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Rethinking Physical Access to Healthcare: Aligning Healthcare Facilities with Population in Mbeya City, Tanzania

Christopher M.P. William[*] *& Kizito August Ngowi*[**]

Abstract

Local governments, such as the Mbeya City Council (MCC), desire its citizens to have better physical access to healthcare services as stipulated in the national health policy and the World Health Organization (WHO). The challenge, however, is for the MCC to ensure that physical accessibility to healthcare facilities align with urban planning initiatives and the respective population in the wards. This study employed the Geographical Information System (GIS) and a Location-Allocation model in data analysis. Multiple spatial and aspatial datasets were analysed to establish the current distribution of healthcare facilities, spatial accessibility by the people, population distribution and how physical accessibility to healthcare facilities is reflected in physical planning of urban space. The results show that on average people in the respective wards travel over 15–25km, which is beyond the 5km distance recommended by the WHO. In addition, people spend 30–51 minutes to reach healthcare facilities that are centrally located within the city. Similarly, physical planning of urban space mismatch with actual required people's accessibility to healthcare facilities. The locations of healthcare facilities and population distribution do not align, implying that there are still demand points that need to be served in the wards. It is concluded that physical planning for the location of healthcare facilities should reflect the population distribution and pace of urbanization of a city to improve access to healthcare facilities. The use of the central place theory in physical planning of the city, when combined with a people-centred perspective in planning for healthcare facilities, would place healthcare facilities in close proximity to the people. It is recommended that new siting of healthcare facilities should consider the distribution of the population in the city. In addition, physical planning of the urban infrastructure and the initiatives to improve accessibility to health must align at local level.

Keywords: *healthcare, Mbeya city, physical accessibility, population, Tanzania*

1. Introduction

1.1 A Global and Local Context of Access to Healthcare Facilities

Worldwide physical accessibility to healthcare facilities is crucial (Wang, 2011) because it translates into people having access to promotive, preventive and rehabilitative health intervention at affordable costs (WHO, 2016). Noting the importance of people's physical access to healthcare facilities, the World Health Organization (WHO), in its 58th World Health Assembly, emphasized on its member states to ensure that their people receive appropriate and accessible

[*] Department of Geography, University of Dar es Salaam

[**] Mbeya University of Science and Technology

healthcare services. When people in a country have better physical accessibility to healthcare, this is a step towards meeting the global and national strategies that would ensure people's better access to healthcare services, which in turn save lives (Alexander, 2018; Turin, 2010). In fact, globally, there has been significant achievements in providing access to healthcare facilities (Alexander, 2018). Nevertheless, looking at local situations in rapidly urbanizing cities in the developing world, each country has a different context.

The government of Tanzania considers health access central to the wellbeing of its people (URT, 2017) in the post-2015 Sustainable Development Goals (Wuneh et al., 2019). The country intends to meet internal needs and contribute to the global agenda, particularly the Sustainable Development Goals 2030 (Alexander, 2018). The country, among other things, is targeting to achieve a 5km travel distance to a healthcare facility for people who seek medical care, the standard travel distance to a healthcare facility suggested by the WHO. Nevertheless, the country's national health policy explicitly targets equitable health services provision, and prioritizes on those in the society that are most vulnerable: those living in the poorest councils (URT, 2017).

Amer (2007) and Ahmed (2004) argue that over 70% of the population that live in grossly overcrowded informal settlements are chronically poor, and in unhealthy living conditions. Attaining better physical accessibility to healthcare facilities calls for intervention in the sector. Local government authorities, with support and guidance from the central government, ought to ensure that healthcare facilities are fairly and equally distributed to reflect the population distribution in cities. Similarly, healthcare facilities should be optimally located for easy access by the people. This implies that urban planning (physical planning) by city planners needs to align with a city's population and the pattern of its distribution.

1.2 Spatial Planning and Healthcare

A myriad of factors influence access to healthcare facilities, from individual behaviour, terrain, socio-economic status, and climate change. The location of human settlements in relation to that of healthcare facilities have a profound effect on access to healthcare facilities, and the overall health of the people (Thummapol et al., 2020; Barton et al., 2015; Marmot, 2013; Marmot & Bell, 2010). The pattern of built environment, transport infrastructure networks, and location of healthcare facilities are known indicators of health globally (Barton, 2009). Thus, access to healthcare is, among other aspects, a function of urban planning of urban space.

