


Children With Inguinal Hernia Repairs: Age and Gender Characteristics

Global Pediatric Health
Volume 5: 1–6
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DOI: 10.1177/2333794X18816909
journals.sagepub.com/home/gph



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Abstract

Objective. This study reports the age and gender characteristics of children with inguinal hernia repairs (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] Operation Codes 530-533). **Methods.** We used a retrospective cohort study design based on 2 data sources from 2007 to 2011 (the Bureau of National Health Insurance, Department of Health, Taiwan, and a local teaching children's hospital database) and descriptive statistics to analyze the group's age and gender differences as independent variables. **Results.** The gender ratio was 7 males to 1 female in the general population, whereas the gender ratio in children was 3.5 males to 1 female. Gender difference was found statistically significant in the age subgroup difference: boys (49.1%) were more than girls (39.3%) in ages 1 to 4, while girls (37.8%) were more than boys (23.7%) in ages 5 to 9. Based on the local hospital's data, of those 611 (15%) children born and who received herniorrhaphy, 204 (33.4%) were born as preterm infants and 407 (66.6%) as term infants. The gender ratio among 204 children born prematurely and received herniorrhaphy was 3 males to 1 female. Of those 353 infants under 6 months who received herniorrhaphy, 155 (76%) were preterm infants while 198 (48.6%) were term infants. **Conclusion.** Early screening of inguinal hernia for children is important and should focus on those born prematurely, particularly those aged <6 months and boys.

Keywords

screening, inguinal hernia repairs, children, preterm infants, age, gender

Received July 14, 2018. Received revised October 13, 2018. Accepted for publication October 23, 2018.

Introduction

Herniorrhaphy becomes the choice and standard treatment for inguinal hernia and is estimated as used in more than 20 million cases per year worldwide.¹ However, the availability of epidemiological data on patients with inguinal hernia repairs in general and child populations is limited and therefore warrants investigation. Reports of the number of inguinal hernia repairs vary between countries, ranging from 100 000 in the United Kingdom to 500 000 in the United States annually, with 27% men and 3% women receiving inguinal hernia repairs at least once in their lifetime.¹⁻⁴ Inguinal hernias occur in 5% of full-term and 30% of preterm infants, and it is 4 to 10 times more frequent in boys.⁵ In Taiwan, a recent study attempted to estimate the incidence of children with inguinal hernia repair using a national health insurance (NHI) database and determined that the cumulative incidence of inguinal hernia in children up to age 15 was 6.62% in boys and 0.74% in girls.⁶ With the advancement in medical technology and

care, it remains unclear to date if there is any change in the prevalence, including gender difference, of inguinal hernia repairs in the preterm infants. Studies reporting the prevalence of inguinal hernia repairs in preterm infants were disseminated back in the 1980s.^{7,8} Our study used both NHI database in Taiwan, which was launched in 1995⁹ and offers universal health care services to nearly all residents (coverage rate 99.6%) claimed with a citizenship card (or an identity card),¹⁰ and a local hospital database not only to report the incidence of inguinal hernia repairs in general population and in children up to age 19, but also to identify the

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prevalence and gender discrepancy between term and preterm infants with inguinal hernia repairs.

Aim

The study aimed to determine the age and gender differences in the populations with inguinal hernia repairs, including preterm infants.

Materials and Methods

Using a NHI database from 2007 to 2011 in Taiwan, we first aimed to analyze age and gender difference of children with inguinal hernia repairs. Second, using a local teaching children's hospital database, we conducted age-specific and gender-specific analyses on those children aged 0 to 19 years born as term versus preterm infants (<37 gestational weeks) who received inguinal hernia repairs.

Research Design

A retrospective cohort study design was used to report the age-specific and gender-specific characteristics of children aged 0 to 19 years with inguinal hernia repairs in Taiwan's population between 2007 and 2011. All the subjects' inpatient and outpatient department (OPD) claim data from 2007 to 2011 were included for the estimation of age and gender differences of the targeted populations (Aim 1). The data from the local teaching children's hospital were retrieved for age and gender differences of the infants (term vs preterm) who received herniorrhaphy (Aim 2). The teaching children's hospital was chosen for these data because it claimed to perform approximately 19% to 20% of all hernia repairs among the 24 hospitals accredited for this procedure in Taipei. This figure was determined by counting the number of cases of inguinal hernia repairs undertaken in this local hospital (858/780/780) and comparing it with the cases of inguinal hernia repairs that occurred across the 24 hospitals in Taipei (4358/4120/4080) recorded in the NHI database from 1999 to 2011.

