Regional caries data availability in Saudi Arabia: Impact of socioeconomic factors and research potential

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Abstract Background and aims: Monitoring oral diseases is needed to allocate resources, plan health services and train dental workforce. Caries is one of the oral diseases most commonly included in oral health surveillance systems. The present study assessed (1) caries data availability in the administrative regions of Saudi Arabia and (2) factors associated with this availability.

Methods: We collected caries data in the period 2008–2018 in Saudi Arabia (outcome variable). The explanatory variables included region-level factors: (a) socio-economic indicators (percentage of individuals with university education, percentage of category A governorates, percentage of owned houses, households with computers, internet and smart phones) and, (b) oral health research potential indicators (number of Dental Public Health (DPH) specialists, Ministry of Health (MoH) dentist to population ratio and number of dental schools). ArcGIS was used for data visualization and logistic regression was used for analysis.

Results: Twenty-two studies provided caries data for 46.2% of the regions which were inhabited by 84.7% of the population. Region-level data availability was associated with the number of dental
1. Introduction

The availability of health-related data is important for planning workforce needs, health services, preventive programs and educational curricula (Miyazaki et al., 2017; World Health Organization, 2010; Yamalik et al., 2013) to achieve sustainable development goals (United Nation, 2014). One of the building blocks of a health system is a well-functioning health information system that monitors health (World Health Organization, 2007).

The biggest global oral health data source is the World Health Organization (WHO) Oral Health Data Bank which was established in the 1960s (World Health Organization, 2010). The database includes data from national surveys such as those conducted in United States, United Kingdom, Australia, New Zealand, Germany, Finland and Brazil (Steele, 2012). The bulk of the data in the database, however, comes from scientific publications based on smaller scale studies (World Health Organization, 2016). Oral health data is usually available at subnational level rather than on a national scale (Steele, 2012). Caries is a common indicator included in surveys and surveillance systems (Miyazaki et al., 2017; Ottolenghi et al., 2007) due to the feasibility and validity of its assessment (Ottolenghi et al., 2007). In 1980, the WHO databank included caries data for 107/173 (61.8%) countries. A higher percentage of countries is currently covered (World Health Organization, 2010). Evidence (El Tantawi et al., 2012) showed that only 88 countries (45.6% of the United Nations member states) have data about early childhood caries (ECC). Thus, lack of caries data is a public health issue of global importance.

In Saudi Arabia, no government body is assigned the task of collecting oral health data and in most cases, information about caries is available through published scientific publications without national oral health surveys; mostly due to logistic difficulties than lack of resources. It is not known to what degree the independent and uncoordinated research activities of dental academics might adequately and comprehensively assess caries levels in various regions in the country. The hypothesis of the study was that differences between regions in caries data availability are associated with the number of dental schools in these regions as an indicator of the impact of the dental academic sector to a greater degree than to socioeconomic differences among regions (the latter being an indicator of the ability of the region to commission oral health data collection). The specific objectives were to assess (1) caries data availability in the administrative regions of Saudi Arabia and (2) factors associated with this availability.

2. Material and methods

2.1. Data sources

Caries data were collected from the following sources: (a) previous reviews describing caries status in Saudi Arabia (Al-Ansari, 2014; Al Agili, 2013; Alayyan et al., 2017; Khan, 2014; Khan et al., 2013). These studies did not specifically report on early childhood caries (ECC) as defined by the American Academy of Pediatric Dentistry (2017). Therefore, we conducted a (b) search in PubMed about scientific papers addressing ECC in Saudi Arabia using the search terms (dental caries [MeSH] AND Saudi Arabia [MeSH]) and filtering by age/preschool children (2–5 years). We also searched (c) PubMed for studies about caries in Saudi Arabia after 2013, which was the last year covered by the five previously
Caries data availability in Saudi Arabia

| Variables | Statistics |
|-----------|------------|
| % of category A governorates | Mean (SD) 46.13 (18.35) |
| % of university and higher educated individuals to total population | Mean (SD) 9.75 (2.01) |
| % of housing units that are owned | Mean (SD) 68.75 (10.01) |
| % of households that have computers | Mean (SD) 55.67 (9.84) |
| % of households connected to the internet | Mean (SD) 79.22 (9.57) |
| % of households with smartphones | Mean (SD) 43.15 (11.53) |

Table 1: Indicators of region SES and oral health research potential in Saudi Arabia.

| Variables | Statistics |
|-----------|------------|
| All dentists | Total 16,887 |
| | Population to dentist ratio 1879.7 |
| MoH dentists | Total 9399.6 |
| | Population to dentist ratio 3377 |
| DPH dentists | Total 136 |
| Number of dental schools | Total 27 |
| | Mean (SD) 2.1 (2.4) |
| | Median (min-max) 1 (0–8) |

