Original Article

Gender Disparity in Paediatric Hospital Admissions

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Abstract

Introduction: To determine the magnitude of gender difference in paediatric hospital admissions. Materials and Methods: We reviewed discharge data of general medical paediatric admissions to a university teaching hospital in Hong Kong from 1984 to 2000. Based on ICD-9 codes, 9 broad categories of disease with related sub-categories were used, namely respiratory, gastrointestinal, neurological, renal, cardiac, haematological/oncological, neonatal, miscellaneous and social. Data on patients admitted to the haematological, oncological and neonatal wards were excluded from this analysis. Results: There were 92,332 patients admitted to the general paediatric wards. The 7 leading causes for admission accounted for 62% of all admissions: gastroenteritis (14%), upper respiratory tract infections (12%), asthma/wheezy bronchitis (10%), pneumonia (10%), bronchiolitis (6%), febrile convulsions (7%) and other convulsions (4%). Across almost all categories, there was a consistent excess of males (59.1% of all admissions). The male excess was even more pronounced for urinary tract infections (72%) and nephrotic syndrome (80%). The main sub-categories without this male predominance were accidents, accidental ingestion and social admissions (50% males), failure to thrive (49% males), acyanotic congenital heart disease (48%), endocrine (42%), auto-immune conditions (30%) and attempted suicide (19%). Conclusions: Although male vulnerability to illness has long been recognised, the consistency and magnitude of these gender differentials in admissions was impressive. More vigorous exploration of the underlying mechanisms responsible for this phenomenon is warranted.

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Key words: Males, Morbidity

Introduction

Gender difference in the incidence of childhood diseases has long been recognised.[1-4] but the magnitude of this effect and consistency across many disease categories appears not to attract much attention or research interest. Gissler and colleagues,[1] in a longitudinal follow-up of all children born in Finland in 1987, reported that boys had a 20% higher risk for a low 5-min Apgar score and 11% higher risk for being born preterm. After the perinatal period, boys were found to have a 64% higher cumulative incidence of asthma, 43% higher cumulative incidence of intellectual disability and a 22% higher incidence of mortality. These differences did not vary by social class. Many other studies highlighting gender disparities have focused on single disease categories. For instance, Beeson[5] reviewed a number of autoimmune diseases, which were clearly associated with either males or females. Gender differences have been found in both common disease such as asthma,[6] and in less common conditions such as cancer.[7]

Hong Kong, with a population of 7 million people, has a dual public and private system for both primary and secondary healthcare. Although there are 10 government (Hospital Authority or HA) and 10 private hospitals providing general paediatric inpatients services, the HA system provides the majority of inpatient care. A household survey, conducted as part of an assessment of Hong Kong's healthcare system, showed that for the 72 children aged 15 or under who had utilised hospital services during the past 6 months, 79% had used the HA system and 21% the private system.[8] The Prince of Wales Hospital (PWH), one of Hong Kong's 2 university teaching hospitals, is situated in the Eastern New Territories of Hong Kong. From 1984 to 1997, the Paediatric Department of PWH in Hong Kong collected standardised discharge information on all

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admissions using an in-house dBase programme. Details of this paediatric audit programme have been previously described for 1654 admissions from May 1984 to May 1985.[9] From January 1997, a HA hospitalwide Clinical Management System (CMS) replaced this audit programme. The CMS captures all admissions and requires the discharging doctor to enter one or more ICD-9 diagnostic and procedure codes, information of attending medical staff, a discharge summary and the patient's gender. The system can identify all discharges that remain uncoded and all discharge summaries that are not completed. These 2 data sources were used to investigate the magnitude of gender differences by disease category for general paediatric admissions over a 17-year period (1984-2000).

