Newborn Readmissions to Slovenian Children’s Hospitals in One Summer Month and One Autumn Month: A Retrospective Study

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newborn

Background: With the shortening length of stay of newborns in hospitals after birth, concerns have been raised about the possible rise in readmission rates. In Slovenia, where the normal length of stay is 3 days, no data on readmissions were available. We sought to determine the frequency and causes for readmissions.

Methods: We conducted a retrospective study on all newborns readmitted to Slovenian children’s hospitals and wards in June 2012 and November 2012. We obtained basic demographic data for newborns and mothers, analyzed the frequency of diagnoses, and compared the duration of treatment between summer months and autumn months.

Results: The proportion of readmissions in June 2012 and November 2012 was 6% and 5.9%, respectively. Around 10% more boys were readmitted in June 2012 and November 2012. In June 2012, the mean age was 12.2 days, and the mean birth weight was 3444 g. In November, the mean age was 10.5 days, and the mean birth weight was 3271 g. Around 50% of mothers were primiparous, and their mean age was around 31 years. Most received > 10 prenatal check-ups and participated in a prenatal class. The most common diagnosis in June 2012 and November 2012 was jaundice. The duration of treatment did not statistically significantly differ between summer months and autumn months, but it was associated with the admission diagnosis and infants’ characteristics.
1. Introduction

Throughout the developed world, attempts have been made to reduce the length of stay of newborns and their mothers in hospitals after birth. Trends to decrease the length of stay were mainly attributed to lowering health care costs, when financial pressures on hospitals and insurance companies were rising. Due to various reasons, one being medical risks, the trends later reversed and early discharge is currently defined as a stay of < 48 hours for women who had vaginal delivery and < 96 hours for women who delivered via cesarean section.

With this trend of reducing postnatal hospital stay, concerns have been raised regarding the impact on the health of women and newborns. While some studies have shown an increase in hospital readmissions, others have found no correlation between the length of postnatal stay and rehospitalizations. In most cases, newborns were readmitted because of hyperbilirubinemia or dehydration, associated with weight loss and/or failure to thrive. In addition, a recent study showed that factors other than the severity of newborns’ illness contributed to readmissions; namely, familial factors as well as sociological factors, such as age of the mother, her marital and employment status, and the number of previous deliveries.

In Slovenia, newborns are discharged from the hospital on the 3rd day after a vaginal delivery, provided that no complications arise in that period. In the first 24 hours after discharge, a community nurse visits the family, providing them with basic advice on the care and well-being of their baby. In addition, primary as well as secondary pediatric care is well established and easily accessible, should the need arise. No data exist, however, regarding the percentage of hospital readmissions or the most common reasons for them in Slovenian hospitals.

To shed more light on the problem, a retrospective study was performed, in which the number and reasons for readmissions in Slovenian children’s hospitals and wards were analyzed. Two months, namely June 2012 and November 2012, were chosen to elucidate any possible differences between summer months and autumn months. These two months were chosen based on epidemiological data for the years 2006–2011, which showed that respiratory viruses such as respiratory syncytial virus and influenza viruses began circulating in the population around the start of November but were not present during the summer.

Conclusion: Our study showed that the readmission rate in Slovenia was much higher than in some other developed countries. Prospective studies are needed to further confirm the findings and highlight the possible causes for this observation.

2. Methods

2.1. Data source

Patient data were gathered from Slovenian hospitals with pediatric wards, specialized children’s hospitals, and maternity hospitals. Data were obtained from hospital records. Approval for the study was obtained from The National Medical Ethics Committee of Slovenia.

2.2. Patient cohort

Data were obtained for all infants between the ages of 0 days and 28 days who were readmitted to Slovenian hospitals after having been discharged from the maternity hospital where they were born. Data were gathered for all readmissions that occurred in June 2012 and November 2012. Among the data gathered for the newborns were age, sex, birth weight, diagnosis on admission, and duration of treatment. In addition to infants’ data, data for their mothers were also obtained. Among these were age of the mother, type of delivery, number of previous deliveries, number of prenatal check-ups, education level, employment status, marital status, and place of residence. Total number of births in Slovenia in June 2012 and November 2012, as well as perinatal mortality rates for 2011, were obtained from The National Institute of Public Health of the Republic of Slovenia.