Data Source and Study Population

The data from the Executive Yuan of the Department of Health indicated both the inpatient and OPD claims data for the number of the patients who received inguinal hernia repairs during the years 2010 and 2011; the associated individual health identification number of each data item was anonymous. The data were retrieved from the NHI claims database in Taiwan targeting children aged 0 to 19 years (born between January 1, 2007, and

December 31, 2011, or turning 19 before December 31, 2011) who had been diagnosed with the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) Operation Codes 530-533. We were interested in the subjects who were diagnosed with inguinal hernia by physicians' physical assessment and observation confirmed by X-ray and received herniorrhaphy presenting with ICD-9-CM Operation Codes 530, *unilateral repair of inguinal hernia*; 531, *bilateral repair of inguinal hernia*; 532, *unilateral repair of femoral hernia*; and 533, *bilateral repair of femoral hernia*. The subjects' dates of birth and gender were also obtained. The calculation of the age of the study cohort was based on the difference between the date of birth and the date of the herniorrhaphy (defined as the index date). The primary outcomes were defined as the primary diagnosis of inguinal hernia repairs in either outpatient or inpatient claims occurring 1 year after the index date. To ensure each patient was equally followed for 1 year, only the data from 2010 to 2011 were analyzed. The secondary outcomes were the age and gender of the retrieved subjects either from the NHI database or the local children's hospital records.

Statistical Analysis

The study used descriptive statistical methods to analyze independent variables in reporting the patients' age and gender characteristics, which were presented as the number and percentage. The statistical analyses were conducted using SAS version 9.3 (SAS Institute, Cary, NC), and a 95% confidence interval with $P < .05$ were seen as statistically significant. Age and gender differences among age subgroups and term versus preterm infants were performed using χ^2 tests.

Ethical Approval

Ethics approval for this study was obtained from the Institutional Review Board of Ethics Committee of the teaching hospital (Institutional Review Board No. 12MMHIS080).

Results

Age and Gender Differences

The largest group of children with inguinal hernia repairs during the period 2007 to 2011 in the NHI database was those aged 1 to 4 years, which accounted for 46.9% of the total number of children aged from 0 to 19 years with inguinal hernia repairs (Table 1). The smallest group of children with inguinal hernia repairs was

Table 1. Age and Gender Difference of Children With Inguinal Hernia Repairs in Total (National Health Insurance Database From 2007 to 2011)^a.

Age	Boys, n (%)	Girls, n (%)	Total, n (%)	Male–Female
<4 weeks	449 (1.2%)	245 (2.2%)	694 (1.4%)	1.8:1
1-12 months	5827 (15.3%)	1090 (9.9%)	6917 (14.1%)	5.3:1
1-4 years	18 715 (49.1%)	4337 (39.3%)	23 052 (46.9%)	4.3:1
5-9 years	9017 (23.7%)	4173 (37.8%)	13 190 (26.9%)	2.2:1
10-14 years	2410 (6.3%)	817 (7.4%)	3227 (6.6%)	2.9:1
15-19 years	1676 (4.4%)	367 (3.3%)	2043 (4.2%)	4.6:1
Total	38 094 (100.0%)	11 029 (100.0%)	49 123 (100.0%)	3.5:1

^aP for χ^2 test <.001.

Table 2. Age Difference in the Subgroups of Children Receiving Herniorrhaphy in OPD and Hospital (Without Case Repetition) From 2007 to 2011 (N = 3984; From Local Children's Hospital Database).