Materials and Methods

Epiinfo (Version 6.04c, CDC Atlanta) programming routines were used to combine and recode the PWH paediatric audit programme and the CMS data. The original PWH paediatric audit programme defined 9 broad categories of disease with related sub-categories based on ICD-9 codes: respiratory, gastrointestinal, neurological, renal, cardiac, haematological/ oncological, neonatal, miscellaneous and social (Table 1). These 9 categories and their related sub-categories were retained in the final Epiinfo record file that contained all the data from 1984 to 2000. From 1984 to 1991, data on all haematology/oncology admissions were collected but from 1992 to 1996, data on these patients were entered into a separate audit programme. Likewise, data on all neonatal admissions from 1984 to 1997 were not collected in the general paediatric audit programme. The CMS from 1997 includes data on all hospital admissions. The present analysis therefore used only the data for general paediatric admissions (0 to 15 years) and excluded admissions to the haematological, oncological and neonatal wards. Severe trauma, surgical, orthopaedic and gynaecology patients were usually managed by the respective surgical subspecialties and not included in the general paediatric admissions. Odds ratios (OR) and 95% confidence intervals (95% CIs) were compiled and *P* values <0.05 were considered statistically significant.

Results

Between 1984 and 2000, there were 118,095 admissions, of which 115,004 were children aged 15 years or less and 92,332 were recorded as being admitted under the care of the general paediatric service. Diagnostic category coding was unavailable for 8 of these patients and the month and year of discharge were missing for 15. The 7 leading causes for admission accounted for 62% of all admissions: gastroenteritis (14%), upper respiratory tract infections (12%), asthma/wheezy bronchitis (10%), pneumonia (10%), bronchiolitis (6%), febrile convulsions (7%) and other convulsions (4%) (Table 1).

Across almost all categories, there was a consistent excess of males (>55% of admissions). Males were especially more likely to be admitted for lower respiratory tract problems such as asthma (OR, 1.40; 95% CI, 1.34-1.47; *P* <0.001] and bronchiolitis (OR, 1.39; 96% CI, 1.31-1.47; *P* <0.001) (Table 1). In renal diseases such as urinary tract infection (UTI) (OR, 1.77; 95% CI, 1.61-1.94; *P* <0.001) and nephrotic syndrome (OR, 2.72; 95% CI, 2.26-3.28; *P* <0.001), male predominance was in excess of 70%. For UTIs, males accounted for 81% of admissions under 1 year, 66% under 2, 62% under 3, 59% under 4 and 62% under 5 years. In children 5 to 15 years, there was female predominance of UTI (43% male). The main exceptions to this male predominance were in the sub-categories: accidents, accidental ingestion and social admissions (50% male), failure to thrive (49% male), acyanotic congenital heart disease (48% male), endocrine (42% male), autoimmune conditions (30% male) and attempted suicide (19% male) (Table 1).

Overall, 59% of all general paediatric admissions were boys. The gender disparity showed a consistent trend over the study period (range, 55.9% to 61.7%; mean, 59.1%) (Fig. 1). The small number of admissions in 1984 was due to the fact that the hospital opened in the latter part of that year. Over the 17-year period, the percentage of male admissions had remained similar. Using the test for seasonality developed by Walter and Elwood,[10] the same phenomenon of male excess was evident which did not depend on time of the year (Fig. 2). The phenomenon of male excess in hospital admissions was evident for the first 10 years of life. However, the percentage declined in early adolescence from 58% at 10 years to 41% at 15 years (Fig. 3). Population consensuses in mid 1984, 1990, 1995, 2000 showed a slight male predominance across the age groupings (range, 50.6 to 52.6; Table 2).

Discussion

Our data show consistent excess of male admissions (~ 59%) for most disease categories analysed for these general paediatric patients. Gender difference in the incidence of paediatric disease has been observed by a number of authors.[1-3] In the respiratory category, Remes and co-workers[6] in Eastern Finland confirmed that asthma was almost twice as common in boys (5.0% versus 2.8% in girls). Gerstman and colleagues[11] found a male predominance in asthma admissions. A similar male predominance was also noted for bronchiolitis admissions.[12] Approximately 66% of admissions for bronchiolitis and asthma in our sample were boys. Other authors have shown a similar male predominance for respiratory diseases, gastroenteritis and accidents.[2,4] Approximately 58% of our

