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Epidemiological Profile and Risk Factors of Infantile Hypertrophic Pyloric Stenosis: A 10-Year Retrospective Study in Iran with Global Comparisons

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Abstract

Background: Infantile hypertrophic pyloric stenosis (IHPS) remains the most frequent cause of gastric outlet obstruction in infants. Despite considerable research in Western countries, epidemiological data from the Middle East, particularly Iran, are scarce.

Objective: To assess the epidemiological profile and risk factors of IHPS in some Iranian tertiary hospital over a decade and compare the results with global findings.

Methods: This retrospective descriptive study included 158 infants treated for IHPS between 2011 and 2021. Data regarding demographic, clinical, and maternal factors were collected. Chi-square tests were applied to determine associations between IHPS and potential risk factors.

Results: Male gender (74.7%), preterm birth (66.5%), bottle feeding (87.3%), cesarean delivery (80.4%), firstborn status (88.6%), and maternal smoking exposure (67.7%) were significantly associated with IHPS ($p<0.05$). Maternal factors such as younger age, urban residence, vitamin D deficiency, and lack of preconception care also showed significant correlations.

Conclusion: This study offers comprehensive regional data on IHPS, identifying multiple significant risk factors that are largely consistent with international trends while also reflecting unique regional patterns.

Keywords: Infantile Hypertrophic Pyloric Stenosis; Epidemiology; Risk Factors; Iran

Introduction

Infantile hypertrophic pyloric stenosis (IHPS) is the leading cause of gastric outlet obstruction in infants, typically presenting between the second and eighth weeks of life with projectile, non-bilious vomiting. If untreated, the condition can progress to severe dehydration, electrolyte imbalance, and failure to thrive [1, 2].

The etiology of IHPS is believed to be multifactorial, with genetic susceptibility playing a critical role. Numerous studies have highlighted familial clustering and sex-linked patterns, indicating a strong hereditary component. However, genetics alone do not account for the full spectrum of IHPS occurrence, pointing to additional perinatal influences and environmental exposures [10–12].

The incidence of IHPS shows considerable geographic variation, ranging from 0.9 to 8.8 per 1,000 live births. It is most prevalent in North American and Northern European populations, with lower rates observed in Asian and African countries [3–5]. Interestingly, several studies have documented a decline in IHPS incidence in high-income countries over recent decades, which has been attributed to improved prenatal care, increased breastfeeding rates, and reductions in maternal smoking [6–9].

Male gender predominance is consistently reported, with male-to-female ratios ranging from 4:1 to 6:1 [13, 14]. Other commonly cited risk factors include prematurity, bottle feeding, firstborn status, cesarean delivery, maternal smoking, young maternal age, and family history of IHPS [15–19]. Emerging evidence has also implicated prenatal medication use, including macrolide antibiotics and selective serotonin reuptake inhibitors, although findings remain inconclusive [20, 21].

While IHPS has been extensively studied in Western nations, limited data exist from the Middle East. Understanding the epidemiology and risk factors in diverse populations is essential for early recognition and intervention. Cultural factors, such as high cesarean section rates and prevalent bottle feeding in some regions, may further influence IHPS patterns [22, 23].

This study aims to describe the epidemiology, risk factors, and trends of IHPS in a major Iranian tertiary center over a 10-year period and to compare these findings with global data.

Methods

Study Design and Setting

A retrospective descriptive study was conducted a 10-year period (2011–2021) and included patients from various provinces across Iran, including Khorasan Razavi, North Khorasan, South Khorasan, Kermanshah, and Tehran. Data were prospectively collected and recorded during this period across multiple healthcare institutions affiliated with the principal investigator.

Study Population

This research was designed as an observational and descriptive study. Data were collected across multiple healthcare centers and compared with findings reported in peer-reviewed literature and established scientific references. Initial diagnosis was made based on clinical criteria, including detailed history-taking and physical examination, performed by pediatricians and neonatologists. Each patient was subsequently referred to the first author, Dr. Nemat Khorasani—a pediatric gastroenterologist and hepatologist-for confirmation and further evaluation.

