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Assessment of the efficiency of dental services in Turkey

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ABSTRACT

Aim: The present study aimed to measure the efficiency of dental services at the provincial level in Turkey and to identify the potential areas of improvement.

Methods: The study population comprised hospitals and centers providing dental services under the Ministry of Health, located in 81 provinces of Turkey. All hospitals, oral and dental centers under the Ministry of Health were included in the study. The number of units and dentists were considered as input variables, while the number of polyclinics, tooth extractions, root canal treatments, dental fillings, dental surgeries, prosthesis fittings, fissure sealant procedures and local flor procedures were considered as output variables. The efficiency of oral and dental centers was evaluated using the Data Envelopment Analysis method.

Results: While the CCR method showed that 18 of the 81 provinces were efficient and 63 provinces were inefficient, the BCC method showed that 32 provinces were efficient and 49 were inefficient. According to the scale efficiency scores, 32 provinces were found as efficient and 49 provinces as inefficient. Statistically significant differences were found between the efficient and inefficient provinces, in terms of the input and output variables ($p < 0.05$).

Conclusion: The present results are expected to provide important clues to policy makers for planning oral health services.

Introduction

Dental services comprise a branch of medicine that pertains to the prevention, diagnosis, and treatment of all diseases related with the mouth cavity and teeth [1]. Dental services are one of the most important components of general health and they have a direct impact on it [2,3]. Additionally, since dental diseases provide significant information about other diseases such as diabetes, pneumonia, Alzheimer's disease, and cardiovascular diseases, dental services have been considered as one of the most important health services in recent years [4].

Although diseases related to oral health are very common, they do not receive sufficient attention because they are not fatal. However, due to their high incidence and prevalence rates, and high treatment costs, both for the society and for the national economy, several countries now consider dental diseases as a public health problem, and they are developing related solution proposals [5,6].

This change in the perspective on dental services can be explained in several ways. Firstly, although dental diseases are preventable, almost everybody experiences such diseases at least once in their lifetime, which makes the number of patients quite high. Secondly, dental services directly affect the quality of life of individuals, and of the society as a whole. Thirdly, dental services have a crucial impact on the health systems and economic efficiency of countries [7].

The dental services affect individuals at the micro level and governments at the macro level. They impact not only the physical and economic aspects of individuals, but also their interpersonal relations, socialization, self-confidence, and psychological aspects. Dental services have an economic impact on governments. When such services are well planned and executed, long-term costs decrease; however, an opposite situation would lead to a significant increase in health expenditure for governments [2,8,9]. For instance, according to a study conducted in Canada in 2010, 2.26 million school days and 4.15 million workdays were wasted due to dental diseases [10]. Similarly, 1.6 million school days and 2.4 million workdays were wasted in the USA in 1996. In Thailand, in 2008, 1900 school hours per 1000 children were wasted due to dental problems [7]. Therefore, dental services are considered to have a significant impact on the economy of countries.

Although there are no comprehensive data on the financial burden of dental diseases, the World Health Organization estimates dental diseases to rank fourth among diseases with a high

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treatment cost [7]. For example, according to Australian data, the treatment cost for dental diseases was the second highest after cardiovascular diseases, and was much higher than that spent on cancer treatment [11]. According to the 2009 OECD data, OECD countries allocated an average of 5% of their total health expenditure and 16% of the private health expenditure to the treatment of dental diseases. Moreover, dental services are financed by out-of-pocket health expenditure in many countries. For example, in Spain, dental services are mainly provided by the private sector, which requires patients to pay for all services out of their pockets. In Denmark, dental services are free for citizens aged below 18 years, whereas adult patients pay for all the services themselves. Indeed, out-of-pocket expenditure for dental services may particularly create significant problems for the low-income groups [11].

In Turkey, a vast majority of oral and dental health services are provided by institutions affiliated to the Ministry of Health, as well as by universities, and private and other institutions (such as foundations). In 2014, 689 institutions provided oral and dental health services under the Ministry of Health (number of units = 8427), while there were 54 universities (number of units = 4682), 1736 private health institutions (number of units = 6878), and 35 other institutions (number of units = 194) [12].

In Turkey, dental services accounted for 4.8% of the total health expenditure in 2002, which increased to 5.3% in 2015 [13]. Such increases in the realized expenditure for dental services have led countries to use the allocated resources more effectively and efficiently. However, studies examining the efficiency of dental services in Turkey are limited.

