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Determining the Midwifery Staff in the Maternity Ward of Hospitals Using the Birthrate Plus Model

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ABSTRACT

BACKGROUND AND OBJECTIVE: In addition to reducing the costs in hospitals, manpower planning can ensure the quality of patient care. Therefore, this study, which is part of a comprehensive study, was conducted with the aim of applying the birth rate method to estimate the number of midwives required in the maternity ward.

METHODS: In this analytical study, 334 patients who referred to the delivery ward of two hospitals affiliated to the Social Security Organization in Khorasan Razavi province were selected by systematic random sampling. Retrospective data were collected from patients' medical records using the Birthrate Plus (BR^+) model questionnaire consisting of 34 items related to maternal and neonatal clinical factors based on scores obtained in five groups (score 6 in group one, score 7-9 in group two, score 10-13 in group three, score 14-18 in group four, and score 19 and above in group five). Then, the data were analyzed.

FINDINGS: The results showed that the duration of stay in the maternity wards of the province and district hospitals was 12.07±5.18 and 7.17±4.22 hours, respectively ($p<0.001$). The mean duration of midwife's care in the two hospitals was significantly different ($p<0.001$). The results indicated more patients with complex conditions in the maternity ward of the province hospital. According to the "BR^+" model, about 60% of patients in the province hospital were in groups 4 and 5, while it was 18% in another hospital. The number of midwives required in district and province hospitals was 27 and 72, respectively, based on full-time equivalent (FTE), which was obtained by converting it into an index equivalent to one midwife for 142 and 95 annual deliveries in the mentioned hospitals.

CONCLUSION: The results of the study showed that the use of the BR^+ model, considering the length of stay and the severity of clients' symptoms, is a suitable model for determining the midwifery staff in the maternity ward.

KEY WORDS: *Birthrate Plus, Midwife, Hospital, Client.*

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Introduction

Manpower is one of the most important and at the same time the most costly resources of health sector organizations, which is necessary to determine the most appropriate level and composition to ensure the optimal and effective use of limited resources (1). In addition, the shortage and improper distribution of human resources and lack of professional development may lead to a decline in the quality of patient care (2, 3). In workforce planning, different methods are used to estimate the number and composition of employees (4). In the field of nursing, there are five methods: professional judgment, nurses per occupied bedmethod, acuity-quality method, timed-task/activity approaches, and regression-based systems (4).

Timed-task/activity approaches include the method called "Workload Indicators for Staffing Needs", which has been used in the last two decades to estimate health staff, including midwives (5-12). Regarding the method of Nurse/Midwife to Patient Ratio, we can refer to the recommendation of the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN), which mentions the ratio of nurses to women referring to obstetrics and gynecology care, the stages and process of services in the delivery blocks as well as the condition of the clients in terms of the intensity of the need for care from 1:1 to 1:6 (13).

One of the specific models in midwifery estimation is the Birthrate Plus(BR^+) method, which was first introduced by Ball and has been used since 2001 in the UK National Health System and a number of maternity units in Ireland and Australia (14-18). This method is a framework for manpower planning and strategic decision making that is designed to estimate the midwife needed to provide antenatal, intrapartum, and postnatal care. This tool is based on understanding the total time required for midwifery care for women and predicting the minimum standard of one-to-one midwifery to the client (19). The strength of this model in the scoring system is that it differs from the top-down methods (which estimate the number of staff required in relation to bed occupancy) and uses valid clinical indicators of the process and outcomes of delivery to classify results in the five groups (20). In fact, this model uses a kind of acuity-quality method of disease, because according to the placement of clients in groups based on the degree of high risk and complexity of their clinical condition, more midwives are assigned to them (21). The method of the Iranian Ministry of Health and Medical Education to estimate the number of midwives in the maternity ward of the hospital is based on the ratio of midwives to the number of annual deliveries. In the traditional maternity ward of the hospital, 10 midwives are added as a minimum and then one midwife is added for every 800 normal deliveries or 1200 annual cesarean deliveries (22). One of the disadvantages of this method is the same prediction of midwives for cases of elective and emergency cesarean section, lack of attention to the severity of clients' clinical symptoms and the length of their stay in the delivery ward.

