A Study on the Distribution of and Equity in Accessibility to Health Facilities in Dhaka (North and South) City Corporation

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It is hereby declared that this thesis or any part of it has not been submitted to elsewhere for the award of any degree.

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Dedicated to our families

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ABSTRACT

Healthcare and medical facilities have been recognized as significant elements of urban living. Dhaka is facing a huge development and health crisis as well for being the capital and most densely populated city of Bangladesh. This research is aimed at exploring the existing condition of health facilities from planning perspectives through identify the distribution patter of that particular facility and determining the equity in accessibility to those facilities. , Area under the jurisdiction of two Dhaka City Corporations – North and South, boundary has been selected for this research as study area. It is mainly a secondary database based research. To find out the concentration and distribution, location quotient (LQ) method has been used and kernel density model has been built using ArcGIS. Pivot table, charts and different have been constructed to represent the equity using Microsoft excel and ArcGIS. This analysis indicates that there exists a huge disparity in the distribution and equity in accessibility to the healthcare facilities within the study area. The facilities are mainly concentrated to some specific wards of DCC area and the newly extended wards need to depend on these areas to get those facilities. Some wards such as ward no 1, 19, 27, and 32 of DNCC and ward no 35, 37, 50, and 51 of DSCC are highly dense with health facilities. On the other hand, some wards such as ward 34, 43, 44, 46 of DNCC, ward-6, 7, 34 of DSCC and many other wards are lack of minimum health facilities, not even public and private health facilities.

Moreover, the ratio of the number of public and private healthcare facilities is inversely proportionate to the ratio of the number of low- and high-income people within the jurisdiction of the study area. Even not only from economic perspective, but the deprived areas are also not well connected with other wards availing those facilities. This study will be a great help to planners and policy maker to find out the opportunities and areas to work on and also, help indirectly to achieve the SDG as well through providing proper guiding principles.

LIST OF ABBREVIATIONS

DCC	Dhaka City Corporation
DNCC	Dhaka North City Corporation
DSCC	Dhaka South City Corporation
RAJUK	Rajdhani Unnayan Kartripakkha
HIS	Household Interview Survey
DAP	Detailed Area Plan
RSTP	Revised Strategic Transport Plan

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Health refers to the conditions of physical, mental well-being of a person which is the key element of any development of a state. It is not only the conditions or the state of a people but also recognized as one of the fundamental human rights at the global governance institutions (Shahen, Islam & Ahmed, 2020). The right to health denotes that people despite of economic, social status and other condition should have access to the health services (Ghebreyesus, 2017). It is universally accepted that strengthening of health care facilities is one of the primary responsibilities of the state (Lovely, 1998). Because health system is considered as the societal response to the determinants of health (Islam & Biswas, 2014). But there are some challenges in this area which need to be solved in order to improve the significant level of health services (Health Policy, 2011). Healthcare in Bangladesh is not so sophisticated compared to the developed and developing countries. Though Bangladesh has made great strides in increasing healthcare access for its people, still there is a long way to go (Tashin, 2020). Among all the facts, decentralization of the facilities, regulation and control of facilities for profit maximization are significant ones which lead to socioeconomic inequality among healthcare in Bangladesh (Tashin, 2020).

It is the new era of sustainable development goals which are set out a vision for a world free from poverty, hunger and disease. Health has a central place in SDG 3 which stands for "Ensure healthy lives and promote well-being for all at all ages", underpinned by 13 targets that cover a wide spectrum of the work by the World Health Organization (WHO, 2022). It highlights the importance of proper health facilities planning. It can be assured through a proper distribution of and ensuring accessibilities to health facilities (United Nations Development Programme, 2021). Also weak health systems act as one of the main barriers in reaching the health-related Millennium Development Goals (MDGs) (Islam & Biswas, 2014).

Currently, the world is facing a global health crisis as form of Covid-19. This ongoing pandemic have further showed the importance of the planning of health facilities. The COVID-19 pandemic had a great negative impact on those healthcare facilities, with

massive outbreaks being reported in them all over the world, affecting not only the residents but also the care workers and visitors (Thompson, Barbu, Beiu, Popa, Mihai, Berteanu, & Popescu, 2020). Moreover, due to the existence of inequality among them, all have not been accessible to all classes of people. For being a densely populated country it became a big threat to the cities of Bangladesh, particularly in Dhaka (Zamaan, 2020).

