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RESEARCH ARTICLE

The economic impact of early tooth loss in turkish children and adolescents

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ABSTRACT

Objectives: We sought to measure the financial burden on the Turkish government from early tooth loss and tooth impaction requiring prosthetics in 6–22-year-olds.

Material and Methods: We evaluated 28784 teeth from 1028 patients (379 males and 649 females) between the ages of 6 and 22 and assessed the indications for prosthodontic treatment. As the study age range is not reliable for the presence of third molars, third molars were ignored. We divided the patients into pediatric and young adult groups. The homogeneity of data was evaluated with the Kolmogorov-Smirnov test. Differences between the genders and groups were evaluated with Pearson's Chi-squared test and the Mann-Whitney U-test.

Results: Missing permanent teeth predominated in the young adult group (1.61) %, while impacted permanent teeth predominated in the pediatric group (0.81 %). Applying these rates to the population as a whole, 1.8 million pediatric and 6.2 million young adult cases of missing teeth may be extant in Turkey.

Conclusions: Making dental hygiene information available to all socioeconomic groups would require an initial outlay of expenses, but savings would be realized both from preventing lost work and school time and from avoiding the need for prosthetic work in millions of Turkish citizens.

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INTRODUCTION

Dental caries and periodontal diseases are the main predictors of tooth loss.[1] Other factors related to this outcome include advanced age, low socioeconomic status, and difficult access to dental health services.[2-4] With developments in the food industry and revolutionary changes in the human diet,[5] an increased incidence of early age caries and tooth loss is inevitable in young populations in developing countries. Some reasons for tooth loss in developing countries include unstable finances and haphazard economic and educational opportunities. Consequently, preventive medical and dental care and educational resources are unevenly available. A 2003 WHO report on global oral health mentioned persistent inadequacies even in the face of improvements. The report covers a wide range of worldwide major public dental health problems, including caries, periodontal disease, tooth loss, oral mucosal lesions, oro-pharyngeal cancers, human immunodeficiency virus/acquired immunodeficiency syndrome- (HIV/AIDS) related oral disease, and oro-dental trauma. Most of these maladies cause restriction of activities at school, work, and home, causing millions of school and work hours to be lost each year throughout the world, while billions of dollars are spent for treatment. Although the incidence of dental caries was not high in developing countries in the past, the increased availability and consumption of sugars and the lack of fluorides have been associated with a greatly increasing prevalence of dental caries. The WHO report concludes that the need for dental treatment is increasing significantly.[6] In countries without an adequate national preventative dental health strategy that includes oral hygiene education in preschool and school-age children, the incidence of oral diseases and related oral symptoms of systemic illnesses increases more and more each day.[7]

Since the need for dental prostheses is caused mostly by tooth loss, there are many studies of tooth loss in adult or older populations,[8-10] while the data for adolescents are insufficient.[11]

Tooth loss is accompanied by masticatory dysfunction, which may lead to malnutrition. Tooth loss also affects phonation and aesthetics, which may alter the social acceptance of afflicted individuals.[12] Overall, as a consequence of tooth loss, the quality of life is reduced.[13] Preventative oral health programs and education about oral diseases and related tooth losses can help to avoid tooth loss. The best programs are tailored to the needs of a given population. The aim of this study is to quantify the needs of 6- to 22-year-olds in order to design programs that will provide the most good for the least expense.

MATERIALS AND METHODS

We evaluated 28,784 teeth in 1028 patients (379 males and 649 females) between the ages of 6 and 33 for indications for prosthodontic treatment. Third molars were ignored since the study range of age is not reliable for presence of third molars. Assuming all permanent tooth eruptions are finalized by 14 years of age, we divided the patients into a pediatric group (6–14 years old) and a young adult group (15–22 years old).

