

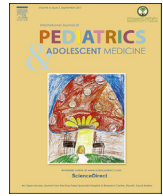
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## Consumption of antibiotics by children in Greece: a cross-sectional study



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## ABSTRACT

**Background:** Greece is among the European countries with the highest consumption of antibiotics.**Objectives:** To study the rates and characteristics of consumption of antibiotics in the community by children in Greece.**Methods:** Questionnaire-based study of parents of hospitalized children.**Results:** A total of 549 children were studied; 247 (45%) received at least one course of antibiotics the previous year (mean number of antibiotic courses the past year: 1.9), including 427 (91.8%) following examination by a pediatrician, 6 (1.3%) following phone consultation, 2 (0.4%) following suggestion by a pharmacist and 2 (0.4%) as self-medication. Prevalent reasons for antibiotic consumption were acute otitis media (AOM) (27.3%), pharyngotonsillitis (25.4%), and bronchitis (17.8%). Amoxicillin-clavulanate was the prevalent antibiotic for pharyngotonsillitis, urinary tract infection (UTI) and skin infection (30.5%, 35.7% and 36.4% of cases, respectively), amoxicillin for AOM and pneumonia (32.3% and 36.4% of cases, respectively), and clarithromycin for bronchitis (27.7%). We found 84.3%, 81.9%, 64.3%, 63.7%, and 50% of parents reporting treatment consisted with the national guidelines for AOM, pneumonia, UTI, skin infection, and pharyngotonsillitis, respectively. In the multivariate analysis, an age of 1–5 years and asthma were significantly associated with a higher probability for antibiotic consumption.**Conclusions:** Antibiotic consumption of children in Greece is mainly driven by pediatricians. Continuing medical education is expected to further improve antibiotic prescription practices by pediatricians.© 2017 Publishing services provided by Elsevier B.V. on behalf of King Faisal Specialist Hospital & Research Centre (General Organization), Saudi Arabia. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

The emergence of pathogens that are resistant or multi-resistant to antibiotics in association with the unavailability of new antibiotics in the near future is a major public health problem globally [1]. Unnecessary or inappropriate antibiotic consumption has been closely associated with the emergence of antibiotic resistance and adds avoidable adverse events and unnecessary medical costs.

Therefore, elimination of unnecessary antibiotic consumption is a public health priority [2].

Greece is among the European countries with the highest rates of consumption of antibiotics and antibiotic resistance [3]. In response to that, the Hellenic Center for Disease Control and Prevention issued guidelines in 2007 in order to promote the rational prescription of antibiotics by physicians in hospital and community settings. In 2012 we studied the antibiotic prescription practices for common infections by pediatricians in Greece [4]. In Greece, antibiotics, except quinolones and specific broad-spectrum antibiotics, are available at pharmacies without a physician prescription. Data about pediatric community-based antibiotic consumption and mode of antibiotic supply in Greece are not available. This cross-sectional study aimed to estimate the rates and characteristics of antibiotic consumption, as well as the mode of antibiotic supply in

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the community by children in Greece.

## 2. Patients and methods

A standardized questionnaire was designed by a group of healthcare professionals at the Hellenic Center for Disease Control and Prevention (Athens) and was piloted on 20 parents employees.

The study was conducted in Aghia Sophia Children's Hospital, a 750-bed tertiary-care pediatric hospital in Athens. The hospital is one of the two main public hospitals in Athens and provides healthcare irrespective of socioeconomic characteristics. During May and June 2014 the standardized questionnaire was distributed to 350 parents of children consecutively hospitalized in the First Department of Pediatrics. Parents were asked to participate irrespective of their demographic or socioeconomic characteristics or cause for hospitalization. Parents who could not understand and communicate in Greek were excluded.

Demographic, household, and socioeconomic data and data about consumption of antibiotics for community-acquired infections during 2013 were collected by four trained pediatricians using one questionnaire per parent. Data were collected anonymously by reviewing the health booklet of each child and through personal interviews at the bed site before discharge from the hospital. The completed questionnaires were sent to the Hellenic Center for Disease Control and Prevention for data entry and analysis. The 2007 national guidelines for antibiotic treatment of community-acquired infections were used as reference in order to interpret antibiotic consumption. The study was approved by the Institutional Review Board committee of the hospital. Informed consent was requested by the parents of children.

The technique of multiple logistic regressions (stepwise selection) tested the relation of consumption of antibiotics the previous year and children, parental and household characteristics. The sample size of 549 children yield to a relatively "narrow" 95% confidence interval (CI) for the proportion of children who had consumed antibiotics the past year. The precision of the CI was 4.2% which is less than 5.0%. The corresponding 95% CI was  $45.0 \pm 4.2\%$  [40.8%, 49.2%]. *P*-values of 0.05 or less were considered statistically significant. The nQuery Advisor 5.0 software (Statistical Solutions) was used for the statistical analysis.

