

## Original Article

# Burden of Oral Diseases in Iran, 1990–2010: findings from the Global Burden of Disease Study 2010

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## Abstract

**Background:** Oral diseases, as a group of chronic diseases, are among the major public health problems that lead to disability throughout the world. The major part of burden of oral diseases is caused by dental caries, periodontal diseases, edentulism, mouth cancer, cleft lip, and cleft palate. The aim of the present paper is to report the global results for the burden of oral disease in Iran from 1990 to 2010, derived from the Global Burden of Disease study 2010 (the GBD study 2010) by sex and age.

**Methods:** The Global Burden of Disease Study 2010 was a systematic effort with a common framework to estimate disability adjusted life years (DALYs) for diseases in different parts of the world. Years of life lost due to premature mortality (YLLs) were assessed based on cause-of-death estimates and by means of a cause of death ensemble model (CODEm). Years of life lost due to disability (YLDs) were computed by multiplying the prevalence, the disability weight for a sequel, and the duration of symptoms. A systematic review of published and unpublished data was conducted to estimate disease distribution using a Bayesian meta-regression method (DisMod-MR). Disability weights were measured by collecting data from population-based surveys. Uncertainty interval (UI) from all inputs into the calculations of DALYs was disseminated using Monte Carlo simulation techniques. In this paper, we describe the results of the GBD study 2010 regarding oral diseases in Iran, critique the results, and provide some recommendations.

**Results:** Between 1990 and 2010 in Iran, an increase occurred in DALYs at all ages, attributed to dental caries (from 37,230 to 56,521) as well as periodontal diseases (from 21,482 to 43,308), and a decrease was found for edentulism (from 53,134 to 47,960). DALYs at all ages attributed to mouth cancer increased (from 5,597 to 7,771), while a decline was noted for cleft lip and cleft palate (from 6,157 to 5,034). The age-standardized DALY rates per 100,000 population did not considerably change for dental caries and periodontal diseases, while edentulism showed a reduction. The corresponding DALY rate due to mouth cancer decreased, while it remained almost unchanged for cleft lip and cleft palate over this period. DALY rates per 100,000 population due to dental caries and edentulism were higher among Iranian women than for Iranian men at all ages, while Iranian men suffered from a higher burden of periodontal disease, mouth cancer, cleft lip, and cleft palate. The most significant burden due to dental caries and periodontal diseases was found in Iranians aged 15–49 and 50–69 years, respectively and edentulism and mouth cancer led to the highest burden in Iranians older than 70 years of age. The highest burden caused by cleft lip and cleft palate occurred in children younger than 5 years old.

**Conclusion:** The findings address the challenging changes in oral diseases and difficulties in responding to the urgent oral health needs in Iran. The burden of oral diseases should be considered as a priority in Iran. A need also exists to pay more attention to the oral health policies and principles of preventive oral care. Global analyses of disease burdens provide a useful framework to guide a suitable policy in response to disease changes. In fact, strong national and sub-national analyses will be required to provide more effective public health strategies.

**Keywords:** Global Burden of Disease, Iran, Oral disease

**Cite this article as:** Shoaee S, Ghasemian A, Mehrabani K, Naderimaghani S, Hessari H, Delavari F, et al. Burden of oral diseases in Iran 1990–2010: findings from the Global Burden of Disease Study 2010. *Arch Iran Med.* 2015; 18(8): 486 – 492.

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Accepted for publication: 22 July 2015

## Introduction

Oral health is defined as the health of the entire orofacial complex and covers more than just the health of teeth.<sup>1</sup> According to the definition by the World Health Organization (WHO), oral diseases are considered a group of chronic diseases.<sup>2</sup> Given the extent of oral diseases, these are major public health problems leading to disability in all parts of the world. The pain, suffering, impairment of functions such as eating, chewing, smiling, communication, and the reduced quality of life mean that the impact of oral diseases on individuals and communities is considerable. Moreover, oral diseases restrict activities at school, work, and home and incur millions of lost work hours each year worldwide.<sup>3</sup>

A number of oral diseases are associated with non-communicable chronic diseases mainly due to their common risk factors.

