Estimation of economic burden of preterm and premature births in Iran

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Abstract

Background: Tremendous difficulties are imposed on families with preterm and premature babies, both at birth and during their lifetime. The present study aimed at evaluating the potential economic impact of preterm and premature birth in Iran.

Methods: In this descriptive cross-sectional study (2014-2015), we studied preterm and premature newborns, who have been subjected to hospitalization in Ali-Asghar hospital. We followed social perspective to estimate the economic consequences of preterm and premature birth in 3 categories of direct medical, direct non-medical, and indirect costs. Required data were collected from documents in the NICU, and studying medical records, and interviewing their parents. Data were analyzed by Microsoft Excel.

Results: Direct medical, direct non-medical and indirect affairs were 84%, 6%, and 10% of the total cost, respectively. The estimated social costs were 373, 529, 189; 508, 774, 181; and 529, 481, 996 US dollars (according to their corresponding incidence of 5.8%, 7.9%, and 9.9%). We also found that 75% of the direct medical costs of initial hospitalization were due to intensive care beds.

Conclusion: The economic burden of preterm and premature birth in Iran is considerable and to decrease the costs, it is necessary to implement preventive programs for preterm and premature newborns and to provide management care and support for families dealing with this problem.

Keywords: Premature and preterm infants, Neonatal Intensive Care Unit (NICU), Economic burden

Introduction

Prematurity is characterized by gestational age and is defined as childbirth occurring at less than 37 weeks(1). The rate of preterm births ranges from 12% to 13% in the U.S. and 5% to 9% in other developed countries (2, 3); and in Iran, it ranges from 5.5% in Shiraz to 8.21% in Arak (1). Depending on the condition and age at birth and birth weight, the premature and preterm neonates might suffer from a spectrum of defects. In general, preterm newborns have more medical issues and hospitalization costs than the full term (4, 5). They are also prone to a broad range of adverse consequences including chronic lung disease, severe brain injury, retinopathy of prematurity, and neonatal sepsis(6). Compared to those with normal births, premature newborns are more likely to suffer from temperature instability, respiratory distress, apnea, hypoglycemia, seizures, jaundice, kernicterus, feeding difficulties, periventricular leukomalacia, and rehospitalizations (7-9).

Although advances in technology and intervention approaches during the past two decades have led to substantial improvements in the antenatal and infant cares and survival of even the most premature newborns (10, 11), there is still a great concern about costs of hospitalization and intensive care for prematurity (11, 12). Health systems not only play a critical and important role in improving health, but also are responsible to protect individuals against the financial costs of illnesses and diseases (13). Regarding the fact that financial management is one of the basic principles in the
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The economic burden of preterm and premature births is critical (14). Studies have shown increases in hospitalization costs during the first year of life for the infants suffering from some early defects such as bronchopulmonary dysplasia and intraventricular hemorrhage (15, 16). In studies on the clinical consequences of children under one-year-old with prematurity (born between 35 and 36 weeks of gestation), some investigators found more clinical problems and costs of hospitalization for the premature newborns than full-term babies (10). Premature birth is also a strong predictor of the amount of money spent for hospital services by an individual in the first 5 years of life (17). Thus, beyond its large extent of socioeconomic impact on families, prematurity causes wide economical and human-resource to hospitals and national initial hospitalization costs (ie, age) to be able to match their health care policies.

This study was conducted to assess the costs of initial hospitalization, as the most expensive phase of intensive care (18), of premature and preterm neonates in Iran. This is vitally important as it may help the policy-makers to decide on new policies based on the measured facet of care, and hence, upgrade their strategies in consuming the financial and human resources to provide better services. Also, it might help to gain the stakeholders’ attention to the importance of prevention strategies.

