RESEARCH ARTICLE / *Araştırma Makalesi*

Investigation of Antibiotic Prescription Related Factors in Sakarya Province

Sakarya İlinde Antibiyotik Reçetelerine İlişkin Faktörlerin Araştırılması

Hüseyin Pehlivan[1], Oğuz Karabay[2], Ayten Yılmaz Yalçıner[3], Aziz Öğütlü[4], Elif Elçin Günay[3]

[1] Sakarya University, Faculty of Engineering, Mechanical Engineering Department, Sakarya, Türkiye
[2] Sakarya University, Faculty of Medicine, Department of Infectious Diseases, Sakarya, Türkiye
[3] Sakarya University, Faculty of Engineering, Industrial Engineering Department, Sakarya, Türkiye
[4] Sakarya Province Health Directorate, Sakarya, Türkiye

Yazışma Adresi / *Correspondence:*
Ayten Yılmaz Yalçıner

Sakarya University, Faculty of Engineering, Industrial Engineering Department, Esentepe Campus, 54187 Sakarya, Türkiye
T: **+90 505 521 61 81** E-mail**: ayteny@sakarya.edu.tr**

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Orcid ve Mail Adresleri
Hüseyin Pehlivan https://orcid.org/0000-0003-3048-8986, pehlivan@sakarya.edu.tr
Oğuz Karabay https://orcid.org/0000-0003-1514-1685, okarabay@sakarya.edu.tr
Ayten Yılmaz Yalçıner https://orcid.org/0000-0001-8160-812X, ayteny@sakarya.edu.tr
Aziz Öğütlü https://orcid.org/0000-0003-3840-4038, aogutlu@sakarya.edu.tr
Elif Elçin Günay https://orcid.org/0000-0002-4464-8779, ekabeloglu@sakarya.edu.tr

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Abstract

Introduction	Because consumption of antibiotics is very critical for public health, it was aimed to analyze and evaluate the data of number of antibiotic packages prescribed by Family Physician (FP) and other doctors than family physicians (ODTFPs) serving in the province of Sakarya and Turkey in terms of cost and prescription related factors for 2019.
Materials and Methods	This study was based on the measurement of antibiotic consumption relied on retrospective data. The number of antibiotic packages prescribed for the year 2019 belonging to Turkey and Sakarya province was analyzed and compared based on cost and expertise of physicians. Chi-square test of homogeneity and two-sample Poisson tests were used in the analysis. p value less than 0.05 was accepted as significant.
Results	Consultation per capita for FPs (z = 307.57, p-value < 0.0001) and ODTFPs (z = 278.27, p-value < 0.0001) in Sakarya were significantly higher than that of those in Turkey. However, both FPs (Chi-Sq =17231.434, df = 1, p-value <0.0001) and ODTFPs (Chi-Sq = 5197.376, df = 1, p-value < 0.0001) in Sakarya prescribed fewer antibiotics than that of in Turkey for 2019. The most prescribed antibiotic group was the J01C group penicillins and its derivatives.
Conclusion	It is thought that the reasons of fewer antibiotics prescribed in Sakarya than in Turkey are related to regular training and feedback to physicians. In this context, feedback policies implemented in hospitals are very valuable for antibiotic consumption management and post-graduate training of physicians is very beneficial for rational antibiotic usage.
Keywords	Antibiotic, consumption, surveillance.

