Research Article

Mapping the geographic availability of public dental services in Uganda relative to ruralization and poverty of the population

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ABSTRACT

Objectives: Uganda is a low-income country faced with a number of challenges in health service delivery, including oral health services. Despite reports of an increased prevalence of oral diseases, they are afforded less priority, amidst competing priorities of infectious and other non-communicable diseases. Oral health-care services are offered free-of-charge in public health facilities. The majority of the Ugandan population live in rural areas. This would imply that public dental services should be more widely distributed in rural areas to meet the needs of the majority population. This study, therefore, aimed to determine the geographic distribution of public dental services relative to poverty and ruralization of the Ugandan population.

Materials and Methods: All 112 districts in Uganda were to be surveyed for this study using an ecological design that incorporated the Ugandan population with socio-demographics obtained from the latest Uganda National Housing and Population Census and poverty data from the national Poverty Status Report 2014. The data from the districts were on the availability of public dental services and the physical location of these dental facilities. Overall, 182 public facilities were included in the study. The geographic location of public dental clinics was established using open-data sources. The data on ruralization were aggregated at the district level and that on poverty at the subregion level. Spatial analysis was done using geographic information science software, Quantum Geographic Information System.

Results: The total Ugandan population was 34 million. Overall, 19.7% of the population was poor with the highest proportion located in the North and East of Uganda. Urban-rural characteristics varied across the country. Information on the 182 public dental clinics was collected from 97 of the 112 Ugandan districts. Among the 97 districts, 15% had no public clinic and were located in the poorest Ugandan regions. Among the 40 districts containing over 90% of the rural population, 20% had none, and 55% only had one dental clinic. In general, service availability reduced as the proportion of the rural and poor population increased.

Conclusion: The spatial analysis presents an avenue to inform and guide the decision making and planning process by identifying geographic areas with access gaps relative to population socio-demographic characteristics. This study revealed that public dental services were least available for the poorest and rural populations, and yet they are already vulnerable to other access barriers. It is recommended that efforts should be made by health planners and policymakers to avert the health inequalities presented by inequitable access.

Keywords: Geographic information systems, Dental care, Socio-economic factors, Poverty, Uganda

INTRODUCTION

Uganda is a low-income sub-Saharan African country, with one of the lowest gross national per capita incomes in the world, at $US670.[1] Over 80% of the population is rural[2] and there is widespread poverty, with almost a fifth of the population living below the poverty line. Although the majority of Ugandans are classified as not poor, among these, 43% are insecure and vulnerable to falling back into poverty.[3] Despite significant reductions in poverty during the last two decades, certain regions (e.g., North Region) are lagging behind and remain the poorest, while the West and Central Regions have made remarkable progress and their poverty rates are below the national average. For example, nearly 90% of households in Kampala – the capital city in the Central Region – are middle-class, while <1% are classified as poor. By contrast, <10% of households in the Northeast are middle-class, with nearly three-quarters of all households in the subregion living in poverty.[3]

Uganda's poor population experiences a greater burden of disease and yet have less access to health services, a common occurrence in other parts of the world.[4] Geographic distance is a major barrier to health care access, especially for the poor and rural residents[5,6] with the utilization of services from formal health facilities greatly influenced by the distance.[7] The poor population is sometimes forced to seek care from traditional practitioners if they are located closest to their home.[5] The use of public health facilities is highest among households in the lowest welfare quintile and reduces as the welfare quintile of household increases. Kampala, with the highest middle-class population, has previously recorded only 17% of its population as attending public health facilities, and 76% attending private health facilities. Conversely, the northeast had only 4.7% and 77% attending private and public health facilities, respectively.[8]

Public health care in Uganda is focussed on health services which have been defined in the Uganda National Minimum Health Care Package that includes oral health care.[9] The Ugandan Ministry of Health (MoH) operates on a budgetary allocation of only 9% of the national budget,[10] which appears inadequate for optimal service delivery in the complex environment that is Uganda. Of this, the direct oral health-care budgetary allocation is <0.1%.[11] Basic oral health services are free in government health units, whereas secondary and tertiary services are provided at a fee. However, due to shortages of materials, supplies, equipment and workforce, patients have to seek and pay for basic treatment elsewhere.[11] Therefore, the burden of financing dental services is predominately borne by the patients.