2.3. Statistical analysis

The percent of readmissions for June 2012 and November 2012 was calculated based on data for the total number of births in these months. Descriptive statistics was used to present basic demographic data about readmitted infants and mothers. Chi-square test was used to test the association between two categorical variables when no expected frequency in the contingency table was lower than five. If the frequency was lower, likelihood ratio test was used. Comparison between observational months in numerical variables was done using Mann–Whitney U test for non-normal data and with Student t test for normal data. Multiple linear regression was used to test the association between observational month, infants’ gender, age, weight, and readmission diagnosis as independent and treatment duration as the dependent variable. Due to the smaller sample of mothers, a separate multiple linear regression
model was built to test the association between mothers’ variables and infants’ treatment duration. Significance tests were two-sided. A p value ≤ 0.05 was considered statistically significant. Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

3. Results

3.1. General information on readmissions

The proportion of readmissions in June 2012 and November 2012 was 6% and 5.9%, respectively. No statistically significant difference in readmission rate between summer months and autumn months was found (p = 0.896).

A Spanish study reported readmission rates between 0.6% and 5.9%.\(^8\) The readmission rate of 6% observed in Slovenia statistically significantly differs from the highest observed rate reported by the aforementioned study, i.e., 5% (χ\(^2\) = 7.2; p = 0.007). It does not differ statistically significantly from the observed readmission rate as reported by a Taiwanese study,\(^14\) i.e., 5.7% (χ\(^2\) = 0.5; p = 0.462), but it is statistically significantly lower than 7.9% as noted in Lebanon\(^15\) (χ\(^2\) = 17.5; p < 0.001) or 8.3% as observed in India\(^6\) (χ\(^2\) = 24.5; p < 0.001).

The mean age of the mothers in 2012 according to the National Institute of Public Health of The Republic of Slovenia was 29.6 years. Mothers of readmitted infants were marginally statistically significantly older with a mean ± standard deviation (SD) age of 30.7 ± 5.2 years; t = 1.9; p = 0.059). A larger sample size than the available n = 73 should be provided to reach a more reliable conclusion regarding the effect of the age of the mothers on readmissions.

The latest perinatal mortality rates in Slovenia were available for the year 2011, and was 6.7 per 1000 births.

3.2. Newborns’ descriptive statistics

Approximately 10% more boys than girls were readmitted in June 2012 and November 2012 (male to female ratio was 60% to 40%). Mean ± SD age of readmitted infants in June 2012 and November 2012 was 12.2 ± 7.1 days and 10.5 ± 7 days, respectively. Mean weight ± SD of readmitted children in June 2012 was 3444 ± 0.7 g, and in November 2012 was 3271 ± 0.7 g. No statistically significant difference in newborns’ characteristics between summer months and autumn months was found.

3.3. Mothers’ descriptive statistics

Data were available for n = 33 mothers in June and n = 41 in November. Mothers’ mean ± SD age in June 2012 and November 2012 was 31.4 ± 4.5 years and 30.3 ± 5.7 years, respectively. In June 2012, a higher percentage (81.8%) of mothers that resided outside the city was readmitted, compared with November (46.4%; p = 0.002). Mothers in June 2012 and November 2012 were comparable regarding the number of previous births (mean number of previous births was 1.6 in both months), as well as the number of prenatal check-ups (majority with > 5 check-ups in both months). The share of mothers that participated in a prenatal class in June 2012 and November 2012 was 68.8% and 75%, respectively. In June 2012, 71.9% of mothers were breastfeeding upon discharge from the hospital. The corresponding percentage in November 2012 was 80.5%.

3.4. Diagnosis on admission

In June 2012, the most frequent diagnoses on admission were jaundice (13.3%), infection (13.3%), and lung problems (12.4%), followed by gastrointestinal (GIT) problems, skin problems, and failure to thrive (11.4% each). In November 2012, the most frequent diagnoses were jaundice (25%), GIT problems (15.4%), infections and morbus (Mb; 9.6% each). Mb encompassed diagnoses that could not be classified elsewhere.

Failure to thrive was a less frequent diagnosis in November 2012 than in June 2012 (1.9%), while Mb (9.6%) and neurological problems (8.7%) were more common. The distribution of readmission diagnoses is statistically significantly different between summer months and autumn months (p = 0.019; Table 1).