## 3. Results

A total of 287 parents (mean age: 35.8 years, range: 16–57 years) participated in the study (82% response rate). Table 1 shows their characteristics. The 287 parents had a total of 549 children with a mean age of 6.4 years (range: 1 month–18 years). There were

**Table 1**  
Characteristics of parents.

Characteristic	Parents N = 287 (%)
Mean age, years (range) (n = 275)	35.8 (16–57)
Level of education (n = 286)	
Illiterate or elementary school	39 (13.6)
Secondary school	44 (15.4)
High school	82 (28.7)
Technologic institution/University	104 (36.4)
Unknown	17 (5.9)
Roma population (n = 287)	34 (11.8)
Immigrants (n = 287)	56 (19.5)
Unemployed (n = 287)	47 (16.4)
Urban area of residence (n = 285)	264 (92.6)
Mean no. of family members (range) (n = 281)	4.1 (2–10)
Mean no. of children in the family (range) (n = 287)	1.9 (1–9)

n: number of parents for whom an answer was available.

a mean number of 4.1 (range: 2–10) household members and a mean number of 1.9 (range: 1–9) children per household. An underlying disease was present in 60 (10.9%) children, including 17 with asthma.

Of the 549 children, 247 (45%) had received at least one course of antibiotics for community-acquired infections during 2013. In particular, the 247 children had received a total of 465 courses of antibiotics, which corresponds to a mean of 1.9 courses of antibiotics (range: 1–9) per child the past year (mean duration of administration: 6.1 days). In the overwhelming majority of cases (427 courses; 91.8%), the antibiotic was prescribed by a paediatrician following examination. In the remaining cases, a phone consultation preceded the administration of antibiotics in 6 (1.3%) cases, the antibiotic was suggested by a pharmacist in 2 (0.4%) cases or was already available at home (self-medication with leftovers) in 2 cases (0.4%). In 28 cases this information was not available. A respiratory infection (acute otitis media, pharyngotonsillitis, bronchitis, pneumonia) was the reason for receiving an antibiotic course in 343 (73.8%) cases. In terms of clinical indications for antibiotic consumption, acute otitis media and pharyngotonsillitis accounted for most antibiotic courses, followed by bronchitis (27.3%, 25.4% and 17.8%, respectively). Other indications were urinary tract infection (3.0%), pneumonia and skin infection (2.4% each), sinusitis (0.9%), gastroenteritis (0.6%), other infections (6.5%), and unspecified (13.8%).

Table 2 shows the antibiotic consumed per clinical indication. Amoxicillin-clavulanate was the prevalent consumed antibiotic for pharyngotonsillitis, urinary tract infection and skin infection

**Table 2**

Antibiotic consumption by children in the community in Greece per clinical indication.

Clinical indication/Antibiotic*	n (%) N = 465
<b>Acute otitis media (n = 127)</b>	
Amoxicillin	41 (32.3)
Amoxicillin/clavulanate	38 (29.9)
2nd generation cephalosporin	28 (22.1)
Clarithromycin	9 (7.1)
Unknown	11 (8.7)
<b>Pharyngotonsillitis (n = 118)</b>	
Amoxicillin/clavulanate	6 (30.5)
Amoxicillin	32 (27.1)
Clarithromycin or azithromycin	27 (22.9)
2nd generation cephalosporin	14 (11.9)
Unknown	9 (7.6)
<b>Bronchitis (n = 83)</b>	
Clarithromycin	23 (27.7)
2nd generation cephalosporin	17 (20.5)
Amoxycillin/clavulanate	15 (18.1)
Azithromycin	5 (6.0)
Amoxycillin	4 (4.8)
Unknown	19 (22.9)
<b>Urinary tract infection (n = 14)</b>	
Amoxicillin/clavulanate	5 (35.7)
Cefuroxime	4 (28.6)
Cefaclor	1 (28.6)
Amoxycillin	1 (7.1)
Unknown	3 (21.4)
<b>Pneumonia (n = 11)</b>	
Amoxicillin	4 (36.4)
Amoxicillin/clavulanate	2 (18.2)
Clarithromycin	2 (18.2)
Cefuroxime	1 (9.1)
Unknown	2 (18.2)
<b>Skin infection (n = 11)</b>	
Amoxicillin/clavulanate	4 (36.4)
Clarithromycin	3 (27.3)
2nd generation cephalosporin	1 (9.1)
Unknown	3 (27.3)

\* Clinical indications with at least 10 antibiotic courses are presented.