Among the few studies that have been conducted, in the study conducted by Gülcü et al. [14] the efficiency scores of six departments were evaluated using a data envelopment analysis by taking into account the number of academic staff, number of patients treated, and net profit from patients in the revolving fund of a faculty of dentistry from 1999–2001. Özdemir [15] conducted a study on the efficiency of 115 oral and dental centers providing dental services using a data envelopment analysis. On the other hand, another study performed by Öner [16] measured only the efficiency of 2 dental hospitals and 26 oral and dental centers. Coşgun et al. [17] aimed to investigate whether institutions providing oral and dental health services are clustered by using the random forest method, and whether these clusters lead to differences in service delivery. Öztaş et al. [18] aimed to examine the workload of physicians working in oral and dental health centers in Turkey. Since the samples in these studies were limited and the variables used to evaluate efficiency were not unique to dental services, the obtained results are not considered adequate to make generalizable conclusions. Therefore, to improve the external validity of the present study, it was aimed to measure the efficiency of dental services at the provincial level in Turkey, and to identify the areas of improvement to increase the efficiency of inefficient provinces.

Method

Sample

The population of this study comprised hospitals and centers providing dental services under the Ministry of Health, located in the 81 provinces of Turkey. The study included all hospitals, and oral and dental centers under the Ministry of Health, and no sampling method was used. The data were generated from the dataset of Public Hospitals Statistics Yearbook [19]. Since the most recent data in the dataset is from 2014, the same was used in this study. In 2014, there were 6 oral and dental health hospitals, 137 oral and dental health centers, and 546 dental clinics affiliated to the Ministry of Health. The services provided by these institutions in 2014 were as follows: 31,791,075 outpatient clinics, 7,395,928 tooth extractions, 2,053,886 channel treatments, 8,382,284 fillings, 6,367,532 prostheses, 518,024 surgical interventions, 83,836 autodontic treatments, 1984 implants, and 459,528 fissure sealant procedures [19].

Variables of the study

The input and output variables used to assess the province based efficiency of dental services have been listed in the research model presented in Fig. 1. The number of units and dentists were considered as input variables, while the number of polyclinics, tooth extractions, root canal treatments, dental filling, dental surgeries, prosthesis fittings, fissure sealant procedures and local flor procedures were considered as output variables.

The number of units was considered as an input variable based on the studies conducted by Özdemir [15], Öner [16], Buck [20], Widsröm et al. [21], Grytten and Rongen [22]. Similarly, the number of dentists was used because it had been used in the studies conducted by Özdemir [15], Öner [16], Widsröm et al. [21], Grytten and Rongen [22], and Linna et al. [23]. In addition to these input variables, it was intended to include technicians, nurses, and equipment numbers to make a more comprehensive efficiency evaluation, but these variables could not be included in the study model because the corresponding data could not be obtained.

Based on a literature review, the number of polyclinics, tooth extractions, root canal treatments, dental fillings, and dental surgeries and prosthesis fittings were determined as the output variables. Grytten and Dalen [24] used the number of filling treatments, root canal treatments, implant treatments, dental surgeries, and tooth extractions as output variables to measure the efficiency of private dental clinics. Özdemir [15] measured the efficiency of oral and dental centers in Turkey, operating under the Ministry of Health, using the number of regular and surgical extractions, fillings, root canal treatments, and fitting of fixed and other prostheses, as well as the scaling and referral rates as output variables. A similar study by Öner [16] used the number of prosthesis fittings and dental surgeries and treatments as output variables. Therefore, the output variables used in the present study can be considered as compatible with the literature.

Data analysis

In the present study, the efficiency of oral and dental centers was evaluated using the Data Envelopment Analysis method and the Efficiency Measurement System (EMS) program. Data envelopment analysis, which was first used by Charnes et al. [25], is a mathematics-based method used to measure the efficiency of decision-making units with each other using the same type of input and generating the same type of output. As a result of this evaluation process, the input and output amounts required to generate maximum efficiency in a decision-making unit are defined. Thus, the aim of the data envelopment analysis is to calculate the relative efficiency scores of decision-making units and to identify the changes that need to be made in the input and output amounts to increase the efficiency of inefficient decision-making units [26–28].

Data envelopment analysis may be applied using two different models, the Charnes, Cooper, Rhodes (CCR) model and the Banker, Charnes, Cooper (BCC) model. The CCR model is based on constant returns to scale, while the BCC model is based on variable returns to scale. Both these methods can be applied either with input-oriented or output-oriented data, depending on the features of the data to be used in the study. The input-oriented model minimizes the input amount provided to maintain the output amount at a certain level. The output-oriented model maximizes the output provided to maintain the input at a certain level [28,29].