Methods

All the preterm and premature neonates, who have been born and subjected to initial hospitalization in the NICU section of Ali-Asghar hospital in Tehran during a year (referred from the first to the last day of the year 2014-2015; n= 116), were included in this cross-sectional study. To assess the economic burden of these cases and to extend the results of this study to the Iranian population, a social approach was applied. Direct medical costs, which included the costs of visit and consultation, medicines, diagnostic tests, surgery, medical devices, accommodation, and hospital bed, were collected from the medical records of the neonates with predesigned forms. We used the WHO’s guidance (19) to measure the costs of the cases within different age groups. Accordingly, 5.2%, 10.4%, and 83.4% of the cases were, respectively, attributed to age groups of <28, 28 - <32, and >32 weeks of gestation. To obtain an assessment of the average cost per neonate in the private hospitals, the average cost of public hospitals was multiplied to the tariff difference between public and private hospitals (2.32) (20). Because 15% and 85% of NICU beds are, respectively, ascribed to private and public hospitals (20), distribution of the premature neonates receiving benefits from either hospital was accordingly considered as 15% and 85%.

The direct non-medical costs were measured by conducting telephone interviews with parents. We asked the parents about their expenses on travelling, accommodation of the parent, and their entourage at the time of early hospitalization.

To measure the indirect costs, we applied the human capital approach, taking into account the estimated costs of parents and other family members’ (entourage) absence from their works. Notably, informal caretaking costs were not included as part of the indirect costs. For those families/family members, who were not willing to give information about their income and also the housekeeping wives, we considered the lowest wages issued by Department of Labor in the same year (2014-2015) as their income (21).

To estimate the incidence of premature and preterm birth in Iran, we used the fact sheet issues by WHO, which estimated that the incidence of premature newborns in Iran was 7.9% (5.8–9.9%; 95% CI) of all births (22). This statistic is consistent with some other reports from Iran (23-26). The total births rate in Iran in the same year was obtained from the website of Department of Statistics of Iran. Therefore, direct medical costs were estimated based on different incidence rates of 5.8%, 7.9%, and 9.9%. The data were analyzed by Microsoft Excel.

Results

In this study, 116 premature and preterm neonates, who were subjected to initial hospitalization in the NICU section of Ali-Asghar hospital in Tehran, were included. More than half of the cases (54.7%) were female and more than half (61.2%) of the births were from 32 to less than 37 weeks of gestation, and on average they had 22.1 days of hospitalization (Table 1). Only 8.6% of the newborns had normal weight at birth (Table 1).

We found that on average, 75% of the direct medical costs were due to length of stay in special ward, followed by 8% and 6% for medicine and diagnostic tests, respectively. The least costs (with only 1% of the costs) belonged to physician visit, consultation, and surgery (Fig. 1).

Neonates with 28 weeks gestational age had the most and

### Table 1. Demographic (Quality) Distribution of the Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (%)</th>
<th>Mean (SD)</th>
<th>Least</th>
<th>Most</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>53</td>
<td>45.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>63</td>
<td>54.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth Weight (gr)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBW</td>
<td>49.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VLBW</td>
<td>32.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELBW</td>
<td>9.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gestational Age (Week)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>extremely preterm (&lt;28 weeks)</td>
<td>16.7</td>
<td>31.87</td>
<td>0.78</td>
<td>26</td>
</tr>
<tr>
<td>very preterm (28 to &lt;32 weeks)</td>
<td>27.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate to late preterm (32 to &lt;37 weeks)</td>
<td>61.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitalization (Day)</td>
<td></td>
<td>22.1</td>
<td>19.16</td>
<td>1</td>
</tr>
</tbody>
</table>

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those with 32 to 37 weeks had the least direct medical costs (Table 2). The average direct non-medical costs of each neonate was around $237.91 (US Dollars), from which almost half was due to traveling of the parents and/or entourages during the hospitalization period (Table 3).

