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Current Epidemiological Data on Community Acquired Pneumonia in Children After Improvements in the Health System and Socioeconomic Changes in Turkiye

Türkiye'de Sağlık Sistemindeki İyileşmeler ve Sosyoekonomik Değişimler Sonrası Çocuklarda Toplumdan Edinilmiş Pnömoniye İlişkin Güncel Epidemiyolojik Veriler

Ahmet BOLAT[1] [ID], Melike ARSLAN[1] [ID], Necati BALAMTEKİN[1] [ID], Cengiz ZEYBEK[1] [ID], Yüksel Hakan AYDOĞMUŞ[1] [ID], Bülent ÜNAY[1] [ID]

[1]Department of Pediatrics, Gulhane Training and Research Hospital, University of Health Sciences, Ankara, Türkiye.

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Correspondence: Ahmet Bolat; Asst.Prof., Department of Pediatrics, Gulhane Training and Research Hospital, University of Health Sciences, Ankara, Türkiye. E-mail: ahmetbolat96@gmail.com

Abstract

In this study, it was investigated that current epidemiological situation and risk factors of community-acquired pneumonia (CAP) in pediatric patients in Türkiye, after socioeconomic changes and health system improvements in the past two decades. In total 1,488 children treated with a diagnosis of pneumonia in Gulhane Training and Research Hospital (Ankara) Pediatrics Department between 2016 to 2021 were included in the present study. The patients' demographic data, personal and family histories, and socioeconomic status were recorded. Of the 1,488 pediatric patients (mean age; 43.20±41.04 months and 46.8% girls); 108 were aged 0-6 months (7.3%), 672 were aged >6-24 months (45.2%), 444 were aged >24-60 months (29.8%), and 264 were aged >60 months (17.7%). In total, 98.4% of patients underwent routine vaccination and the rate of seasonal influenza vaccination was 5.6%. Additionally, 444 patients (29.8%) had chronic disease; asthma and cerebral palsy were the most common chronic diseases, 276 and 84 patients respectively. A family history of asthma in first-degree relatives was present in 396 patients (26.6%). There have been substantial changes in the epidemiology of CAP in Türkiye, due to socioeconomic changes, increasing urbanization, and health system improvements and the current effects of these changes are presented in our study with comprehensive data that can be used in further comparative studies.

Keywords: Community-acquired pneumonia, Children, Epidemiology, Risk factors, Improvements.

Özet

Bu çalışmada, son yirmi yıldaki sosyoekonomik değişiklikler ve sağlık sistemi iyileştirmeleri sonrasında pediatrik hastalarda toplum kökenli pnömoninin Türkiye'deki güncel epidemiyolojik durumu ve risk faktörleri araştırılmıştır. Çalışmaya, 2016 ile 2021 yılları arasında Gülhane Eğitim ve Araştırma Hastanesi (Ankara) Çocuk Sağlığı ve Hastalıkları Anabilim Dalı'nda pnömoni tanısıyla tedavi gören toplam 1.488 çocuk dahil edildi. Hastaların demografik verileri, kişisel ve aile öyküleri, sosyoekonomik durumları kaydedildi. Toplam 1.488 pediatrik hastanın (ortalama yaşları; 43.20±41.04 ay ve %46.8'i kız), 108'i 0-6 ay (%7.3), 672'si >6-24 ay (%45.2), 444'ü >24-60 ay (%29.8) ve 264'ü >60 ay (%17.7) yaşında idi. Tüm hastaların %98.4'ü rutin aşılama programları ile aşılanmıştı ve mevsimsel grip aşısı yapılanların oranı %5.6 idi. Ayrıca, 444 (%29.8) hasta kronik hastalığa sahipti; en sık görülen kronik hastalıklar ise astım ve serebral palsi idi, sırasıyla 276 ve 84 hasta. Hastaların 396'sının (%26.6) birinci derece akrabalarında ailesel astım öyküsü mevcuttu. Sosyoekonomik gelişmeler, artan kentleşme ve sağlık sistemindeki iyileştirmeler nedeniyle Türkiye'de toplum

kökenli pnömoni epidemiyolojisinde önemli değişiklikler olmuştur. Bu değişikliklerin güncel yansımalarını kapsamlı bir şekilde sunan çalışma verilerimiz gelecekte yapılacak karşılaştırmalı çalışmalar ve ileri analizlerde kullanılabilecektir.