Table 1. Gender Differences by Disease Category[9] for General Paediatric Admissions (0-15 years), Prince of Wales Hospital 1984-2000

Disease	No. of patients	% male	OR (95% CI)	*P*
Respiratory				
Upper respiratory tract infections	10642	56.9	0.90 (0.87-0.94)	<0.001
Tonsillitis	1554	60.9	1.08 (0.97-1.19)	0.16
Otitis media	620	59.2	1.00 (0.85-1.18)	0.98
Pneumonia	9025	56.9	0.90 (0.86-0.94)	<0.001
Asthma/wheezy bronchitis	9294	66.3	1.40 (1.34-1.47)	<0.001
Bronchiolitis	5685	66.3	1.39 (1.31-1.47)	<0.001
Other respiratory disorders	2050	63.7	1.22 (1.11-1.33)	<0.001
Gastrointestinal				
Acute gastroenteritis NOS	9404	58.8	0.99 (0.95-1.03)	0.54
Acute bacterial gastroenteritis	1596	56.5	0.90 (0.81-0.99)	0.032
Acute viral gastroenteritis	1842	57.3	0.93 (0.84-1.02)	0.11
Chronic diarrhoea	88	53.4	0.79 (0.52-1.20)	0.28
Hepatitis	204	61.3	1.09 (0.83-1.45)	0.54
Hepatobiliary disorders	229	57.2	0.92 (0.71-1.20)	0.55
Other gastrointestinal disorders	3071	52.2	0.75 (0.70-0.80)	<0.001
Neurological				
Febrile convulsions	6020	59.0	0.99 (0.94-1.05)	0.76
Convulsions	3727	55.9	0.87 (0.81-0.93)	<0.001
CP/mental handicap	438	60.5	1.06 (0.87-1.28)	0.56
CNS infections: bacterial	99	62.6	1.16 (0.77-1.74)	0.48
CNS infections: viral	155	65.2	1.29 (0.93-1.80)	0.128
Neuromuscular disorders	227	63.9	1.22 (0.93-1.60)	0.15
Other neurological disorders	1236	49.2	0.67 (0.60-0.74)	<0.001
Renal				
Urinary tract infection/cystitis	2153	71.6	1.77 (1.61-1.94)	<0.001
Nephrotic syndrome	678	79.6	2.72 (2.26-3.28)	<0.001
Nephritis	573	54.8	0.84 (0.71-0.99)	0.034
Other renal/urogenital disorders	656	73.6	1.94 (1.63-2.31)	<0.001
Cardiac				
Acyanotic congenital heart disease	396	48.2	0.64 (0.53-0.78)	<0.001
Cyanotic congenital heart disease	224	57.1	0.92 (0.71-1.20)	0.54
Other Cardiac disorders	481	49.9	0.69 (0.57-0.82)	<0.001
Haematological/Oncological/Neonatal*				
Haematological	2182	60.1	1.04 (0.96-1.14)	0.34
Oncological	1511	63.8	-	
Sepsis	438	69.2	1.55 (1.27-1.90)	<0.001
Neonatal/neonatal jaundice	581	58.5	-	
Miscellaneous				
Observation only	2494	55.7	0.87 (0.80-0.94)	<0.001
Pyrexia of unknown origin	220	52.3	0.76 (0.58-0.99)	0.04
Auto-immune and immune deficiency	760	30.1	0.30 (0.25-0.35)	<0.001
Psychosocial/adolescent	154	55.2	0.85 (0.62-1.17)	0.32
Endocrine	760	41.8	0.49 (0.43-0.57)	<0.001
Metabolic	196	51.5	0.73 (0.56-0.97)	0.03

Table 1. Contd.