In addition, general diseases such as diabetes or HIV/AIDS often have oral manifestations. The relationship between periodontal diseases or tooth loss, and increased risk of cardiovascular disease, pulmonary disease, diabetes, poor pregnancy outcome, and all-cause mortality have become an active issue of discussion in the current scientific literature.<sup>4</sup>

Dental caries, periodontal diseases, and edentulism are the most prevalent oral diseases. Since dental caries affect nearly 100% of the population in the majority of countries, globally, the prevalence is high among adults.<sup>3</sup> Dental caries affect 60–90% of schoolchildren and adults in the Eastern Mediterranean Region (EMR).<sup>5</sup> In 2002, 82% of all 18-year-old Iranians experienced dental caries,<sup>6</sup> and 2% of all 35–44 year-old Iranians had DMFT = 0.<sup>7</sup> An estimated 5% to 20% of adults suffer from severe generalized periodontitis worldwide, and moderate generalized periodontitis affects a majority of adults.<sup>5,8</sup> According to the WHO data, the prevalence of periodontal diseases remains high in developing countries.<sup>9</sup> In 2002, 20% of 18-year-old Iranians had shallow pockets and 1% had deep pockets.<sup>6</sup> In addition, 43% of 35–44-year-old Iranians had shallow pockets and 10% had deep pockets.<sup>7</sup> The burden of complete tooth loss is highlighted in the recent World Health Survey (WHS).<sup>10,11</sup> While research on missing teeth has been conducted in EMR countries; in general, data from this region are scarce.<sup>12</sup> In 2002, 70% of 18-year-old Iranians retained all their teeth,<sup>6</sup> 10% of 35–44 year old people had all their teeth, 36% had 25–28 teeth, and 3% were edentulous.<sup>7,13</sup>

Mouth cancer is a serious and growing problem and cleft lip and palate (CLP) is one of the most common congenital anomalies; both are life-threatening oral diseases that may cause death and disability. Oral and pharyngeal cancer together are the sixth most common cancer in the world.<sup>14</sup> In developing countries, oral cavity cancer is estimated to be the third most common malignancy.<sup>15</sup> Oro-pharyngeal cancers accounted for 3% of all cancers in Iran in 2003.<sup>16</sup> A national survey from 1995 to 2004 has indicated that mortality rates for oral cavity cancer were 0.09, 0.59, and 0.30 per 100000 in 1995, 2002, and 2004, respectively.<sup>17</sup> The reported prevalence of CLP varies from 0.19 to 2.69 per 1000 births in different parts of the world.<sup>18</sup> The incidence rate of CLP varies from 1500 to 12000 live births, depend on the population. In general, native American and Asian populations have the highest incidence. Caucasians are placed in the middle and Africans have the lowest incidence.<sup>19–21</sup> Different studies in Iran reported various incidences of these defects, ranging from 0.77 to 3.37 per 1000 live births during 1990–2007.<sup>22,23</sup>

Summary measurements of distribution of injuries and diseases burden and their risk factors provide a unique perspective for planning interventions and developing public health policies.<sup>24,25</sup> To date, the Global Burden of Disease Study 2010 (the GBD study 2010) is the only comprehensive effort to estimate summary measurements of population health worldwide. The study produced systematic comparable estimates of burden of diseases, injuries, and their sequelae from 1990 to 2010.<sup>26</sup> The aim of the present paper is to report the global assessment of the burden of dental caries, periodontal diseases, edentulism, mouth cancer, cleft lip, and cleft palate by sex and age from 1990 to 2010 for Iran using the results of the GBD Study 2010. The data, methods, and limitations of the study will be discussed.

## Materials and Methods

The GBD Study 2010 was a systematic effort that used a unique method to provide a dataset and consequently, to estimate disability adjusted life years (DALYs) for diseases and injuries in different regions of the world.<sup>26–33</sup> Further details about the data and the methods used for specific diseases such as oral diseases are available elsewhere.<sup>34</sup> The three oral diseases including dental caries, periodontal diseases, and edentulism rarely have death as a direct result; therefore, DALY estimates were only based on YLDs. For mouth cancer, cleft lip, and cleft palate, DALYs were based on YLLs and YLDs.

YLLs were assessed based on cause-of-death estimates, developed by databases of vital registration, verbal autopsy, and surveillance data. The cause of death ensemble model (CODEm) was used to develop ensembles of the best performance models.<sup>26</sup> The final uncertainty for YLLs was estimated by computing values for the cause-of-death assessments by standard simulation analysis.<sup>35</sup>

YLDs were calculated by multiplication of prevalence (frequency), the disability weight for a sequel (severity), and the duration of symptoms. Disease distribution was estimated by conducting a systematic review of published and unpublished data in order to investigate the prevalence, incidence, remission, and excess mortality. Prevalence estimates were assessed using the database for all age-sex-country-year groups, with a Bayesian meta-regression method (DisMod-MR). In managing data reported for any age interval, the meta-regression used two types of covariates: those explaining true variation in prevalence and those explaining variation across studies. Where appropriate, DisMod-MR used data on incidence, prevalence, remission, excess mortality and cause-specific mortality to generate prevalence estimates, assuming these rates were constant over time. Uncertainty distribution for the prevalence of each disease by age, sex, country, and year was also calculated by DisMod-MR.<sup>26</sup>