Tanzania's city planning, like elsewhere in the world, is facing challenges of rapid urbanization amid growing urban population (World Bank, 2016). Urban planning in Tanzania tends to prioritize economic development. While urban development that fuels overall economic development is an acceptable development trajectory, urban development has been inconsistent with

masterplans. Moreover, the pace of the development of urban infrastructure has been surpassed by rapid urbanization and population growth to the detriment of access to healthcare facilities (Peter & Yang, 2019).

The mismatch between physical planning of urban space and access to healthcare facilities tend to infringe on the rights of people to access healthcare facilities in their proximity (Grant et al., 2017; Braubach et al., 2011). This mismatch could be explained partly by the lack of understanding of the pattern of population distribution in a city. Thus, poor urban planning facilitates inequalities in accessing healthcare in urban areas (WHO, 2016a; Allen & Allen, 2015; Townshend & Lake, 2017), more so in rapidly urbanizing cities in developing countries like Tanzania. Thus, physical planning of urban space should provide an enabling environment for people in cities to have better access to healthcare.

1.3 Planning of Urban Space as an Enabler of Healthcare

Nations set policy solutions to address challenges associated with physical access to health facilities. However, for these policies to address local challenges of access to healthcare, facilities have to align with urban planning (Carmichael et al., 2013). Relevant policy solutions, when aligned with the pace at which cities urbanize and the growth of population, provide a better trajectory for improved access to health facilities (Nieuwenhuijsen, 2016; Oppong, 1994). A mismatch between urban planning and the pace of urbanization constrains the role of urban planning as a health enabler.

Often studies on accessibility to health facilities tend to focus on synergies between healthcare facilities and drivers of access to healthcare. These include, for example, synergies between resources constraints and policy short-terminism on access to healthcare services (Fischer et al., 2018a); urban land development, air quality and housing (European Commission, 2017); and urban planning and access to healthcare (Chavehpour et al., 2019). Others address urban design and planning dimensions (UN, 2015), and how that affects access to healthcare; and policies regulating land use, connectivity and density, transport and green infrastructure that offer paths to improved health outcomes (Nieuwenhuijsen, 2016). In essence, these studies are reflective of the physical planning of cities as a facilitator of healthcare. These studies employ methods and models for measuring physical accessibility to healthcare using several layers of information integrated in a GIS (Kanuganti et al., 2015; Paez et al., 2010; Peter & Yang, 2019; Luo & Wang, 2003). Similar approaches and methods were used in this study to unravel the spatiality of both population and healthcare facilities, and how they either align or misalign.

1.4 Prioritising the Local Context and Situating the Problem

Inherently urban planners often, either explicitly or implicitly, practice their planning of urban space in view of the central place theory. Walter Christaller's (1893–1969) central place theory of urban planning has been influential in siting

services and infrastructure in urban areas (Guo, 2018; Hsu & Zou, 2019). The theory focuses on a spatial centre hierarchical perspective that has persisted in conceptual planning of the use of urban space (Graham, 1997). However, the theory fails to accommodate processes of change (Guo, 2018). In fact, it is this theory that explains the location and functional content of the settlement in peri-urban Mbeya city. This paper challenges the current physical planning of Mbeya city's healthcare facilities that is characteristically reflective of the central place theory. The paper argues that spatial distribution of population and healthcare facilities should align to inform access to healthcare in the city based on the local context.

While studies discussed in preceding sections (Guo, 2018; Grant et al., 2017; Nieuwenhuijsen, 2016; UN, 2015; Braubach et al., 2011; and others) present pertinent issues in the access to healthcare, they incline less towards a discourse on aligning provision initiatives of healthcare facilities with population distribution in rapidly urbanizing cities such as Mbeya. The latter has to be brought to light because in Mbeya city, 120 children out of 1,000 die before reaching five years because of delays in accessing healthcare facilities (Mbeya City Council, 2007), partly because healthcare facilities are far from where the majority of the population live. Poor road networks, rugged terrain, poor public transport, and unpaved roads (ibid.) compounds the problem of accessibility to healthcare facilities in the city.