3.5. Duration of treatment

Concern was raised that the duration of treatment would differ between summer and autumn due to a higher prevalence of respiratory disease during autumn and winter. Therefore, we checked for any statistical difference in the

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Readmission diagnoses in June 2012 and November 2012.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readmission</td>
<td>Jun</td>
</tr>
<tr>
<td>Yes</td>
<td>105 (5)</td>
</tr>
<tr>
<td>No</td>
<td>1633 (94)</td>
</tr>
<tr>
<td>Readmission diagnosis</td>
<td>Jun</td>
</tr>
<tr>
<td>Jaundice</td>
<td>14 (13.3)</td>
</tr>
<tr>
<td>GIT</td>
<td>12 (11.4)</td>
</tr>
<tr>
<td>Infection</td>
<td>14 (13.3)</td>
</tr>
<tr>
<td>Lung</td>
<td>13 (12.4)</td>
</tr>
<tr>
<td>Skin</td>
<td>12 (11.4)</td>
</tr>
<tr>
<td>Failure to thrive</td>
<td>12 (11.4)</td>
</tr>
<tr>
<td>Mb</td>
<td>3 (2.9)</td>
</tr>
<tr>
<td>Neuro</td>
<td>4 (3.8)</td>
</tr>
<tr>
<td>UGT</td>
<td>7 (6.7)</td>
</tr>
<tr>
<td>Blood</td>
<td>5 (4.8)</td>
</tr>
<tr>
<td>Dehydration</td>
<td>4 (3.8)</td>
</tr>
<tr>
<td>Cardio</td>
<td>2 (1.9)</td>
</tr>
<tr>
<td>Eyes</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Trauma</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>

Data are no. (%) of patients unless otherwise indicated. GIT = gastrointestinal problems, Mb = morbus, UGT = urogenital.

* Chi-square test.
† Likelihood-ratio test.
duration of treatment between June 2012 and November 2012. The mean treatment duration was approximately 4 days in June 2012 and November 2012, with no statistically significant difference between summer months and autumn months ($p = 0.649$). The dissimilar distribution of readmission diagnoses in the observed months could influence the comparability of treatment duration between these months. Multiple linear regression was applied to test which factors were associated with treatment duration. Observational month, admission diagnosis, infant’s age, gender, and weight were included in the model as independent variables. Most frequent admission diagnoses were included in the model [GIT, jaundice, skin, infection, Mb, neuro, lung, and uro-genital tract (UGT)], while less frequent diagnoses were combined under the category “other” and thus formed a reference category. A natural logarithm of treatment duration was included as a dependent variable. A multiple regression model showed that admission diagnosis was associated with treatment duration when other variables were controlled for. Infection prolonged treatment, while UGT problems shortened it. Jaundice seemed to shorten treatment duration, although the association was only marginally statistically significant. Infant’s age, when other variables were kept fixed, was also associated with treatment duration. Older children needed longer treatment. For a child included in the sample, 1 day of age more resulted in on average a 1 day longer treatment. Infant’s weight was statistically significantly associated with treatment duration when other variables were controlled for, with lower weight children needing longer treatment. With each kg less, the treatment duration for children in the sample on average was prolonged by approximately 1.5 days (Table 2). Included variables explain 27% of variability in the duration of treatment.

As fewer data for mothers were available, mothers’ variables were not included in the first regression model. Because of the smaller sample size, inclusion would result in less reliable estimates of regression coefficients. Therefore, separate regression analysis with only mothers’ characteristics as independent variables (mother’s age, education, employment, area of residence, number of prenatal check-ups, vaginal vs. cesarean delivery, number of previous births, prenatal class, and breastfeeding) and logarithm of treatment duration as a dependent variable was performed. Results showed no statistically significant association between any of the mothers’ characteristics and treatment duration of their newborn.