Disease	No. of patients	% male	OR (95% CI)	*P*
Paediatric surgical/orthopaedic	253	64.0	1.23 (0.95-1.59)	0.11
Dermatology and allergy	1196	59.1	1.00 (0.89-1.12)	0.99
Rash NOS	319	59.2	1.00 (0.80-1.26)	0.97
Notifiable diseases	684	59.5	1.02 (0.87-1.18)	0.85
Viral illness NOS	3580	56.5	0.89 (0.83-0.95)	0.001
Complications of treatment	398	57.3	0.93 (0.76-1.13)	0.45
Admission for investigation	1122	60.1	1.04 (0.92-1.17)	0.52
Social paediatrics				
Failure to thrive	100	49.0	0.66 (0.45-0.98)	0.04
Non-accidental injury	382	53.9	0.81 (0.66-0.99)	0.038
Feeding problem	223	56.1	0.88 (0.68-1.15)	0.35
Accident/accidental ingestion	791	50.4	0.70 (0.61-0.81)	<0.001
Attempted suicide	81	18.5	0.16 (0.09-0.28)	<0.001
Social problems	75	52.0	0.75 (0.48-1.18)	0.21
Other miscellaneous	1457	57.2	-	

NOS: not otherwise specified; OR: odds ratio

As regional database is unavailable, the odds ratios were compiled and interpreted using the male-predominant population of 92332 as reference database.

* Patients admitted under the care of the haematological/oncological and neonatal services were excluded from the analysis but a proportion of patients admitted to the general paediatric service had a diagnosis coded under these categories

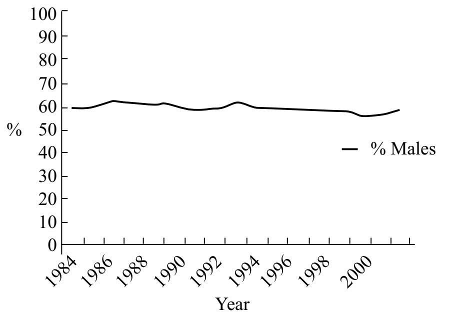

Fig. 1. General paediatric admissions at Prince of Wales Hospital (0-15 years), 1984-2000.

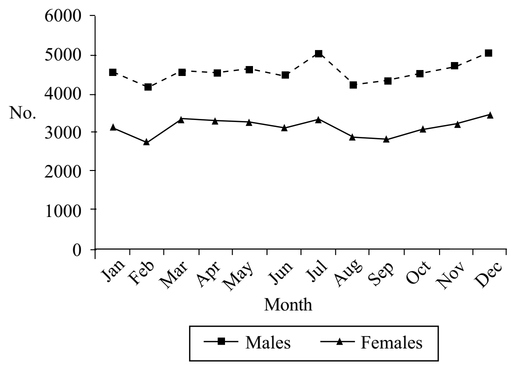

Fig. 2. Gender disparity by month of admission.

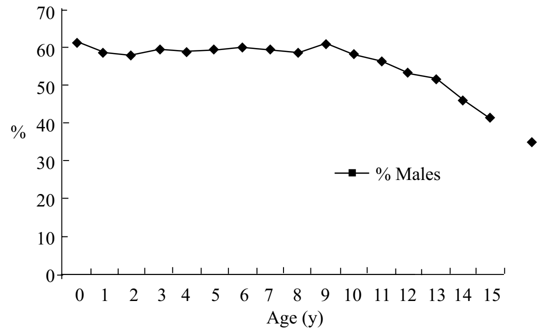

Fig. 3. Gender disparity by age of patient.

gastroenteritis admissions were boys (57% viral cause, 57% bacterial cause and 59% cause not specified). Convulsions have been noted to occur more commonly in boys.[1,12] A male preponderance of 57% in 910 children with a first febrile seizure has been reported.[13] We documented that 59% of admissions for febrile convulsion were boys, as were 56% for other forms of convulsions. UTIs have been noted to occur more commonly in male neonates but the incidence in males decreases with time.[14,15] Van den Bosch and colleagues[2] noted that girls suffer from more episodes of UTI than boys, although the males with UTIs may experience higher morbidity.[16] Male gender was shown to be an independent predictor for vesico-ureteric reflux in a child with a first UTI in another study.[17] Analysis of 2361 renal biopsies in Korean children showed a male-to-female ratio of 2.3:1.[18] In excess of 70% of our patients with UTIs and nephrotic syndrome were males. We noted a male predominance for UTIs up to the age of 5 years, after which time infections were more common in girls.