Öz

Amaç	*Antibiyotik tüketiminin halk sağlığı açısından oldukça kritik olması nedeniyle, 2019 yılı için maliyet ve reçeteyle ilgili faktörler açısından Sakarya ilinde görev yapan Aile Hekimleri (FP) ve aile hekimleri dışındaki doktorlar (ODTP'ler) tarafından reçete edilen antibiyotik kutu sayılarına ait verilerin analiz edilmesi ve değerlendirilmesi amaçlanmıştır.*
Yöntem ve Gereçler	*Bu çalışma, retrospektif verilere dayanarak antibiyotik tüketiminin ölçülmesine dayanmaktadır. Türkiye ve Sakarya iline ait 2019 yılı için reçete edilen antibiyotik kutu sayıları analiz edilerek maliyet ve hekimlerin uzmanlıklarına göre karşılaştırma yapılmıştır. Analizdeki ki-kare homojenlik testi ve iki örnekli Poisson testi kullanılmıştır. p değerinin 0,05'ten küçük olması anlamlı olarak kabul edilmiştir.*
Bulgular	*Sakarya'daki FP (z = 307,57, p-değeri < 0,0001) ve ODTFP'ler (z = 278,27, p-değeri < 0,0001) için kişi başına düşen konsültasyon oranı Türkiye'dekilerden anlamlı derecede yüksektir. Ancak Sakarya'daki hem FP (Chi-Sq =17231.434, df = 1, p-değeri <0,0001) hem de ODTFP'lerin (Chi-Sq = 5197.376, df = 1, p-değeri < 0,0001) Türkiye geneline göre daha az sayıda antibiyotik reçete ettiği görülmektedir. 2019 yılında en çok reçete edilen antibiyotik grubu J01C penisilinler ve türevleridir.*
Sonuç	*Sakarya'da Türkiye geneline göre daha az antibiyotiğin reçete edilmesinin nedeninin, hekimlere verilen düzenli eğitim ve geri bildirim olduğu düşünülmektedir. Bu bağlamda hastanelerde uygulanan geri bildirim politikaları antibiyotik tüketimi yönetimi açısından oldukça değerlidir ve hekimlerin mezuniyet sonrası eğitimleri de akılcı antibiyotik kullanımı açısından oldukça faydalıdır.*
Anahtar Kelimeler	*Antibiyotik, tüketim, sürveyans.*

INTRODUCTION

Antibiotic overuse and misuse have emerged as critical global concerns, primarily due to the rise of antibiotic-resistant bacteria. Studies have revealed that Turkey exhibits a notably high rate of antibiotic consumption compared to Eastern European countries. This excessive utilization of antibiotics contributes significantly to the development of antimicrobial resistance, thereby posing a substantial threat to public health worldwide[1,2]. Monitoring antibiotic prescriptions serves as a vital component of effective antimicrobial management, a practice already implemented by numerous European countries through the utilization of diverse indicators[1]. Given Turkey's considerable consumption of antimicrobials, it becomes imperative to establish and implement antimicrobial management programs, particularly within hospital settings[3,4].

To address these pressing issues, the study aims to analyze prescription data from the year 2019, focusing on both Turkey's overall antibiotic consumption and the specific situation within the province of Sakarya. Emphasis will be placed on scrutinizing the prescribing patterns of antibiotics and investigating the potential associations with the respective specialties of the prescribing physicians. Additionally, the study seeks to evaluate the efficacy and impact of the in-service training conducted by the Sakarya Province Health Directorate on antibiotic prescribing practices, while concurrently developing a comprehensive roadmap to guide future strategies. The collaboration between Sakarya University and the Sakarya Province Health Directorate aims to not only assess the number of antibiotic prescriptions but also to evaluate their medical and economic ramifications. By conducting a comprehensive analysis, this study aims to yield valuable insights into antibiotic prescribing practices, which will subsequently inform the development of effective strategies for antibiotic usage in Turkey. Ultimately, the study aspires to enhance patient outcomes and mitigate the threat of antimicrobial resistance.

The present study endeavors to conduct an analysis of antibiotic consumption within Turkey, specifically focusing on the province of Sakarya. The primary objective is to investigate the prescription patterns of antibiotics and their correlation with the specialties of the prescribing physicians. Furthermore, the study aims to assess the impact of in-service training provided by the Sakarya Province Health Directorate on antibiotic prescribing practices, and subsequently develop a comprehensive roadmap for future strategies.

