

# The Evaluation of Dental Imaging Services in Turkey Between Years 2010-2013

## 2010-2013 Yılları Arasında Türkiye’de Dental Görüntüleme Hizmetlerinin Değerlendirilmesi

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### Abstract

**Background:** Radiological monitoring is especially important for the effective planning of services related to oral and dental health care. The aim of this study is to evaluate the national data of radiological imaging methods in Turkey which are used for diagnostic and therapeutic purposes.

**Methods:** For this retrospective, cross-sectional study, the radiological imaging data from Oral and Dental Health Centers and Hospitals affiliated to the Institution of Public Hospitals in all 81 cities of Turkey between years 2010-2013 were evaluated. The data were presented with one and two-dimensional tables, the statistical analysis was carried out using SPSS for Windows, Version 22.0 package program.

**Results:** Increasing by years, the number of radiological imagings have been; 2,964,713, 3,972,361, 4,830,532 and 5,829,750 in years 2010, 2011, 2012 and 2013, respectively. Of the total population, 4.02, 5.32, 6.39 and 7.60% have been applied any kind of dental radiography in the same years, respectively.

**Conclusions:** This situation is in compliance with the increasing population as well as the increasing service delivery in the content of “Health Transition Program”. Treatment needs play a major role in the effective planning of oral and dental health services by policymakers.

**Keywords:** Radiography, Dental, Dental Health Services, Turkey.

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## Özet

**Giriş:** Radyolojik izlem, ağız ve diş sağlığı ile ilgili hizmetlerin etkili bir şekilde planlanması için önemlidir. Bu çalışmanın amacı, Türkiye’de tanı ve tedavi amaçlı kullanılan radyolojik görüntüleme yöntemlerinin ulusal verilerini değerlendirmektir.

**Yöntem:** Bu retrospektif, kesitsel çalışma için, 2010-2013 yılları arasında Türkiye’nin 81 ilindeki Kamu Hastaneleri Kurumuna bağlı Ağız ve Diş Sağlığı Merkezleri ve Hastanelerinden alınan radyolojik görüntüleme verileri değerlendirilmiştir. Veriler tek ve iki boyutlu tablolarla sunulmuştur. İstatistiksel analizler SPSS for Windows Sürüm 22.0 paket programı kullanılarak yapılmıştır.

**Bulgular:** Yıllar içinde artan radyolojik görüntülemelerin sayısı; 2010, 2011, 2012 ve 2013 yıllarında sırasıyla 2.964.713, 3.972.361, 4.830.532 ve 5.829.750’dir. Aynı yıllarda toplam nüfusun% 4.02, 5.32, 6.39 ve 7.60’ına her türlü diş radyografisi uygulanmıştır.

**Sonuç:** Bu durum, ‘Sağlıkta Dönüşüm Programı’ içeriğinde artan nüfus ve artan hizmet sunumuyla uyumludur. Politika yapımcılar tarafından ağız ve diş sağlığı hizmetlerinin etkin bir şekilde planlanmasında tedavi ihtiyaçları önemli bir rol oynamaktadır.

**Anahtar Kelimeler:** Radyografi, Diş, Diş Sağlığı Hizmetleri, Türkiye.

## Background

Health service is a concept which involves protecting health, facilitating the treatment of the sick and wounded and also serving for rehabilitation when required [1-3].

Oral and dental health services involve the preventive and protective services for dental, gingival patterns and other related tissues as well as the the diagnosis and treatment of abnormalities [4]. World Oral Health Report 2003 from WHO has noted that those belonging to the lower socioeconomic ranks of developing countries are more prone to oral and dental diseases [5]. Studies on this issue have shown deeper inequalities compared with other health areas and marked that socioeconomically advantaged groups have access to dental services more efficiently [6-8]. According to WHO Report in 2006, global problems are still present although some countries have had.great improvements on the subject [9].

It is observed that; national health systems, independent from the development level, try to handle and improve strategies against increasing demands, limited sources, inequalities in delivery of health care and lack of number and quality in labor force in health, today. Planning and revising national health systems require close scrutiny of those belonging to the developed world as well as national progress priorities [2, 10, 11].