Every year, the government of Bangladesh spends substantial amounts of resources on health services with the expression of dissatisfaction over availability and quality of these services (Mannan, 2013). Although physical accessibility is no longer a major barrier, economic accessibility remains as a major hurdle. The recent population of Bangladesh is almost 167 million which is increasing with the time and Dhaka is the most dense one having a population of 14.4 million (World population prospects, 2019). About 20.5 percent of population are living under poverty line who are the most vulnerable one to health issues. And these poor are the largest users of public health facilities bearing a disproportionate share of the burden of ill health and sufferings (Mannan, 2013).

Being the capital, Dhaka is the largest and most densely populated city of Bangladesh and also recognized as world's ninth largest megacity (United Nations, 2019). Though the built up area of this city is expanding rapidly, there exists disparity in the distribution of public facilities and lack of coordination among implementing agencies throughout Dhaka (Rajuk, 2015; Jahan, & Oda, n.d.). Moreover the unregulated profusion of the private sector and immoral practices of service providers result in high out-of-pocket expenditures for urban poor, leading to debt and further impoverishment (Shafique, Bhattacharyya, Anwar & Adams, 2018). And the health system of Bangladesh desperately is requiring a dynamic leadership that is prepared to design and enforce evidence-based policies and programs in order to fully realize the potential (Islam & Biswas, 2014).

There are several research works regarding health facilities in Bangladesh and all over the world, but most of them are generally done from clinical perspective by different people of medical background rather than on spatial or sociological aspects.

There are a few studies about health facilities in Bangladesh from planning perspective. Some studies have the evidence that there are significant wealth-related inequalities favoring the wealthiest of society in Bangladesh considering many of the indicators (Zere, Suehiro, Arifeen, & Moonesinghe, 2013). In Khulna city, though disparity was found in the distribution pattern of health facilities, clinics are more accessible than hospitals in terms of travel distance. So, it was recommended that heath facilities should be accessible to all income classes of people in any area (Uddin, 2016). Lovely (1998) studied about the delivery system of private health facilities which were emerged in Dhaka to support the rapid growing population besides government institutions after liberation.

There exists disparities in the quality of services provided by both public and private hospitals in Bangladesh (Andaleeb, 2000). Accessibility to public health facilities in terms of financial condition, their poor level of services as well as their utilization have been analyzed for Bangladesh (Mannan, 2013).

Also some researches have been conducted in other developing and under developed countries regarding healthcare facilities. It has been found that in Punjab, India, inter-district disparities exist in provision of health infrastructure and facilities (Kumar & Singh, 2020). In Kano state, Nigeria utilization of health care facilities declines exponentially with the increasing travel distance (Stock, 1983). The relatively good distribution of health facilities was achieved through establishing public health centers at the sub-district level and staffing them through a system of compulsory service for doctors, nurses in Indonesia (Heywood & Harahap, 2009).

To the best of the authors' knowledge, there is no study regarding the distribution and equity of both public and private health care facilities and their accessibility in Dhaka. So, this study will reflect different scenarios of conventional health system of Dhaka.

1.2 Objectives and possible outcomes

The main aim of our study is to explore the existing condition of health facilities from planning perspectives within the boundary of Dhaka City Corporation. Two objectives are set to achieve the goal:

- To explore the distribution of health facilities in Dhaka (North and South) City Corporation
- To study the equity in accessibility to health facilities in study area in terms of population and their socio-economic condition

Spatial pattern of the distribution of health facilities will be identified to find the concentration of facilities throughout the city corporation area and a comparative relation will be built to find the equity among the distribution of different categories health facilities in terms of population and their socio-economic condition as an expected outcome.

1.3 Scopes and limitations of the study

This study only contains the research regarding distribution and equity of health facilities of study area done from population and their socio-economic perspective.

This study will be helpful to policy makers and service provider to find out any suitable location for health facility based on the result of distribution and equity of corresponding facilities. It will also provide an indirect indication the guidelines or planning principles regarding meet up the corresponding sustainable development goals.