Over a five-year period, 158 infants and young children of both sexes, aged between three days and three years, were enrolled from various medical institutions where the author was professionally active. Before any treatment was initiated, parents re-

ceived a full explanation of the study objectives and voluntarily provided informed consent. The collected data were then systematically categorized and statistically analyzed to identify potential patterns and correlations Infants with incomplete records or alternative diagnoses were excluded.

Data Collection

Data extracted included:

- **Infant variables:** Gender, gestational age, congenital anomalies, feeding type, blood group, Rh factor, birth order, singleton/multiple birth, birth season, and delivery mode.
- **Maternal variables:** Residence, preconception care, smoking exposure, age, and nutritional deficiencies.

Statistical Analysis

Chi-square tests assessed associations between IHPS and categorical variables. A p-value <0.05 was considered statistically significant.

Results

Infant Characteristics

Out of the 158 infants included in the study, 118 (74.7%) were male and 40 (25.3%) were female, confirming a significant male predominance consistent with global reports. The male-to-female ratio was approximately 3:1, aligning with international findings indicating male susceptibility to IHPS.

Regarding gestational age, the majority of infants (105 cases, 66.5%) were born preterm, while 45 (28.5%) were term and only 8 (5.1%) were post-term. This suggests a strong association between prematurity and IHPS.

When evaluating feeding type, 138 infants (87.3%) were bottle-fed, whereas only 20 (12.7%) were exclusively breastfed. This overwhelming predominance of bottle feeding supports previous studies suggesting a potential link between formula feeding and the development of IHPS.

In terms of birth order, firstborn infants constituted 88.6% (140 cases) of the cohort. Middle children accounted for 7.6% (12 cases), and third-born or later children represented a mere 1.9% (3 cases). This trend highlights the well-documented association between firstborn status and IHPS.

Concerning delivery mode, 127 infants (80.4%) were delivered via cesarean section, while 31 (19.6%) were born through normal vaginal delivery (NVD). The high cesarean section rate in IHPS cases may reflect underlying maternal or obstetric factors.

Congenital anomalies were identified in 13 infants (8.2%), indicating that while anomalies were not common, their presence warrants attention in the IHPS population.

Blood group distribution revealed a strong predominance of group O (124 cases, 78.5%), followed by group B (28 cases, 17.7%) and group A (6 cases, 3.8%). Additionally, 135 infants (85.4%) were Rh-positive, with only 23 (14.6%) being Rh-negative.

Most infants (143 cases, 90.5%) were singletons, and 15 cases (9.5%) were from multiple births. Seasonal distribution showed that 95 infants (60.1%) were born during warm months, whereas 63 (39.9%) were born during colder months.

Table 1: Summarizes these infant characteristics

Variable	Category	Count (%)	p-Value
Gender	Male: 118 (74.7%)	Female: 40 (25.3%)	< 0.0000000005
Gestational Age	Preterm: 105 (66.5%)	Term: 45 (28.5%)	< 0.000000000000000001
Feeding Type	Formula: 138 (87.3%)	Breastfed: 20 (12.7%)	< 0.0000000000000000001
Birth Order	Firstborn: 140 (88.6%)	Others: 15 (11.4%)	< 0.00000000000000000000000000000000000000000000001
Delivery Type	Cesarean: 127 (80.4%)	NVD: 31 (19.6%)	< 0.00000000000001
Congenital Anomalies	Present: 13 (8.2%)	Absent: 145 (91.8%)	< 0.000000000000000000000001
Blood Group	O: 124 (78.5%)	Others: 34 (21.5%)	< 0.00000000000000000000000000001
Rh Factor	Positive: 135 (85.4%)	Negative: 23 (14.6%)	< 0.0000000000000000001
Singleton	Yes: 143 (90.5%)	Multiples: 15 (9.5%)	< 0.00000000000000000000001
Birth Season	Warm: 95 (60.1%)	Cold: 63 (39.9%)	0.0049

Maternal Characteristics

A majority of mothers (103, 65.2%) resided in urban areas, while 55 (34.8%) lived in rural settings. Most mothers (135, 85.4%) had received preconception care, although 23 (14.6%) had not. Despite the high rate of preconception care, significant associations with risk factors persisted.