Anahtar Kelimeler: Toplum kökenli pnömoni, Çocuklar, Epidemiyoloji, Risk faktörleri, İyileştirmeler.

Introduction

Pneumonia is defined as inflammation of the lung parenchyma that involves the airways, alveoli, vascular structures, and visceral pleura [1]. It may have an infectious or non-infectious origin. The onset of pneumonia in a previously healthy individual with no history of hospital admission within the past two weeks is regarded as community-acquired pneumonia (CAP) [2,3].

Pneumonia is one of the most important causes of morbidity and mortality in children [4,5], and is associated with socioeconomic status; its prevalence and mortality rates are higher in low-and middle-income nations [6]. The incidence of pneumonia is 33 to 34 per 10,000 in children under the age of 5 years in developed countries, while about 14.6 per 10,000 in children between the ages of 0 and 16 years [7]. According to a global report, there were 6.4 million children under the age of 5 years in Türkiye in 2010 [8]. However, information regarding the incidence of pneumonia is limited in Türkiye.

Host factors for pneumonia onset include young age (<1 month), low birth weight, premature birth, malnutrition, vitamin D deficiency, underlying disease, and immune deficiencies [9,10]. Social and environmental factors include a lack of breastfeeding, low socioeconomic status, crowded living conditions, lack of access to health care services, low maternal age, low maternal education level, smoking, air pollution, inadequate immunization, and cold weather (because staying in crowded and enclosed places for extended periods may facilitate transmission via droplets) [9,11,12]. Some routinely administered vaccines can protect against CAP [13]. Türkiye has undergone many significant social, cultural, and economic changes since the year 2000, including improvements in health policies, such that all children are eligible for free health care under the auspices of general health insurance [14–16]. Moreover, vaccinations against pneumococcal infections and *Haemophilus influenzae* were incorporated into the national vaccination program [17,18]. The proportion of the population residing in urban areas has markedly increased, and national income per capita has almost doubled [19–21].

The present study was performed to investigate the current status of the epidemiology of pediatric CAP in Türkiye, and to determine risk factors for disease onset.

Material and Method

This retrospective study analyzed data collected between September 2016 and September 2021 at the Pediatrics Clinic of Gulhane Training and Research Hospital (Ankara). The study protocol was approved by the local ethics committee. In total, 1,488 patients aged 0–18 years who were treated with a diagnosis of CAP were included in this study. Patients who did not meet the diagnostic criteria for CAP were excluded [2].

Demographic data, personal and family histories, and socioeconomic status were retrieved from patients' medical records. Personal history data included the mode of delivery, birth week and weight, breastfeeding status and duration, formula feeding status and duration, cow's milk intake within the first year of life, routine vaccination status, seasonal influenza vaccination status, chronic disease status, school attendance, and history of frequent infections. Family history data included the incidence of asthma. Socioeconomic status data included parental age, parental education status, parental smoking status, parental work status, parental relationship status, monthly family income, number of siblings, number of family members, and caretaker involvement.

Statistical analysis was carried out using IBM SPSS Statistics version 22.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were recorded for all patients. Continuous data are reported as means ± standard deviations (SDs), medians,

minimums, and maximums. Categorical data are reported as numbers and percentages. For comparison of continuous data between groups, independent samples t-tests and the Mann–Whitney U test were used for normally and non-normally distributed data, respectively. Categorical data were compared between groups using the chi-squared test. A p-value of<0.05 was considered statistically significant.

Results

In total, 1,488 pediatric patients (46.8% girls; mean age: 43.20±41.04 months) diagnosed with CAP were included in the present study. The demographic characteristics of the patients are shown in Table 1. Although the proportion of patients undergoing routine vaccination was high (98.4%), the proportion undergoing seasonal influenza vaccination was low (5.6%). Additionally, 444 patients (29.8%) had comorbid chronic disease. Asthma and cerebral palsy were the most common chronic diseases (Table 2). A history of asthma in first-degree relatives was present in 396 patients (26.6%). The sociodemographic status of the patients is detailed in Table 3.

Table 1. Patient demographic information.