Also this study can be replicated for other cities of Bangladesh to find the condition of health system meeting up the basic need of the nation and SDGs for achieving sustainability.

Limitations are also an integral part of a research study. Specially, as this study has been conducted during COVID-19 pandemic, it is full of some special contextual limitations alongside the others.

- To pursue the study, only Dhaka has been selected as the study area to identify the demand and spatial supply of health facilities due to the time and human resource constraints.
- Our study is mainly secondary data based. And the data used in this study are not contemporary because the surveys regarding household information

including household income and composition have not recently been done yet due to pandemic maintaining COVID protocol.

- Due to data unavailability, data transparency and time constraints, service wise categorization of health facilities was not possible to do.
- Moreover only those health facilities have been considered in this study which are referred in Detail Area Plan of Dhaka through structure survey. Also some data were found missing and irrelevant in the database during data processing.
- It was difficult to reach a conclusion with this huge database consisting of more than six hundred health facilities comparing the incomes of thirty thousand households among 14.4 million population.

1.4 Organization of the study

The study is described in detail through dividing the whole discussion into seven chapters. Every chapter of this study has equal importance to carry out the research paper. A brief description of the chapters is given below:

Chapter One: It consists of the background of the study containing the statement of the problem and the justification of the study for selecting this task along with the rationale, aim, objectives and possible outcomes of the study. In addition, it also describes the scope of the study and limitations in conducting the research.

Chapter Two: This chapter deals with various literature related to the topic. The existing research gap has been explained through reviewing some related literatures, and the theoretical framework of the study has been discussed. Actions taken worldwide to address the homogeneous problems and analysis of some historical data have also been discussed in this chapter.

Chapter Three: It describes the methodological and procedural approach of the study to achieve the objectives. It consists of detail work process with different working stages from topic selection to study area selection, data collection, processing, and strategy of analysis in brief.

Chapter Four: It consists of the physical, socio-economic factors and characteristics of the selected study area.

Chapter Five: This chapter focuses on the first objective of the research which includes different analysis such as Location Quotient Method, to explore the distribution of health facilities through Dhaka (DNCC and DSCC) City Corporation.

Chapter Six: This chapter focuses on the second objective of the research which consists of the analysis regarding equity checking in accessibilities to the facilities in terms of population, socio-economic condition and road network.

Chapter Seven: It is the concluding chapter for this research study. Major findings concluded from previous chapters are discussed here. This chapter is an overview of the whole study and associated findings. It also includes the strategies and recommendation for further progress.

This chapter includes a review of literature relevant to the research topic. At first, the related terms are explained along with the definitions of all the components. Then previous research works in this field both in Bangladesh and foreign literatures are reviewed. This chapter also examines the literature on analysis strategy through the theoretical development of the concept and its applicability.

2.1 Related terminology

2.1.1 Healthcare facilities

Health which is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity health is one of the fundamental rights of every human being without distinction of race, religion, and political belief, economic or social condition. The attainment of peace and security is dependent upon the fullest co-operation of individuals and States. The achievement of any State in the promotion and protection of health is necessary to all. Unequal development in different countries in the promotion of health and control of disease, especially communicable disease, is a common hurdle. Governments have a responsibility for the health of their peoples which can be fulfilled by providing adequate health and social measures. (WHO, 2020).

A health facility is, in general, any location where healthcare is provided which can be bring under the range from small clinics and doctor's offices to urgent care centers and large hospitals with elaborate emergency rooms and trauma centers. The number and quality of health facilities in a country or region is an indicator of that area's development and quality of life. In many countries, health facilities are regulated to some extent by law. Health facilities may be owned and operated by for-profit businesses, non-profit organizations, governments, and in some cases by individuals, with proportions varying by country (Ahmadi-Javid et al,2017).According to ownership, health care facilities can be divided into two categories such as public health care facilities which are owned by government and private health care facilities which Hospital not owned by government or parastatal organizations (includes both

private not-for profit, e.g. owned by religious organizations, and private for-profit). By the constitution of WHO, health care facilities can be divided into various categories according to services, service area, target population etc such as general hospital, specialized hospital, district/first-level referral hospital, primary health care center/clinic (World Health Organization,2010), emergency centers, trauma centers. (Ahmadi-Javid et al, 2017) etc.