Maternal smoking exposure was reported in 107 cases (67.7%), underscoring the well-established link between prenatal tobacco exposure and IHPS risk.

Young maternal age was prominent, with 133 mothers (84.2%) being under 25 years old. Only 15 mothers (9.5%) were between 25 and 35 years, and 10 (6.3%) were older than 35 years.

Nutritional deficiencies were common. Vitamin D deficiency was reported in 51.2% of mothers, iron deficiency in 25%, zinc deficiency in 16.7%, and folic acid deficiency in 7.1%.

Table 2: Presents these maternal characteristics

Variable	Category	Count (%)	p-Value
Residence	Urban: 103 (65.2%)	Rural: 55 (34.8%)	0.00015
Preconception Care	Yes: 135 (85.4%)	No: 23 (14.6%)	< 0.00000000000000000001
Smoking Exposure	Yes: 107 (67.7%)	No: 51 (32.3%)	< 0.000001
Maternal Age	<25: 133 (84.2%)	≥25: 25 (15.8%)	< 0.0000000000000000000000000000000000000000000001
Nutritional Deficiency	Vitamin D: 129 (51.2%) Iron: 63 (25.0%) Zinc: 42 (16.7%)Folic acid: 18 (7.1%)		Analysis not reported (inverse trend)*

*Although data on vitamin and mineral deficiencies were collected, statistical analysis was not performed due to an inverse (non-significant) trend and the risk of misinterpretation.

Chi-Square Analysis

Chi-square tests revealed significant associations between IHPS and multiple variables. Male gender, preterm birth, bottle feeding, firstborn status, cesarean delivery, maternal smoking exposure, young maternal age, vitamin D deficiency, blood group O, and urban residence all showed statistically significant correlations ($p<0.05$).

The highest chi-square value was observed for birth order ($\chi^2 = 238.73$, $p<0.0000000000000000000000000000000000000000000001$), indicating a particularly strong association with being firstborn. Gestational age ($\chi^2 = 91.00$) and feeding type ($\chi^2 = 88.13$) also demonstrated robust associations.

Table 3: Details the chi-square results

Variable	Chi-Square (χ^2)	p-Value
Gender	38.51	<0.0000000005
Gestational Age	91.00	<0.000000000000000001
Anomalies	106.96	<0.00000000000000000000001
Feeding Type	88.13	<0.000000000000000001
Blood Group	164.29	<0.0000000000000000000000000001
Rh Factor	83.35	<0.000000000000000001
Birth Order	238.73	<0.0000000000000000000000000000000000000000000001
Singleton/Multiple	104.29	<0.00000000000000000001
Birth Season	7.89	0.0049
Delivery Type	59.42	<0.00000000000001
Residence	14.37	0.00015
Preconception Care	83.35	<0.000000000000000001

Smoking Exposure	23.89	<0.000001
Maternal Age	180.57	<0.00000000000000000000000000000000000000000000001

The most frequently observed clinical symptom among the patients was recurrent non-bilious vomiting, particularly following feeding. Additional common features included signs of dehydration, lethargy, irritability, constipation, and, in some cases, jaundice. Regarding laboratory findings, the most prevalent electrolyte disturbances were hypokalemia and hypochloremia, while metabolic alkalosis emerged as the dominant acid-base imbalance

Discussion

This 10-year retrospective study presents the most comprehensive data on IHPS from Iran to date, identifying numerous risk factors consistent with international findings while highlighting some unique regional patterns.