In some countries (Turkey, Korea and Greece), unnecessary and misuse of antibiotics is common, and inappropriate use of antibiotics is frequently encountered both among physicians and the public. Infection control measures may be inadequate compared to many countries, access to antibiotics may be more desirable by the public, antibiotic misuse may be common in the livestock sector, and the increasing demand for antibiotics among the population is a factor in the increase of this resistance. For these reasons, a comprehensive strategy should be developed in these countries and the use of antibiotics should be regulated[5,6].
In the report of OECD (Organisation for Economic Co-operation and Development) Health Policy Studies,[6] it is stated that the antimicrobial resistance rate of Turkey is high among OECD member countries. It has been shown that Turkey is the leading country in Europe in antibiotic consumption.[7] Per capita antibiotic consumption increased by 39% between 2000 and 2015, mainly driven by increases in consumption in low-income and middle-income countries.[8]

The fact that both humans and animals have become resistant to conventional treatments due to increasing disease and infection is the reason why antibiotic consumption has received great media attention in recent years. The emergence of antibiotic-resistant bacteria as a result of the use of antibiotics in case of illness or infection causes a global health problem.[9,10,11] Many countries in Europe use a variety of indicators to monitor antibiotic prescrip-

tions as part of their national antimicrobial management.[12] Since Turkey is one of the largest consumers of antimicrobials, antimicrobial management programs are also needed in hospitals in Turkey.[13]

In this study, the prescription data of 2019 were analyzed and the antibiotic consumption in Turkey and in the province of Sakarya, and the antibiotic prescribing relationships with regards to the specialties of the physicians prescribing these prescriptions were investigated. In addition, it was requested to draw up a road map about the effect of the in-service training given by Sakarya Province Health Directorate within the scope of antibiotic prescribing (and use) on the general results and the future strategy. It is also aimed to analyze the number of antibiotic prescriptions and to evaluate their medical and economic effects within the scope of the study carried out jointly by Sakarya University and Sakarya Province Health Directorate.

MATERIAL and METHODS

General situation

In the study, prescription data for 2019 belonging to 83,154,997 people living in Turkey were used. The data on the antibiotic prescriptions of the physicians in Sakarya according to the physicians' speciality (with regards to the physician type) were requested from the Sakarya Province Health Directorate by official correspondence. Antibiotics prescribed for Turkey and Sakarya provinces were examined within the scope of the number of prescriptions, the number of antibiotic prescriptions, the group of antibiotics used, their costs, and consumption data according to physicians' specialty, and the results were compared and interpreted.

The quantity data of the number of antibiotic packages prescribed for the year 2019 belonging to the provinces of Turkey and Sakarya used in the study were obtained from the authorized units of the institution on 17th June 2021 as a result of official correspondence with the Rational Drug Use Department of the Turkish Medicines and Medical Devices Agency.

Training by Province Health Directorate

Sakarya Province Health Directorate provided online training to FPs to rationalize antibiotic use in 2016, 2018, and 2019. These trainings were organized as eight trainings in total in 2019 and were given by experts authorized by the Ministry of Health.

The content of the training sessions were tailored in such a way to include various medical topics that aim to improve the effectiveness of rational use of antibiotics provided by the Ministry of Health Turkish Medicines and Medical Devices Agency. All 313 FPs in Sakarya province have been ensured to complete the training sessions.

Feedback Mechanism

The objective of this feedback mechanism was to increase the sensitivity of FPs to antibiotic prescribing. In this regard, prescription data for the first six months of 2021 throughout Sakarya province were queried by the Ministry of Health Prescription Information System, and the antibiotic prescribing ratio was determined. Accordingly, 130 FPs above the average among 313 FPs were officially informed by Sakarya Province Health Directorate about the total number of prescriptions, the number of antibiotic prescriptions, and the ratio of antibiotics prescribed in Sakarya Province in an attempt to provide a baseline for antibiotic prescribing.