Given the current organization of oral health care in Uganda, and the widespread nature of oral diseases, it is important to analyze the extent to which the population can potentially access public oral health care, assuming that other access barriers have been overcome. Therefore, this study sought to examine the geographic distribution of public oral health services in Uganda and how this distribution relates to population poverty and ruralization.

MATERIALS AND METHODS

This study was an ecological assessment of population data relative to the distribution of public dental facilities in Uganda. It involved the use of secondary data from open sources.

Data collection

Population data were retrieved from the latest Uganda National Population and Housing Census 2014 published by the Uganda Bureau of Statistics website.[2] The census population demographics and details on rural-urban characteristics were aggregated at the district level; the main administrative unit after the national level and the fourth level of the geographical division after the national, regional, and subregional divisions. Data on the poverty status of the population were extracted from the Poverty Status Report 2014, published by the Ministry of Finance, Planning and Economic Development.[3] The poverty data were aggregated at the subregional level, the third level of geographical division. Given that a group of adjacent districts constitutes a subregion, each district population was matched to the relevant subregional poverty data. The latest geographic data in the form of shapefiles on regions, subregions, districts, and waterbodies were downloaded from an open source website.[12] Data on functional dental facilities[3] were collected between May and August 2016 and were provided by District Health Officers (the health managers at the district levels), through direct communication. Functional dental facilities were defined as those that had at least one Dental Cadre and equipment for oral health treatments. The data on services included fixed facilities at all levels – tertiary and lower – and for all oral health services (general and specialized). Very few districts (six) offered occasional mobile services; therefore, these were also included as facility-based. Global positioning data (longitude and latitude) of most of the public facilities were retrieved from the open-source website which has a record of the location of the majority of public health facilities in Uganda.[12] The facilities that were missing from this published database were located using free access geocoding website, Google maps.[13] An additional data file shows the geographic location of these public facilities, and their respective longitudes and latitudes in more detail (see additional file) a randomly selected sample of 20% of the facilities downloaded from the open-source database were tested by reverse geocoding of the coordinates onto Google

maps to determine the integrity of data. These were found to be 95% concordant with the Google maps.

Analysis

All data were entered into Microsoft Excel (version 2013 Microsoft, Redmont USA). This included population sociodemographic at the district levels; dental services data at all administrative levels; and geo-coding of public dental facilities.

Geographic boundary data for each subregion and district were integrated with the population, ruralization, income poverty, and health facility data using the Quantum Geographic Information System (GIS) (version 2.16.0).[14] Multiple data layers were used in different combinations to produce the various maps representing the different socio-demographic characteristics in relation to the geographic distribution of public dental services and provided the basis for the analysis.

RESULTS

Ninety-seven districts out of the total of 112 districts (86.6%) were included in the analysis, as the remaining districts could not be contacted to obtain information on the availability of public dental services. The population in the included districts represented 89.5% of the total population of 35 million Ugandans.

Among districts with dental services, the majority (*n* = 42, 51%) had a single public clinic [Table 1]. The overall facility-to-population ratio was 1:170,000 people. It should be noted that the total population within the 15 districts, which had no public dental services, was 2.5 million (8.2%) [Table 2].

All districts without public services were in the North and East regions of the country. The northeast subregion was the most affected, with 71% of its population without dental services, while the eastern subregion had 15% without services [Figure 1].

Distribution of dental public facilities and ruralization

Analysis of the ruralization and distribution of public facilities revealed that generally, the number of facilities increased with decreasing ruralization [Figure 2]. Most of the 40 districts with over 90% ruralization had none (*n* = 8, 20%) or one (*n* = 22, 55%) dental facility, while the exceptions were Kibaale and Arua districts, with four dental facilities each. Among the 38 districts with 80–90% ruralization, eight (21%) had no facilities. However, at this level of ruralization, the most outstanding number of facilities was eight in Kibaale district within the south-western subregion. Kampala subregion – enlarged to the right bottom corner [Figure 2] – was fully urbanized with 15 facilities.

Table 1: Number of public dental clinic availability within each district.

Public clinics/district	Districts
0	15
1	42
2	11
3	17
4	7
5	1
6–10	3
11–15	1
Total	97

Kampala district/subregion with the capital city had 15 facilities

Table 2: Uganda population without services by subregion.

