent on childcare techniques thought to be necessary when caring for the newborn.

Nursing care time every 24 hours: With the time of birth as 0 hours, data were grouped into 24-hour periods from 0 to 23 hours, 24 to 47 hours, 48 to 71 hours, 72 to 95 hours, and 96 to 119 hours.

Nursing care time from 0 to 23 hours: Time spent providing nursing care in front of a cot from the time of birth to 23 hours 59 minutes 59 seconds after birth, hereinafter 0-23-hour period.

Nursing care time from 24 to 47 hours: Time spent providing nursing care in front of a cot from 24 hours 0 minutes 0 seconds after birth to 47 hours 59 minutes 59 seconds after birth, hereinafter 24-47-hour period.

Nursing care time from 48 to 71 hours: Time spent providing nursing care in front of a cot from 48 hours 0 minutes 0 seconds after birth to 71 hours 59 minutes 59 seconds after birth, hereinafter 48-71-hour period.

Nursing care time from 72 to 95 hours: Time spent providing nursing care in front of a cot from 72 hours 0 minutes 0 seconds after birth to 95 hours 59 minutes 59 seconds after birth, hereinafter 72-95-hour period

Nursing care time from 96 to 119 hours: Time spent providing nursing care in front of a cot from 96 hours 0 minutes 0 seconds after birth to 119 hours 59 minutes 59 seconds after birth, hereinafter 96-119-hour period.

Data Analysis

Data analyses included nursing care time data of newborns given birth during the study period for whom there was no missing data from the time of birth to discharge, and this was confirmed via their respective electronic medical records. Newborns who stayed in the same room as their mother, who spent time in an incubator, or who were transferred to pediatrics were excluded from the analysis set. In total, 17 healthy newborns born full term were included for data analyses. Among the subjects, 15 were born via vaginal delivery and 2 via cesarean section.

As the time of birth and date and time of discharge differed for each newborn, data were grouped into 24-hour periods for analysis. The analysis set included newborns with a minimum stay of 119 hours 59 minutes 59 seconds. Nursing care time for each 24-hour period (birth to 23 hours, 24 to 47 hours, 48 to 71 hours, 72 to 95 hours, 96 to 119 hours) was tested for normality using the Kolmogorov-Smirnov test with repeated measures analysis of variance (ANOVA). After confirming equal variance/normality testing, each period was compared using a Friedman Test and multiple comparisons using Bonferroni's method. Statistical analyses used EZR.version1.37. The significance level was 5%.

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Ethical Considerations

We carried out an explanatory meeting with the nursing manager (head of the nursing department/head of the ward) and the ward nurses using written documents to explain the aims and development of the study before obtaining agreement and written consent. Regarding the subjects' mothers, at the time suitable for an outpatient visit before delivery, the research aims and development were explained to the mothers and their respective families, and written consent was obtained from the mothers. We made it clear that declining participation in this study would not incur in any disadvantages, and that the researchers would ensure confidentiality for all subjects. Mothers were permitted to withdraw their consent at any point.

This study was conducted after receiving approval from the ethical review board of the Kobe University Graduate School of Health Sciences (Approval No.: 568).

RESULTS

Subjects' Background

In total, 30 infants were born during the study period, and the average number of newborns at the ward per day was 4.5. The maximum number of newborns at the ward per day was 8. The gestational age of the 17 subject newborns averaged 39 weeks and 3 days, and their average birth weight was 3098 g (Table I).

Table I. Profiles of the Newborns

Number of Newborns		17
gestation in weeks (Mean \pm SD)		39.7 \pm 0.9
birth weight (g) (Mean \pm SD)		3098.5 \pm 310.0
gender	male	9
	female	8
mother's age(year) (Mean \pm SD)		30.6 \pm 5.9
Apgar Score	after 1 minute	8.7 \pm 0.6
	after 5 minute	9.5 \pm 0.5

SD: standard deviation

Ward Situation

The study was conducted in a neonatal room in a mixed ward. The site had a policy stating that care for mothers and newborns in the initial stages after delivery should be performed in separate rooms. Following birth, a newborn received initial care in the delivery room, if their condition was stable, the infant was placed in a cot in the neonatal room. A newborn was breastfed based on an autonomous breastfeeding method: when they were to be fed, the mother went to the neonatal room to breastfeed her infant. The neonatal nurses were stationed in the neonatal room or at the adjacent neonatal staff station. When a neonatal nurse went for a meal or rest break, a nurse from another department filled in so that nurses were always present in the neonatal room.