In addition, in 2020 and the first six months of 2021, a bar chart showing the antibiotic prescribing rates was plotted monthly for a total of 21 FPs whose antibiotic prescription rate was over 30%, delivered with an official letter. In the official letter, the high antibiotic prescribing rate was associated with FP's work intensity. Sakarya Province Health Directorate also declared support to FPs in increasing the preventive health services of the society and eliminating unnecessary usage and side-effects of antibiotic treatment. Additionally, FPs were strongly encouraged to collaborate

with the health directorate on reducing antibiotic consumption.

Statistical Analysis

Chi-square tests of homogeneity were performed to compare the proportion differences across groups regarding the number of prescriptions and number of antibiotic prescriptions. Prescribing rates (number of prescriptions per physician) of physicians were compared under the assumption of Poisson-distributed counts. Tests were considered as significant for the values of P less than 0.05. All the statistical tests were performed with Minitab 15 software.

RESULTS

The number of prescriptions, number of antibiotic prescriptions, antibiotics prescription rate (%), total prescription cost and total antibiotic cost (TL) with regards to physician type (FPs vs. ODTFPs) for Sakarya province and Turkey were presented in Table1.

Initial analyses were performed to observe whether there were differences between the number of FPs, ODTFPs, and total physicians (FPs+ ODTFPs) per capita for Sakarya province and Turkey. (Sakarya= 1,029,650, Turkey= 83,154,997, year 2019).14 There was no significant difference in the number of FP per capita between Sakarya province and Turkey (Chi-square=0.577, df=1, p-value=0.447). However, the ratio of ODTFPs (Chi-square=691.225, df=1,p-value < 0.0001) and the ratio of total physicians (Chi-square = 620.976, df = 1, p-value< 0.0001) were significantly lower in Sakarya province.

FP consultation per capita in Sakarya was significantly higher than FP's consultation in Turkey (z = 307.57, p-value < 0.0001). Likewise, ODTFPs consultation per capita in Sakarya was significantly higher than ODTFPs consultation per capita in Turkey (z = 278.27, p-value < 0.0001). According to the statistical data of the Ministry of Health, the number of consultation to a physician per capita in Turkey in 2019 is 6.6 in the OECD (35) and 9.8 in Turkey, while this rate is 10.8 in Sakarya.15 This shows that the number of doctor visits in Sakarya is above both Turkey and OECD averages.

Using the data in Table 1, prescribing patterns of antibiotics were analyzed considering the percentage of antibiotics prescribed in the total prescriptions (number of prescriptions for antibiotic/total number of prescriptions). The percentage of prescriptions for antibiotics in Sakarya province was less than in Turkey (Chi-Sq = 20200.208, df = 1, p-value < 0.0001). When the analyses were broken according to the physician specialty, it was observed that the ratio of antibiotics prescribed by FPs in Sakarya was less than that of those prescribed by FPs in Turkey (Chi-Sq =17231.434, df = 1, p-value < 0.0001). Likewise, ODTFPs in Sakarya prescribed fewer antibiotics than that of ODTFPs in Turkey (Chi-Sq = 5197.376, df = 1, p-value <

Table 1. Some important parameters for prescribed antibiotics for Sakarya and Turkey in 2019.[14,15]

	Sakarya Province		Turkey	
	FP	ODTFP	FP	ODTFP
Number of Prescription	2,578,819	3,076,130	168,178,768	208,810,026
Number of Antibiotic Prescription	389,119*	818,669	30,723,783	59,472,945
Antibiotics prescription rate (%)	15.09*	26.61†	18.27*	28.48†
Total Antibiotic Cost (TL)	7,641,113.79	19,429,862.26	600,479,714.57	1,812,608,145.44
Total Prescription Cost (TL)	260,374,553.18	328,716,615.87	19,429,487,004.69	27,312,296,295.83
Number of Physicians	314	1,109	26,476	193,735
Number of beds (per 10.000 population)	19.20		28.50	
Population	1,029,650		83,154,997	
*,† Significantly lower in the Sakarya region, p-value<0.000				

0.0001).