Table 2. Baseline Demographic Data for Age 0-15 Years in Censuses 1984, 1990, 1995 and 2000

Age in year	% males			
	1984	1990	1995	2000
0-1	52.0	51.7	52.0	52.3
1-2	51.6	52.0	52.4	52.1
2-3	51.8	51.7	52.1	52.0
3-4	51.5	51.9	51.8	52.1
4-5	51.9	52.1	52.0	51.8
5-6	52.0	52.2	52.0	52.6
6-7	51.6	51.9	51.6	51.8
7-8	52.1	51.8	51.4	51.8
8-9	52.1	51.9	51.1	52.1
9-10	52.0	52.0	51.2	51.8
10-11	52.1	52.1	50.6	51.8
11-12	52.3	51.9	51.6	50.9
12-13	52.2	52.0	51.5	51.8
13-14	52.1	52.2	51.6	51.0
14-15	51.9	52.2	51.8	51.4
15-16	52.0	52.2	52.0	51.7

Table 3. Hong Kong (HK) and Prince of Wales Hospital (PWH) Livebirths by Gender, 1984 to 2000

Year	Total HK births	(% male)	Total PWH births	(%male)
1984	77,297	(51.7)	-	
1985	76,126	(51.6)	-	
1986	71,620	(51.5)	-	
1987	69,958	(51.4)	-	
1988	75,412	(51.8)	-	
1989	69,621	(51.4)	-	
1990	67,731	(51.8)	-	
1991	68,281	(51.5)	-	
1992	70,949	(51.7)	-	
1993	70,451	(51.8)	-	
1994	71,646	(52.0)	-	
1995	68,637	(51.8)	7705	(52.1)
1996	63,291	(51.6)	7144	(51.6)
1997	59,250	(52.1)	6308	(52.1)
1998	52,977	(52.3)	5813	(52.7)
1999	51,281	(52.1)	5753	(52.9)
2000	54,134	(52.2)	6023	(53.6)

Autoimmune diseases in children have been shown to vary by gender.[5] Although the numbers were relatively small, autoimmune disease was one of the few disease categories in our data with an excess of females with systemic lupus erythematous being the most common diagnosis.

For accidental ingestion and accidents, the frequency of medical admissions was similar between the genders in our data. On more in-depth analysis, however, gender disparity is again apparent. In the category of poisoning in children, we found that females accounted for 47% of the unintentional poisoning (UP) but 86% of the intentional poisoning (IP) (OR of female for IP, 7.05; 95% CI, 2.95 to 17.28). When compared with UP, IP patients were significantly older [mean (SD), 14.9 (1.7) versus 3.6 (3.3) years].[19] Therefore, adolescent females were much more likely to be admitted for IP, whereas no such difference was found in UP in the younger age group. In a case series of snakebites, we identified that the victims were nearly all males, and more than half of them were teenagers in their mid teens.[20] LoVecchio and DeBus[21] also documented a male predominance in the paediatric victims. We speculate that this may be associated with the possible curiosity and adventure-taking behaviour of teenager males in rural environments. Although surgical patients have not been included in this analysis, it is likely that the nature of accidents in Hong Kong may differ from those in other countries. For example, incidents of near drowning at home are uncommon in Hong Kong where high-rise living is in stark contrast to other suburban cities where backyard swimming pools are common.

In contrast to much of this data showing excess male morbidity, one study from the United Kingdom assessing healthcare utilisation of children in households with 1 adult reported that with the exception of asthma, no gender disparity in healthcare utilisation was found for general illness, infections and acute respiratory infections.[22] A possible explanation is that the study evaluated morbidity and healthcare utilisation of children in households in a general practice setting which may be different from that of our hospital setting.