The Turkish Republic is a country important in the region it is located with a population of 77,695,904 and 8.2% of this population lives in the countryside. Turkey is

among the midscale countries in a ranking of health levels. Neonatal mortality rate is 11.1 per thousand, 23% of the population falls within the 0-14 years of age group and 9% is older than 65 [12].

Ministry of Health, a leading participant within the Health Transition Programme in Turkey, carries out studies on highly improved, patient oriented, easily reached, nondiscriminating health service for health policies to be improved. New implementations on oral/dental health in Turkey promise new resources and more flexibility [13-16].

The oral and dental health services in Turkey have been financed mainly privately until 2003. In 2002, there were 16,371 dentists in Turkey, and only 20% of this number was employed by Ministry of Health [17]. This situation has changed parallel to the Health Transition Project and payment is mainly by national assistance today.

Together with the Health Transition Program conducted during the 2002-2013 period in Turkey, at least one Oral and Dental Health Center (ODHC) has been opened in each city and the number 14 in 2002 has increased to 137 in 2013. The breakdown of the units offering oral and dental health services and working as affiliated with the Institution of Public Hospitals is given as; 6 ODHs, 237 ODHCs and 546 hospital polyclinics of oral and dental health with 753, 4832 and 1784 dental units, respectively. Within the scope, 689 institutions render service with 7369 dental units today. Moreover, 45 institutions with 3167 units and 511 private corporation serve for dental care [18-19].

## Imaging Services in Dentistry

The art of dentistry is a versatile profession which necessitates knowledge and skill in medicine as well as affinity to artistry and technology. Radiology is the main helper of clinical examination and it is continuously making progress to increase imaging quality and to decrease the radiation dose exposed [20]. The improvements in material and laboratory technologies provide many advantages to the dentists like reduced treatment time and standard dental care. Patient comfort has increased by intraoral optical scanners developed. The personnel health protection owing to computer (CAD/CAM) and laser technologies for laboratory productions is another pleasing aspect [20, 21].

Imaging methods used in dentistry are [18];

Conventional Methods (Extraoral, intraoral)

Digital Imaging

Cone Beam Computed Tomography (CBCT)

Ultrasonography

Magnetic Resonance Imaging

Radiology units are needed in all facilities giving oral/dental health and data of dental imaging services between 2010-2014 are given in Table 1. According to the table, the number of dental imagings has doubled since 2010 to 2014. By the end of 2014, dental imaging service is given in 340 of all 589 ODHC/ODHs, moreover CBCT is performed in 8 ODHCs [18].

**Table 1 Dental Imaging Data in Turkey According to Years**

Year	Number of patients radiographed in ODH units
2010	3121037
2011	4229244
2012	5079783
2013	6192472
2014	6214408

The oral and dental health services implemented should be analysed carefully in order to plan the future in an accurate and effective way. Our aim in this study was to evaluate data of radiological imaging services used both for diagnostic and therapeutic purposes in Turkey and thus contribute to the effective planning of healthcare services in that area.

## Methods

### Content of the study

ODHCs/ODHs affiliated to the Ministry of Health were recruited for the research. In 2014, there are 18,070 dental units of which 7,956 belong to the Ministry of Health in Turkey. Also, a total of 37,925,956 polyclinic admissions were reported [19]. Of this, 24,204,277 is to ODHCs/ODHs. The included ODHCs/ODHs, which form the universe of the study, had a total capacity of 4872 and 846 dental units, respectively, and stand for 42.39% of the total dental units and for 63.82% of polyclinic admission numbers in Turkey. The universe of the study is the whole population admitted to these institutions. Other service units like universities, private practice etc. from which data could not be gathered were excluded. All of the universe was included for the study, so no sampling was performed.

### Data collection and evaluation

Data gathered monthly for five years for this retrospective, cross-sectional study beginning from 2010 were obtained from the Public Hospitals Institution of Ministry of Health.. Data from 137 ODHCs and 6 ODHs in all 81 cities in Turkey were gathered in a data pool till the beginning of analyses in 2015. No healthy information could be reached for the term before 2012 and year 2014 was also excluded because of insufficient data related to dental imaging.