The hospital allows a mother and her infant to stay in the same room beginning on the fifth day after birth if both the mother and the infant are progressing well, but none of the subjects of the present study stayed in the same room with their mothers.

Length of Hospital Stay for Newborns

According to the study site hospital's policies, newborns born to primiparous mothers were to be discharged 6 days after birth; newborns born to multiparous mothers were to be discharged 5 days after birth; newborns born by cesarean section, either to primiparous or multiparous mothers, were to be discharged 7 days after birth. According to the study results, there was one primiparous and one multiparous mother who gave birth to a newborn by caesarean section, and the infant born from the primiparous mother was indeed discharged 6 days after birth, while the infant born from the multiparous mother was discharged 7 days after birth. The average length of hospital stay for all the newborns was 8231.3 minutes (5.7 days).

Nursing Care Time for Newborns

Average nursing care time for newborns overall. The average time of nursing care administered to newborns from their birth until they were discharged was 533.8 minutes, which accounted for 6.5% of the time newborns spent in the ward.

Average nursing care time for newborns per 24-hour period. As shown in Figure 2, the nursing care time for newborns per 24 hours reached its highest number during the 0-23-hour period, with 157.6 minutes of care time. In the following time periods, nursing care time gradually decreased. It reached its lowest number during the 96-119-hour period, with 59.3 minutes of care time. Multiple comparisons showed that nursing care time was longer in the 0-23-hour period than any other period (0-23:24-47, $p=0.04$; 0-23:48-71, $p=0.00$; 0-23:72-95, $p=0.00$; 0-23:96-119, $p=0.00$), and that the difference was significant. The nursing care time found in the 24-47-hour period did not significantly differ from that found in the 48-71-, 72-95-, or 96-119-hour period (24-47:48-71, $p=1.00$; 24-47:72-95, $p=1.00$; 24-47:96-119, $p=0.15$). The nursing care time found in the 48-71-hour period did not significantly differ from that found in the 72-95- or 96-119-hour period (48-71:72-95, $p=1.00$; 48-71:96-119, $p=0.12$), and the nursing care time found in the 72-95-hour period did not significantly differ from that found in the 96-119-hour period (72-95:96-119, $p=0.88$).

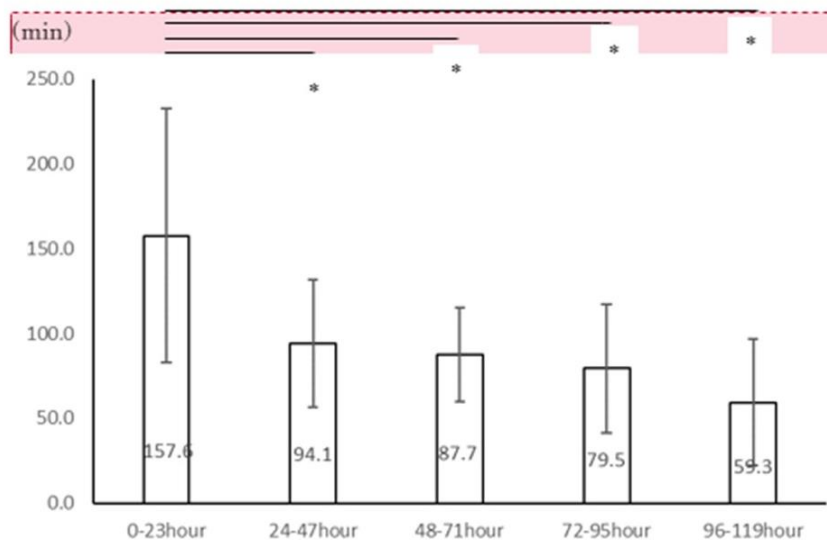


Figure 2. Average Nursing Care Time (Minutes) per 24-hour Period from Birth
The vertical axis represents the nursing care time (minutes) for the newborns, and the horizontal axis represents the elapsed time since birth. min: minutes. * $p<0.05$