Age groups and demographic parameters	Number of patients, n (Total: 1,488)
0–6 months, n (%)	108 (7.3%)
>6–24 months, n (%)	672 (45.2%)
>24–60 months, n (%)	444 (29.8%)
>60 months, n (%)	264 (17.7%)
Age (months), mean (min–max) ± SD	43.20(1-204)±41.04
Gender	
boy, n (%)	792 (53.2%)
girl, n (%)	696 (46.8%)

Table 2. Personal and family histories of the patients.

Patient history							
Mode of delivery (Normal vaginal route, n (%)				756 (50.8%)			
Week of pregnancy, (min–max) ± SD				37.90 (25-42)±2.49			
Premature, n (%)				408 (27.4%)			
Birth weight (g), mean (min–max) ± SD				3145 (900–4500)±685			
Low birth weight (<2,500 g), n (%)				180 (12.1%)			
No breastfeeding, n (%)				96 (6.5%)			
Breastfeeding for 6 months, n (%)				948 (63.7%)			
Breastfeeding for 12 months, n (%)				696 (46.8%)			
Breastfeeding for 24 months, n (%)				468 (31.5%)			
Duration of breastfeeding (months), mean (min–max) ± SD				12.50 (0-36)±10.38			
Formula feeding, n (%)				732 (49.2%)			
Duration of formula feeding (months), mean (min–max) ± SD				3.59 (0-13)±4.01			
Feeding with cow’s milk, n (%)				132 (8.9%)			
Duration of feeding with cow’s milk (months), mean (min max) ± SD				0.23 (0-6)±0.98			
Complete routine vaccination status, n (%)				1,464 (98.4%)			
Influenza vaccination status, n (%)				84 (5.6%)			
School, n (%)				468 (31.5%)			
History of frequent infection, n (%)				420 (28.2%)			
Chronic disease, n (%)				444 (29.8%)			
Asthma	276 (18.5%)	Leukemia	24 (1.6%)	Chronic renal failure	12 (0.8%)	Epilepsy	12 (0.8%)
Cerebral palsy	84 (5.6%)	Lymphoma	24 (1.6%)	Autism spectrum disorder	12 (0.8%)		
Family history							
Asthma/allergy				396 (26.6%)			

Table 3. Parental socioeconomic information.

Maternal age (years), mean (min–max) ± SD	33.60 (18-53)±7.06
Paternal age (years), mean (min–max) ± SD	37.70 (19-58)±7.01
Maternal education status, n (%)	
Literate	108 (7.3%)
Primary school	480 (32.3%)
Secondary school	228 (15.3%)
High school	528 (35.5%)
University	144 (9.7%)
Paternal education status, n (%)	
Literate	84 (5.6%)
Primary school	396 (26.6%)
Secondary school	204 (13.7%)
High school	636 (42.7%)
University	168 (11.3%)
Maternal smoking status, n (%)	264 (17.7%)
Paternal smoking status, n (%)	768 (51.6%)
Maternal work status, n (%)	264 (17.7%)
Paternal work status, n (%)	1,368 (91.9%)
Parental separation, n (%)	24 (1.6%)
Monthly family income (TL), mean (min–max) ± SD	4,784 (1,000-10,000)±2,489.6
Number of siblings, mean (min–max) ± SD	2.20(0-6)±1.17
Number of family members, mean (min–max) ± SD	4.35 (3-7)±1.01
Caretaker of the child, n (%)	
Mother/father	1,452 (97.6%)
Grandmother	36 (2.4%)

Discussion

Pneumonia is the major cause of death in children under the age of 5 years, excluding newborns [22]. CAP contributes to a substantial proportion of these adverse outcomes because of its high incidence and mortality rates [23]. Within the past few decades, important progress has been made in the medical treatment of CAP, including standardization of its definition, recognition of CAP risk factors and etiology, the introduction of various national vaccination protocols for mass immunization, and the advent of new antibiotics [24,25]. These developments have contributed to changes in the epidemiology, etiology, and mortality of CAP [26]. In Türkiye, there is a need to investigate the effects of socioeconomic changes and health system improvements on the epidemiology of CAP.