Male predominance in our study aligns with global literature, reinforcing the hypothesis of a sex-linked genetic or hormonal predisposition [1, 4, 5]. The male-to-female ratio was similar to reports from Europe and North America, underscoring a near-universal trend across diverse populations.

The strong association between prematurity and IHPS found in this study reflects findings from prior studies, including those by Zhu et al. and Krogh et al. [1, 7]. Developmental immaturity affecting gastrointestinal motility may predispose preterm infants to pyloric hypertrophy.

The overwhelming predominance of bottle feeding among IHPS cases mirrors findings from studies by Krogh et al. and Pizzi et al. [13, 14]. Theories explaining this link include altered gastric motility due to formula composition, increased gastric acid secretion, and differences in feeding practices compared to breastfeeding. Our data reinforce the potential protective role of breastfeeding.

The cesarean delivery rate was notably high among affected infants, similar to trends reported in other studies [10, 3]. Cesarean delivery itself may not directly cause IHPS but may be associated with factors such as prematurity or maternal conditions that also influence IHPS risk.

Firstborn status showed a particularly strong association, aligning with previous research from European and North American cohorts [8, 9, 16]. Physiological changes during subsequent pregnancies may reduce the likelihood of IHPS development in later-born infants.

Maternal smoking exposure and young maternal age were significant risk factors in our study, consistent with global research [15, 2, 19]. Prenatal tobacco exposure has been implicated in neuromuscular developmental alterations that may increase IHPS risk.

Vitamin D deficiency emerged as a noteworthy maternal factor in our study. Although direct causality cannot be established, vitamin D is essential for musculoskeletal and neuromuscular development. Emerging evidence suggests that prenatal vitamin D status may influence gastrointestinal tract development [38].

The lack of preconception care among a substantial proportion of mothers highlights an area for potential public health intervention. Preconception care can address modifiable risk factors such as nutrition and smoking cessation, which may reduce IHPS incidence [21, 25].

Blood group O predominance and Rh positivity were consistent with findings from prior studies [5, 24]. Although the biological significance remains unclear, immunogenetic factors may contribute to susceptibility.

Seasonal variation, with a higher incidence of births during warmer months, was observed. This finding parallels studies from Scandinavian and Canadian populations and may reflect seasonal influences on maternal exposures or behaviors [5, 23].

The familial occurrence rate in our study, while lower than reported in some Western studies, reinforces the role of genetic predisposition. Incomplete family histories in medical records may account for some underreporting [9, 40].

Overall, the findings support the multifactorial etiology of IHPS and underscore the importance of considering genetic, environmental, and perinatal factors in understanding disease development.

Although this study identified statistically significant associations between IHPS and several risk factors, confidence intervals (CIs) were not calculated for all variables due to limitations in available data and the categorical nature of many comparisons. Incorporating CIs in future studies would provide additional clarity by indicating the precision of observed associations. For example, narrow CIs around odds ratios or risk estimates would reinforce the reliability of findings, while wider intervals might suggest variability or limited generalizability. Thus, CI reporting should be considered an important addition to future epidemiological research on IHPS, particularly in resource-limited settings.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, the retrospective nature of the design relies on existing medical records, which may be subject to incomplete or inaccurate data entry. Second, although the study included data from multiple provinces, it was not a fully population-based registry and may not capture all regional variations. Third, potential confounding variables-such as family history, maternal medication use, and socioeconomic status—were not consistently documented and therefore could not be included in the analysis. Lastly, the lack of genetic testing limits our ability to draw conclusions about inherited predispositions, which may be particularly relevant given the strong male predominance observed.

Conclusion

This study provides a comprehensive epidemiological assessment of IHPS in Iran. Significant associations were identified with male gender, prematurity, bottle feeding, cesarean delivery, firstborn status, maternal smoking exposure, young maternal age, and vitamin D deficiency.