Disability weights were generated using collected data based on population-based surveys in five countries and an open internet survey. The details are provided elsewhere for the methods of pair-wise comparisons analysis to produce disability weights.<sup>30</sup> Uncertainty in the disability weight for each disease and injury was propagated into the estimates of YLDs. Uncertainty from all inputs into the calculations of DALYs was disseminated using Monte Carlo simulation techniques, with 1,000 draws taken for each age, sex, country, year, and cause.<sup>26</sup> The entire measures have been reported with a 95% Uncertainty Interval (UI). With our knowledge of the GBD study methods for collecting the data, we decided to extract an estimation about the oral diseases in Iran to prepare a comprehensive view and finally, discuss its limitations.

## Results

The present paper reports deaths or disease burden caused by oral diseases including dental caries, periodontal diseases, edentulism, mouth cancer, cleft lip, and cleft palate between 1990 and 2010 for Iran.

Over the study period, a 52% increase occurred for DALYs at all ages, caused by dental caries (from 37,230 [95% UI: 14,707–75,480] to 56,521 [95% UI: 22,114–118,157]) as well as a 102% increase in periodontal diseases (from 21,482 [95% UI: 5,324–55,735] to 43,308 [95% UI: 11,758–113,505]). However, a 10% decline was seen in the number for edentulism (from 53,134 [95% UI: 31,109–84,185] to 47,960 [95% UI: 27,595–77,864]). The number of deaths at all ages due to mouth cancer increased

from 190 (95% UI: 144–243) to 298 (95% UI: 242–371), and an increase in the DALYs also occurred for all ages from 5,597 (95% UI: 4,024–7,637) to 7,771 (95% UI: 6,197–9,594). However, a decline was observed in the number of deaths at all ages caused by cleft lip and cleft palate from 26 (95% UI: 14–41) to 10 (95% UI: 4–21), and in DALYs at all ages from 6,157 (95% UI: 4,454–8,311) to 5,034 (95% UI: 3,521–6,825).

The age-standardized DALY rates per 100,000 population from 1990 to 2010 did not noticeably change for dental caries (from 72.2 to 72.8) and periodontal diseases (from 68.6 to 67.6); in contrast, a decline was seen in edentulism (from 201.3 to 90.3). The age-standardized DALY rates caused by mouth cancer declined (from 18.3 to 13.2), but remained almost unchanged (from 7.2 to 6.7) for cleft lip and cleft palate. During the two decades, DALY rates per 100,000 population for all ages showed upward trends for dental caries and periodontal diseases, whereas the corresponding rates for edentulism had a downward trend for both sexes. There was a fluctuation in deaths and DALY rates due to mouth cancer for all ages, and the rates decreased persistently for cleft lip and cleft palate (Figure 1).

Estimates of DALY rates per 100,000 population attributed to dental caries, periodontal diseases, edentulism, mouth cancer, cleft lip and palate by sex and different age groups from 1990 to 2010 are presented in Table 1. DALY rates for all ages due to dental caries and edentulism were higher for women than for men. However, males had higher rates of DALYs due to periodontal diseases, mouth cancer, cleft lip, and cleft palate. Those aged 15–49 years, 50–69 years, and 70+ years, respectively, had the highest burden attributed to dental caries, periodontal diseases, and edentulism in both sexes in Iran. The greatest burden of mouth cancer was observed among Iranians older than 70 years of age, and the greatest burden of cleft lip and cleft palate was found among children under 5 years of age. Figure 2 illustrates age trends of DALY rates per 100,000 population caused by dental caries, periodontal diseases, edentulism, mouth cancer, cleft lip, and cleft palate among males and females at five-year age intervals from 1990 to 2010.

Overall, three oral diseases including dental caries, periodontal diseases and edentulism contributed to 0.5% (95% UI: 0.3%–0.9%) and 0.8% (95% UI: 0.4%–1.3%) of the total DALYs in 1990 and 2010, respectively. The percentages of total DALYs for mouth cancer, cleft lip, and cleft palate were 0.03% (95% UI: 0.02%–0.04%) in 1990, while in 2010 it was 0.04% (95% UI: 0.03%–0.05%) for mouth cancer and 0.03% (95% UI: 0.02%–0.04%) for cleft lip and cleft palate.