Apart from the Finnish data, we identified no other comprehensive studies looking at gender disparity across a wide range of childhood disease.[1] Although our data is consistent with that published for individual diseases, it also helps to emphasise the consistency of these gender differentials across a wide range of conditions. Despite the consistency of these data, what is not adequately explained is why this male predominance of morbidity exists. A number of possibilities exist both in general terms and more specifically for Hong Kong. The first explanation is that during childhood the extra X-chromosome or the absence of the Y-chromosome confers an inherent survival advantage and these admission differentials reflect inherent differences in susceptibility to a wide range of diseases.

The second explanation would be a social one. Parents, favouring the male offspring, may visit healthcare facilities more readily than they would with their female offspring. Van den Bosch and co-workers suggested the differences between girls and boys in terms of non-serious morbidity and referral and admission rates, could indicate a different way of handling health problems in boys and girls in early childhood.[4] Gender differences in the incidence of these diseases might therefore be the direct consequence of hospital emergency department visiting patterns and the resultant effect on acute admissions. For instance, Zimmerman and colleagues described the epidemiology of paediatric visits to the emergency departments of general hospitals by age and gender, and found male predominance in all age groups.[23] Likewise, more boys were referred to specialists and admitted to hospital than were girls.[2,4] However, if preferential visiting and referral were the reason for the gender disparity, one might anticipate that males would have a lower overall mortality, which Grissler's data fail to show.[1]

The third explanation could be a predominance of males within a population. The number of births in Hong Kong in general, and at PWH in particular, show a minor male predominance (52%) (Table 3). Although gender selection in China has attracted media attention, a recent report showed that the sex ratio at birth for the whole of China is 1.17 with a slight male excess.[24]

A fourth possible explanation for our findings is that male might have been used as the default assignment for gender, resulting in a bias during data entry. Although this might have been possible during the early years of the paediatric audit programme (1984 to 1996) it is considered unlikely for the CMS gender data which is entered by admission clerks who view birth certificates and other identification.

An important potential limitation of this study is the unknown reliability of the ICD coding in the CMS. A previous review of diarrhoeal diseases at the same hospital showed that there were some ICD coding discrepancies of the CMS discharge diagnoses when these were linked with laboratory data.[25] The ICD codes in the CMS are entered by the responsible medical officer and are therefore dependent on the information available at the time of discharge and on the ability of the medical officer to locate the correct diagnosis through the CMS. Laboratory results that might influence the final diagnosis may only return to the ward after the discharge diagnosis data have been completed. In some cases, the medical officer may update the discharge diagnosis, but in most cases, this is unlikely to occur.

The purpose of this study is not for in-depth analysis of each disease category but rather a holistic approach to overview the general situation using a large database of general paediatric admissions. Our study will stimulate further in-depth studies of individual disease categories.

Although male vulnerability to illness has long been recognised, the consistency and magnitude of the gender differences shown with these data are impressive. Whether these differences represent genuine differences in predisposition to illness or whether they reflect, at least in part, social or other factors, remain unclear. Under the categories of attempted suicide, autoimmune and endocrine diseases, our data did suggest female excess in hospital admissions. The percentage of male admissions also declined in early adolescence from 58% males at 10 years to 41% at 15 years. The implications of these phenomena are puzzling. It might be that teenage males are physically stronger and therefore less vulnerable to diseases; whereas females are more vulnerable to a number of predominately female conditions. There are a number of problems in the interpretation of these data. The single institutional nature of this study does not allow us to verify the generalisability of these observations, even within the Hong Kong population. There are likely to be many factors determining hospital admission, some of which are unrelated to the actual disease. For instance, we have documented male excess in dermatology admissions in this study. On the other hand, males were 2-fold more likely not to attend the dermatology clinic relative to females[26] and girls were more likely to be referred to the laser clinic than boys.[27] Hospital admission, therefore does not always correspond to incidence of disease or morbidity associated with disease. It is important to explore the underlying mechanisms responsible for this occurrence.

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