### Table 2 Factors associated with treatment duration (results of multiple linear regression).

<table>
<thead>
<tr>
<th>Independent variable (reference category)</th>
<th>B</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.36</td>
<td>8.01</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Mo (Jun)</td>
<td>0.09</td>
<td>0.78</td>
<td>0.436</td>
</tr>
<tr>
<td>GIT</td>
<td>−0.30</td>
<td>−1.60</td>
<td>0.110</td>
</tr>
<tr>
<td>Jaundice</td>
<td>−0.31</td>
<td>−1.78</td>
<td>0.077</td>
</tr>
<tr>
<td>Skin</td>
<td>−0.17</td>
<td>−0.74</td>
<td>0.460</td>
</tr>
<tr>
<td>Infection</td>
<td>0.70</td>
<td>3.52</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Mb</td>
<td>0.14</td>
<td>0.58</td>
<td>0.566</td>
</tr>
<tr>
<td>Neuro</td>
<td>−0.20</td>
<td>−0.76</td>
<td>0.451</td>
</tr>
<tr>
<td>Lung</td>
<td>0.08</td>
<td>0.40</td>
<td>0.690</td>
</tr>
<tr>
<td>UGT</td>
<td>−0.62</td>
<td>−2.34</td>
<td>0.020</td>
</tr>
<tr>
<td>Infants’ age (d)</td>
<td>0.02</td>
<td>1.97</td>
<td>0.050</td>
</tr>
<tr>
<td>Infant’s weight (kg)</td>
<td>−0.40</td>
<td>−4.97</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Infants’ gender (male)</td>
<td>−0.17</td>
<td>−1.53</td>
<td>0.127</td>
</tr>
</tbody>
</table>

$R^2 = 0.27$

Data are presented as $n$.

4. Discussion

Our study shows that readmission rates to Slovenian hospitals are not significantly different between autumn months and summer months at around 8%. This is higher than was previously reported in other studies, where the range of readmission rates was between 0.8% and 2.3%. In Lebanon and India, however, the readmission rates were significantly higher than ours, 7.9% and 8.3%, respectively, while they do not differ statistically significantly from the observed readmission rate as reported by a Taiwanese study. In all of the mentioned studies, newborns were discharged < 48 hours after birth, which makes our higher percentage values that much more interesting. As hyperbilirubinemia usually occurs on the 3rd day of life or later, one would expect that by increasing the length of stay to 3 days at least some of those cases would be recognized while infants were still in the hospital, thereby reducing the need for readmission. This does not seem to be the case; however, as countries (i.e., USA) with a recommended length of hospital stay of 48 hours have fewer readmissions.

One possible explanation for our findings is the organization of primary pediatric care and community nurses in Slovenia. A community nurse, who is employed by the local health practice, normally visits the newborn within 24 hours after hospital discharge. At this visit, parents are counseled on various aspects of nursing, and follow-up visits are scheduled. In addition, there is good accessibility of primary and secondary care pediatricians to whom anxious parents can turn; the distance to a health care provider is small, and there is no fee to consult a doctor as this is covered by the national health insurance. All this might indicate that there is a greater frequency of patient referrals to hospitals, which then leads to higher readmission rates. Furthermore, women and children receive legal support and protection irrespective of their social status, which might also contribute to their seeking pediatric help earlier. Finally, prenatal care seems to be an important factor as well; a study found that women who received poorer prenatal care were less likely to visit an emergency department with their newborns. Prenatal care in Slovenia is well established and adheres to strict guidelines. These dictate that pregnant women are entitled to 10 prenatal check-ups by their gynecologist as well as to
two ultrasound scans, all paid for by the national health insurance. In addition, they are encouraged to take part in prenatal classes. All of this teaches future mothers how to detect signs of distress in their newborns. This standard of care could thus also account for the higher frequency of doctor visits and consequently higher rates of readmission, as evidenced by the fact that half of the mothers in our study had between five and 10 prenatal check-ups, half of mothers had > 10 prenatal check-ups, and most of them also participated in prenatal classes.

Of the mothers that were readmitted with their newborns, around 50% were primiparous. Even though the sample was too small to enable any definitive conclusions to be made, this does suggest that parity is not that important a factor in determining the likelihood of readmission. However, a recent study did find that multiparous women were hospitalized more frequently, but they did not offer any reasons as to why.\(^5\) In addition, the average age of the mothers in our study was around 31 years. Having a first child at an older age might suggest that mothers would be more anxious and prone to seeking help earlier than younger mothers. The sample size was too small, however, so this hypothesis would have to be confirmed with a larger, prospective study.