In this study, antibiotics were defined for systemic use of antibiotics class J01 of the WHO Anatomical Therapeutic Chemical (ATC) classification system. Sales data of antibiotics for the year 2019 were collected from Pharmaceutical Manufacturers Association of Turkey (IEIS) and IMS Health Inc.

Figure 1 shows the distribution of antibiotics prescribed in Turkey and Sakarya according to ATC codes. It is seen that the contents of antibiotics prescribed in Turkey and Sakarya tend to be in the same direction. In addition, it is understood that Penicillins (J01 C) were prescribed at the highest rate and Aminoglycosides (J01G) were prescribed at the lowest rate as the antibiotic type. The antibiotics which are listed in Figure1: J01A Tetracyclines, J01C Beta-Lactam Antibacterials, Penicillins, J01D Other Beta-Lactam Antibacterials, J01F Macrolides, Lincosamides And Streptogramins, J01G Aminoglycoside Antibacterials, J01M Quinolone Antibacterials and J01X Other Antibacterials.

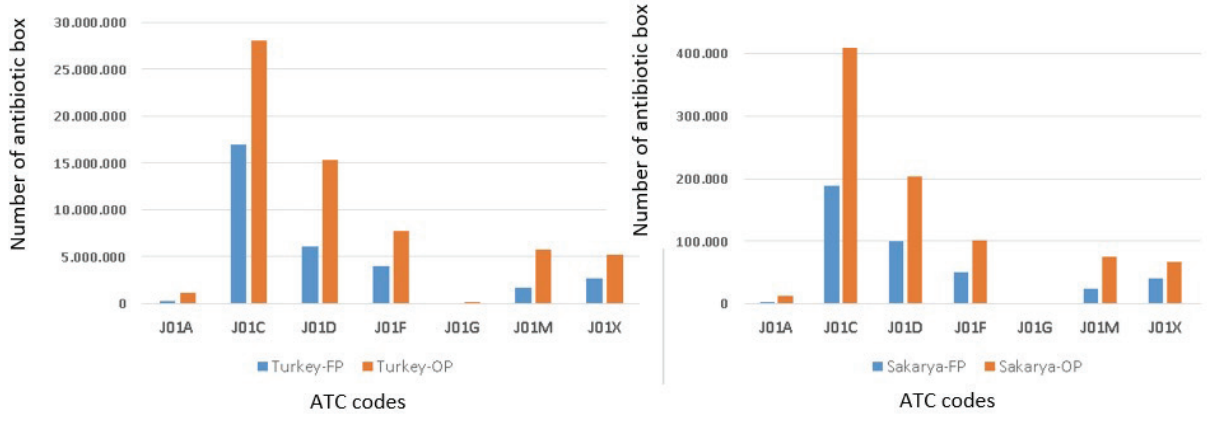

Figure 1. Prescribed antibiotics in Turkey (TR) and Sakarya (54)

Further analyses were performed to investigate the group of antibiotics prescribed in Figure 1. Figure 2a and 2.b show the bar chart of prescribed antibiotic types for Sakarya and Turkey, respectively, for 2019. Accordingly, "Amoxicillin and enzyme inhibitor", "Clarithromycin", "Cefuroxime", and "Cefixime" were some of the most commonly prescribed antibiotics, in both charts.