Results revealed that during hospitalization in NICU, parents lost 35 work days on average. The number of working days that mothers lost was almost two times more than that of the fathers. Indirect cost per neonate is presented in (Table 4). Based on the assessments, the average cost due...
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Table 6. Direct medical costs of premature and preterm neonates hospitalized in NICU based on different incidences (US Dollars)

<table>
<thead>
<tr>
<th>Number of All Preterm and Premature Births in the Year 1393</th>
<th>Estimated Number of Gestational Age-specific Number of Neonates in Iran</th>
<th>Direct Medical Cost of Premature Neonates Based on Gestational Age (Public vs. Private)</th>
<th>Direct Medical Cost of Premature Neonates Based on Gestational Age (Public vs. Private)</th>
<th>Total Direct Medical Cost of Premature Neonates Based on Gestational Age in the Year 1393</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8%</td>
<td>88993</td>
<td>28&lt; 4 628</td>
<td>3 933</td>
<td>2846.52</td>
</tr>
<tr>
<td>7.1%</td>
<td>121215</td>
<td>28&lt; 7 889</td>
<td>7 175</td>
<td>4727.35</td>
</tr>
<tr>
<td>9.3%</td>
<td>151902</td>
<td>28&lt; 12 606</td>
<td>10 715</td>
<td>4727.35</td>
</tr>
</tbody>
</table>

Table 7. Estimated costs of premature and preterm neonates hospitalized in NICU based on Rial (Iranian Currency) and US Dollars in 2014

<table>
<thead>
<tr>
<th>Prevalence of prematurity (9/8)</th>
<th>Estimated Number of Premature Neonates (Public vs. Private)</th>
<th>Total Direct Medical Cost of Premature Neonates in Iran (Public vs. Private)</th>
<th>Total Direct Medical Cost of Premature Neonates in Iran</th>
</tr>
</thead>
<tbody>
<tr>
<td>8%</td>
<td>n=88993</td>
<td>10,191,106,485,301</td>
<td>13,881,035,279,356</td>
</tr>
<tr>
<td>9%</td>
<td>n=121215</td>
<td>13,881,035,279,356</td>
<td>13,881,035,279,356</td>
</tr>
<tr>
<td>9%</td>
<td>n=151902</td>
<td>13,881,035,279,356</td>
<td>13,881,035,279,356</td>
</tr>
</tbody>
</table>
found that 44% of the direct medical expenses are due to the first age group (under 28 weeks), while encompassing only 11% of the cases. Thus, the average per day cost of each neonate of this group would be $8,076,261, which is almost twice that of a neonate aged 32 to under 37 weeks ($4,532,011). This is in agreement with the previous data wherein duration and costs of initial hospitalization for premature neonates have negatively been correlated with age and weight at birth (9, 31). In 2006, Smith and Piggins also demonstrated that for each two weeks increase in gestational age, there would be about $28,870 to $64,021 (on average) saving for premature newborns under 33 weeks and $206,000 for those under 26 weeks (16).

To have a more realistic assessment of the prematurity costs, we also attempted to calculate the direct non-medical expenses including accommodation and feeding of parents as well as clothing and feeding of other children (ie, siblings of the affected one). Togo et al. also have indicated direct non-medical costs ($101 - $ 1128.1; $257.2 on Ave.) (32). Furthermore, the absence days of parents (related to prematurity initial hospitalization) were also calculated as indirect costs. As demonstrated in Table 7, indirect costs comprise a major portion of all costs (10%) during initial hospitalization. In a study, the parents’ average wage loss due to absence from prematurity initial hospitalization was €5,990 and €8,175 in the first and second years (following preterm born), respectively (33).

Noticeably, there are variations between the results of these studies, which can be due to various factors including year and geographical region of study, inflation rates in the corresponding countries, salary and benefits, tariff, and costs in the studied region/hospitals. Also, the costs of medicine and other expenses can be affected by the severity of the disease, birth weight, and NICU- or hospital-specific guidelines.

Because we have no information on the real incidence of prematurity at national level in Iran, we only made an estimation based on the statistics issued by WHO, and thus this might have influenced our results. Similar studies in other hospitals and regions of Iran would be helpful in obtaining a more precise statistic from the costs of prematurity. Therefore, this problem should be managed more efficiently for better cost assessment; moreover, preventive programs should also be implemented.

Conflict of Interests
The authors declare that they have no competing interests.

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