Midwifery staff have a special place due to their role in providing vital services to mothers and infants. Their appropriate role in maternity wards has always been one of the concerns of countries due to its impact on the safety and quality of midwifery care, as well as its relationship with morale, job satisfaction, staff leave and their recruitment and retention (23). There is limited information about the effect of midwifery staff on birth outcomes, but the shortage of midwives in the delivery wards has been correlated with a higher incidence of adverse and near-miss events such as delays in time-sensitive processes (24, 25). Tucker et al. have shown a relationship between midwifery shortages and an increase in neonatal resuscitation cases (26).

Due to the increasing complexity of deliveries due to medical, social and psychological health factors (such as diabetes, obesity, increasing gestational age and depression) it seems that clients need more midwifery care during childbirth compared to the past (27), which leads to an increase in workload and, of course, more midwives per client. Therefore, it seems that estimating and providing a sufficient number of midwives with scientific and specialized methods to provide midwifery care is a necessity. In particular, midwifery studies have often been conducted in Iran in the form of nursing staff and by comparing the existing methods (28, 29). Therefore, this study was performed to estimate the number of midwives required in the delivery ward of two hospitals affiliated to the Social Security Organization in Khorasan Razavi province using the BR^+ model.

Methods

This study is part of a comprehensive study that was conducted with a retrospective approach and descriptive-analytical method in 2018 in hospitals affiliated to the Social Security Organization. In this study, according to the purpose of applying the BR^+ model in estimating the number of midwives, it was sufficient to select two hospitals at the province and district levels. The medical records of the patients

admitted to the maternity ward of the hospital were reviewed. In order to eliminate the possible effects of the seasons of the year on the geographical access of the patients to the hospital (and of course on their stay), sampling was performed using random systematic method. In order to comply with the ethics of research and keep the medical information of the clients confidential, their names were not recorded in the data collection form. The research plan was reviewed and approved by Social Security Research Institute with the registration number of 395003140. Due to the lack of similar studies, estimating the standard deviation of 4 hours (equivalent to one-sixth of at least one and at most 24 hours of mothers staying in the maternity ward) and considering 95% confidence and half-hour estimation precision for the length of stay in the ward. Using Cochran's formula, 121 and 136 samples were estimated in the two hospitals of the province and the district. In order to increase the accuracy and to estimate about 30% of cases with incomplete or abnormal data (staying less than half an hour or more than 24 hours in the maternity ward), 157 and 177 cases were selected in the mentioned centers, respectively.

The medical records of mothers with pregnancies that led to normal delivery or emergency cesarean section in 2017 were reviewed. Therefore, the medical records of cases with elective cesarean section were excluded from the study. To collect the data, a standard questionnaire of BR+ model was used. It's Persian version was reviewed and matched with the forms and logbooks of the delivery room in a meeting with the head midwife and two midwives of one of the selected hospitals. To ensure face validity and comprehensibility of this tool, data collected from 10 medical files in a pilot study and the necessary corrections were made. Data were extracted from clients' medical records based on the questionnaire of BR^+ model, which included 34 items: time of admission and discharge of the client from the delivery room (2 items), gestation (3 items), length of labor (2 items), interventions during delivery (5 items), type of delivery (7 items), neonatal conditions such as Apgar score and birth weight (6 items) and other conditions (9 items).

According to the scoring system of the model, each client was assigned to one of the five groups based on the total points earned (Table 1). For example, cases with a score of 6 were in group "one" and cases with a score of 19 or more were in group "five". Then, according to the grouping of clients, the coefficient was considered as "ratio of midwife time", which is applied for the groups of three to five from 1.2 to 1.4, respectively. In the next step, the mentioned ratio was multiplied by each patient's stay (i.e. the time from admission to discharge the delivery room) to calculate the midwifery care required for clients and their related five categories.