We developed a Prosthetic Need Model (PNM) (Table 1) to score subjects according to missing teeth totaling up to three. This enabled us to estimate the cost of treatment. One missing tooth, two adjacent missing teeth, two separate missing teeth, three adjacent, two adjacent plus one separate, and three separate missing teeth were calculated as 3, 4, 6, 5, 7 and 9 units, respectively. After assessing the fixed partial dentures (FPD) unit scores, the

Table 1. Prosthetic need model (PNM)

Model	Situation	Number of FPD units needed
1	One missing tooth	3
2	Two adjacent missing teeth	4
3	Two separate missing teeth	6
4	Three adjacent or two missing teeth with pier abutment	5
5	Two adjacent and one separate	7
6	Three separate missing teeth	9

average cost per patient was calculated for both gender and age groups.

The homogeneity of data was evaluated with the Kolmogorov-Smirnov test. The differences between genders and groups were evaluated with Pearson's Chi-squared test and the Mann-Whitney U-test. A value of $P < .05$ was considered significant.

RESULTS

Table 2 displays the statistical data. The mean age (± standard deviation) in the pediatric group was 10.44 ± 2.13; and the average age in the young adult group was 18.29 ± 2.21.

The percentages of missing teeth between age and gender groups are shown in Table 2. Missing teeth occurred more often in the young adult group (1.75% vs. 0.5%), $p < .001$. The first molars were found to be the most frequently absent.

Missing teeth prevalence's by gender and age groups are shown in Table 3. The FPD units required, with percentages for gender and age groups, are shown in Table 4. In both the pediatric and young adult groups, males needed more fixed prostheses and financial support than females. The cost per patient for the female and the male group is presented in Table 5. Since just a part of the population has health insurance, the cost to the government is estimated as follows: 6.4 million fixed prostheses performed at governmental dental clinics and hospitals cost 238 million $, while almost 435 million $ as untreated tooth restoration fees are a potential debt for the government.

DISCUSSION

The main purposes of this study were to provide data on the prevalence of impacted or missing teeth and related prosthodontic requirements of citizens between 6 and 22 years old. The sample was collected in the same manner and the same areas in Turkey and decayed missing filled teeth (DMFT) components were not evaluated. There is a dearth of studies on the prevalence of missing and the need for dental prostheses in the pediatric and young adult Turkish populations. Our results concerning the prosthetic needs of patients reflect the differences in tooth loss between young adults and children. The cost of prosthetic treatments was calculated using the PNM. The most significant FPD unit requirements are 3 units and 6 units (Table 4), which is possibly due to the high absence rate of tooth numbers 26, 36, and 46.

Table 2. Descriptives of the groups

Group	Gender	Missing	%	Patients	Age (mean±SD)
Pediatric	Male	18	0.39	162	10.40±2.09
	Female	27	0.62	155	10.46±2.19
	Total	45	0.50	317	
Young adult	Male	126	2.07	217	17.93±2.11
	Female	222	1.61	494	18.44±2.24
	Total	348	1.75	711	
Total		393	1.36	1028	

Table 3. Missing tooth prevalence up to three missing teeth by gender and age

Missing teeth	Age (%)		Gender (%)	
N	Pediatric	Young adult	Female	Male
0	88.7	73.9	78.6	78.5
1	6.5	14.8	12.2	12.2
2	4.2	7.9	6.7	6.9
3	0.6	3.4	2.5	2.5

Correa et al.[14] assessed the prevalence of use and need for dental prostheses (UNDP) by individuals at age 24 and their life-course determinants. In their study, demographic and socio-economic trends and oral health and dental service utilization patterns during the life course were exploratory variables and the prevalence of UNDP was 2.1% and 29.7%, respectively. They found that low socioeconomic status, lower levels of maternal education, no history of oral hygiene demonstration by a dentist by age 15, and caries present at age 15 were associated with increased prosthetic treatment needs. Our study showed similar results. Akın et al.[15] also mentioned in their study that prosthetic expenses can be altered by increasing knowledge and/or education level.

Herrera Mdel et al.[16] found a positive correlation between dental caries in primary dentition and dental plaque. Positive correlation between brushing teeth at least once a day, and having received preventive dental care was also identified. In our study the missing tooth statistics point out the upper or lower first molars. Missing/impacted upper canines drew attention due to lack of orthodontic treatment.