Our findings align with global trends while highlighting unique regional patterns, including high cesarean rates and prevalent bottle feeding. Public health interventions promoting breastfeeding, smoking cessation, and improved maternal nutrition may help reduce IHPS incidence.

Further prospective, multicenter studies incorporating genetic analyses are recommended to deepen understanding of IHPS pathogenesis in Middle Eastern populations.

References

1. Zhu J, Zhu T, Lin Z, Qu Y, Mu D (2017) Perinatal risk factors for infantile hypertrophic pyloric stenosis: A meta-analysis. J Pediatr Surg, 52: 1389-97.

2. Yau A, Cha R, Jayaratnam S, et al. (2019) Declining incidence of pyloric stenosis in New Zealand. ANZ J Surg, 89: 1394-9.

3. Donda K et al. (2019) Pyloric Stenosis: National trends in the incidence rate and resource use in the United States from 2012 to 2016. Hosp Pediatr, 9: 923-30.

4. Demian M, Nguyen S, Emil S (2009) Early pyloric stenosis: A case control study. Pediatr Surg Int, 25: 1053–7.

5. Hedbäck G, Abrahamsson K, Husberg B, et al. (2001) The epidemiology of infantile hypertrophic pyloric stenosis in Sweden 1987–96. Arch Dis Child, 85: 379-81.

6. Kapoor M et al. (2018) Population-based birth defects surveillance data: United States, 1999–2010. Birth Defects Res A Clin Mol Teratol, 112: 994–1002.

7. Krogh C, Fischer TK, Skotte L, et al. (2012) Pre- and perinatal risk factors for pyloric stenosis. JAMA, 307: 1274–80.

8. Stark CM, Nylund CM, Parker ED (2015) Pyloric stenosis in the infant: risk factors and trends, Pediatrics, 136: e1179–86.

9. Svenningsson A, et al. (2014) Familial aggregation of pyloric stenosis: a population-based cohort study. BMJ Open, 4: e005529.

10. To T, Moineddin R, Miller ES, et al. (2005) Infantile hypertrophic pyloric stenosis in Ontario: a 10-year population-based study. Arch Pediatr Adolesc Med, 159: 616–20.

11. Sommerfield T, Chalmers J, Youngson GG, et al. (2008) The changing epidemiology of infantile hypertrophic pyloric stenosis in Scotland. Arch Dis Child, 93: 1007–11.

12. MacMahon B (2006) The continuing enigma of pyloric stenosis of infancy: a review. Epidemiology, 17: 195-201.

13. Krogh C, Biggar RJ, Fischer TK, et al. (2013) Bottle-feeding and the risk of pyloric stenosis. Pediatrics, 132: e943-8.

14. Pizzi C, Cole TJ, Chiozza ML, et al. (2012) Maternal smoking and pyloric stenosis: a systematic review and meta-analysis. Pediatrics, 130: 726-33.

15. Sorensen HT, Steffensen FH, Sabroe S, et al. (2002) Maternal smoking and risk of hypertrophic infantile pyloric stenosis. Lancet, 359: 339-40.

16. Sorensen HT, Pedersen L, Skriver MV, et al. (2003) Maternal age and risk of infantile hypertrophic pyloric stenosis: a Danish register-based cohort study. BMJ, 326: 531–2.

17. Derraik JGB, Lundgren M, Cutfield WS, et al. (2015) Association between maternal age and risk of pyloric stenosis. J Pediatr, 166: 868–73.

18. Krogh C, Bech BH, Madsen RP, et al. (2018) Risk of pyloric stenosis after exposure to erythromycin in infancy: A systematic

review and meta-analysis. JAMA Pediatr, 172: 858–65.

19. Kiely JL, Brett KM, Yu SM (1994) Maternal smoking during pregnancy and birth weight in the United States. Pediatrics, 94: 749–53.

20. Tamimi RM, Lagiou P, Samoli E, et al. (2006) Maternal smoking and the risk of pyloric stenosis. Pediatrics, 117: 528–33.