Frequency of vital sign measurements per 24-hour period. The average frequency of vital sign measurements was 5.6, 2.5, 2.5, 2.3, and 2.5 times for the 0-23-, 24-47-, 48-71-, 72-95-, and 96-119-hour period, respectively. Multiple comparisons showed that the frequency of vital sign measurements found in the 0-23-hour period significantly differed from those found in any other period. The frequency of vital sign measurements after 24 hours was virtually constant, and no significant difference was observed.

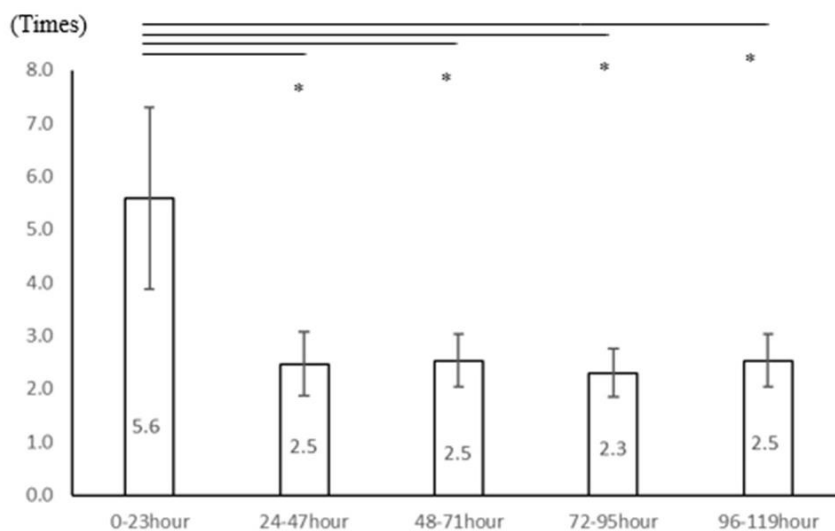


Figure 3. Frequency of Vital Sign Measurements per 24-hour Period
The vertical axis represents the frequency of vital sign measurements (times), and the horizontal axis represents the time elapsed since birth. * $p<0.05$

DISCUSSION

Length of Hospital Stay for Newborns

According to the Organization for Economic Co-operation and Development, the length of postpartum hospital stay varies from country to country: 1.3 days for Mexico; 1.5 days for Canada, UK and Turkey; 2.1 days for New Zealand; 2.3 days for Denmark and Sweden; 2.6 days for Australia; 3.0 days for Germany; 3.4 days for Italy and Korea; 4.0 days for France; and 5.8 days for Japan [17]. Thus, it can be inferred that the length of postpartum hospital stay is shorter in other countries compared to Japan, a fact corroborated by our results, which showed that healthy term newborns stayed in the hospital after birth for an average of 8231.3 minutes (5.7 days). However, even though the Japanese number seems to be higher, the actual length varies among hospitals and clinics, and there are no governmental regulations in this regard.

Our results also showed nursing care time for newborns accounted for 6.5% of their entire hospital stay. However, there are no other studies available that also measured nursing care time for newborns during their hospital stay. We believe future studies on the matter are warranted to provide further knowledge as to what the outcomes are of this aspect of nursing care for newborns, and to allow for future comparisons.

In terms of hospital stay time, postnatal hospital stays that are too long may expose the mother and the newborn to nosocomial infections because the risk increases with length of stay time [7]. As part of the American Academy of Pediatrics Policy Statement, Benitz stated that the hospital stay of a healthy term newborn infant should be long enough to allow for the identification of problems and for the mother to be sufficiently recovered and prepared to care for her newborn at home [3]. In the United States, the length of postpartum hospital stays decreased by 50% from 1970 to 1992; in 1992, the American Academy of Pediatrics and American College of Obstetricians and Gynecologists defined early discharge as a discharge within 48 hours for uncomplicated vaginal delivery, and within 96 hours for cesarean birth [3, 5].