Variables	Number	Percentage
Age		
<1 year	1219	30.6
1-4 years	1523	38.2
5-9 years	1013	25.4
10-14 years	174	4.4
15-19 years	55	1.4
Total	3984	100

Abbreviation: OPD, outpatient department.

those infants aged less than 4 weeks, which accounted for only 1.4% of the total number of children with inguinal hernia repairs. Furthermore, there was a significant gender-ratio difference across the age subgroups of the children. The infants aged less than 4 weeks showed the least gender-ratio difference of 1.8 boys to 1 girl; while among children aged 1 to 12 months, compared with other age subgroups, the greatest difference in gender ratio was 5.3 boys to 1 girl. Frequency in the age subgroups was found to be significantly different by their gender discrepancy ($P < .001$), that is, boys (49.1%) were more than girls (39.3%) in the 1 to 4 age subgroup, resulting in 10% increase in boys, while girls (37.8%) were more than boys (23.7%) in the 5 to 9 age subgroup, leading to 15% increase in girls.

In contrast, from a local children's hospital records, the total number of children with inguinal hernia repairs from OPD and hospital cases from 2007 to 2011 were 3984 (without repeated cases; Table 2). The largest group of children with inguinal hernia repairs from both OPD and hospital cases between 2007 and 2011 were identified in those aged 1 to 4 years, which accounted for 38.2% of the total cases, similar to those from the NHI database. Similarly, the local hospital data showed

3096 (77.7%) boys and 888 (22.3%) girls, and the gender ratio of boys to girls was 4:1, akin to the gender ratio in children population from the NHI database.

We then made the linkage within the 2007 to 2011 local children's hospital data between the number of children born (N = 24 935) and those with inguinal hernia repairs (N = 3984), finding that 611 children, 15.3% born in the local children's hospital, received herniorrhaphy. We then attempted to connect the data pertaining to the preterm infants born in the local children's hospital (N = 3366) and the 611 children who received herniorrhaphy, finding that 204 (33.4%) children who were born prematurely and who received inguinal hernia repairs in this local hospital. This means that for every 3 children born and who received inguinal hernia repairs in this local hospital, one would be identified as born prematurely.

When analyzing the age-specific and gender-specific differences of the 611 children who received herniorrhaphy within the local children's hospital data, age-specific difference was found while gender-specific difference was not statistically significant (Table 3). The percentages of children receiving herniorrhaphy across age subgroups was significantly different against their birth types (term or preterm infants; $P < .001$). Among those infants who received herniorrhaphy within 6 months, 155 (76%) infants were born prematurely while 198 (48.6%) were born as a term infant. In addition, those infants younger than 6 months were more likely to receive inguinal hernia repairs compared with other age subgroups, particularly if they were born prematurely.

Furthermore, among the 204 children born prematurely who received herniorrhaphy as reported in the data of the local children's hospital, there were 152 boys (74.5%) and 52 girls (25.5%), resulting in the gender ratio of 3 males to 1 female. In contrast, the gender ratio of the children born as term infants who received herniorrhaphy was similar to the gender ratio of the children aged 0 to 19 years in the NHI database, namely, 4 boys

Table 3. Children Born and Who Received Herniorrhaphy (N = 611; From the Local Children's Hospital Database).

	Term Infants, n (%)	Preterm Infants, n (%)	Total, n (%)
Age^a			
<6 months	198 (48.6%)	155 (76.0%)	353 (58%)
6-12 months	36 (8.8%)	7 (3.4%)	43 (7%)
1-2 years	86 (21.1%)	29 (14.2%)	115 (19%)
2-3 years	50 (12.3%)	11 (5.4%)	61 (10%)
>3 years	37 (9.1%)	2 (1.0%)	39 (6%)
Total	407 (100%)	204 (100%)	611 (100%)
Gender^b			
Boys	327 (80.3%)	152 (74.5%)	479 (78%)
Girls	80 (19.7%)	52 (25.5%)	132 (22%)
Total	407 (100%)	204 (100%)	611 (100%)

^aP for χ^2 test by age <.001.

^bP for χ^2 test by gender >.05.

to 1 girl. No statistical difference was found between gender and whether the infant born prematurely or not ($P > .001$).