## Discussion

The data of the GBD Study 2010 for Iran indicate that DALYs for all ages attributed to dental caries and periodontal diseases increased by 52% and 102%, respectively. However, the DALYs of edentulism decreased by 10% between 1990 and 2010. In addition, DALY rates per 100,000 population due to dental caries and periodontal diseases increased for all ages, but declined for edentulism. In 2010, compared with 1990, adults retained more teeth at older ages and the proportion of edentulous adults fell markedly in Iran.<sup>36</sup> This condition resulted in a greater burden of dental caries and periodontal diseases in 2010. Moreover, during the past years, the oral health system in Iran underwent substantial changes. The number of dentists and dental schools have increased and

provision of dental services has improved. However, preventive services have been ignored, which has led to an increased number of untreated dental and periodontal diseases.

During the past two decades, deaths and DALYs caused by mouth cancer increased at all ages, but they decreased for cleft lip and cleft palate. Furthermore, deaths and DALY rates per 100,000 population at all ages for mouth cancer fluctuated and a reduction was observed in the rates due to cleft lip and cleft palate. The changes in the death and burden attributed to mouth cancer could be due to the establishment of a death registration system in Iran by the National Organization for Civil Registration (NOCR) of the Ministry of Health and Medical Education (MOHME) in 1995.<sup>37</sup> Moreover, in 1993, the Cancer Institute initiated a cancer registry program to assist public health authorities in different regions of Iran to establish regional population-based cancer registries.<sup>38</sup> A substantial proportion of the burden of mouth cancer could be decreased by the application of cancer control knowledge, and implementing programs for tobacco control<sup>39</sup> as well as early detection and treatment. The reduction in death and burden of cleft lip and cleft palate could arise from any of the following: more genetic counseling, fewer unwanted pregnancies, improvement of mother and baby care, the awareness about risk factors during pregnancy such as smoking, alcohol and medications use and finally, increasing the number of protected deliveries.<sup>18</sup>

Iranian women lived more years with disability attributed to dental caries and edentulism than men, whereas the disability-adjusted life years caused by periodontal diseases, mouth cancer, cleft lip and cleft palate were greater among Iranian men. Except for cleft lip and cleft palate anomalies that were life threatening only in the early years of life, the burden of the other four diseases increased until old ages, that the burden of dental caries and periodontal diseases decreased due to a reduction in number of teeth, while the burden of mouth cancer reached its maximum level in the oldest ages. Based on the global facts on oral health, a majority of adults have dental caries that often lead to pain and discomfort.<sup>40</sup> Moreover, factors associated with aging can also increase the risk of dental caries.<sup>41</sup> Periodontal disease is a common oral chronic inflammatory disease often found in adults through the world. Net tissue destruction (e.g., bone loss) due to periodontal disease is also cumulative with age.<sup>42</sup> Complete loss of natural teeth is widespread, and particularly affects older people globally. Furthermore, oral cancer causes more deaths and disabilities among elderly.<sup>40</sup> However, birth defects such as cleft lip and palate lead to significant infant mortality and childhood morbidity around the world.<sup>40</sup> We believe that the same facts, as reported worldwide, are true for Iran.

The present study has many of the same important limitations seen in the GBD study 2010.<sup>26–33</sup> Oral diseases estimations for Iran were affected by the non-use of data sources showing the importance of establishing an oral health surveillance system. Different comprehensive nationally representative sources of oral health data in Iran have been ignored in the GBD estimations on the burden of oral diseases, including population-based epidemiological studies, national registration systems (death and cancer) as well as national and sub-national health surveys such as national oral health surveys (NOHS) and national health surveys (NHS). Because of the data gaps for some countries like Iran, the GBD estimation via this approach is one of the important limitations of the study. The lack of access to data sources for assessing oral diseases in Iran may have imposed a significant limitation in