Subregion	Population	Population without services (%)
Northeast	965,008	680,526 (70.5)
Mid-North	3,145,827	775,535 (24.7)
West Nile	2,057,378	426,216 (20.7)
Eastern	4,558,439	666,784 (14.6)
Total	10,726,652	2,549,061 (23.8)
Uganda	30,988,962*	2,549,061 (8.2)$

*Is the total Ugandan population. $The proportion of the overall Ugandan population without services

Distribution of dental public facilities and poverty

The proportion of the population living below the poverty line was considered as the prevalence of poverty in a subregion. Districts without services were located in the four poorest subregions which are all in the eastern and northern regions. These are the eastern, Mid-north, West Nile, and northeast subregions, in the order of increasing poverty [Figure 3]. On the other hand, the highest number of dental facilities was in Kampala, where poverty of the population was the lowest.

DISCUSSION

The challenges in oral health service delivery in Uganda are enormous due to inadequate funding, low prioritization, poor planning, inadequate workforce, and insufficient coordination between the central government and the local governments. The spatial analysis presents an avenue to inform and guide the decision-making and planning process by identifying geographic areas with access gaps relative to the population and its socio-demographic characteristics.

The macro-analysis of service provision before incorporating geo-data and socio-demographics revealed that the 182 public facilities in the 82 districts were providing dental services to 91.8% of the Ugandan population. This left only 8.2% of the population lacking public services in terms of availability, within
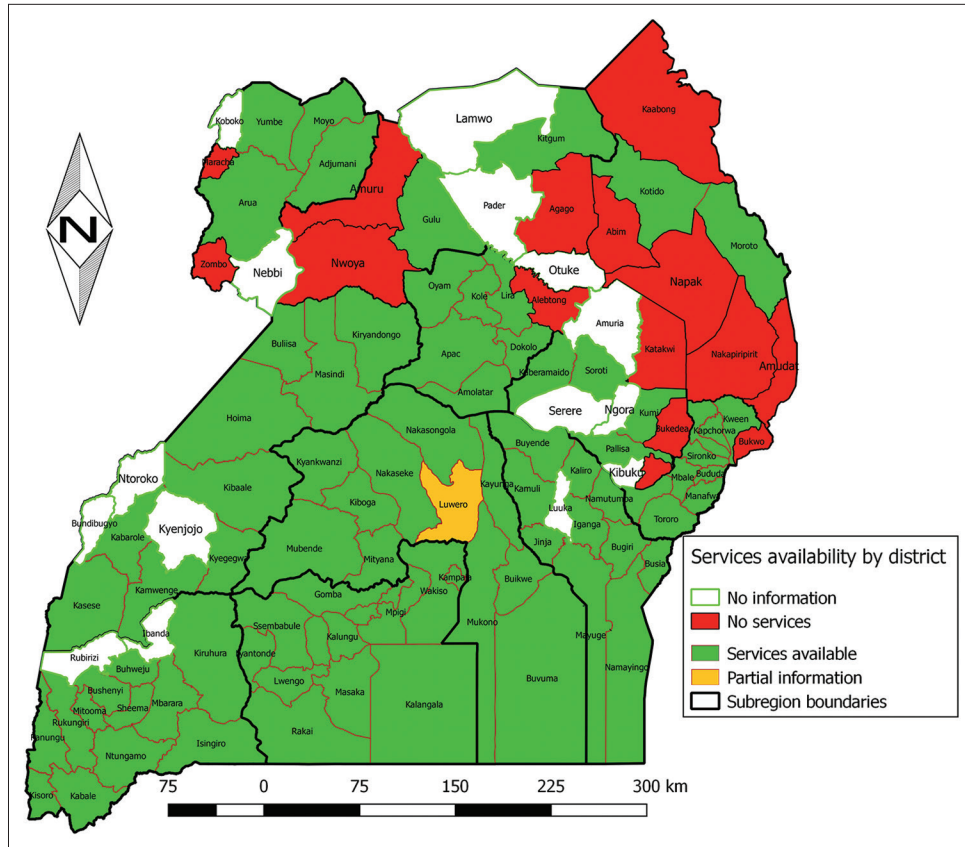
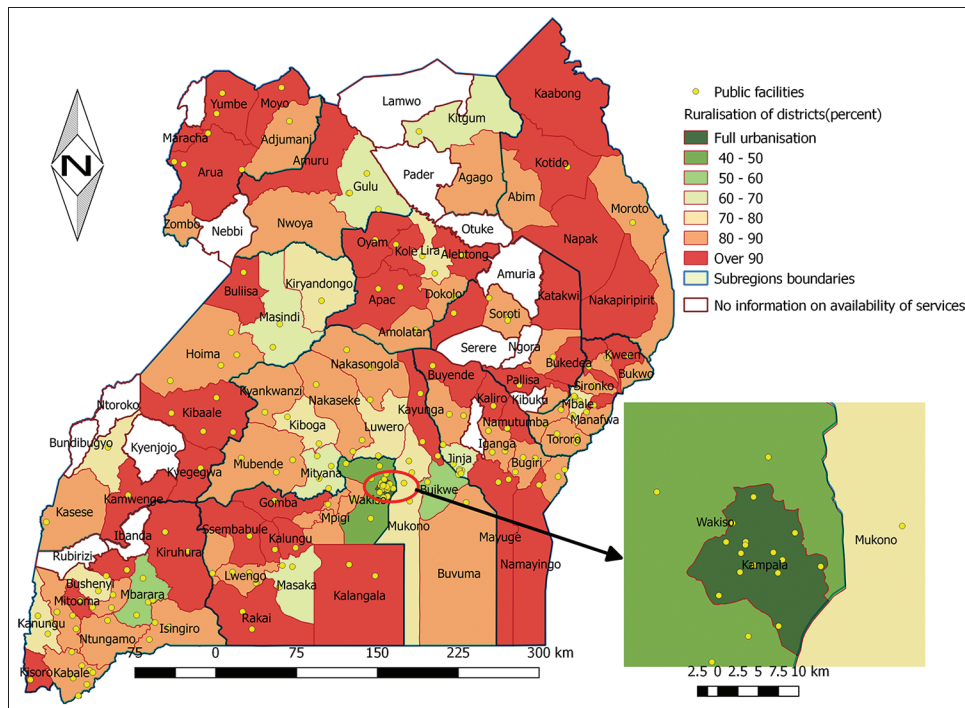**Figure 1:** Public dental services availability by district in Uganda.