Discussion

This study adds to the confirmation of empirical data on the age-specific and gender-specific characteristics of children with inguinal hernia repairs and found that preschoolers (aged 1-4 years) comprise the greatest group of children presenting with inguinal hernia repairs compared with children in other age groups, which is similar to the reports from the United States and the United Kingdom.^{3,6} Furthermore, the study has found the gender differences in the general population as 4 males to 1 female, which is consistent with the literature showing that women are less likely to present with inguinal hernia repairs compared with men.⁵⁻⁸

Using a local hospital database from a teaching children's hospital that had treated a high number of cases of preterm infants and herniorrhaphy, our analysis found that for every 3 children with inguinal hernia repairs, 1 child would be born prematurely and 25% of this group would require herniorrhaphy within 6 months. Reports on preterm infants' risk of development with inguinal hernia repairs generally were found in the 1980s till the 2000s¹¹⁻¹³; however, more recent studies investigating age and gender characteristics in preterm infants with inguinal hernia repairs have not seen decreases. Our study has identified that more infants were born prematurely (76%) than born as a term infant (48.6%) in receiving herniorrhaphy within 6 months. In addition, those infants aged less than 6 months were more at risk compared with other age subgroups for inguinal hernia repairs, particularly if they were born prematurely.

Literature has pointed out that the preterm infants have an increasing risk of developing inguinal hernia based on their anatomical position, that is, the infant's inguinal canal is short that crosses the abdominal wall perpendicularly rather than obliquely, resulting in the external ring being located on the top of the internal ring.¹⁴ This can lead to an exacerbation if the preterm infants who are treated by mechanical ventilation where intra-abdominal pressure becomes elevated resulting in the likelihood of inducing inguinal hernia. Furthermore, our study has showed the ratio of gender differences among children born prematurely differs from those of children born as a term infant, namely, 3 males to 1 female in the preterm children with inguinal hernia repairs.

This study has at least 2 methodological strengths in relation to the source and size of the data used. First, we retrieved data from a NHI database from 2007 to 2011 that recorded all inguinal hernia repairs performed for patients diagnosed with inguinal hernia that provided a large sample size, thus resulting in reduced type 2 error in statistical analysis. In Taiwan, NHI started in 1995, and since 2000, it has covered 99% of the population^{9,10}; thus, it has the quality of representativeness in the reports of children with inguinal hernia repairs in terms of their age and gender distinctive features. Furthermore, the local data from the teaching children's hospital are representative in terms of the high number of infants born and inguinal hernia repairs performed in this hospital. In comparison to the national database, the chosen children's hospital is accountable for performing 20% of inguinal hernia repairs for all cases in Taipei. Second, we used a large database that can result in a significant effect in identifying the age and gender characteristics of children with inguinal hernia repairs.

Implication and Conclusion

Hernias are a common disorder in the general population and may be more prevalent in children. Prompt surgical intervention is essential to prevent therapeutic implications and lifelong consequences. Regular screening and assessment of inguinal hernia among young children is important, particularly among infants aged less than 6 months and preschoolers. Moreover, early screening of inguinal hernia for children who were born prematurely, particularly within 6 months after birth, is crucial for hernia repair. Boys have a greater risk than girls for inguinal hernia repairs, especially for those boys born prematurely.¹⁵⁻¹⁷ In Taiwan, births occur mainly in hospitals, and therefore, clinical awareness and prompt screening for children at risk for development of inguinal hernia and then initiating early hernia repair are important,¹⁸ particularly for boys, preschoolers, and children born as preterm infants.

Limitations

This study is limited in at least 2 aspects. Despite our study purpose was focused on reporting age and gender differences in children with inguinal hernia repairs, we did not investigate the recurrence rate, comorbidities, preoperative status, or the likelihood of bilateral hernias as compared with unilateral hernia in children, which may be considered in future research. We believe that we have avoided overestimation in retrieving and analyzing the large dataset because the cases of inguinal hernia repairs were substantive, and therefore, the accumulation of false-positive cases should not have occurred.

Acknowledgments

We thank the National Health Insurance Database and the MacKay Memorial Hospital for providing the raw data. Our appreciation is made to Mackay Medical College for support and Raising Statistic Consultant for statistical enquiries and consultations.