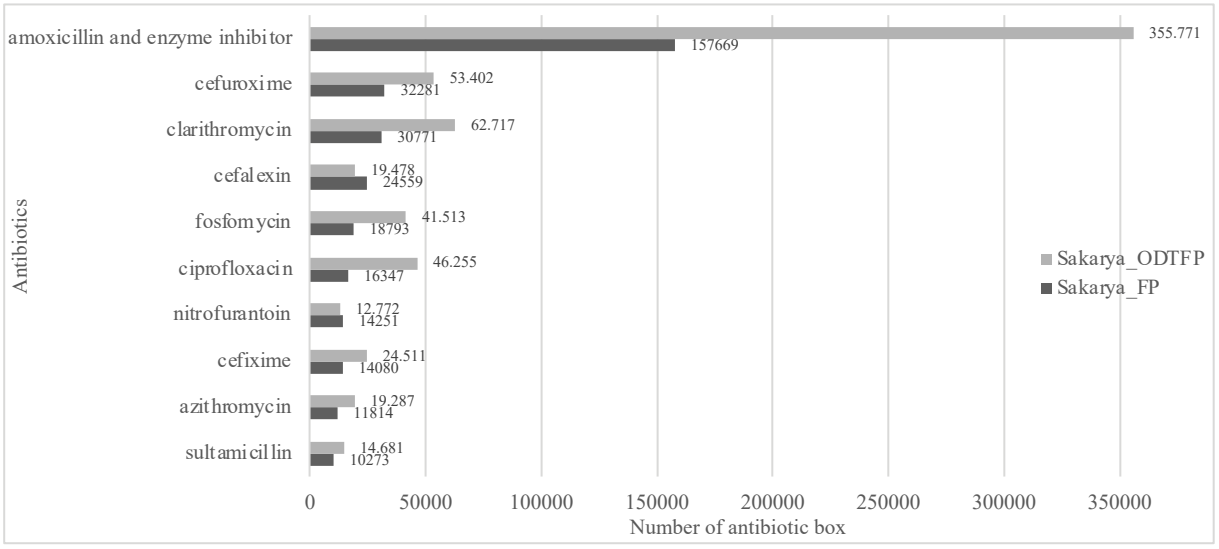

Figure 2a. Bar chart for prescribed antibiotics by FPs and ODFPs in Sakarya

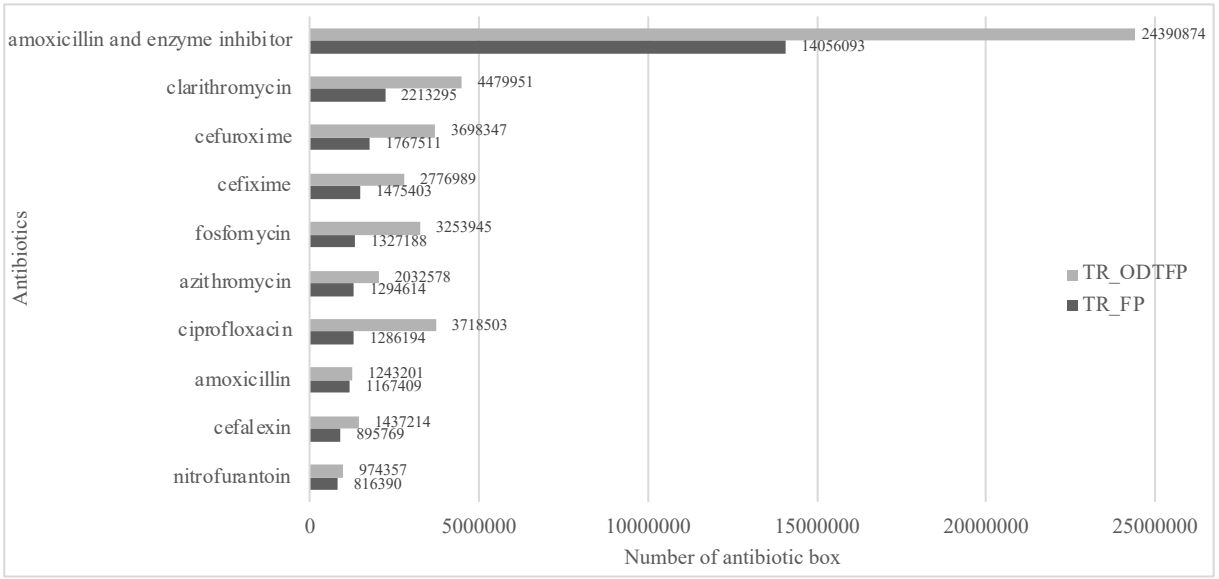

Figure 2b. Bar chart for prescribed antibiotics by FPs and ODFPs in Turkey

DISCUSSION

The number of prescriptions in Sakarya province is 1.5% of the total prescriptions in Turkey. Among those prescriptions in Sakarya, 45.6% is covered by FP. The ratio of antibiotic prescription of FP is 34.06% and 32.22% for Turkey and Sakarya respectively. From the economical burden, Sakarya accounts for 1.12% of the total antibiotic cost in Turkey. FP in Sakarya was responsible for 28.23% of total antibiotic cost while the same ratio was 24.88% in Turkey (see Table 1).

The number of beds in the hospitals in Sakarya province is 19.20 for 2019, and Sakarya ranks 74th among 81 provinces in the number of beds per 10 thousand people in Turkey. The main factor determining the number of physicians other than FPs is the bed capacity in that province. Due to the low bed capacity of Sakarya, the number of ODTFPs is also low. It is thought that the ODTFPs difference between Turkey and Sakarya will be closed by increasing the bed capacity in the province with legal regulations. The number of specialist physicians in Sakarya is lower than the number of specialist physicians in Turkey. However, there is no difference in FPs. Because the number of FPs is determined according to the population of that province. The number of FPs and ODTFPs should be balanced with the population. Fewer ODTFPs except FPs in Sakarya serve more patients than the average in Turkey.

Despite the fact that fewer specialist physicians and much more patients are consulted in Sakarya in general than in Turkey, the rate of prescribing antibiotics in Sakarya is below the Turkey average. The reason for this is thought to be the training and feedback given to both specialists and FPs in Sakarya.[16,17,18] Feedback is a very important regulation tool that affects people and their behavior. With regular, synchronous feedback mechanisms without any intervention to people and without punishment or reward, physicians' drug-prescribing behaviors and their antibiotic-using behaviors can be changed. The physician who thinks that he is under control (follow-up), changes his behavior in order to be least affected by this follow-up. It is thought that the physician who knows that the antibiotic use behavior is tracked and reported