Figure 2: Distribution of public dental clinics in relation to ruralization of districts in Uganda.
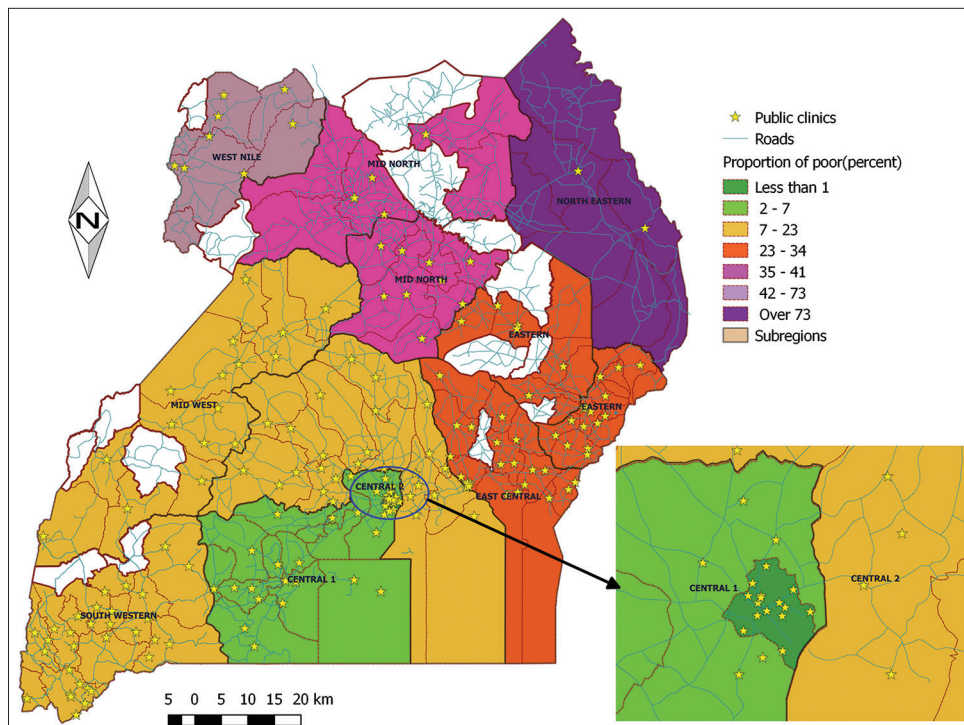
Figure 3: Distribution of public dental clinics in relation to the subregional population poverty in Uganda.