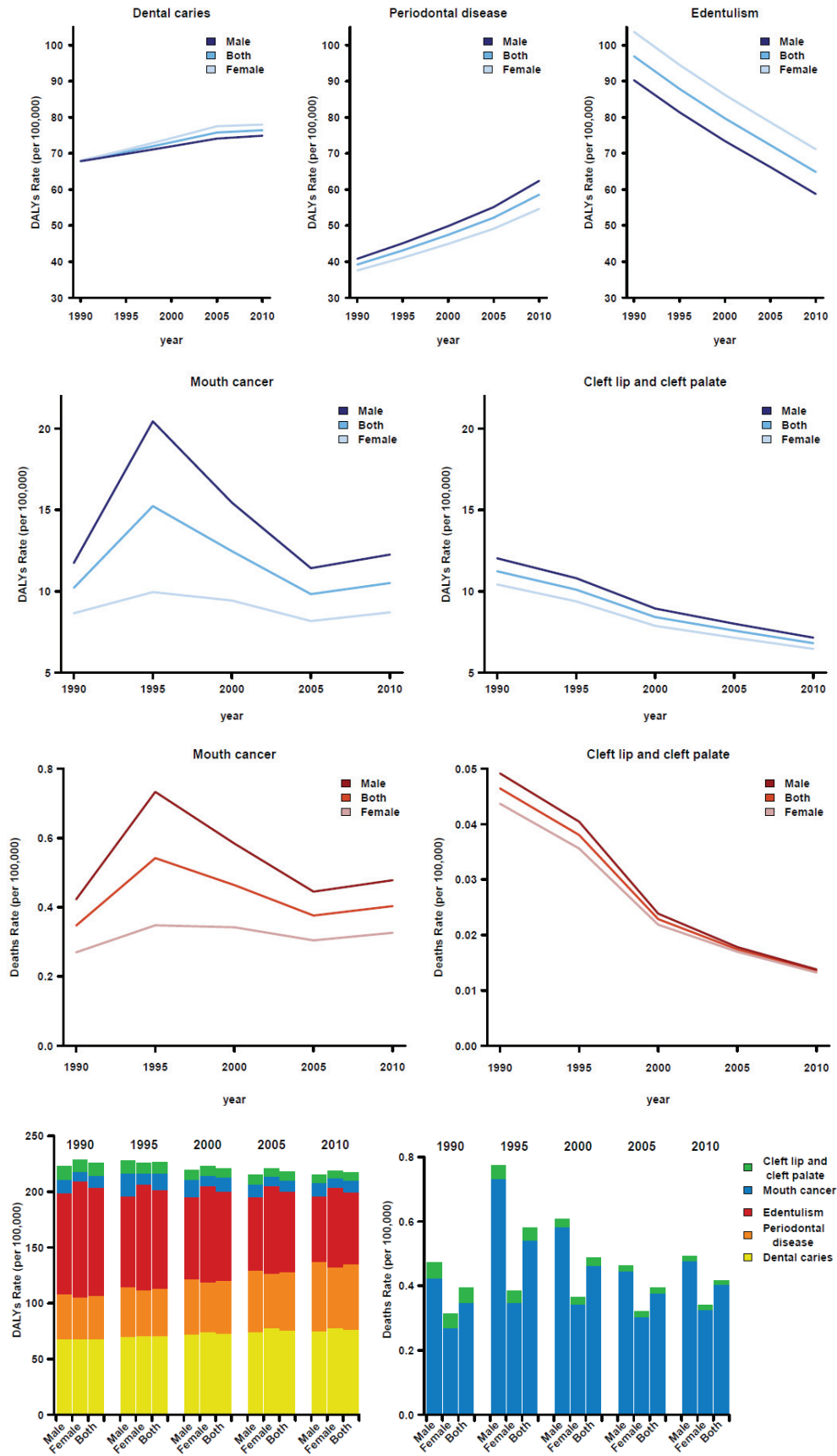
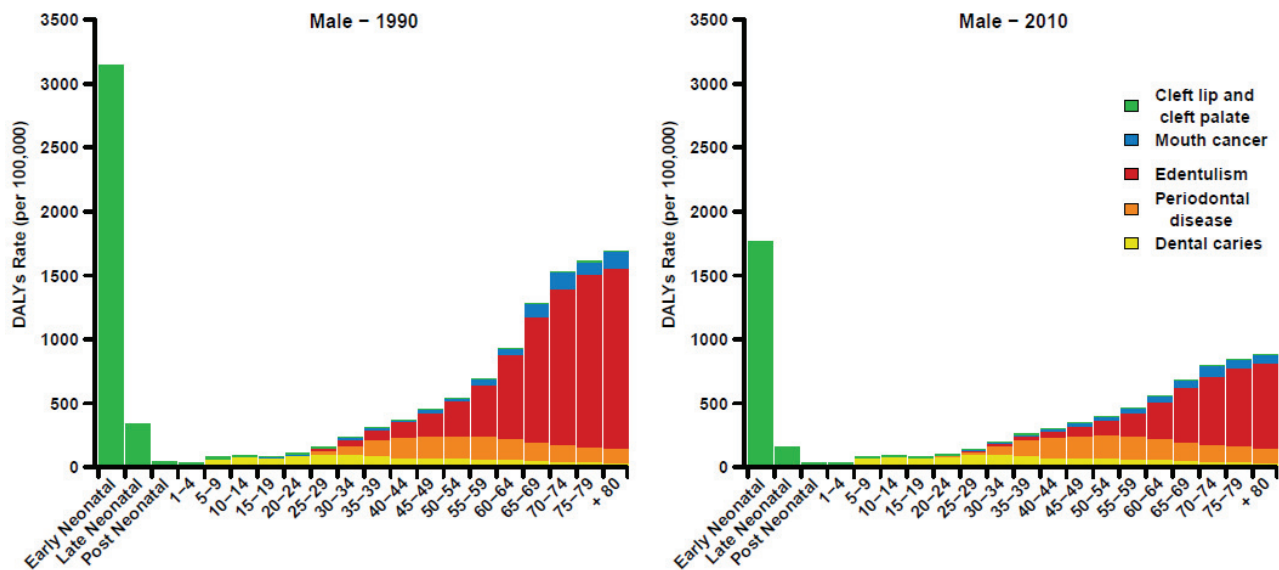