The regions in this study were selected according to the Nomenclature of Territorial Units for Statistics-1 (NUTS-1) classification, as defined in Table 2. Cities were classified as “Level 3” in NUTS, neighbour cities similar to each other socially and geographically were grouped as “Level 1” and those similar to each other in development and population sizes as “Level 2”, thus hierarchical NUTS was formed. Each one of the 81 cities was designated as a statistical region unit with regard to Level 3. Twenty-six Level 2 NUTs were defined by grouping Level 3 neighbour cities and twelve Level 1 NUTs were defined by grouping Level 2 NUTs. In all regional studies in governmental sector, NUTS study is taken as a basis [19].

**Table 2** Nomenclature of Territorial Units for Statistics and Provinces

NUMBER	LEVEL 1	LEVEL 2	LEVEL 3
1	Istanbul	Istanbul Subregion	Istanbul
2	Western Anatolia	Ankara Subregion	Ankara
		Konya Subregion	Konya, Karaman
3	Eastern Marmara	Bursa Subregion	Bursa, Eskişehir, Bilecik
		Kocaeli Subregion	Kocaeli, Sakarya, Düzce, Bolu, Yalova
4	Aegean	İzmir Subregion	İzmir
		Aydın Subregion	Aydın, Denizli, Muğla
		Manisa Subregion	Manisa, Afyon, Kütahya, Uşak
5	Western Marmara	Tekirdağ Subregion	Tekirdağ, Edirne, Kırklareli
		Balıkesir Subregion	Balıkesir, Çanakkale
6	Mediterranean	Antalya Subregion	Antalya, Isparta, Burdur
		Adana Subregion	Adana, Mersin
		Hatay Subregion	Hatay, Kahramanmaraş, Osmaniye
7	Western Blacksea	Zonguldak Subregion	Zonguldak, Karabük, Bartın
		Kastamonu Subregion	Kastamonu, Çankırı, Sinop
		Samsun Subregion	Samsun, Tokat, Çorum, Amasya
8	Central Anatolia	Kırıkkale Subregion	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir
		Kayseri Subregion	Kayseri, Sivas, Yozgat
9	Eastern Blacksea	Trabzon Subregion	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane
10	Southeastern Anatolia	Gaziantep Subregion	Gaziantep, Adıyaman, Kilis
		Şanlıurfa Subregion	Şanlıurfa, Diyarbakır
		Mardin Subregion	Mardin, Batman, Şırnak, Siirt
11	Mideastern Anatolia	Malatya Subregion	Malatya, Elazığ, Bingöl, Tunceli
		Van Subregion	Van, Muş, Bitlis, Hakkari
12	Northeastern Anatolia	Erzurum Subregion	Erzurum, Erzincan, Bayburt
		Ağrı Subregion	Ağrı, Kars, Iğdır

## Statistical Method

The computerised data were presented as one and two-dimensional tables. The statistical analysis was carried out using SPSS for Windows, Version 22.0 package program. The results were summarized by tables and figures. Admission numbers to ODHCs/ODHCs were calculated by analyzing polyclinic numbers. Radiological imaging numbers for regions and years were noted as a sum. Radiological imaging application numbers per dentist, dental unit and per capita were given as means. These means were obtained by proportioning each NUTS' radiological imaging application number to that region's dentist, dental unit numbers and number of population. ODHCs in our country are divided into four groups according to the number of dental units as; below 40, between 40-70, between 71-100 and above 100. Neither hypothesis testing was applied nor comparisons were made because the data were mass data. The results were interpreted as an 'increase' or 'decrease' compared to the previous year.

## Results

Table 3 shows the percentages of admission numbers to ODHCs and ODHs according to years and NUTS-1.