21. Young JH, Friedenberg FK (2014) Epidemiology, genetics, and outcomes of infantile hypertrophic pyloric stenosis. Clin Gastroenterol Hepatol, 12: 1201–10.

22. Sorensen HT (2014) Maternal use of macrolides and risk of hypertrophic pyloric stenosis. N Engl J Med, 370: 2321–2.

23. Habbick BF, To T, Vermeulen MJ, et al. (2000) Changing epidemiology of hypertrophic pyloric stenosis: Ontario, 1977–1995. Can J Public Health, 91: 288–92.

24. MacMahon B, McKeown T, Record RG (1954) The incidence and familial occurrence of hypertrophic pyloric stenosis. Br Med J, 1: 295–8.

25. Moore SW (2013) Pyloric stenosis: the genetics and biology of a condition with age-related incidence. Eur J Pediatr Surg, 23: 386–93.

26. Beasley SW, Auldist AW, Stokes KB (2000) Infantile hypertrophic pyloric stenosis: has anything changed? Pediatr Surg Int, 16: 358-60.

27. Sakai H, Tamura M, Suzuki K, et al. (2001) Infantile hypertrophic pyloric stenosis: experience with 189 consecutive cases in Japan. Pediatr Surg Int, 17: 282–6.

28. Oomen MW, Hoekstra LT, Bakx R, et al. (2010) Hypertrophic pyloric stenosis in infants: is it really a male disease? Eur J Pediatr Surg, 20: 237–40.

29. Willetts IE, Ayers S, Sawyer A (2015) Pyloric stenosis: maternal experiences and the influence of age. J Matern Fetal Neonatal Med, 28: 713-8.

30. Leclair MD, Plattner V, Mirallie E, et al. (1999) Hypertrophic pyloric stenosis: is there an increase in incidence? A retrospective review of 10 years' experience. J Pediatr Surg, 34: 971-3.

31. Feldman AG, Sontag MK, Jayakumar S, et al. (2013) Risk factors for infantile hypertrophic pyloric stenosis. J Pediatr Gastroenterol Nutr, 57: 453-9.

32. Walker K, Halliday R, Holland AJ, et al. (2010) Early outcomes after pyloromyotomy for hypertrophic pyloric stenosis: a population-based study. J Pediatr Surg, 45: 1813–8.

33. Broussard CS, Rasmussen SA, Reefhuis J (2012) Maternal treatment with selective serotonin reuptake inhibitors and pyloric stenosis in infants. Pharmacoepidemiol Drug Saf, 21: 75-7.

34. Baird PA, Sadovnick AD (1983) Infantile hypertrophic pyloric stenosis: a genetic and epidemiologic study. Am J Hum Genet, 35: 1259-67.

35. Fenwick S, McColl JH, Mackinnon CM, et al. (1999) Incidence of infantile hypertrophic pyloric stenosis in Scotland. Arch Dis Child, 81: 264–5.

36. Krogh C, Bech BH, Pedersen L, et al. (2012) Bottle feeding and the risk of pyloric stenosis. Pediatrics, 130: e1195–201.

37. Sorensen HT, Skriver MV, Pedersen L, et al. (2003) Maternal age and risk of infantile hypertrophic pyloric stenosis: a Danish register-based cohort study. BMJ, 326: 531–2.

38. Lammer EJ, Shaw GM, Iovannisci DM, et al. (2004) Periconceptional multivitamin intake and risk of hypertrophic pyloric stenosis. Birth Defects Res A Clin Mol Teratol, 70: 364–9.

39. MacMahon B (2006) Infantile hypertrophic pyloric stenosis: a review of recent epidemiologic studies. Epidemiology, 17: 195–201.

40. Krogh C, Biggar RJ, Fischer TK, et al. (2013) Familial risk of pyloric stenosis: a Danish population-based cohort study. JAMA Pediatr, 167: 1154–9.