Evaluations of sociodemographic characteristics have revealed that pediatric CAP occurs more commonly in boys [27–30]. Although epidemiological studies on CAP in children have been limited in Türkiye, Aksoy et al. reported that 65.5% of affected patients were boys [31]. In the present analysis of pediatric patients with CAP, 696 (46.8%) were girls and 792 (53.2%) were boys. Our results are therefore consistent with those reported in the literature.

The age group with the highest risk of childhood CAP is 6–12 months [30,32]. Lee et al. reported that 43.6% of pediatric patients with CAP were under the age of 2 years, 31.3% were between the ages of 2 and 5 years, 18.7% were between the ages of 5 and 12 years, and 6.3% were between the ages of 12 and 18 years [32]. In the present study, 45.2% of the patients were between the ages of 6 and 24 months, which is consistent with published findings and indicates that children aged 6–24 months have the highest risk of CAP in Türkiye.

Low birth weight and prematurity are important risk factors for the onset of pneumonia [12,33]. The low birth weight rate has been reported as 7.0% in high-income countries,

16.5% in middle-income countries, and 18.6% in low-income countries [34]. The low birth weight rate is 11% in Türkiye, according to the Turkish Health and Population Census Investigation [35], and the prematurity rate is reportedly 15.6%, according to data from the General Directorate of Public Health [12,33,35]. In the present study, the proportion of children with a low birth weight was high (12.1%), but similar to the general rate for infants in Türkiye. The mean gestational age was 37.90±2.49 weeks and the rate of premature births was high (27.4%), which suggests that prematurity remains an important risk factor for pediatric CAP in Türkiye.

Another important factor in the onset of CAP is the manner of feeding after birth. A lack of breastfeeding facilitates the onset of pneumonia by weakening the immune system [12,33]. In developing countries, the rate of exclusive breastfeeding during the first 6 months was reportedly 36% between 2007 and 2014 [36]. Although breastfeeding is a common practice in Türkiye, the rate of exclusive breastfeeding dropped from 42% in 2008 to 30% in 2013, according to the Turkish Health and Population Census Investigation. Therefore, exclusive breastfeeding is not widely practiced, despite medical recommendations [37]. In our study, 63.7% and 31.5% of the patients had received breast milk for 6 and 24 months, respectively, while 6.5% did not receive breast milk. Moreover, the mean duration of breast milk intake was 12.5 months. We found that 49.2% of the patients received formula, and the mean duration of formula use was 3.59 months. Furthermore, 8.9% of the patients received cow's milk, and the mean duration of cow's milk intake was 0.23 months. Concerning the diet of children with CAP at 0–2 years of age, the overall nutritional approach between 0 and 2 years of age in Türkiye giving oral formula and/or cow's milk together with breast milk demonstrates the similarity. There has been a marked reduction in child mortality (age <5 years) in Türkiye within the past two decades [6,38]. This favorable development may be due to the increased duration of breastfeeding associated with programs encouraging breastfeeding and offering maternal training for improved health outcomes.

Pneumonia is a heterogeneous disease, the etiology of which involves various bacteria and viruses. In the past 30 years, effective vaccines have been developed against *Streptococcus pneumoniae* and *H. influenzae* type B, which are the most common causes of bacterial pneumonia in children [23,28]. Routine vaccination in children against both *S. pneumoniae* and *H. influenzae* has substantially reduced the rates of disease caused by these pathogens [39]. Notably, in the United States, the rate of hospitalization due to CAP was 53.6 per 100,000 prior to the advent of the 13-valent pneumococcal vaccine, but decreased to 23.3 per 100,000 after its; this led to considerably lower rates of complicated pneumococcal pneumonia [40]. In Türkiye, after the year 2000, *H. influenzae* and pneumococcal vaccines were introduced into the national vaccination program and administered to all children free of charge [41]. However, for CAP caused by viruses, the most valuable development in the past two decades was the influenza virus vaccine. Influenza is a common cause of CAP and may contribute to mortality. Moreover, individuals who receive influenza vaccination have lower rates of infection [23]. Therefore, seasonal influenza vaccination is recommended worldwide, especially for high-risk groups. In Türkiye, this vaccine has not yet been incorporated into the national vaccination program, but it can be purchased from pharmacies and readily administered. In the present study, although the rate of routine vaccination was 98.4%, the rate of influenza vaccination was only 5.6%. This result illustrates the need to include specific vaccines in the national vaccination program and administer them free of charge. In Türkiye, there has been a substantial reduction in the number of deaths of children under the age of 5 years in the past two decades [38]. This reduction is clearly related to health system improvements in Türkiye, especially widespread vaccinations for bacterial CAP.