It was also pointed out that, while hospital stays were shortened to reduce costs savings were considerably less when sufficient staffing was maintained shortening the stay does not appear to have affected patient safety [22]. Furthermore, previous studies showed that, while it is difficult to standardize the length of hospital stay or develop the indices, the length of hospital stay should be based on safe discharge criteria, and then adjusted by the characteristics and needs of mothers and infants [16, 22]. Thus, to ensure this happens, appropriate guidelines should be developed [3] and large randomized trials are required [4]. For example, a large survey study, such as the study of the relationship between the onset of neonatal MRSA infection and the mixed ward in the study of Kitajima in 2018 [11], could provide valuable information. More data are also required to provide sufficient analyses that allow for the provision of appropriate regulations and guidelines in Japan. For example, some believe that if mother and infant are stable during their hospital stay, there is no need for acute nursing care, and the mode should be switched to midwifery-led educational hospitalization; but this belief requires supporting data. Studying how much professional nursing care is needed during the healthy newborns' hospital stay will offer valuable information for patients and medical professionals.

Nursing Care Time for Newborns per 24-hour Period

Nursing care time for newborns per 24-hour period from their birth was chronologically analyzed, and it was found that the nursing care time during the first 0-23 hours after birth was longer than the nursing care time found in any other subsequent 24-hour period. This indicates that the first 0-23 hours of an infant is the period that requires the most attention from the nurses'. According to a study by Needleman et al., licensed nurses provide, in average, 9 hours of care per patient, per day [19]. However, this was a study that covered 11 adverse outcomes for both medical and surgical patients, and 3 adverse outcomes for surgical patients only, so a simple comparison is not possible because our study covered outcomes for only 2 types of medical patients, with a specific focus on newborns. Ohki et al. conducted a survey study on life-threatening events for preterm newborns among 456 main perinatal facilities in Japan and found that 32% of the life-threatening events occurred within 2 hours after birth, and 84% occurred within 48 hours after birth [21]. Going forward, the appropriate amount of nursing care should be examined by measuring the amount of care given to one specific newborn in order to collect more data on more specific cases, so as to allow for the development of a standard of nursing care for newborns.

It was found that nursing care time per 24-hour period gradually decreased as the time passed during the hospital stay. We believe this may have happened because the newborn's health stabilizes with the passage of time after normal delivery, so the nurses tend to gradually entrust greater portions of the infant's care to their respective mothers because they are aware that the mother must practice breastfeeding, handing a crying baby, and changing diapers. Further, nurses, more often than not, need to help the new mothers and encourage mother to practice their skills as often as possible, allowing them to develop these capabilities and ensuring that these new mothers will be able to successfully take care of their infants at home.

Based on this data, which indicates more nursing care time is needed for 0 to 23-hour-old newborns than for 24-hour-old or older newborns, and in light of the nurses' possible need to respond to life-threatening events, we

deem it necessary for a nurse to be assigned to newborns within 0-23 hours of birth, to ensure they do not incur in any abnormalities. In order to allocate nursing staff according to the number of newborns in the hospital, and to adjust the number of postpartum care staff during the 0-23-hour period, it is desirable to subdivide the pediatric nursing field, which is a specialized nursing field, and designate nurses that should be specialized in newborn care.

The need for care represents a change over time from the observation of maternal and child health to the acquisition of child-rearing skills over the course of the hospitalization. A survey conducted by Mizuho Information and Research Institute on the postpartum care business is currently underway in 2018 [15]. The postpartum care business has resolved mothers' concerns about childcare and breastfeeding. On the other hand, a survey by the National Center for Child Health and Development found that there were 92 suicides from 2015 to 2016 throughout the year after birth, and about half were women who were over 35 years old, or who had their first child [18]. Recognition of the postpartum care business in Japan is desired. In the UK, Australia and Germany, postpartum midwives visit their homes and postpartum care is carried out according to the guidelines. Since not all mothers can fully acquire childcare skills during hospitalization, subsequent follow-up through home visits is necessary. Follow-up studies could demonstrate the most appropriate time period for continuing visits.