3. Results

The five previous reviews about caries in Saudi Arabia included 20 studies conducted in the period 2008–2018. Our search for ECC studies in the current study retrieved 35 studies of which five fulfilled the inclusion criteria. In addition, we also found 14 studies about caries in Saudi Arabia published after 2013 of which 10 were eligible (Fig. 1). After removing duplicates, 22 studies were left (Appendix). They included 11,422 individuals with age ranging from 2 to 72 years. Seventeen studies (77.3%) were conducted by authors from the academic sector including 8 institutions. Of the remaining 5 studies, two were authored by investigators from the Ministry of Health, one by authors from the Armed Forces Hospitals, one by an author from a non-Saudi dental school and another by an author from the private sector.

The total population in Saudi Arabia was 31 million and the mean percentage of category A governorates in the 13 regions was 46.13% with 9.75% of the population having at least university education. Most of the housing units were owned (68.75%). Most households had computers (55.67%), were connected to the internet (79.22%) with lower percentage
of those with smart phones ownership (43.15%). In total, there were 16,887 dentists in the country, 3377 dentists employed by the MoH, 136 specialists and 27 dental schools (see Table 1).

Figs. 2 and 3 show that no caries data was available in the northern part of the country. The age group where data were most available was 6–12-year-old children followed by <6-year-old children. Fig. 3 shows that Riyadh, Makkah and Asir had caries data for ≥2 age groups. Seven regions (53.8%) had no caries data in any age group with a population in these regions = 4,855,997 representing 15.3% of the total population in Saudi Arabia. Six regions (46.2%) had caries data. These regions were inhabited by 84.7% of the population.

Fig. 4 shows that Riyadh region had the greatest number of dental schools among all 13 regions. The northern part of the country either had no dental schools or only one school in each region.

Table 2 show that regions with greater number of dental schools had higher odds of caries data availability (OR = 1.63) with the unadjusted model correctly classifying 61.5% of the regions. The percentage correctly classified did not change greatly when SES indicators were added to the model. A higher percentage of correctly classified regions was obtained when either one of the indicators of oral health research potential was added individually (76.9% for the model including population to MoH dentist ratio and 92.3% for the model adjusted for number of DPH specialists). In these models, regions with greater number of population to MoH dentist ratio or DPH personnel had 23–27% higher odds of caries data availability than other regions.

4. Discussion

Our study showed that in the last decade, there was information about caries in 46.2% of the administrative regions in Saudi Arabia with 84.7% of the population represented. Data availability was associated with the number of dental schools and DPH specialists. This sheds light on the role of the dental academic sector in filling the knowledge gap about caries in Saudi Arabia. It also shows that the presence of 136 DPH dentists provides a critical mass of specialists to support caries data availability. Our findings, thus, support the study hypothesis.

Our study showed that uncoordinated, individual oral health research activities represented the majority of the population in Saudi Arabia although not all its regions. Whether or not this is considered adequate coverage depends on the purpose for which the information would be used. For example, pooling caries prevalence values per age group may produce an overall estimate in the absence of a nationally representative oral health survey. This data, however, cannot inform the allocation of human and non-human oral health care resources among the thirteen regions because of the inadequate geographic coverage. The limited data availability in our study corroborates with the situation reported for groups of developing and developed countries (Dal Poz et al., 2009; Smith et al., 2005). For example, Kilpelainen et al. (2012) reported that in 31 European countries, the average availability score of the European Community Health indicators was 74%. Yamalik et al. (2013) reported that all ten developed
Fig 2  Availability of caries data in Saudi Arabia in 5 age groups (2008–2018).

Fig. 3  Number of age groups with caries data in the 13 regions in Saudi Arabia (2008–2018).
countries had data about ECC and caries in the 1st permanent molars in children compared to 7/12 (58.3%) and 10/12 (83.3%) respectively of developing countries. El Tantawi et al. (2018) reported that 73% of 193 countries had no data about ECC in children younger than 3 years and 46% had no ECC data about 3–5-year-old children.