Thus, this paper examines the alignment of the distribution of healthcare facilities with population distribution pattern (Farahani & Hekmatfar, 2009; Rezwana, 2018) as an enabler of improved access to healthcare facilities. The paper contributes to the discourse on access to healthcare in rapidly urbanizing cities of the developing world. It also contributes to policy through establishing an understanding that, when informed by population distribution in a city, spatial location of healthcare facilities enhances the meeting of national and global health goals.

2. The Study Area and Research Methodology

Mbeya City is located between latitudes $8^{0}50'$ and $8^{0}57$ South and longitudes $33^{0}30'$and $35^{0}35'$ East. It occupies a total land area of 214 km^2, and borders Mbeya Rural District. Mbeya City is the headquarters of Mbeya region. The city (Figure 1) is located in a rift valley between two high mountain ranges of Mbeya Peak (Loleza) and Uporoto. The area is rapidly urbanizing and highly populated.

Data that were collected and analysed include the global positioning systems (GPS) data on healthcare centres (2018) from the Ministry of Health. Others were the road network (2018) from Mbeya City Urban Planning Department, and the Landsat image of Mbeya City (2016) from the United States Geological Survey. Other data were sought from the Tanzania Population and Housing Census General Report (2012 and 2018), and the Digital Elevation Model (2014) Shuttle Radar Topographical Mission (30m).

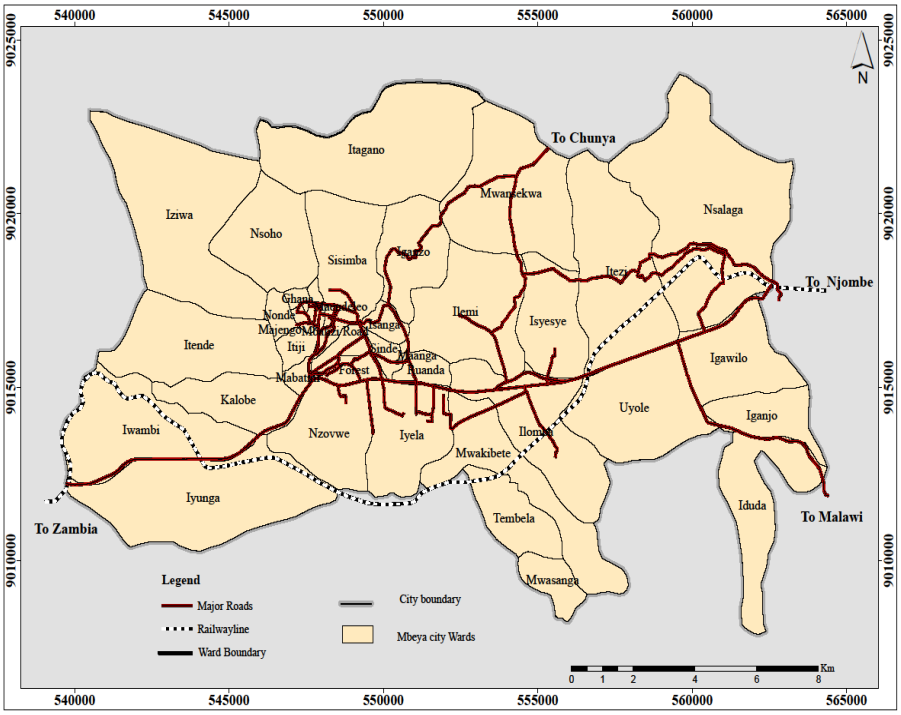

Figure 1: ***Location of Mbeya City***
Source: Ngowi and William (2018)

Data analysis used a location-allocation model using the candidate locations for service facilities; the demand locations; and the distance between service facilities and demand locations (Samat et al., 2010). Population (centroids), terrain, state of the roads and land use/cover, and travel time were inputs in the model (Luo & Wang 2003; Luo & Qi, 2009). Accessibility analysis was done as in Wang and Luo (2005), Onega et al. (2008) and Hansen (1959) model equation (1).

$$A_i^H = \sum_{j-1}^{n} S_j d_{ij}^{-\beta} \qquad (1)$$

Where A_i^H is the accessibility at location i; S_j is the supply capacity at location j; d_{ij} is the distance between the demand (at location i) and a supply location j; β is the travel friction coefficient, and n is the total number of supply locations. The superscripts H in A_i^H denotes the measure based on the Hanson model versus F for the measure based on the two-step floating catchment area method (equation 2).