2.1.2 Accessibility

‘‘Accessibility’’ is an extensively used term in the transportation-planning arena, but it is an abstract concept. Accessibility can be defined through interrelationships between patterns of land use and the nature of transportation systems, also different indicators influence accessibility to various services. Among definitions of accessibility, one definition of accessibility is ‘‘the ease and convenience of access to spatially distributed opportunities with a choice of travel’’ (U.S. Department of Environment, 1996). But quantifying ‘‘ease and convenience,’’ is complex as it is a function of various types of trips and activities which varies across people according to their tastes, preferences, and affordability. Health care facilities are one the basic primary services people need to survive. Different studies shows accessibility to health facilities depends on numerous factors such as spatial interaction, and more specifically on the spatial behavior of consumers. The concept of distance decay, namely that the rate of interaction (utilization) tends to vary inversely with distance, has been a dominant theme. Not only the travel behavior, ownership of the health facilities can be a determinant factor. Manly in developing country such India, the rate of utilization of public health facilities is higher among low income people due to free health service (Muraleedharan et al, 2020).

2.1.3 Equity

Instead, there is a wide variety of notions of equity and fairness in the economics and decision theory literature that depend on the context. The primary concern for equity in resource allocation is treating entities fairly, such that everyone receives the same level of service and no one is at a disadvantage. The allocated resource(s) can be a particular good, or bad, or a chance of good or bad. The entities can be a population,

group of people at some location or belonging to some social classes or organizations, etc. In general, most equity literature aims at equal distribution of benefits between entities (Mostajabdaveh et al., 2019). Although there is no single equity concept that we can use to design inequity-averse HCF location models, there are four key areas of equity research for health systems (Cardoso et al., 2016) such as equity of access, equity of utilization, socioeconomic equity, geographical equity. To ensure the Socioeconomic in health care facilities, government of different countries should invest in public health facilities. Another dimension of equity is social equity .The social equity concept quantifies equity based on how any good received is proportional to the need (Levinson, 2010). For example, the volume of the demand for a particular health service may differ among demand nodes in rural and urban areas. If only a fraction of the demand can be satisfied, measures such as the proportion of the satisfied demand can be used to measure equity and service quality (Karsu and Morton, 2015).

2.2 Distribution, accessibility and equity of facilities related studies within Bangladesh

Among various diversifying factors underlying access and utilization, income is only one factor that might explain access to health services in developing countries like Bangladesh. In a study, it has been stated that although physical accessibility is no longer a major barrier, economic accessibility remains as a major obstacle. The poorest are the largest users of public health facilities though they contribute a disproportionate share of the burden of ill health and sufferings. According to the findings of the survey, low-income people are more likely to use the government health facilities compared to their non-poor or middle- and high-income people. Low-income people seem to utilize government facilities more as well as the rate of utilization decreases with an increase in the economic status of the household. The reason behind this difference is that the rich have the ability to get expensive, but presumably also better quality, private facilities. So, it can be said that economic reasons do play an important role in decision to utilize public facilities and the perceived need for treatment depends on affordability of the persons for treatment (Mannan, 2013).

Inequity affecting the health care system is becoming a major problem in health sector of Bangladesh. In research, it has been suggested the health system faces multifaceted challenges such as lack of public health facilities, scarcity of skilled workforce, inadequate financial resource allocation and political instability but Bangladesh has demonstrated much progress in achieving the health-related Millennium Development Goals (MDGs) especially MDG 4 and MDG 5. Although the country has a growing private sector which are providing tertiary level health care services at a primary level, still Bangladesh is lack of a comprehensive health policy to strengthen the entire health system. Bangladesh does not have adequate number of hospital beds to serve its large population. For instance, Bangladesh has only 0.4 bed per 1,000 population, on the other hand, Ghana has 0.9 bed per 1,000 population. Also, Kenya at the same level of economic development as Bangladesh but it has 35% higher number of hospital beds than Bangladesh. (Islam and Biswas, 2014). The health spending in Bangladesh accounted for 3.4% of gross domestic product (GDP) being lower than the average (3.8%) in Southeast Asia (SEA) region, below the average of low-income countries (5.4%), lower-middle income countries (4.3%), and far below the world (8.5%) (Normand, 1993). In another study, it has been showed Health systems financing in Bangladesh seems regressive. Inequality increases due to healthcare payments where differences between the Gini coefficient and the Kakwani index for all sources of finance are negative indicating regressivity. It has been shown that financing is more concentrated among the poor and the reason behind income inequality is assumed for high out-of-pocket payments. The increase in income inequality because of out-of-pocket payments is 89% due to negative vertical effect and 11% due to horizontal inequity (Molla 2017).