(30.5%, 35.7% and 36.4% of cases, respectively), amoxicillin for acute otitis media and pneumonia (32.3% and 36.4% of cases, respectively), and clarithromycin for bronchitis (27.7%). An analysis of the antibiotic consumed had an overall good compliance with the national guidelines in most clinical indications except for pharyngotonsillitis. In particular, for acute otitis media we found 84.3% of parents reporting antibiotic treatment to be consistent with the national guidelines (first choice: amoxicillin; alternative choices: amoxicillin/clavulanate or 2nd generation cephalosporin), for pneumonia 81.9% of parents reported antibiotic treatment consistent with the national guidelines (first choice: amoxicillin/clavulanate, penicillin V or clarithromycin; alternative choice: cefuroxime, amoxicillin or cefuroxime), for skin infection 63.7% (first choice: amoxicillin/clavulanate or clindamycin; alternative choice: penicillin V or macrolide), and for urinary tract infection 64.3% (first choice: trimethoprim/sulfamethoxazole, alternative choice: cefuroxime, cefaclor, cefixime or amoxicillin). In contrast, only 50% of parents reported treatment for pharyngotonsillitis consisted with the national guidelines (first choice: penicillin V, alternative choice: amoxicillin or clarithromycin).

The multivariate analysis revealed that an age of 1–5 years and asthma were statistically significantly associated with an increased probability for antibiotic consumption (Odds ratios: 2.9 (CIs = 1.6, 5.3) and 3.6 (CIs = 1.1, 11.7), respectively, and *P* values <.001 and 0.028, respectively). No significant association was found between antibiotic consumption by children and parental age, level of education, being a Roma, an immigrant or unemployed, residence area, family size or number of children in the family.

#### 4. Discussion

In light of the current global rise of antibiotic resistance, all issues of antibiotic consumption should be studied and addressed carefully. To the best of our knowledge, this is the first study conducted in order to estimate the current rates and indications of pediatric community-based antibiotic consumption in Greece. Similarly to others [5–7], we found that almost half the children had received a mean of two courses of antibiotics the past year. In contrast, 95% of older adults in a similar study had received antibiotics the past year in Greece, which is partially attributed to the associated increased morbidity in the latter group [8]. In the current study, an age of 1–5 years and asthma were the only statistically significant determinants of increased antibiotic consumption during childhood. The higher antibiotic consumption in toddlers, which is in accordance with others [5], is attributed partially to the increased frequency of infections in this age group. In contrast to others [6,9–11], socioeconomic parameters had no influence on antibiotic consumption behavior in our study group.

Our study also indicated that antibiotic consumption during childhood in Greece is mainly driven by pediatricians. In practice, non-prescription-based consumption of antibiotics (suggestion by a pharmacist or self-medication) concerned a very small number of cases among our patients, in accordance with others [11]. It is possible however, that this will increase the next years because of the current economic crisis in Greece. In contrast, a similar study conducted by our team in older adults found that non-prescription based use of antibiotics accounted for almost one third of antibiotic courses during this age group [8]. This differentiation in antibiotic use between children and older adults in Greece is attributed to the increased sensitivity of parents for their children in this country. Another potential explanation is better education and an increased awareness about the disadvantages of overuse of antibiotics among parents-younger adults compared to older adults.

In our study, respiratory tract infections accounted for most courses of antibiotics. Acute otitis media, pharyngotonsillitis and

bronchitis were the main indications for antibiotic use, which reflects the age-specific morbidity during childhood. These findings are in accordance with others [2,12,13]. In addition, broad-spectrum penicillins accounted for most antibiotic courses consumed by children, followed by cephalosporins and macrolides. Similar findings have been reported globally [5,6,12,14]. Overall, a good compliance of Greek pediatricians with the national antibiotic guidelines in terms of first-line prescribed antibiotic was found in most clinical indications except for pharyngotonsillitis. Gaps in antibiotic prescription habits were found in pediatricians in Greece a few years ago [4]. Well-designed educational interventions to promote the rational prescription of antibiotics by pediatricians have achieved significant and sustained reductions in antibiotic prescription rates [14,15] and are warranted in this country.

Our study has few potential limitations. First, we studied hospitalized children, which may not reflect precisely the general pediatric population in Greece. Second, there is a possibility of recall bias in cases where data about antibiotic use were not recorded in the health booklet of the children. Third, previous data about pediatric antibiotic consumption are not available in Greece, therefore the potential benefit of the 2007 national guidelines cannot be evaluated. However, our study provides valuable data for future analyses of the trends of antibiotic consumption during the current economic crisis in Greece. Overall, our goal was to analyze data on actual antibiotic consumption, including non-medical (pharmacist) suggestion and use of leftovers, and not to focus on antibiotic prescriptions, which is a clear advantage in this study.

#### 5. Conclusions

Our study clearly showed that seven years after the first national guidelines for antibiotic prescription were issued in Greece, antibiotic use by children in the community is almost exclusively driven by pediatricians. Our study showed that almost half the children received a mean of two courses of antibiotics per year. Educational interventions are a key measure to promote the rational prescription of antibiotics and should be promoted in order to tackle the rise of antibiotic resistance in the community.

#### Declaration of interest

No conflict of interest to declare.

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