$$A_i^H = \sum_{j\in\{d_{ij}\le d_0\}} R_j = \sum_{j\in\{d_{ij}\le d_0\}} \left(\frac{S_j}{\sum_{k\in\{d_{kj}\le d_0\}} D_k}\right) \qquad (2)$$

Where d_{ij} is the distance between i and j; and R_j is the supply-to-demand ratio at supply location j that fall within the catchment centred at i, that is, $d_{ij} \le d_0$.

3. Result and Discussion

3.1 Population Distribution in the City

Figure 2 shows the distribution of population density per km² in Mbeya City. The population (4674–7957 people per km²) category (darker shade) indicate a clumped population pattern that follows the road patterns in the city. This population, although most of it forms a semi-concentric ring around the Central Business District, is somewhat disjunct between the central part of the city and that in the east (Ntezi, Isalaga, and Igawilo wards). The ruggedness of the topography and the physical planning of city may have influenced the distribution of the population (Behaylu, 2016). It also reflects the common practice of town planning using the central place theory in planning of the city, and the associated spatial interaction (Kotsubo & Nakaya 2021, Openshaw & Veneris, 2003). In addition, the observed disjunction could be explained by the ex-urban nature of urban morphology indicating settlement development in the fringes of the city.

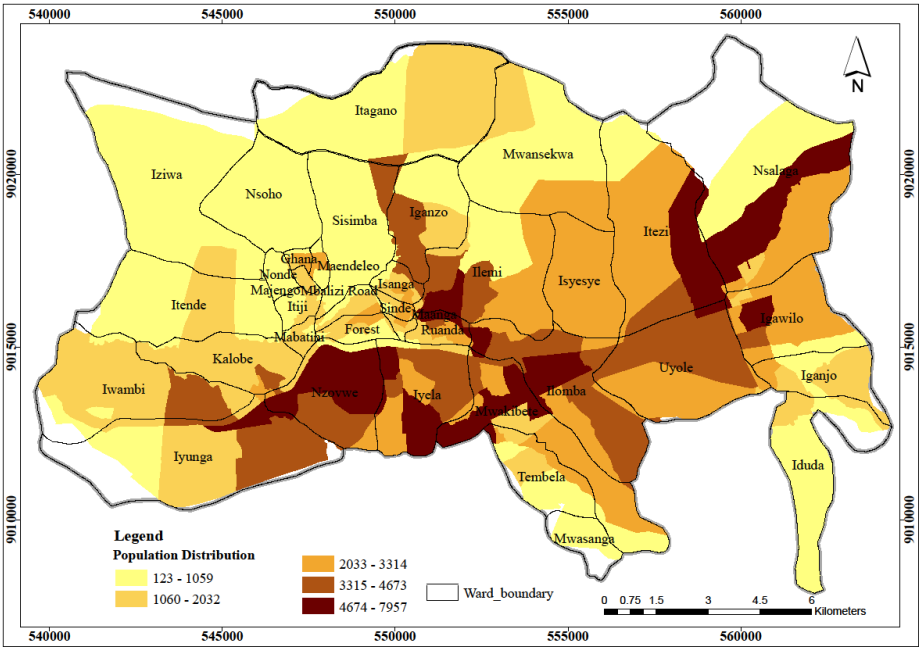

Figure 2: Population Density Distribution in Mbeya City

Source: Field Survey (2018)

The next population density category (in Figure 2) shows clumps that are roughly linear crisscrossing Eastern-western and North-western-South-eastern. The remaining populations seem to form a semi-concentric shape in the fringes of the city centre, mostly in the northern part of the city. Again, topography (Behaylu, 2016) and major roads (Breheny & Rookwood, 2013) infrastructure oriented West-east and North-south seems to influence the observed population pattern. However, the northern and western areas are less populated, which is a typical characteristic of the fringes of the city (Theobald, 2004).

For a population to have better access to healthcare facilities, it is expected that the distribution of the healthcare facilities will reflect the distribution of the population in the city; and the contrary would indicate inequalities (Munga & Mæstad, 2009; WHO, 2006; Onouma & Barton, 2020). In the next section we present the distribution pattern of healthcare facilities in Mbeya city.