the designated administrative boundaries. Unfortunately, this level of analysis does not provide the actual geographic distribution of those subpopulations most affected.[15] Several previous studies have argued that macro-analyses which do not incorporate geographic and socio-demographic variables are not accurate and no longer necessary, given the recent developments in GIS and spatially referenced data[16-18] that are proven to have higher acuity and accuracy.[17-19]

In practice, macro-analyses on the availability of services are not considered very useful for meticulous planning but can be used in workforce planning and for policy discussions in some countries.[17] In addition, these crude ratios are useful in obtaining a snapshot to compare service delivery among regions and identify the most disadvantaged subpopulations at the national level – lacking any form of services – as was revealed at this level for Uganda. The northern region and western subregion were the only areas with districts lacking public dental services.

When the 182 facilities are visualized on a map, the distribution pattern shows some urban areas as having a relative advantage, characterized by clustered clinics. This is confirmed further with the general trend of having more services in urban than rural areas – a common finding from other studies,[17,20-24] and described as the "inverse care law."[25] Poor oral health continues to be higher among the rural population,[26] further increasing the health inequalities between the rural and urban populations. Rural populations having fewer public

dental services have also been demonstrated in Sri Lanka,[27] another developing country. This phenomenon might be expected in some developed countries that have private dental services – whereby economic factors influence the location of facilities. In such cases, governments respond by providing a safety net for those who may be disadvantaged by rural and remote dwelling.[19,20]

However, in developing countries, this does not only apply to dental services, but generally for all health care offered in the public system. In Uganda, rural areas have few formal health providers and even fewer public providers.[4,8,28,29] Since 80% of the population resides in rural areas, this shows that the majority of the population is affected by limited or scarce health services, which has been demonstrated in a number of Ugandan studies.[4] Therefore, the findings here that most districts in the rural areas have none, or only one facility, augments the point of the scarcity of dental services in rural Uganda.

There is no current record of the dental workforce in Uganda, but previous records in 2006, reported the dentist-to-population ratio as 1:158,000 people, with 39% of the workforce based within the capital city; Kampala.[11] The current national oral health policy spells out that each district hospital must have a dental surgeon, and each sub-district hospital, a lower cadre public health dental officer. In addition, specialists would be trained and posted to every regional referral hospital. Unfortunately, there is no reliable information on the extent to which this policy was

implemented. Although beyond the study objectives of this project, it was established that some of these public dental facilities, especially in the rural and remote districts, had several challenges, including dental workforce issues (having none, very few, or only the lower cadres, who might not be in a position to appropriately serve their catchment areas).

Unfortunately, findings revealed a very wide gap between the most and least disadvantaged subregions. Evidence of the poorest populations having no public services is highly unacceptable, but widely occurring in both developed and developing countries.[17,19,21,22,24,30] The Ugandan poor is a vulnerable group in most aspects of life and with very complex relationships affecting their health outcomes.[4,8,29] A fifth of Uganda's population faces these health inequities because of poverty, and so does the 43% that is non-poor but vulnerable in many aspects and hence, prone to the inequities in health.[31] Based on poverty, the lack and inadequate distribution of services in the north region (especially the northeast subregion; and eastern subregion) is a sign of social injustice – a situation that needs to be reversed.

A limitation of this study was that the poverty data analyzed were based on income poverty classified at the subregional level, a big geographic area. Socio-economic measures of the Ugandan population on a smaller area level to reduce ecological fallacy were not available.

CONCLUSIONS

This study sought to analyze the spatial distribution of public dental services in relation to the Ugandan population distribution by poverty and rurality. The findings revealed that the poorest and most rural populations had the least access to public dental services, and yet they are already vulnerable to other access barriers. Allowing such health inequities to perpetuate is an unacceptable injustice to the Ugandan population and goes against the principles of equity, on which the Ugandan constitution and all health policies are established. The evidence also shows that identifying locations of future services need to take into consideration several population socio-demographic characteristics, rather than merely using distance to a health facility as the only criterion. Therefore, it would be prudent to include GIS techniques in the planning of location for new service points. It is recommended that the relevant policymakers, stakeholders, and planners define standard criteria for access to dental services so that a clear, holistic approach is used to identify the most disadvantaged and vulnerable populations.

Ethics approval

Ethical approval was not deemed necessary because only secondary data were used with no personal information collected.

Declaration of patient consent

Patient consent not obtained as patients identity is not disclosed or compromised.

Conflicts of interest

There are no conflicts of interest.

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