Figure 1. Time trends of DALYs rates (per 100000 population) attributed to dental caries, periodontal diseases, edentulism, and deaths and DALYs rates (per 100000) attributed to mouth cancer, and cleft lip and cleft palate from 1990 to 2010 in Iran.

**Table 1.** DALYs Rates (per 100000) attributed to mouth cancer, cleft lip and cleft palate, dental caries, periodontal diseases and edentulism, by sex and age from 1990 to 2010 in Iran.

		Men				
Year	1990	1995	2000	2005	2010	
<b>Mouth cancer</b>	<b>DALYs</b>	<b>DALYs</b>	<b>DALYs</b>	<b>DALYs</b>	<b>DALYs</b>	
15–49 years	11.9 (7.0–19.8)	18.2 (7.4–28.4)	11.3 (7.3–14.9)	7.5 (5.8–10.0)	7.8 (5.2–11.3)	
50–69 years	48.4 (33.8–68.6)	99.3 (43.8–140.3)	72.6 (43.6–91.2)	43.3 (35.1–56.1)	40.8 (28.8–57.4)	
70+ years	122.7 (79.3–184.2)	150.6 (83.4–226.4)	111.3 (82.2–142.4)	76.3 (61.4–106.5)	73.1 (51.2–106.1)	
All Ages	11.7 (8.7–15.6)	20.5 (9.4–27.4)	15.5 (10.3–18.4)	11.4 (9.8–14.5)	12.3 (9.5–15.7)	
<b>Cleft lip and Cleft palate</b>						
5–14 years	11.7 (6.6–18.3)	11.6 (6.6–18.2)	11.6 (6.6–18.2)	11.5 (6.7–17.7)	11.6 (6.7–17.9)	
15–49 years	4.0 (2.3–6.2)	4.4 (2.5–6.6)	4.7 (2.6–7.2)	5.0 (3.0–7.6)	4.7 (2.9–7.1)	
50–69 years	0.8 (0.3–1.5)	0.9 (0.4–1.7)	1.0 (0.4–1.8)	1.1 (0.4–2.0)	1.1 (0.4–2.1)	
70+ years	0.7 (0.3–1.4)	0.7 (0.3–1.5)	0.8 (0.3–1.6)	0.9 (0.4–1.7)	0.9 (0.4–1.7)	
Under 5	40.2 (24.3–63.6)	41.0 (21.2–74.5)	35.1 (17.5–63.1)	32.3 (15.8–58.7)	28.6 (14.5–51.5)	
All Ages	12.0 (8.2–17.5)	10.8 (6.9–16.2)	8.9 (5.7–12.8)	8.0 (5.3–11.5)	7.1 (4.7–10.3)	
<b>Dental caries</b>						
5–14 years	73.4 (28.3–151.5)	73.9 (28.5–152.6)	74.5 (28.7–153.7)	75.0 (28.3–157.3)	73.9 (28.2–153.6)	
15–49 years	86.6 (31.9–182.9)	86.2 (31.8–182.1)	85.8 (31.6–181.3)	85.4 (31.5–184.1)	86.8 (31.2–187.9)	
50–69 years	65.2 (24.1–138.0)	65.0 (24.0–137.7)	64.9 (24.0–137.4)	64.8 (24.1–142.3)	65.8 (23.7–143.4)	
70+ years	44.4 (16.8–92.0)	44.0 (16.6–91.1)	43.5 (16.4–90.2)	43.1 (15.9–93.5)	42.5 (15.3–91.0)	
Under 5	14.8 (4.9–31.8)	15.1 (5.0–32.4)	15.4 (5.1–33.0)	15.7 (5.3–33.8)	15.7 (5.4–33.0)	
All Ages	67.8 (25.8–140.3)	69.9 (26.5–144.5)	72.0 (27.3–148.8)	74.1 (28.0–157.2)	74.9 (27.7–159.9)	
<b>Periodontal diseases</b>						
15–49 years	54.3 (10.7–165.3)	55.2 (10.9–168.2)	56.2 (11.1–171.1)	57.1 (11.4–184.3)	61.9 (12.4–196.9)	
50–69 years	166.4 (32.5–508.6)	167.4 (32.7–511.4)	168.3 (32.9–514.3)	169.2 (35.3–542.6)	170.6 (33.3–532.3)	
70+ years	122.4 (24.5–369.3)	122.5 (24.5–369.5)	122.5 (24.5–369.7)	122.6 (25.5–386.5)	122.0 (24.6–369.5)	
All Ages	40.8 (8.0–124.0)	45.1 (8.9–137.1)	49.9 (9.8–151.6)	55.1 (11.3–180.8)	62.4 (12.6–198.6)	
<b>Edentulism</b>						
15–49 years	41.5 (23.3–66.2)	34.0 (19.1–54.3)	27.9 (15.7–44.5)	22.9 (13.1–36.3)	20.0 (11.0–32.2)	
50–69 years	536.9 (308.3–884.9)	429.2 (246.4–707.4)	343.1 (197.0–565.5)	274.3 (156.5–439.1)	209.5 (119.4–343.1)	