3.2 Distribution of Healthcare Facilities in Mbeya City

Figure 3 presents the distribution of healthcare facilities in Mbeya city, which has a total of 70 healthcare centres. The facilities are concentrated at the central part of the city, and decrease outward towards the periphery (peri-urban area). About 96.7% of the facilities are located in the central urban area; the centrality being a reflection of using the central place theory in urban planning, where services are located within the central business district.

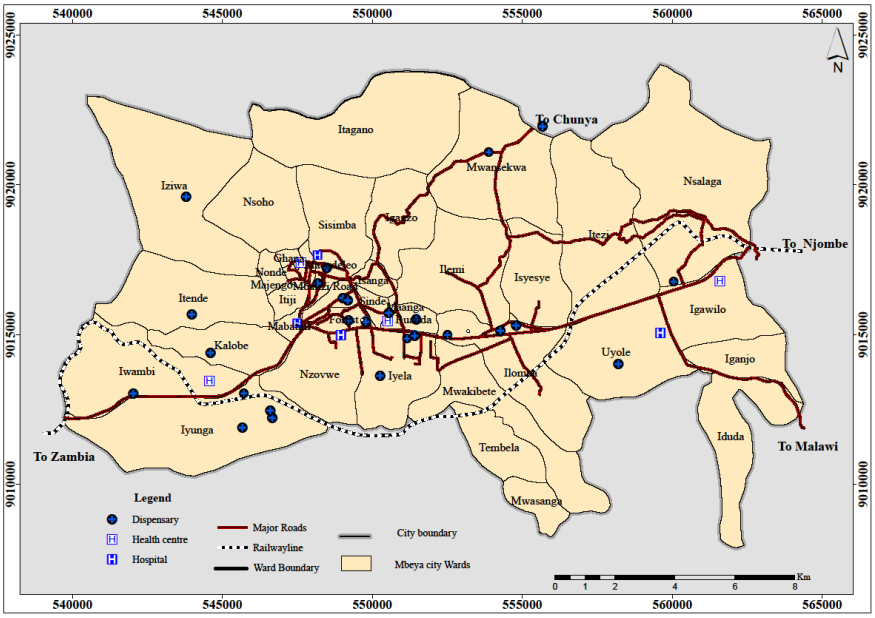

Figure 3. ***Distribution of Health Facilities in Mbeya City***

Source: Field Survey (2018)

Moreover, Figure 3 reveals, for example, that wards such as Iziwa, Itagano and Mwasenkwa have only one healthcare facility: a public dispensary. Wards such as Tembela, Mwasanga, Itagano, Nsoho, and Iduda, among others, have no healthcare facilities. Wards, particularly in the fringes of the city, are most affected by distance and cost to reach healthcare facilities.

People living in these wards and other similar areas travel long distances to secure medical services from healthcare facilities located in the central business district of the city. Average drive distance to the hospitals in the city centre was over 15–25kms that require 30–51 minutes of drive time. This finding on poor access and travel over long distances to access healthcare services is similar to other cities in the developing world such as Barguna and Bangladesh (Rezwana, 2018; Ray-Bennett et al., 2010). In fact, in Bangladesh, over 60% of the people do not have access to healthcare facilities (Ray-Bennett et al., 2010).