As expected, the most frequent diagnosis on admission in November 2012 and June 2012 was jaundice. As already mentioned, hyperbilirubinemia tends to occur on the 3\(^{rd}\) day after birth or later, thereby contributing significantly to parents seeking professional help after being discharged. Several studies have confirmed that hyperbilirubinemia was the most common cause of both emergency department visits as well as rehospitalizations and also the most common problem encountered at follow-up.\(^6,8,11,15,19,23,26\) A hospital stay of < 72 hours seems to contribute significantly to rehospitalization for hyperbilirubinemia.\(^10,19,25\) This is in contrast with our study, where newborns are routinely discharged after 72 hours and readmission rates should therefore be lower. We believe, however, that the accessibility of professional help greatly contributes to higher readmission rates. It would be interesting to see how the severity of hyperbilirubinemia influenced readmission rates. Data that were available did not specify the bilirubin level, however, so no conclusions regarding the influence of bilirubin levels on readmissions were possible. It is noteworthy that only two studies were found in which less exposure to daylight might have also been a contributing factor in decreasing levels of bilirubin and prolonged exposure to bilirubin.\(^27\) In neonatal jaundice in children born at term, season of birth (between October and March) seems to play an important role and could be associated with disorders of psychological development.\(^28\)

One of the aims of our study was to determine whether any differences existed in readmission rate between the summer months and autumn months. Questions were asked whether a higher incidence of respiratory infections in autumn months and winter months would contribute to higher rates of readmissions. In fact, the frequency of readmissions in November 2012 was smaller than in June 2012, albeit not statistically significant. Therefore, we conclude that there are no differences between summer months and autumn months, as newborns are mostly readmitted for hyperbilirubinemia, dehydration, and feeding problems, whereas respiratory and other infections are usually dealt with in an outpatient setting. Duration of treatment did not differ between summer months and autumn months. To account for the dissimilar distribution of readmission diagnoses in the observed months, multiple linear regression was employed. It showed that the duration of treatment did not correlate with the season so much as with the readmission diagnosis and infant’s age and weight. It seems obvious that lower weight infants would need longer treatment simply because of other factors associated with low weight, such as health issues related to prematurity. Hyperbilirubinemia seems to require shorter treatment than other diagnoses, such as infection. Having data on exact bilirubin levels would help to explain this marginal statistical significance, because levels that are only slightly elevated can easily be treated with phototherapy, while higher levels require longer treatments. As already mentioned, however, no such data were available.

It has to be noted that given the differences in length of stay, legislation, as well as the organization of primary care providers and community nurses, the results of studies in different countries are harder to compare.\(^27\) Nevertheless, it is interesting that in Slovenia, where newborns are discharged after 3 days, should have higher readmission rates than countries where the usual length of stay is 48 hours. This is especially the case since there has been evidence that the 3\(^{rd}\) day after birth is the optimal age for detection of early health problems and therefore possible readmissions.\(^19,25\)

There are several limitations to our study. Firstly, the study was retrospective, which means that we were reliant on the accuracy of hospital records and their availability. The response rate was high, however, so we are reasonably confident that the sample size is representative of the whole population. Secondly, data on the mothers were scarce, so the conclusions that we made are not reliable and further studies should address this particular issue. Thirdly, taking 1 month to represent an entire season might be slightly over-generalizing, and having at least 3 months’ worth of data would be preferable. Future studies should take this into consideration. Finally, it has to be noted that given the differences in the length of stay, legislation, as well as the organization of primary care providers and community nurses in different countries, the results of studies are harder to compare.\(^29\)

In conclusion, this study showed that the frequency of readmission rates in Slovenia is much higher than in some other developed countries. The reasons for this remain unclear and should be confirmed with a prospective study. Nevertheless, the higher readmission rate could be influenced by adopting some changes to the public health policy. Firstly, the community nurse visiting newborns after discharge should be a trained midwife who would need to receive additional training. Secondly, the primary pediatric care network needs to be strengthened, as there are still areas where there are not enough practicing primary care pediatricians. Finally, the time of the first pediatric appointment after discharge, which is currently scheduled at 4–6 weeks after birth, may need to be reconsidered and the appointment perhaps scheduled sooner.
Conflicts of interest

The authors declare that they have no competing interests and have received no funding.

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