back by the Sakarya Province Health Directorate, prescribed fewer and more justified antibiotics. It is known that a physician who used to prescribe antibiotics easily and frequently in many indications no longer prescribes antibiotics thanks to the feedback mechanism. A similar result was obtained in FPs. It is thought that the fact that FPs in Sakarya prescribe antibiotics less often than FPs in Turkey is the result of these feedbacks and regular training.[19,20,21]

The limitations of this study are that the data are retrospective and not defined as Defined Daily Dose (DDD). In addition, the fact that the reasons for the indication-based antibiotic prescribing of the physicians were not included in the study causes insufficient data to be obtained to show the cause-effect relationships.

Frequently prescribed drugs are antibiotics that are generally taken orally and are not subject to any legal restrictions and can be easily prescribed by FPs and other specialists. It is seen that the more easily an antibiotic is available, the more it is consumed. The data we obtained are important in understanding antibiotic use in the Sakarya region, and the results show that antibiotic consumption could be reduced through interventions such as education and feedback. However, we think that new research on the subject is essentially needed.

The data we obtained are important for providing data on antibiotic use in the region we live in, and we have shown that antibiotic consumption can be reduced through interventions such as education and feedback. We think that new research on the subject is needed.

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Ethical statement

Non-interventional Ethics Committee approval was obtained for the study from Sakarya University Faculty of Medicine Dean's Office on 20th October, 2020 (71522473/050.01.04/532 Issue 20/10/2020). After this approval, an antibiotic data request was made from Turkish Medicines and Medical Devices Agency Department of Rational Use of Medicines (25.11.2020).

Authors' contributions

All of the authors participated in the design of the study. HP and AYY obtained data. EEK analyzed and processed data via software. OK and AO interpreted the results. All the authors drafted and the approved the final version of the manuscript.

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Conflicts of interest

None declared.

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