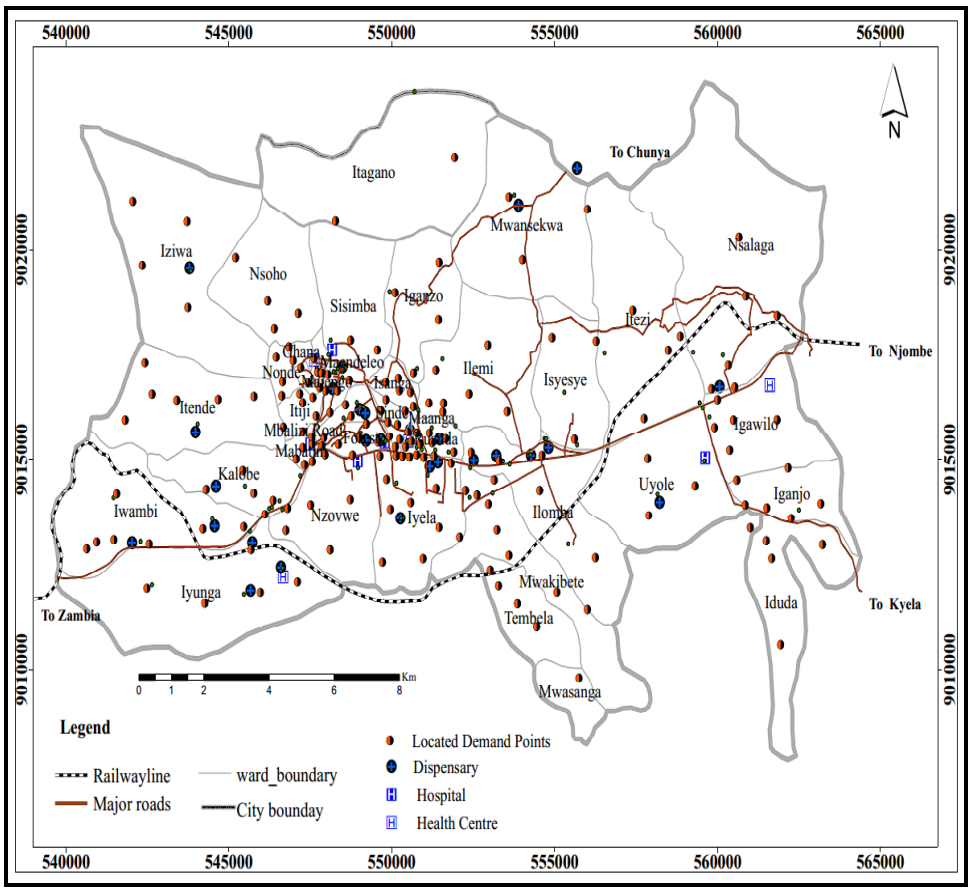

Figure 4: ***Distribution of Demand Points and Healthcare Facilities***

Source: Ngowi and William (2018)

According to the 2012 national population census and statistics obtained during fieldwork, the wards in the study area had approximately 243130 people. 96.9% of the households live in areas that have low accessibility (above 5km). Traveling beyond 5km to access healthcare facilities exceeds WHO's recommended 5km travel distance to access healthcare facilities (WHO, 2016).

3.3 Spatial Locations of Healthcare Facilities and Population Distribution

Figure 5 shows the population distribution by wards in Mbeya city. The highest population (21,794) reside in Ilomba ward. The ward is located in the central business district. It is served by three dispensaries located in close proximity to the main roads. Nzovwe, Mwakibete and Ruanda wards have 14818, 14558 and 14402 people, respectively. While the population of the wards are relatively similar, the distribution of healthcare facilities does not reflect the latter.