Table 1. Classification of the clients of maternity ward based on BR^+ model

Total score of the questionnaire	6	7-9	10-13	14-18	≥19
Group (category)	one	two	three	four	five
Ratio of midwife time	1	1	1.2	1.3	1.4

In this study, according to the recommendation of the BR^+ model, the estimation of midwives required for clients in the maternity ward who receive midwifery care in the form of examination, NST diagnostic test or temporary hospitalization, was determined based on expert e opinion and according to the time standard and annual service volume (Table 2).

Table 2. Other services and midwifery care in the maternity ward of the hospital

Activity	Average activity standard time	Criteria/variable
Triage/ Midwifery examinations when clients refer to the maternity ward	12 minutes or 0.2 hours	Total number of (attendants or admittants) to the maternity ward during one year
Performing NST diagnostic test	20 minutes or 0.33 hours	Total NST minus total number of normal deliveries and emergency cesarean section during one year
Midwifery care for mothers admitted to the maternity ward without termination of pregnancy	180 minutes or 3 hours	Number of hospitalizations in maternity ward with other causes including groups X, A2, A1, R in BR^+ model
Midwifery care for mother and baby in the operating room in cases of elective and emergency cesarean section	120 minutes or 2 hours	Number of elective and emergency cesarean section during one year

In estimating the number of midwives, the full time equivalent index (FTE) was used; for its calculation, the workload of the midwifery care required by the clients, the annual available working time of midwives and 10% relaxation allowance (30) were considered according to the following formula:

$$\text{The estimated midwives in FTE} = \frac{\text{Total workload of midwifery care}}{\text{Annual available working time} \times (0.1\text{-}1)}$$

In this study, the available working time of midwives was calculated to be 1683 hours, by summing absent days (i.e. public holidays, paid leave, sick leave, maternity leave and , training leave) and reduced weekly working hours according to the "Improving Productivity Act" for clinical staff (that was passed by the Iranian parliament in 2009), and subtracting the sum from the total working days in a year; according to this, if a midwife was present 24 hours a day at work shifts in the maternity ward, 5.2 midwives were needed ([365 days×24 hours]÷1683= 5.2).

The data extracted from the clients' medical records were entered into an Excel spreadsheet (Excel 2016). Preliminary calculations including length of stay in the maternity ward, total score of the questionnaire, ratio of midwifery care time, duration of midwifery care required for clients and also distribution of clients in maternity wards during the day and night were performed using the mentioned software. For final analysis of data and comparison of the indices in the two hospitals, Student's t-test and analysis of variance were used in SPSS 17 statistical software and $p<0.05$ was considered significant.

Results

327 questionnaires containing complete and flawless information were analyzed. The mean length of stay of patients in the maternity ward of province and district hospitals was 12.07±5.18 and 7.17±4.22 hours, respectively ($p<0.001$). The mean ratio of midwife care time in the maternity ward of the province hospital was 1.27±0.08 and in the district hospital was 1.12±0.13 ($p<0.001$) (Table 3).

The mean length of stay of mothers in the maternity ward of the district hospital varied from the shortest time in low-risk groups of one and two (5.69±3.36 hours) to the longest time in group five (11.40±4.68 hours) ($p<0.05$). The mentioned index did not differ significantly between groups three, four and five, despite the difference in the severity of factors and clinical symptoms of mothers. The mean length of stay of mothers in the maternity ward of the province hospital ranged from 9.44±9.81 hours in group two to 12.58±5.97 hours in high-risk group five, but this difference was not statistically significant.

The distribution of delivery cases in terms of acuity was different in the two hospitals. In the district hospital, half of the maternal clients were in low-risk groups of one and two, while it was less than 2% in the other hospital. The share of groups with more severe clinical factors including categories 4 and 5 was about 18.39% and 60% in district and province hospitals, respectively (Table 4).