Our study showed that most caries studies included in this report were by authors from the academic sector and that the odds of caries data availability increased as the number of dental schools increased. This finding agrees with previous reports showing that the academic sector has the skills and experience to conduct health needs assessment (Smith et al., 2005). For example, in the national Brazilian oral health survey, SBBrasil 2010, health departments and universities collaborated to assess oral diseases and socioeconomic indicators (Moyse´s et al., 2013; Roncalli, 2010). However, the academics’ efforts in the Brazilian context were structured and coordinated at the national level. A more limited scale of action was reported in urban areas in Dublin, Ireland where the department of public health and primary care in Trinity College Dublin was commissioned to conduct oral health surveys (Smith et al., 2005). The largest oral health data repository, the WHO Oral Health Databank (Malmo University, 2010) presents another example of input from the academic sector. It

Table 2  Association between the number of dental schools in an administrative region in Saudi Arabia and caries data availability (logistic regression).

|                                | OR (95% CI)   | % correctly classified |
|--------------------------------|---------------|-----------------------|
| Unadjusted                     | 1.63 (0.79, 3.36) | 61.5%                 |
| Adjusted for % of category A governorates | 1.62 (0.78, 3.38) | 61.5%                 |
| Adjusted for % of university and higher educated individuals | 1.70 (0.79, 3.65) | 61.5%                 |
| Adjusted for % of owned residences | 1.55 (0.72, 3.35) | 69.2%                 |
| Adjusted for % with computers  | 1.50 (0.69, 3.28) | 61.5%                 |
| Adjusted for % connected to the internet | 1.94 (0.80, 4.69) | 69.2%                 |
| Adjusted for % with smartphones | 1.83 (0.79, 4.25) | 69.2%                 |
| Adjusted for population to MoH dentist | 1.23 (0.28, 5.41) | 76.9%                 |
| Adjusted for the number of DPH  | 1.27 (0.04, 39.88) | 92.3%                 |

OR: odds ratio, CI: confidence interval.

Fig. 4  Distribution of dental schools among the 13 regions in Saudi Arabia, 2018.
was built in collaboration with Lund and Malmo universities in Sweden. Our findings disagree with other oral health surveillance models where the academic sector had a limited role. For example, in the US, the national oral health surveillance system (NOHSS) is operated by a governmental body, the Center for Disease Control and a professional association, the Association for State and Territorial Dental Directors (Center for Disease Control and Prevention, 2017). Data availability varies by state and indicator (Malvitz et al., 2009).

Our findings show that including MoH or DPH dentists improved the accuracy of classifying the administrative regions based on caries data availability. This agrees with El Tantawi et al. (2018) who reported higher odds of ECC data availability in countries with higher number of dentists: 1000 population ratio. It also agrees with previous research showing that human resources needed to establish surveillance systems or conduct national surveys may limit or promote health data availability (Dal Poz et al., 2009). The higher percentage of regions correctly classified in the case of DPH compared to MoH dentists can be explained by the fact that epidemiologic studies are usually conducted by DPH specialists.

Our study has implications for oral health policy planning in countries without national oral health surveys or oral health surveillance systems. In most countries, health care systems face competing demands that necessitate prioritization among sectors (Kandelman et al., 2012) and economic factors may affect caries data availability (El Tantawi et al., 2018). Dental schools can help fill the knowledge gap about oral diseases by collecting data in their surrounding communities using standardized data collection methods, forms, formal training and calibration (Yamalik et al., 2013). Coordinated efforts of dental schools are also needed to address data ownership issues and make data available to stakeholders (Harbers et al., 2015). National dental journals can support dental academics by dedicating sections to publish descriptive studies reporting on oral health status of regions where no previous data exist. As more dental schools collaborate, better chances of publication would be secured because of the increased geographic coverage and improved representativeness. This coordination may help build capacity for oral health assessment and address the deficiency of funds (Karamouzian et al., 2016). There is a need to initiate a dialogue on the future of oral health surveillance in Saudi Arabia and whether it should be the responsibility of the Ministry of Health, the Saudi Dental Society or a consortium of Saudi dental schools. Such surveillance may include a clinical component coordinated by one of these bodies or it may use indicators obtained through self-reporting by a number of questions added to the Saudi Health Interview Survey (Saudi Ministry of Health, 2017).

Our study is limited by its design which is liable to ecologic fallacy. In addition, the number of administrative regions in the country might have reduced the study power. In other countries with different roles of oral health care agencies, or fewer dental schools, the impact of the academic dental sector on data availability may differ.

5. Conclusion

Data about caries level is available for most of the population in Saudi Arabia and for about half the administrative regions. The dental academic sector can help address gaps in this area through planning coordinated research activities assessing caries levels in various regions in Saudi Arabia. This solution may apply in other countries with similar large geographic spread and low population density. In the absence of oral health surveillance systems, the academic sector involvement in oral health surveillance may ensure the presence of data to help in planning of oral health initiatives.

Ethical statement

The study was based on literature review and therefore does not require ethical approval

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Conflict of interest

The Authors declare that they have no conflict of interest.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sdentj.2019.01.004.

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