Author Contributions

YHC: Contributed to conception and design; contributed to acquisition and analysis; drafted manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

CHW: Contributed to conception; contributed to acquisition and interpretation; drafted manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

KWKW: Contributed to conception and design; contributed to acquisition, analysis, and interpretation; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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References

1. Kingsnorth A, LeBlanc KL. Hernia inguinal and incisional. *Lancet*. 2003;362:1561-1571.
2. Aldoescu S, Patrascu T, Brezean I. Predictors for length of hospital stay after inguinal hernia surgery. *J Med Life*. 2015;8:350-355.
3. Jakhmola CK, Kumar A. Laparoscopic inguinal hernia repair in the armed forces: a 5-year single centre study. *Med J Armed Forces India*. 2015;71:317-323. doi:10.1016/j.mjafi.2015.05.005
4. Primatesta P, Goldacre MJ. Inguinal hernia repair: incidence of elective and emergency surgery, readmission and mortality. *Int J Epidemiol*. 1996;25:835-839.
5. Pogorelić Z, Rikalo M, Jukić M, et al. Modified Marcy repair for indirect inguinal hernia in children: a 24-year single center experience of 6826 pediatric patients. *Surg Today*. 2017;47:108-113. doi:10.1007/s00595-016-1352-2
6. Chang SJ, Chen JY, Hsu CK, Chuang FC, Yang SS. The incidence of inguinal hernia and associated risk factors of incarceration in pediatric inguinal hernia: a nation-wide longitudinal population-based study. *Hernia*. 2016;20:559-563. doi:10.1007/s10029-015-1450-x
7. Liem M, van der Graaf Y, Zwart R, Geurts I, van Vroonhoven T. Risk factors for inguinal hernia in women: a case-controlled study. The Coala Trial Group. *Am J Epidemiol*. 1997;146:721-726.
8. Salma U, Ahmed I, Ishtiaq S. A comparison of post operative pain and hospital stay between Lichtenstein's repair and laparoscopic transabdominal preperitoneal (TAPP) repair of inguinal hernia: a randomized controlled trial. *Pak J Med Sci*. 2015;31:1062-1066. doi:10.12669/pjms.315.4811
9. National Health Insurance Administration, Ministry of Health and Welfare. Universal Health Coverage in Taiwan. https://www.nhi.gov.tw/Resource/webdata/21717_1_UniversalHealthCoverage-2.pdf. Accessed November 21, 2018.
10. National Health Insurance Administration, Ministry of Health and Welfare. *2017-2018 National Health Insurance in Taiwan Annual Report (Bilingual)*. Taipei: National Health Insurance, Ministry of Health and Welfare; 2018.
11. Boocock GR, Todd PJ. Inguinal hernias are common in preterm infants. *Arch Dis Child*. 1985;60:669-670.
12. Peevy KJ, Speed FA, Hoff CJ. Epidemiology of inguinal hernia in preterm neonates. *Pediatrics*. 1986;77:246-247.

13. Engle WA, Tomashek KM, Wallman C; Committee on Fetus and Newborn, American Academy of Pediatrics. "Late-preterm" infants: a population at risk. *Pediatrics*. 2007;120:1390-1401. doi:10.1542/peds.2007-2952
14. Hebra A, Cuffari C. Pediatric hernias. *Medscape*. <https://emedicine.medscape.com/article/932680-overview>. Accessed November 21, 2018.
15. Chin TW, Pan ML, Lee HC, Tsai HL, Liu CS. Second hernia repairs in children—a nationwide study. *J Pediatr Surg*. 2015;50:2056-2059. doi:10.1016/j.jpedsurg.2015.08.024
16. Lee CH, Chen Y, Cheng CF, et al. Incidence of and risk factors for pediatric metachronous contralateral inguinal hernia: analysis of a 17-year nationwide database in Taiwan. *PLoS One*. 2016;11:e0163278. doi:10.1371/journal.pone.0163278
17. Fu YW, Pan ML, Hsu YJ, Chin TW. A nationwide survey of incidence rates and risk factors of inguinal hernia in preterm children. *Pediatr Surg Int*. 2018;34:91-95. doi:10.1007/s00383-017-4222-0
18. Wang KWK, Chen IH, Chen M. Uncertainty of Parents With Children Undergoing Herniorrhaphy. *Clin Nurs Res*. 2018; 27:343-363. doi:10.1177/1054773816676942