By summing the figures given in the column "average required midwifery care", the weighted average of midwifery care per client in each hospital was obtained which was 15.42±6.77 and 8.24±5.34 hours in province and district hospitals, respectively. In order to ensure the observance of the minimum ratio of 1:1 in the presence of the midwife to the client in the working shifts of the maternity ward, the average distribution of patients in the hours of the day was extracted for the two hospitals. The peak number of patients admitted to the maternity ward of the district and province hospitals was 3.5 and 9.9, respectively (Figure 1).

According to the prediction of at least 5.2 FTE to cover the 24 hours presence of a midwife in the maternity ward, achieving the ratio (1:1) in the peak points of district and province hospitals requires at least 20.8 and 52 midwives for midwifery care of mothers with normal delivery and emergency cesarean section, respectively; Thus, the estimated number of midwives in the district hospital was corrected (Table 5).

Based on the volume of activities related to the maternity ward and using the BR+ model, 27 and 72 FTE midwife were estimated in the hospitals of the district and the province, respectively. Considering the total annual deliveries performed, it could be claimed that one midwife could provide midwifery service to 142 clients a year in district hospital and to 95 clients in province one.

Table 3. Comparison of average indices and ratio of midwifery care time

Hospital	sample size	Stay of clients Mean±SD	T-Test	p-value	Index of midwife care time ratio Mean±SD	T-Test	p-value
province	153	12.07±5.18	9.30	<0.001	1.27±0.08	13.16	<0.001
district	174	7.17±4.22	9.30	<0.001	1.12±0.13	13.16	<0.001

Table 4. Distribution of clients in maternity ward of district and province hospitals in 5 groups

Hospital	Risk group in BR+ method	sample size	Case-mix (%)	Average length of stay (hours) Mean±SD	Midwife care ratio	Average required midwifery care (hours)	Weighted average
district	groups 1 & 2	87	50	5.69±3.36	1	2.85	8.24
	group 3	55	31.61	8.11±4.11	1.2	3.08	
	group 4	27	15.52	9.20±5.06	1.3	1.86	
	group 5	5	2.87	11.40±4.68	1.4	0.46	
province	groups 1 & 2	3	1.96	9.44±9.81	1	0.19	15.42
	group 3	57	37.25	11.50±5.10	1.2	5.14	
	group 4	67	43.79	12.47±4.75	1.3	7.10	
	group 5	26	16.99	12.58±5.97	1.4	2.99	