70+ years	1290.1 (744.8–2041.8)	1066.9 (615.9–1688.4)	882.2 (509.3–1396.2)	729.5 (418.3–1155.0)	598.2 (339.1–963.3)	
All Ages	90.3 (51.8–143.9)	81.4 (46.7–129.7)	73.4 (42.1–117.0)	66.2 (38.1–104.6)	58.7 (33.3–96.5)	
		Women				
Year	1990	1995	2000	2005	2010	
<b>Mouth cancer</b>	<b>DALYs</b>	<b>DALYs</b>	<b>DALYs</b>	<b>DALYs</b>	<b>DALYs</b>	
15–49 years	9.1 (3.9–19.6)	9.0 (4.3–16.3)	7.5 (4.6–11.3)	5.8 (4.0–8.2)	6.0 (3.3–10.7)	
50–69 years	45.1 (26.3–70.6)	51.0 (26.8–84.1)	43.1 (26.5–60.5)	31.1 (22.5–45.5)	28.9 (18.4–44.4)	
70+ years	33.5 (15.6–62.4)	60.8 (31.1–108.0)	58.1 (32.7–85.3)	47.8 (30.4–64.0)	45.3 (28.2–67.0)	
All Ages	8.6 (4.8–14.1)	9.9 (5.3–15.4)	9.4 (6.0–12.6)	8.2 (6.0–10.6)	8.7 (5.8–12.8)	
<b>Cleft lip and Cleft palate</b>						
5–14 years	9.8 (5.4–15.9)	9.7 (5.4–15.7)	9.6 (5.3–15.5)	9.5 (5.3–15.3)	9.7 (5.4–15.6)	
15–49 years	4.1 (2.4–6.3)	4.3 (2.5–6.7)	4.6 (2.7–7.1)	4.8 (2.8–7.4)	4.6 (2.7–6.9)	
50–69 years	0.7 (0.3–1.4)	0.8 (0.3–1.6)	0.9 (0.4–1.8)	1.1 (0.4–2.0)	1.1 (0.4–1.9)	
70+ years	0.5 (0.2–1.1)	0.6 (0.2–1.2)	0.6 (0.2–1.3)	0.7 (0.3–1.4)	0.7 (0.3–1.3)	
Under 5	34.9 (21.0–55.0)	35.4 (18.9–64.4)	30.9 (15.8–57.0)	28.5 (14.7–52.8)	25.1 (14.2–45.2)	
All Ages	10.4 (7.1–14.9)	9.4 (6.1–14.0)	7.9 (5.1–11.4)	7.1 (4.7–10.4)	6.5 (4.1–9.3)	
<b>Dental caries</b>						
5–14 years	69.3 (26.9–146.7)	70.8 (27.5–149.9)	72.4 (28.1–153.2)	74.0 (27.6–153.4)	72.0 (28.1–151.9)	
15–49 years	88.9 (33.4–187.7)	89.5 (33.7–189.0)	90.1 (33.9–190.4)	90.8 (32.9–190.7)	91.6 (33.5–199.1)	
50–69 years	66.3 (25.7–136.6)	66.8 (25.9–137.6)	67.2 (26.1–138.5)	67.7 (25.4–139.1)	68.3 (25.2–146.3)	
70+ years	45.1 (17.1–94.8)	45.1 (17.2–95.0)	45.2 (17.2–95.1)	45.3 (17.0–92.6)	44.9 (16.7–95.5)	
Under 5	12.6 (4.2–27.9)	13.0 (4.4–28.8)	13.4 (4.5–29.7)	13.8 (4.7–29.2)	13.8 (4.7–30.7)	
All Ages	68.0 (26.2–140.8)	71.0 (27.4–147.1)	74.2 (28.6–153.7)	77.5 (29.0–157.3)	78.0 (29.0–165.8)	
<b>Periodontal diseases</b>						
15–49 years	49.9 (9.4–159.7)	50.2 (9.4–160.6)	50.5 (9.5–161.4)	50.8 (10.5–153.5)	54.0 (10.6–156.3)	
50–69 years	151.1 (28.6–478.3)	150.5 (28.5–476.4)	149.9 (28.4–474.4)	149.3 (30.7–459.2)	146.7 (28.9–435.0)	
70+ years	111.1 (20.7–338.8)	110.3 (20.5–336.4)	109.5 (20.4–334.0)	108.8 (22.0–339.3)	106.7 (21.7–306.9)	
All Ages	37.6 (7.1–119.8)	41.1 (7.8–131.0)	44.9 (8.5–143.3)	49.1 (10.2–150.0)	54.6 (11.0–159.2)	
<b>Edentulism</b>						
15–49 years	50.3 (28.6–80.3)	41.3 (23.5–66.0)	34.0 (19.4–54.3)	28.0 (16.2–45.9)	24.6 (13.8–39.4)	
50–69 years	622.8 (350.0–997.1)	505.4 (284.0–809.1)	410.0 (230.4–656.5)	332.7 (194.3–526.2)	258.8 (145.3–415.1)	
70+ years	1517.8 (862.0–2405.1)	1274.1 (723.6–2019.0)	1069.5 (607.4–1694.8)	897.8 (518.8–1413.7)	733.5 (418.3–1193.4)	
All Ages	103.7 (59.8–163.8)	94.6 (54.5–149.4)	86.2 (49.7–136.2)	78.6 (45.8–124.7)	71.1 (40.1–115.6)	