A previous study has reported that the buccal-lingual caries of anterior teeth cannot be used as an indicator for future caries; however, a DMFT score of 5 and above might indicate five or more caries in permanent dentition. They have also stated that children with high caries in primary dentition at the average age of 4.4

Table 4. Required FPD units distribution for age and gender groups according to PN model

FDP Units	Age		Gender	
	Group	Patients n (%)	Group	Patients n (%)
Number of crowns needed				
0	Pediatric	275 (88.7)	Male	284 (78.5)
	Young adult	505 (73.9)	Female	496 (78.6)
3	Pediatric	20 (6.5)	Male	45 (12.4)
	Young adult	103 (15.1)	Female	78 (12.4)
4	Pediatric	352 (0.6)	Male	2 (0.6)
	Young adult	2 (0.1)	Female	1 (0.2)
5	Pediatric	0 (0.0)	Male	1 (0.3)
	Young adult	3 (0.4)	Female	2 (0.3)
6	Pediatric	11 (3.5)	Male	21 (5.8)
	Young adult	48 (7.0)	Female	38 (6.0)
7	Pediatric	0	Male	1
	Young adult	4	Female	3
8	Pediatric	0	Male	3
	Young adult	6	Female	3
9	Pediatric	9	Male	5
	Young adult	13	Female	10

have 2.4 times more caries in permanent dentition at the age of 15.[17,18] That's why in this study statistically a new approach for denture need is applied to find out required prosthetic treatments and expenses.

The statistics of population according to age, gender, and location, which are generated by the Turkish Statistics Foundation, mirror our study's age range. A total of 25.335.145 population distributed as if; 12.643.399 of the population range is between 5-14 year old age range and 12.691.746 of the population range is between 15 and 24 years old.[19] Although the government population statistics groupings do not exactly match ours, the data are very close, and suitable for assessing financial burden. Applying the disease rates to the general population, the pediatric age group will have 1.8 million missing teeth and the young adult group, 6.2 million. The cost can be calculated as the amount the Turkish

Table 5. Cost projections per patient and for total population

	Per patient cost range, ($)	Population	Expected cost range (million $)
Gender			
Male	29–45	12.924.393	375–582
Female	31–43	12.304.532	381–529
Age group			
Pediatric	12–25	12.643.399	152–316
Young adult	39–52	12.691.746	495–660

government pays to the hospitals for FPD: 40$ per unit of fixed partial prostheses. In 2013, 6.4 million fixed prostheses were placed at governmental dental clinics and hospitals. This cost the government 240 million $ without calculating the staff and other expenses. these missing teeth and economical losses may be altered by oral health education, atraumatic restorative treatment (ART) and prevention studies such as fluoride and CHX gel or varnish application, fissure sealant, etc.[18]

Pukallus et al.[20] used phone calls as prevention program and found out the estimated incidence of caries lowered from 54 to 11 per 100 children. Therefore, a total of 43 carious teeth were prevented from the telephone intervention per 100 children at a cost saving of £69.984 for Australia. A previous study also concluded that having a preventive programme is cost-effective by finding that an intervention with examination, varnish and counseling can achieve 70% more averted caries at a cost of US $66 per caries surface prevented. However the treatment costs may vary through countries.[21] Preventive dental measures are more cost-effective than treatment of already-established oral disease, and this needs to be provided using technologies and methods that are affordable and meet the oral health needs of the developing countries and for this study Turkish population.

Ezirganlı et al.[22] searched for congenitally missing premolars however in this study the congenitally missing teeth were excluded. Within the limitations of this study the congenitally missing tooth was not included to the study datum.

CONCLUSION

Within the results of this study its shown that due to early loss of permanent teeth the expenses per patient is significantly high in Turkish population. However the expenses can be decreased with preventative zone studies such as brush on gel fluoride, varnish, fissure sealent application, preschool and school children's dental hygiene education.

Abbreviations used in this paper

WHO = World Health organization; HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome; TL = Turkish lira; PNM = prosthetic need model; FPD = fixed partial dentures; DMFT = Decayed missing filled teeth; UNDP = use and need for dental prostheses.

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