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Perceived Insufficient Milk Supply (PIMS) in Lactating Mothers

Yakov Y. Yakoulev

Abstract

Perceived inadequate milk supply (PIMS) is a factor that hinders successful breastfeeding. The aim of our study was to determine the predictors of PIMS and to evaluate the effect of PIMS on the duration of lactation. More than 5000 mothers with children who had been breastfeeding for some time participated in our study. Analysis was performed using multivariate regression logistic and ROC statistical analyses. Eight predictors increasing the risk of PIMS were identified.

Keywords: breastfeeding, insufficient milk supply, lactation, perceived inadequate milk supply, PIMS

1. Introduction

Adequate breast milk intake by the baby and milk production by the mother can be compared to the paradox of “Which came first, the chicken or the egg?” What is primary, a decrease in milk consumption or a decrease in milk production? Does the deficiency of milk occur after the baby’s intake decreases, or does the deficiency of milk lead to the decrease in intake? [1, 2].

In addition to the terms “not enough milk” and “insufficient milk,” the literature mentions the terms “perceived insufficient milk,” “insufficient milk supply,” and “perceived insufficient milk supply,” describing the same process—the feeling (perception) of not having enough milk [1–4]. Perceived insufficient milk supply (PIMS) is a mother’s belief that she is not producing enough milk for her infant, when in fact there is no objective evidence of normal or low milk production [1, 3]. As a result of the suspicion of a lack of milk, breastfeeding mothers may introduce formula for complementary feeding without objective reasons, which negatively affects the continuation of breastfeeding. There are no Russian papers analyzing the causes of PIMS and their effect on lactation.

The aim of our study was to identify predictors of PIMS in breastfeeding mothers and to evaluate the effect of PIMS on the duration of exclusive breastfeeding (EBF) and breastfeeding (BF).

For the analysis, a sample of mother-child pairs whose data were obtained over a 20-year period in several surveys was formed. The mothers were interviewed using a paper questionnaire and an electronic questionnaire online. Informed consent to participate in the study was obtained from all respondents. At any time, participants could stop entering data, which was regarded as a refusal to participate. After...
processing 6595 questionnaires, the answers of 5414 mothers who lived in the Russian Federation and answered the question about the presence or absence of the PIMS problem were included in the work. Among all included mothers, 40.4% (2187/5414) had already completed breastfeeding and 59.6% (3227/5414) continued lactation. The data were obtained from more than 450 localities in the Russian Federation.

Statistical analysis of the obtained data was performed using licensed software STATISTICA 13RU. Missing data (absence of answer in the questionnaire) were excluded from statistical processing during the analysis. The level of statistical significance (p) for all statistical analysis procedures was calculated and 0.05 was accepted as critical. The character of quantitative variables distribution was determined by Shapiro-Wilk criterion. At p < 0.05, the null hypothesis of normal distribution was rejected. Most of the quantitative data in the study did not have a normal distribution. Therefore, the number of samples from the total number of subjects (n/N), median (Me), and interquartile range (Lower Quartile (LQ) = 25th and Upper Quartile (UQ) = 75th percentile) were used to describe these measures. Data are given as Me (LQ; UQ). Comparison of quantitative characteristics in the two independent groups with a non-normal distribution was performed using the Mann-Whitney U-criterion. A logistic regression model was used to identify and assess the significance and influence of predictors on the target binary variable. In the analysis, missing data were replaced by the mean and a quasi-Newtonian estimation method was used. Neural network ROC-analysis was used to analyze the quality of the models obtained. Estimation of risk (unfavorable outcome) or probability (favorable outcome) of any event in retrospective analysis was done using the ratio of chances of event in one group to the chances of the same event in the other group. Adjusted odds ratio (AOR [CI 95%]) was calculated in logistic regression, and unadjusted odds ratio (UOR [CI 95%]) was calculated when comparing other predictors. The censored data were evaluated with a survival function using the Kaplan-Meier procedure. The median time and quartiles of GW and IGW cessation were determined. Comparison of two samples with censored features was performed using Wilcoxon-Gehan criterion.

2. Study results

A history of PIMS was reported by 38.8% (2101/5414) of the 5414 mothers interviewed. This problem statistically significantly increased the risk of complementary feeding by a factor of 3.4 (OR = 3.36 [2.92; 3.87]). Maternal PIMS had a negative effect (Figures 1 and 2) on both the duration of EBF and the duration of BF. Among mothers with PIMS, the median duration of lactation was 4 months shorter than among mothers without the problem, 8 and 12 months, respectively (p < 0.001). The median duration of EBF was 1 month shorter at 5 and 6 months, respectively (p < 0.001).

All respondents were divided into two groups. The first "PIMS" group included 2101 mothers who indicated a history of PIMS at 2.0 (1.0; 3.0) months of age. The second "Control" group included 3313 mothers who did not indicate a history of PIMS.