**Table 3 Percentages of admissions to ODHCs and ODHs according to years and NUTS-1**

REGIONS	2010 (%)*	2011 (%)	2012 (%)	2013 (%)	2014 (%)
Western Anatolia	15.57	27.70	27.80	42.59	42.01
Western Blacksea	12.27	28.09	26.85	44.18	41.22
Eastern Marmara	19.96	29.26	25.59	39.78	38.41
Western Marmara	9.85	19.48	23.38	40.86	37.47
Central Anatolia	11.69	19.22	21.73	35.55	35.78
Northeastern Anatolia	13.16	25.03	22.34	29.17	34.96
Mideastern Anatolia	13.73	22.27	17.34	31.61	33.07
Aegean	11.87	21.82	20.58	32.74	31.06
Southeastern Anatolia	10.79	19.11	17.51	27.48	28.66
Eastern Blacksea	11.57	18.09	17.30	29.37	28.47
Mediterranean	8.66	16.91	17.56	28.74	27.04
Istanbul	7.49	14.30	12.10	18.98	19.64
<b>Total</b>	<b>11.71</b>	<b>20.93</b>	<b>19.81</b>	<b>31.63</b>	<b>31.15</b>

*\*(Percentages given according to the population)*

The rates of dental imaging applications in ODHCs and ODHHs according to population and admission numbers are given in Table 4.

**Table 4** Dental imaging numbers and percentages per capita and per admission in ODHCs/ regarding years and NUTS-1

REGIONS	2010			2011			2012			2013		
	Number	%pop	%adm	Number	%pop	%adm	Number	%pop	%adm	Number	%pop	%adm
Western Anatolia	556713	7.93	68.23	728879	10.18	45.40	905025	12.47	53.61	1056233	14.35	37.63
Western Blacksea	230928	5.11	41.67	308953	6.90	24.56	489627	10.92	40.68	565209	12.66	28.44
Northeastern Anatolia	140331	6.37	12.84	181220	8.13	9.13	204092	9.17	10.12	205123	9.29	6.54
Central Anatolia	191655	4.98	66.13	248258	6.46	44.47	307896	7.99	61.91	352405	9.10	54.72
Eastern Blacksea	177623	7.06	21.69	207639	8.26	13.90	201531	7.92	14.46	186311	7.30	8.37
Aegean	298685	3.31	25.97	397507	4.10	18.81	508284	5.20	25.26	567536	7.30	17.51
Mideastern Anatolia	129215	3.54	9.46	223069	6.01	10.96	228883	6.09	12.67	271808	7.20	9.49
Mediterranean	345874	3.67	111.03	468851	4.94	74.99	568288	5.91	74.83	637012	6.52	47.55
Southeastern Anatolia	249626	3.29	85.74	354236	4.53	77.91	429634	5.40	97.57	463717	5.73	61.83
Western Marmara	61780	1.95	6.22	86060	2.68	4.42	126179	3.89	7.53	172231	5.25	6.41
Eastern Marmara	352695	5.16	70.40	479385	6.90	58.02	537221	7.61	82.46	667688	4.83	55.96
Istanbul	229588	1.73	51.03	288304	2.11	39.02	323872	2.34	38.68	684477	4.83	49.70
<b>Total</b>	2964713	4.02	34.34	3972361	5.32	25.40	4830532	6.39	32.24	5829750	7.60	24.04

The numbers of dental imaging applications per dentist and per dental unit according to the grouping regarding unit numbers are given in Table 5 and Table 6, respectively.