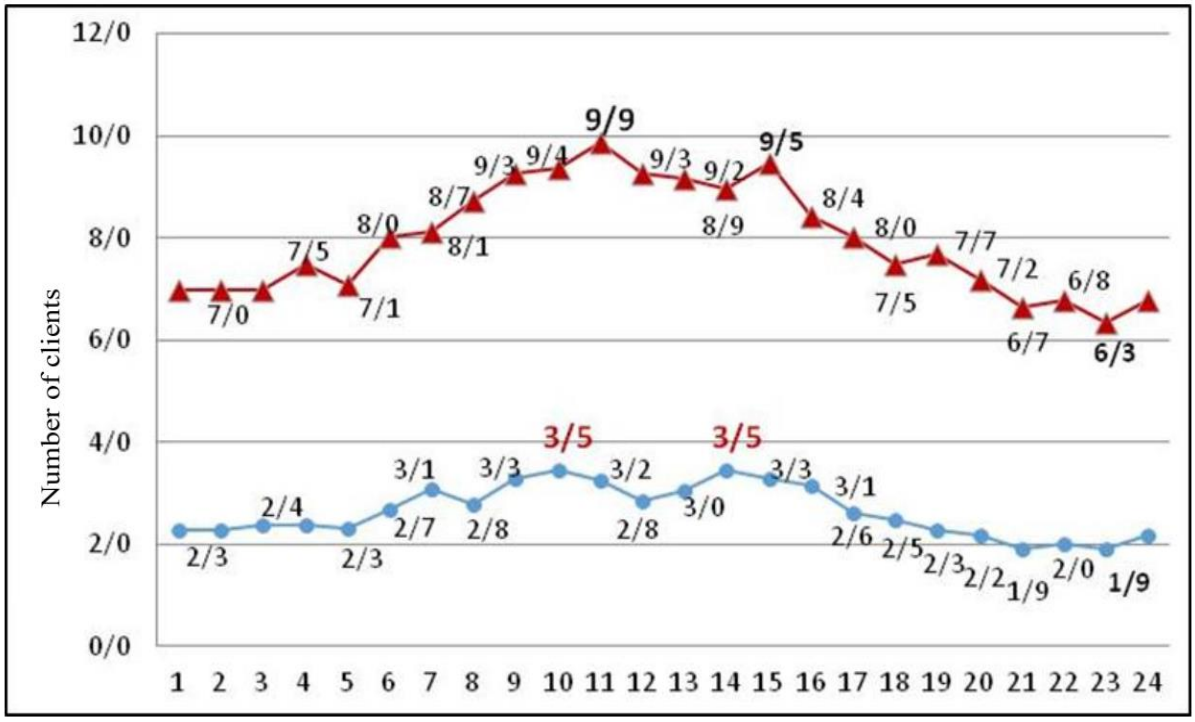

Figure 1. Distribution of mothers' presence in the maternity ward of province (Δ) and district (○) hospitals during the day

Table 5. Estimation of the number of midwives in the delivery ward of district and province hospitals

Midwifery activities	Activity standard (hours)	District hospital			Province hospital		
		Number	The workload of midwives (h)	Number of full-time equivalent (FTE)	Number	The workload of midwives (h)	Number of full-time equivalent (FTE)
Examination / triage of clients in the delivery ward	0.2	13020	2604	1.72	38622	7724	5.1
Performing NST for outpatient clients	0.33	440	145	0.10	7441	2456	1.62
Midwifery care of monitored cases, abortion and ...	3	584	1752	1.16	501	1503	0.99
Maternal and infant care in the operating room	2	1367	2734	1.8	2735	5470	3.61
Midwifery care for mothers with natural delivery and emergency cesarean section	8.24* 15.42**	3272	26961	17.8	5848	90176	59.5
Correction to cover the peak hours of the client's presence in the ward	-	-	-	3***	-	-	-
Supervision and coordination with other departments	-	-	-	1	-	-	1
Number of full-time equivalent (FTE)	-	-	-	27	-	-	72

* Average midwifery care required by the district hospital, ** Average midwifery care required by the province hospital, *** Number of midwives added to cover the peak hours of a client in maternity ward

Discussion

In this study, comparing the number of annual normal deliveries and emergency cesarean section with the estimated number of midwives in the two selected hospitals, it was observed that the number of deliveries performed in the province hospital was 1.8 times more than the district hospital, but the required number of full-time midwives was about 2.7 times more. In justifying this difference, we can point to the effect of other factors (in addition to the number of deliveries) on the need for midwifery care in the maternity ward. In this study, using the BR^+ model, the number of midwives required in the maternity ward in both province and district hospitals was estimated. In addition to the number of deliveries, other factors such as average stay of mothers in the maternity ward, case-mix and allowance time (in which midwives benefit vacations, leave and attending educational programs, etc.) were also assessed. On the other hand, considering the similarity of the latter factor, it seems that the difference in the estimated number of midwives in the two studied hospitals is related to the case-mix and average stay of clients. Comparing the average length of stay of mothers in the maternity ward, it was revealed that this index in the province hospital was significantly 1.7 times higher than in the district hospital. It has been suggested that one of the reasons for the long stay of mothers in the mentioned ward can be related to more complicated condition in terms of symptoms and clinical risk factors. The results also showed an increased trend in average stay in the maternity ward of the district hospital from low-risk groups (i.e. groups one and two in BR^+) toward high-risk groups (i.e. groups four and five in BR^+), which is consistent with the general pattern of clients in the United Kingdom (31) and the results of a study in 10 hospitals in China (20). However, this trend was not true among the five groups of patients in the province hospital. By controlling the severity of the symptoms and clinical conditions of the clients by selecting and comparing similar groups in the two selected hospitals, it was