Babies in the PIMS group were statistically significantly more likely to be first and from the first pregnancy, as well as those born by cesarean section (Table 1) compared with the control group. These predictors increased the risk of PIMS by 15.0, 19.0, and 40.0%, respectively. Paternal education was more common in the control group. However, all of these predictors were not included in the statistically significant PIMS risk model in the multivariate analysis.
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Dynamics of BF cessation among all mothers (Kaplan-Meier)

Completed BF  Censored
Control  PIMS

Duration of lactation, months

Cumulative proportion of mothers who completed BF

Figure 1. Dynamics of BF cessation in mothers.

Dynamics of EBF cessation among all mothers (Kaplan-Meier)

Completed EBF  Censored
Control  PIMS

Duration of EBF, months

Cumulative proportion of mothers who completed EBF

Figure 2. Dynamics of EBF cessation in mothers.
### Multiple Pregnancy - New Insights

#### Table 1.
Differences in predictors in comparison groups.

<table>
<thead>
<tr>
<th>Age period</th>
<th>Group &quot;PIMS&quot;, n = 2101, n/N (%)</th>
<th>Group &quot;Control&quot;, n = 3313, n/N (%)</th>
<th>p</th>
<th>UOR [CI 95%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 0 to 1 month</td>
<td>800 (500; 1060)</td>
<td>1025 (770; 1300)</td>
<td>&lt;</td>
<td></td>
</tr>
<tr>
<td>From 1 to 2 months</td>
<td>950 (750; 1182)</td>
<td>1011 (840; 1300)</td>
<td>&lt;</td>
<td>1.40 [1.22; 1.61]</td>
</tr>
<tr>
<td>From 2 to 3 months</td>
<td>842 (658; 1000)</td>
<td>870 (700; 1070)</td>
<td>0.015</td>
<td></td>
</tr>
</tbody>
</table>

#### Table 2.
Dynamics of body weight gain in comparison groups.

<table>
<thead>
<tr>
<th>Code of predictor</th>
<th>Predictors</th>
<th>β</th>
<th>Wald's Chi-square</th>
<th>p</th>
<th>UOR [CI 95%]</th>
<th>AOR [CI 95%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>p_1</td>
<td>Supplementary feeding with formula after discharge from the maternity hospital</td>
<td>0.91</td>
<td>132.02</td>
<td>&lt; 0.001</td>
<td>3.36 [2.92; 3.87]</td>
<td>2.49 [2.13; 2.91]</td>
</tr>
<tr>
<td>p_2</td>
<td>Regular breast expressions</td>
<td>0.62</td>
<td>65.66</td>
<td>&lt; 0.001</td>
<td>2.69 [2.35; 3.08]</td>
<td>1.86 [1.60; 2.16]</td>
</tr>
<tr>
<td>p_3</td>
<td>Separation of mother and baby up to 6 months of age</td>
<td>0.30</td>
<td>18.28</td>
<td>&lt; 0.001</td>
<td>1.64 [1.44; 1.87]</td>
<td>1.35 [1.18; 1.55]</td>
</tr>
<tr>
<td>p_4</td>
<td>Supplementary feeding with formula in the maternity hospital</td>
<td>0.59</td>
<td>16.15</td>
<td>&lt; 0.001</td>
<td>2.03 [1.55; 2.66]</td>
<td>1.80 [1.35; 2.40]</td>
</tr>
<tr>
<td>p_5</td>
<td>Late first latch</td>
<td>0.24</td>
<td>14.86</td>
<td>&lt; 0.001</td>
<td>1.54 [1.38; 1.72]</td>
<td>1.27 [1.12; 1.43]</td>
</tr>
<tr>
<td>p_6</td>
<td>No prenatal preparation for breastfeeding</td>
<td>0.21</td>
<td>10.54</td>
<td>0.001</td>
<td>1.32 [1.17; 1.48]</td>
<td>1.23 [1.09; 1.40]</td>
</tr>
<tr>
<td>p_7</td>
<td>Water supplementation in the first half of the year</td>
<td>0.30</td>
<td>14.54</td>
<td>&lt; 0.001</td>
<td>2.31 [2.02; 2.63]</td>
<td>1.35 [1.16; 1.57]</td>
</tr>
<tr>
<td>p_8</td>
<td>Maternal higher education</td>
<td>0.27</td>
<td>8.67</td>
<td>0.003</td>
<td>0.85 [0.73; 1.00]</td>
<td>1.30 [1.09; 1.56]</td>
</tr>
</tbody>
</table>

#### Table 3.
Logistic regression model of predictors.
Prematurity, sex of the baby, separation of mother and baby in the maternity hospital, desire to breastfeed in the woman, age of the parents and financial status in the family did not differ in frequency between the groups. They were also not included in the statistically significant probability model of PIMS and did not influence the risk of PIMS.

In the “PIMS” group compared with the “Control” group, children gained less statistically significantly at 2.0 (1.0; 3.0) months of age when milk deficiency was suspected (Table 2). However, these differences had no clinical significance.