**Table 5 Dental imaging numbers per dentist regarding grouping of unit numbers**

<b>REGIONS</b>	<b>Unit numbers</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>
Mediterranean	<40	1478.92	1952.47	2100.78	2391.35
	40-70	2521.80		2839.47	2981.86
	71-100	972.80	996.75	927.18	1012.29
	<b>Total</b>	<b>1483.30</b>	<b>1713.54</b>	<b>1899.72</b>	<b>2120.40</b>
Western Blacksea	<40	912.20	1485.52	1412.51	1536.86
	40-70	3831.60		4904.82	6181.17
	<b>Total</b>	<b>1204.14</b>	<b>1485.52</b>	<b>1761.74</b>	<b>2001.29</b>
Western Anatolia	40-70	3427.15	4412.45	5421.48	5967.82
	71-100	6827.07	7029.91	8319.67	10307.86
	<b>Total</b>	<b>5127.11</b>	<b>5721.18</b>	<b>6870.58</b>	<b>8137.84</b>
Northeastern Anatolia	<40	1015.45	987.92	1360.77	1641.32
	40-70	951.03	1232.73	1069.96	1013.35
	<b>Total</b>	<b>1006.25</b>	<b>1022.8896</b>	<b>1319.22</b>	<b>1551.61</b>
Southeastern Anatolia	<40	544.70	873.69	1371.01	1452.20
	40-70	1489.84	1855.95	2062.41	2177.76
	>100	1032.54	1329.17	1239.17	844.87
	<b>Total</b>	<b>1019.45</b>	<b>1298.97</b>	<b>1613.81</b>	<b>1648.37</b>
Aegean	<40	1685.09	2148.26	2759.19	3002.83
	40-70	918.86	1169.17	1382.89	1453.36
	71-100	813.50	715.14	729.69	809.40
	<b>Total</b>	<b>1384.58</b>	<b>1724.35</b>	<b>2161.43</b>	<b>2341.29</b>
Eastern Marmara	<40	1200.91	1365.50	1556.51	1718.13
	40-70	1416.73	1869.05	1625.32	2051.35
	>100	1220.26	1627.75	1641.86	1987.91
	<b>Total</b>	<b>1284.26</b>	<b>1587.11</b>	<b>1592.98</b>	<b>1876.81</b>
Western Marmara	<40	876.96	837.12	1202.01	1628.11
	<b>Total</b>	<b>876.96</b>	<b>837.12</b>	<b>1202.01</b>	<b>1628.11</b>
Eastern Blacksea	<40	1170.62	1244.43	1137.27	1115.89
	40-70	1202.99	1505.03	2208.85	1634.44
	<b>Total</b>	<b>1176.02</b>	<b>1287.86</b>	<b>1315.86</b>	<b>1202.31</b>
Istanbul	40-70		3916.95		
	71-100	3052.62		4246.52	8824.05
	<b>Total</b>	<b>3052.62</b>	<b>3916.95</b>	<b>4246.52</b>	<b>8824.05</b>
Mideastern Anatolia	<40	769.38	935.54	1068.14	906.31
	40-70	1136.02	1699.74	1538.41	1606.45
	<b>Total</b>	<b>906.87</b>	<b>1222.12</b>	<b>1244.49</b>	<b>1168.86</b>
Central Anatolia	<40	795.25	873.47	926.60	933.54
	40-70	103.00	1096.09	1248.36	1574.01
	<b>Total</b>	<b>908.62</b>	<b>984.78</b>	<b>1087.48</b>	<b>1253.77</b>
<b>Total</b>	<40	1054.03	1319.58	1498.60	1640.97
	40-70	1499.40	1792.85	1994.11	2224.40
	71-100	2527.76	2434.64	3030.05	4393.18
	>100	1126.40	1478.46	1440.52	1416.39
	<b>Total</b>	<b>1272.97</b>	<b>1496.12</b>	<b>1722.33</b>	<b>1961.23</b>