As the present study did not identify detailed nursing activities, it is not known what nursing activities took place when nurses were at the cots, or for how long the activities continued. Nonetheless, the present study provides basic data on nursing care time for newborns per 24-hour period: based on the electronic medical records, it was indicated that the frequency of vital signs measurements were at its highest during the 0-23 hour period (5.6 times); so it is conjectured that nurses placed the most importance on observing the newborn's withdrawal from the fetal circulation and its transition to the neonatal circulation during this period. The infant's vital signs were collected twice during the first 24-hours (6 and 12 hours after birth) if they had been born vaginally; after a caesarian birth, vitals were collected three times (1, 2 and 5 hours after birth). After the first 24-hours, the vital signs were measured twice a day into vaginally and caesarian birth. Although the number of measurements increased when the body temperature of the newborn was not stable at 36.5-37.5 C°, it was not possible to objectively prove whether the increase or decrease in the number of measurements was a judgment made by the nurse.

Future studies should provide more detailed data on the nursing care activities administered on newborns, which will further help elucidate the reason for this gradual reduction of care time per 24-hour period.

Situation of Newborns

In Japan, a newborn without any ailments is not counted as an inpatient, even though they are staying in a medical facility; instead, they are treated as a mere add-on to their mothers [23]. Forster et al. advocates against the mother and her infant being treated as separate entities; they state that one nursing staff member would be ideal to attend to four patients, and concludes that staffing in postnatal wards is a complex issue that needs to be addressed by policy makers [8]. The hospital of the present study followed the practice of separating mothers and infants after birth in different rooms; the newborn was placed in the neonatal room, where one nurse was stationed. The average number of newborns per day was 4.5, and the maximum number of newborns at the ward per day was 8. On days with more newborns, therefore, the suggested ratio of 1 to 4 would not be followed. Instead, one nurse was responsible for eight infants. Many researchers have maintained that proper staffing of nurses improves patient safety and quality of care [1, 2, 6]. Based on these understandings and findings, it is likely that nursing care time was shortened for the newborns when four or more were staying in the ward. In such a circumstance, if there were, additionally, newborns with poor birth conditions, the nursing care time for healthy newborns would be further diminished. Thus, we infer that a newborn must be treated as an individual person under any circumstances, and that the number of nursing staff should be adjusted according to the number of newborns in the ward in order to improve the safety and the quality of care for healthy newborns.

Limitations of the Study

This study had several limitations. First, it involved only one site, and had a small sample size. Future studies should utilize bigger samples, and should perform examinations in more medical institutions in different locations. This can provide more polarized findings that allow for further comparisons.

Second, no distinction was made as to what types of nursing care activities were conducted in front of the cots. Future studies should analyze not just the time but also the content of the activities that are performed with these newborns, providing a better understanding of the process of newborn nursing care. We also could not analyze the difference in nursing time for newborns among nurses and the difference in nursing time depending on the number of newborns in hospitals.

Third, while it is difficult to determine whether giving guidance on breastfeeding and teaching infant care skills should be regarded as caring for mothers or caring for newborns, this study regarded it as caring for newborns. Thus, nursing care activities that cannot clearly be classified as mother- or infant-specific need to be classified as common nursing care activities in future studies.

CONCLUSION

The average length of hospital stay after birth for healthy newborns was 8231.3 minutes (5.7 days). Newborns were provided with 533.8 minutes of care during their hospital stay, which accounted for 6.5% of the total hospital stay. Nursing care time per 24-hour period gradually decreased over the stay. Nursing activities may be specifically provided for mothers, specifically provided for infants, or common to both. There was a certain difficulty in addressing who was the target of the activity when nursing activities were common to both mothers and infants. Finally, we believe that, by elucidating what kinds of nursing activities are carried out, we can determine when care should be given during the hospital stay for acquisition of infant care skills, so that newborns are well taken care of upon leaving the hospital. In addition, newborns should be treated as individuals, and nursing staff should be assigned in accordance with standards that must be created based on data provided by future studies on the topic.

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