**Figure 2.** Trends of DALYs rates (per 100000 population) attributed to dental caries, periodontal diseases, edentulism, mouth cancer, and cleft lip and cleft palate, for male and female by age-group in 1990 and 2010 for Iran.

achieving precise and accurate estimates, and could have caused large and wide uncertainties. As a result, the findings cannot be directly used for public health programs and health policy measures in Iran. In addition, the GBD estimations are model-driven, while data-driven studies are more practical for policymaking. The GBD study results are at a national level, but sub-national studies are still needed on the burden of disease, injuries, and risk factors, for appropriate policymaking and allocating resources in every country.

These limitations of the GBD study 2010 and the need for assessing the burden of disease, injuries and risk factors at the sub-national level have prompted a study namely the National and Sub-national Burden of Disease (NASBOD) in Iran. It is a systematic and comprehensive study that uses a standardized protocol of data gathering, data cleaning, and modeling to calculate the burden of disease, injuries, and risk factors at both national and sub-national levels from 1990 to 2013.<sup>43</sup> NASBOD benefits from two advanced statistical methods whose detailed specifications are explained elsewhere.<sup>44,45</sup> It provides comprehensive information for estimating the health status over time in a province or across provinces, and would be a valuable source for determining the national and sub-national health priorities in Iran.

Many national interventions in health system of Iran address health problems of some sub-national geographic areas.<sup>46</sup> Provision of detailed distributions of diseases and risk factors at all sub-national areas could guide health authorities in selection of appropriate public health interventions addressing main health problems among sub-national populations with a rational resource allocation, and in the design of more efficient public health programs. In this regard, the aim of the national and sub-national burden of oral diseases (BOD) study—a sub-component of the NASBOD study—is to calculate the prevalence, burden and inequalities of oral diseases at national and sub-national levels between 1990 and 2013.<sup>47</sup> The findings could be used as a base for the comparison of national and sub-national estimates with those of global assessments, and could provide effective strategies for public health priorities and policies in different parts of Iran.

In conclusion, the results of the GBD Study 2010 for Iran show that from 1990 to 2010, the burden of dental caries and periodontal diseases increased, while the burden for edentulism, cleft lip, and cleft palate decreased. A fluctuation was noted for mouth cancer with no considerable change in 2010 compared with 1990. Given the improvement of the oral health system in Iran, remarkable progress has been made in oral health over the past few decades to reduce the oral diseases in Iran, but many oral public health activities have not been conducted yet. Therefore, the burden of oral diseases should become a priority in Iran. In this regard, oral health care investment should be devoted for urgent needs and for oral health education and promotion. Overall, more emphasis should be placed on oral health policies and the principles of preventive oral care in Iran.

## Acknowledgments

*We would like to thank the Institute for Health Metric and Evaluation (IHME) team for providing the results of the GBD study 2010. We also thank the Ministry of Health and Medical Education of Islamic Republic of Iran, and Setad-e-Ejraie Farmane Imam for their kind helps and supports.*

## Competing interest

The authors declare that they have no competing interests.

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