**Table 6 Dental imaging numbers per dental unit according to the grouping regarding unit numbers**

<b>REGIONS</b>	<b>Unit numbers</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>
Mediterranean	<40	1187.64	1743.23	2026.32	2404.57
	40-70	1703.78		2239.12	2168.63
	71-100	569.41	798.58	999.28	1104.12
	<b>Total</b>	<b>1097.60</b>	<b>1507.067</b>	<b>1796.16</b>	<b>2049.97</b>
Western Blacksea	<40	563.57	1030.68	1227.84	1309.27
	40-70	2216.93		4216.95	5653.51
	<b>Total</b>	<b>728.90</b>	<b>1030.68</b>	<b>1526.75</b>	<b>1743.70</b>
Western Anatolia	40-70	2356.17	3901.75	5299.13	5625.92
	71-100	5451.52	6099.05	7995.91	9661.31
	<b>Total</b>	<b>3903.84</b>	<b>5000.40</b>	<b>6647.52</b>	<b>7643.61</b>
Northeastern Anatolia	<40	862.17	1001.73	1255.43	1323.51
	40-70	584.29	1063.53	993.04	824.59
	<b>Total</b>	<b>822.48</b>	<b>1010.56</b>	<b>1217.95</b>	<b>1252.24</b>
Southeastern Anatolia	<40	137.56	376.61	802.22	1172.62
	40-70	1145.12	1654.52	1889.36	1832.93
	>100	500.96	605.45	655.47	712.41
	<b>Total</b>	<b>560.82</b>	<b>884.43</b>	<b>1191.55</b>	<b>1362.71</b>
Aegean	<40	1063.0540	1494.0599	2097.9582	2367.42
	40-70	673.5330	961.0355	1194.0727	1295.84
	71-100	698.0971	639.2955	660.5909	744.25
	<b>Total</b>	<b>920.0542</b>	<b>1253.9583</b>	<b>1692.3159</b>	<b>1896.63</b>
Eastern Marmara	<40	778.7672	1083.4279	1292.3496	1584.61
	40-70	1090.1127	1521.9825	1376.4519	1851.023
	>100	730.8839	1144.5089	1392.6518	1569.32
	<b>Total</b>	<b>889.5363</b>	<b>1255.5210</b>	<b>1336.4257</b>	<b>1682.61</b>
Western Marmara	<40	484.9347	731.9338	1061.8078	1485.62
	<b>Total</b>	<b>484.9347</b>	<b>731.9338</b>	<b>1061.8078</b>	<b>1485.62</b>
Eastern Blacksea	<40	859.4925	991.6686	878.6193	940.50
	40-70	1009.8293	1379.6098	1957.4390	1501.56
	<b>Total</b>	<b>884.55</b>	<b>1056.33</b>	<b>1058.42</b>	<b>1034.08</b>
Istanbul	40-70		4401.59		
	71-100	3130.75		4416.44	9333.78
	<b>Total</b>	<b>3130.75</b>	<b>4401.59</b>	<b>4416.44</b>	<b>9333.78</b>
Mideastern Anatolia	<40	417.43	544.40	638.81	686.43
	40-70	551.41	1124.26	1059.57	1328.81
	<b>Total</b>	<b>467.67</b>	<b>761.85</b>	<b>796.60</b>	<b>927.32</b>
Central Anatolia	<40	420.27	549.69	656.24	676.20
	40-70	699.18	891.03	1132.43	1351.64
	<b>Total</b>	<b>559.73</b>	<b>720.36</b>	<b>894.34</b>	<b>1013.92</b>
<b>Total</b>	<40	689.60	998.00	1216.51	1399.91
	40-70	1018.74	1533.42	1729.98	1940.54
	71-100	2083.84	2083.88	3014.30	4389.52
	>100	615.92	874.98	1024.06	1140.87
	<b>Total</b>	<b>861.48</b>	<b>1180.95</b>	<b>1458.48</b>	<b>1723.53</b>



## Discussion

In our study, all data of dental imaging applications performed in ODHCs and ODHHs between 2010 and 2013 revealed from the Public Hospitals Institution of Ministry of Health have been regarded for evaluation. The data include numbers for all dental imaging methods, because the institutions examined in this study report their total dental imaging numbers without any distinction.

Of the total population, 11.71, 20.93, 19.81, 31.63 and 31.15 % have been admitted to the institutions in question in years 2010, 2011, 2012, 2013 and 2014, respectively. This shows an increasing trend especially in years 2013 and 2014, which is valid both for the whole country and for the regions.

The Decree Law Concerning the Organization and Duties of the Ministry of Health numbered 663, published and came into force in 2011, Institution of Public Health which became functional together with the new formation afterwards and the structuring of General Secretary have altogether a great role in this picture. With the legislative decree numbered 663, the ministerial Turkish Institution of Public Health was established to open, run, evaluate and control hospitals, ODHCs and likewise health institutions, furthermore it was authorized to supervise the affiliated units to give preventive, diagnostic, restorative and rehabilitative health services in these hospitals in order to render secondary and tertiary health services.