observed that there is a significant difference in the length of stay of the clients, which can suggest the role of other factors. The shorter stay of mothers in the maternity ward of the district hospital can be due to the geographical access barriers of the dominant rural population in the region, , that could resulted in postponing attending in hospital by mothers to give birth and they may be admitted in their last stages of labor and delivery. As a result, the interval between admission in the maternity ward and the end of pregnancy is shorter. The distribution of clients in the maternity ward was different in the five groups in the two hospitals. Clients with high-risk clinical conditions and symptoms in groups 4 and 5 accounted for about 60% of the total number of clients in the maternity ward of the province hospital, which is consistent with the results of 48 obstetrics and gynecology units in the United Kingdom (31). Nevertheless, the relative frequency of the two mentioned groups in another hospital was less than 20%. Due to the fact that the hospital of the province had more specialized facilities and services for obstetrics and gynecology compared to other hospitals, it seems that some of the mothers admitted in the maternity ward are cases with severe and high-risk clinical symptoms referred from other hospitals. Studies conducted in United Kingdom hospitals have also pointed out the difference between the district' public hospitals and specialized hospitals with third level services in terms of the percentage of mothers in high-risk groups 4 and 5 (31).

In some studies, which estimated the number of midwives using BR+ model, in 13% of working hours around the clock, the number of mothers in the labor wards was higher than the number of midwives assigned in the work shifts (20); that this overload, in addition to not achieving the recommended minimum ratio of midwife to client (1:1), might have negative consequences on the quality of maternal and infant care. Based on the analyzed data , it was showed that the district hospital, with smaller number of annual deliveries (compared to the province hospital), was experienced higher number of clients exceeding of midwives in the work shifts e. Allen et al. based on a simulated model showed that hospitals with a low number of deliveries, when compared to other hospitals, are faced with higher workload and an increase in the number of clients relative to the number of midwives in work shifts, which is consistent with the results of the present study (32). In this study, the number of mothers a FTE midwife could take care of in district and province hospitals, were 142 and 95, respectively, which is consistent with the results of Chinese hospitals with a range of 90-242 patients per midwife (20), but is not consistent with recommended norms of 35-38 in the UK and Australia (18, 19, 33-35). Part of the variance in these countries may be related to differences in the midwifery care system provided by midwives. However, the estimated norm in this study is limited to midwifery interventions and care related to the process of normal delivery and emergency cesarean section in the hospital.

One of the advantages of this method is the analysis of the required manpower based on the needs of the clients, instead of what the midwives do. Furthermore, the process of classifying clients based on case-mix is simple, and the process of collecting and measuring the factors used in grouping the clients makes this model attractive for hospital managers (25). This tool is highly efficient and effective for estimating midwifery workforce in hospitals (20). Therefore, the results of this study showed that the manpower estimation model based on the birthrate is an effective and efficient method for estimating midwives in the maternity ward, which is hoped to be the beginning of developing and replacing scientific methods in midwifery workforcer planning in hospitals at local and national levels as well as a model for the demand and supply of manpower training in this sector.

One of the limitations of this study is that there is no evidence to prove the validity of the BR+ method in estimating the number of midwives in terms of the impact on the outcomes of maternal mortality and morbidity, and it may even be questioned what criteria are used to determine the sufficient midwifery manpower in BR+ method. In addition, using the number of midwives as estimated by this method may not necessarily prevent double workload times in the maternity wards.

Conflict of interest: None of the authors of this article declare a conflict of interest.

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