Children with underlying congenital heart disease, bronchopulmonary dysplasia, cystic fibrosis, asthma, sickle cell anemia, neuromuscular disease leading to swallowing impairment or suppression of consciousness,

gastroesophageal reflux, gastrointestinal disease (e.g., tracheoesophageal fistula), and immune deficiency have a higher risk of pneumonia [42,43]. Nascimento-Carvalho et al. observed that 31.1% of 3,431 children with lower respiratory tract infection had an underlying disease, which was most commonly asthma [44]. In a study carried out in Türkiye, comorbid disease was present in 12.5% of patients: Down syndrome, neurometabolic disease, acyanotic heart disease, and hyperthyroidism were present in 5.5%, 3.5%, 2.5%, and 1% of patients, respectively [31]. In the present study, 29.8% of patients had concurrent chronic disease, and 62.2% of these had asthma. Notably, asthma was the most common chronic disease overall, followed by cerebral palsy. Our results were therefore inconsistent with those of the previous study. In terms of family history, 26.6% of our patients had a first-degree relative with a history of asthma. Asthma is regarded as a multifactorial disease that is more common in developed societies, which may be explained by the "hygiene hypothesis", although there are many other potential etiological factors [45].

Due to socioeconomic changes in Türkiye, school attendance rates have increased considerably in all age groups. Among children with underlying lung disease, the risk of frequent infection increases by 30–40% in those attending school; the risk of pneumonia and frequent infection also increases [42,43]. In our study, 28.2% of the patients had a history of frequent infections, as did all patients with asthma. These findings are consistent with the substantial increase in the prevalence of asthma in childhood in Türkiye, in parallel with the urbanization that has occurred in the past two decades [46]. Consistent with published literature, our results indicate that the increased prevalence of asthma in children, combined with the socioeconomic changes, increased the risk of CAP.

Low socioeconomic status, crowded living conditions, low maternal age, low maternal education level, and active or passive smoking exposure increase the risk of pneumonia [12,33,42,47]. In the present study, the mean maternal age was 33.6 years, and the mean paternal age was 37.7 years. Thus, the parents were generally approaching middle age. The parental education level was moderate; most of the parents were high school graduates and many had received graduate-level education. Our findings are inconsistent with published literature in this regard. The rate of parental separation was only 1.6%, and the mean number of siblings and family members was 2.2 and 4.35, respectively; both of these numbers are low. The mean monthly family income was 4,784 TL, which was two-fold greater than the minimum wage of 2,300 TL. Our results indicate that the change in socioeconomic conditions in Türkiye in the past two decades has led to some important changes in the epidemiology of CAP.

Exposure to cigarette smoke increases the risk of pneumonia and can trigger the onset of an asthma attack [45]. In a study of preschool children, the risk of hospitalization due to pneumonia was greater in children living in homes where at least one person smoked [47]. In the present study, 51.6% of fathers and 17.7% of mothers smoked. These high rates of parental smoking suggest that exposure to cigarette smoke has contributed to the onset of CAP, given the increased prevalence of asthma in the past two decades.

Conclusion

In the context of the socioeconomic developments and radical health system improvements seen within the past two decades in Türkiye, the following conclusions concerning the epidemiology of CAP can be drawn from our findings. (•) In Türkiye, CAP occurs most commonly in 6-24-month-old children, and primarily affects boys. There have not been marked changes in the age and sex distribution of CAP. (•) In terms of birth weight and maturation, the most important risk factor for CAP was prematurity. (•) In Türkiye, with health programs encouraging breastfeeding and maternal training, the duration and rate of breastfeeding have considerably increased. This may be an important reason for the reduction in child mortality (age <5 years) seen in the past two decades. (•) Asthma has become the most important risk factor for CAP in Türkiye because of the socioeconomic changes that have occurred in the past 20 years. (•) The

parental education levels of children with CAP in Türkiye are mostly high school or higher. This striking result is important given the close relationship between CAP and asthma. (•) The rate of smoking among fathers is very high in Türkiye and may influence the rate of CAP.

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