The regions using the oral and dental health institutions in question most have been Western Anatolia, Western Blacksea together with Eastern and Western Marmara. This picture is in agreement with the reality that; factors like health service demand, presentation and transportability are much more developed in western regions. Istanbul, surprisingly, has the lowest rate of application regarding its population. This is an indicator of the oral and dental health structuring of that region in favor of private sector [22].

In our study, dental imaging numbers have increased from 2,964,713 in 2010 to 5,829,750 in 2013. This increase is parallel to the increase in population and service delivery within the scope of 'Health Transition Programme'. In a comprehensive study published lately, the number of dental imagings was reported as 3,121,037 in 2010, while it has doubled to 6,214,408 in 2014 [18].

When we look at the dental imaging numbers in comparison to the population; dental imaging numbers have apparently increased in all regions within the following years except for Eastern Marmara in 2013 and Eastern Blacksea in 2012

and 2013. Even when population increase is eliminated, this increase seems still remarkable.

Western Anatolia, Eastern Blacksea and Northeastern Anatolia are the leaders for 2010 and 2011. In 2012 and 2013; Western Anatolia and Western Blacksea, Northeastern and Central Anatolia are prominent for radiologic imaging numbers. Western and Northeastern Anatolia have kept their leadership in all years. In addition, Eastern Blacksea also stands out for 2012 and 2013. In this regard, Istanbul has been in the last place for all years evaluated. When we generally look at the regions with the highest numbers of dental imaging performances, we see that these overlap with regions having the highest admission numbers.

In our study, dental imaging numbers per dental unit have increased within years except for the decrease in Eastern Blacksea in 2013. Western Anatolia and Istanbul have been the leaders each year in this regard. In other words, Istanbul has been the leader regarding dental imaging numbers per dental unit and dentist for all years considered, while it has brought up the rear considering admission rates and dental imaging numbers per capita. This situation reveals the notable fewness of dentist and dental unit numbers in ODHCs/ODHHs in Istanbul compared to other regions.

When evaluated within Western Anatolia Region, Istanbul is naturally among the leaders regarding admission and imaging numbers per capita as well as imaging numbers per unit or dentist.

ODHCs /ODHHs with 71-100 dental units come in the first order regarding imaging numbers per unit and dentist, followed by the group with 40-70 units.

In our study, dental imaging numbers per dentist have always been higher than dental imaging numbers per unit. This is an indicator of the fewer dentist numbers than dental unit numbers.

## Conclusions

Oral and dental health is essential for continuity of general health [9, 20]. In developing countries, the inability of bringing preventive programs into action and also the inability of bringing the level of oral and dental health services to the desired level of delivery, demand and accessibility delays the progression of oral and dental indicators. The effective planning and actual high level implementation of these preventive health services are key to success in developed countries [5, 22].

As a healthy and strong basis for the planning stage in our country, current condition should be evaluated thoroughly and then, together with the increase in the level of consciousness, the number of institutions, personnel numbers, services should be revised and increased on demand in order to minimize interregional inequalities.

Using widely accepted current technical facilities for diagnosis and therapy in oral and dental health services with maintained accessibility for everyone, are the goals of health suppliers and the rights for citizens.

We think that future researches with larger perspectives, including private sector, university and public hospitals and focused on the qualitative and quantitative analyses of radiology technicians and devices are needed. In that way, a thorough view will appear by "completing the missing parts of the puzzle".

## Declarations

## Abbreviations:

**ODHC(s):** Oral and Dental Health Center(s)    **ODHH(s):** Oral and Dental Health Center(s)

**CBCT:** Cone Beam Computed Tomography

**NUTS-1:** Nomenclature of Territorial Units for Statistics-1

**Ethics approval:** The permission to use the aforementioned national database was provided by the Public Health Institution, Ministry of Health, Republic of Turkey and the mandatory research ethics committee approval was received from the Ethics Committee of Yıldırım Beyazıt University (Date: 28<sup>th</sup> August, 2015, number 107- 04/18).

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## Authors' contributions

KÖD, DÖ, GBG, YÜ, MU initiated the study conception and designed the study. SK assisted with the study design and data analysis. GBG drafted the manuscript. All authors contributed to the revision and final approval of the manuscript.

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