A multivariate regression analysis using logistic regression was performed. A statistically significant (p < 0.001) model included eight of the 20 predictors (Table 3). The percentage of values correctly predicted by the model (diagnostic efficiency) was 66.31%, and the disagreement ratio was 3.35.

In the logistic model including the Chi-square Wald criterion, the most significant predictor with a negative effect was infant formula administration after the maternity hospital—this predictor increased the adjusted risk of PIMS by 2.5-fold. Other predictors increased the risk of PIMS from 1.23 to 1.86-fold, including lack of maternal education. The effect of the latter was statistically significant and increased the adjusted risk of PIMS by a factor of 1.3.

According to the results of ROC analysis, the model quality is good (AUC area 0.73), cutoff value 0.64 (Figure 3). The sensitivity of the test was 35%, specificity 86%, and diagnostic efficiency 66%.

Figure 3.
ROC curve of the logistic model.
3. Discussion

Lactation is initiated during the first days after birth (lactogenesis II), when endocrine regulation of breast milk formation changes to autocrine regulation. The key point in this process is early first lactation, maximal mother-baby contact, and exclusive breastfeeding. The entire subsequent regulation of lactation (lactogenesis III) is related to the frequency and completeness of breast milk elimination from the lactocytes, which contributes to the adequate functioning of prolactin receptors and a decrease in the accumulation of lactation feedback inhibitor in the mammary gland. Frequent lactation and nipple stimulation suppress the production of prolactin-inhibitory factor in the hypothalamus, including by reducing the production of dopamine. The presence of factors negatively affecting lactogenesis II and lactogenesis III at any stage of development or during the established lactation leads to a decrease in the duration of BF [1, 2, 5].

In 2008, Lisa Gatti, in a published literature review, described PIMS in 30–80% of mothers, especially those who stopped breastfeeding early in the absence of objective signs of hypogalactia [3]. According to this review, PIMS ranks as one of the leading causes of lactation cessation. Also, the literature suggests that PIMS is an ongoing risk throughout lactation [3]. In other sources, the causes and predictors of PIMS are not fully reflected, are not systematic, and the exact prevalence of the problem among nursing mothers is not known [1, 2].

In our study of 5414 mothers, the prevalence of PIMS was 38.8%, consistent with previously published foreign [1–3]. This problem occurs more often in the first 3 months of life and increases the risk of supplementation by 3.4 times. Overall, the negative impact of PIMS is associated with a significant reduction in the average duration of EBF (by 1 month) and BF (by 4 months).

A number of predictors of PIMS had statistically significant different frequencies in the groups, but were not included in the multifactorial model. The analysis showed that mothers with no BF experience (first pregnancy and childbirth) were more likely to experience PIMS. Along with this, cesarean delivery is a negative predictor for lactation initiation, which is explained by disrupted physiological processes of transition from lactogenesis I to lactogenesis II and further to lactogenesis III. The presence of a more educated father in the family contributes to successful lactation, but the mother’s education as a separate predictor is irrelevant to this.

At the maternity hospital stage, separation of mother and child, sex of the newborn, and gestational age had no effect on the risk of PIMS at an older age. The woman’s desire to breastfeed, the parents’ age, and the family’s financial status were also irrelevant to the formation of this problem. All these factors occurred with equal frequency in the compared groups and were not included in the multifactorial model.

The dynamics of weight gain in infants were more often statistically significantly different between the groups, but these differences were not clinically significant. All indicators were within the range recommended by WHO and national guidelines. It was not possible to calculate a multifactorial model of the effect of anthropometric parameters on the risk of PIMS.

In this study, eight predictors had the main influence on the risk of PIMS. Construction of a multivariate logistic regression model allowed to estimate the significance of the influence of each of eight predictors on the risk of PIMS. The influence of all factors was quite logically related to each other. For example, late first latch ($p_3$) requires the introduction of formula into the baby’s diet in the maternity hospital ($p_4$). This disrupts the physiological establishment of lactation, which after
discharge from the maternity hospital requires the continuation of supplementation with formula feedings \( p_1 \) to the baby and regular expressions \( p_2 \) for an adequate nutritional status of the baby. Separating the mother and baby in the first half of the year \( p_3 \) with formula feeding and introducing additional fluids \( p_7 \) to the infant only aggravate the situation—the risk of PIMS increases significantly. The mother’s education level \( p_8 \) has no protective effect in this situation. Lack of prenatal preparation for breastfeeding \( p_6 \) worsens the prognosis for successful lactation.

4. Conclusion

Thus, our study identified eight main predictors that increase the risk of PIMS in breastfeeding mothers, which in turn reduces the duration of EBF and BF. To reduce the risk of PIMS, pregnant women should receive good prenatal education, follow WHO recommendations strictly in the maternity hospital (early first latch, avoid introducing of formula to healthy children in the maternity hospital and after discharge) and after discharge (mother and healthy baby sleep together, elimination of unnecessary expressions, elimination of introduction of additional liquid to the breast milk) are necessary.

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