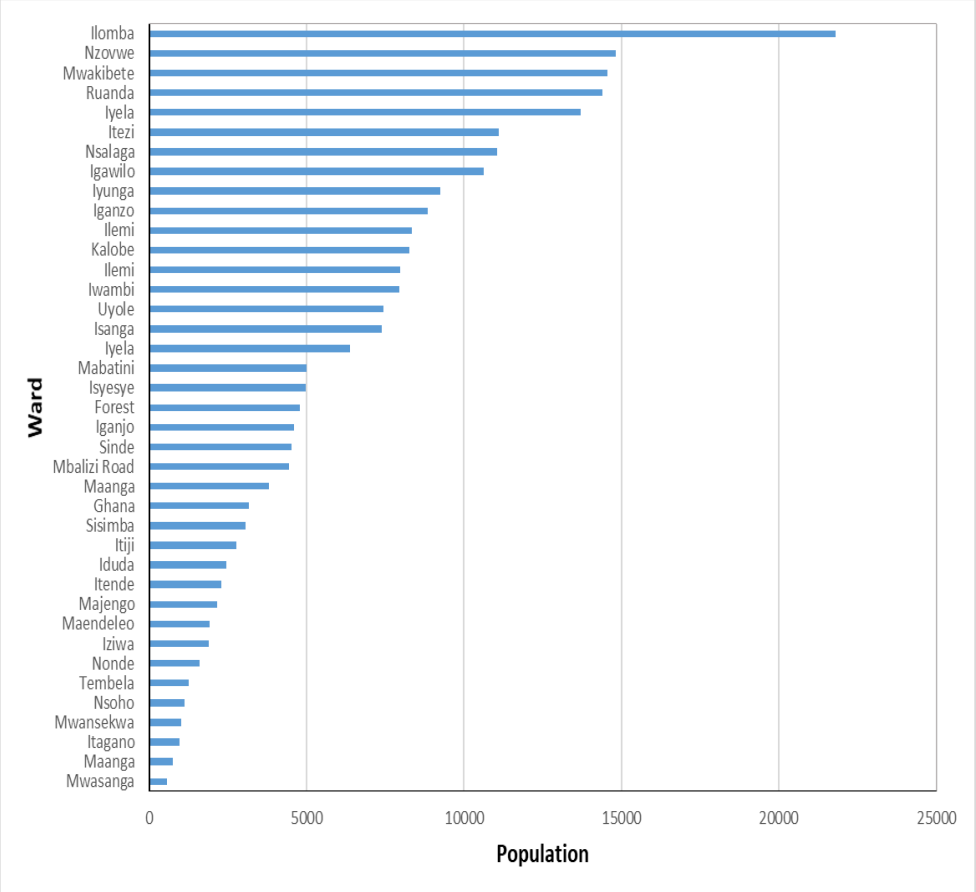

Figure 5: ***Population Distribution by Ward***

Source: URT (2012).

Nzovwe, for example, is served by a hospital located in the ward. Mwakibete ward has no healthcare facility, and Ruanda has a dispensary that serves the high-density population in the area. This indicates a disproportionate spatial distribution of healthcare facilities relative to population distribution in the city. This observed pattern is a common phenomenon in cities that have higher population in developing countries such as Iran (Chavehpour et al., 2019), and Sudan (Ismail, 2020).

Figures 4 and 5, when read concurrently, show a complex relationship between population and demand points where healthcare facilities ought to have been located optimally for people to have a 5km distance to a healthcare facility (Ngowi & William, 2018). The demand points seem to be concentrated in the central business district where there is a high population in the southern than in the northern part of the city centre. This indicates disproportionality in the distribution of healthcare facilities relative to population distribution in the wards. However, the demand points are distributed ubiquitously in all wards. This implies that there is still a need for locating more healthcare facilities to meet population demand for these facilities. This observation indicates that the location of a healthcare facilities does not address the 5km proximity as the WHO suggests (WHO, 2016; URT, 2017).

Against the preceding backdrop, improving spatial accessibility is a critical factor in ensuring people's good health, and saving lives in critical health situations. Spatial accessibility, therefore, determine the response of an individual to saving lives during incidents of illness or any other health issue (Uddin & Mazur, 2014). It may be argued that placing a healthcare facility within the distance of 5km or less will help address large demands (O'Donnell, 2007) depicted in Mbeya city. The 5km catchment area is adequate to cater for the available population within the catchment (Wang, 2000; Oliveira & Bevan, 2006).

4. Conclusion and Recommendation

This paper has shown that the pattern of the healthcare facilities in Mbeya City are concentrated at the centre of the city. The city's physical planning is influenced strongly by the central place theory. The latter implies that there is no people-centred approach in siting of healthcare facilities. Physical urban planning, therefore, is not reflective of the rapidly changing urban land use conditions and population growth. People in the ex-urban have most limited physical access to healthcare facilities, implying that they live in underserved areas of the city. Accessing healthcare facilities costs them time and lives whenever there is need for urgent medical intervention within a short span of time. The distribution of healthcare facilities does not align with the population distribution. This misalignment between the two deprives people the right to access healthcare timely and at affordable costs.

It is recommended that more healthcare facilities be added in the city. The local government or any other interested parties should locate healthcare facilities using a people-centred perspective. Therefore, population distribution should be one of the factors (multi-criteria) needed to decide on optimal areas to locate healthcare facilities. In addition, urban planning of physical space for locating healthcare facilities at the local government level should be reflective of national policies and the recommendations by the WHO. This means that urban planning and health initiatives (local, national, and international) must align with the local context for better delivery of health services to the people in Mbeya city.

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