2.3 Distribution, accessibility, and equity of facilities related studies in other countries

In a study, it has been aimed to find applicable location-allocation solutions in uncertain environment, which plays a critical role to ensure access to public facilities and personal demands as China's government makes efforts to invest abundant funds to ensure healthcare insurance and require health cost reductions to 30% by the end of 2018 (Wang et al,2018). Bi-level multiple objective programming is introduced in that study to determine location and capacity distribution concurrently. In addition, a

modified PSO algorithm is utilized to equilibrate the trade-off between complicated and multidimensional objectives. Also, the study presents a location-allocation optimal model for China's healthcare system to enhance availability and accessibility by using bi-level multiple objective programming in an uncertain environment.(Wang et al,2018) In another study, the use of locational quotient, which is a measure of spatial pattern of services, to examine the distribution pattern of healthcare facilities in the thirty local government areas in Osun State, Nigeria has been employed. Some Local Government Areas are marginally advantaged in the distribution of healthcare facilities and amenities in the state such as the thirty local government areas in the state, eleven are marginally advantaged in terms of location of Comprehensive Health Centers, in that their locational quotients have values that are greater than 1.00..(Fadahunsi,2017).

The spatial pattern of distribution of healthcare facilities and a measure of the degree of accessibility to healthcare services have been analyzed in a study of Akwa Ibom State, Nigeria. The distribution of health care facilities in that state is not even. The disparity in facility provision is observed among the 31 local government areas. For instance, 15 local government areas (41.94%) have no general hospitals whereas Abak, Essien Udium and Etim Ekpo had two each while Etinan has three general hospitals. Another perspective from which health care facilities distribution is examined is the index values of the various communities studied.21 communities (42%) have index value of one (1) and above while 13 communities have index values, which indicate poorer access to health care service delivery. In this sense, inequality in the level of health care facilities distribution illustrated in that study. On the whole, communities with index values less than one are disadvantaged communities while those with index values above one are advantaged areas. These findings are in accord with the findings of Inyang (1992, 1994) who pointed out that health care facilities in Akwa Ibom State are inequitably distributed among the local government areas. Generally, some communities have more than their fair share in terms of type of facility being provided. For instance, higher order facilities such as general hospitals and health centers were observed in communities with threshold requirements for health clinics and dispensaries whereas some communities with higher threshold requirements have no facility of any kind and as such, create deteriorating conditions

in some communities than others. On the whole, the overall performance in this sector is fair, as only 20 (40%) communities attained the minimum requirements (Atser et al, 2009).

The impact of spatial factors on health care behavior and their implications for health care delivery have been major themes in medical geographical research. In a study, spatial patterns of hospital utilization in Chicago were mapped and modelled, and spatial allocation models were developed to predict the nature, volume and location of future demand for health care as that levels of utilization and perceptions of accessibility are mutually and positively related (Earickson, 1970). Those who have easiest access to the service might be expected to use it most (since they have less severe barriers to overcome. In another study relationships between frequency of use and perceptions of accessibility were analyzed for patients of asthmatics and diabetics separately, and for the two groups together in Northampton shire, UK. For diabetics, improved accessibility is associated with older age (65+), females, employment, good access to a car, intermediate-high distances to the surgery and short travel times and for asthmatics, improved accessibility is associated with middle older age (45+), males, unemployment, good access to a car, short distances to the surgery and short travel times. It was also suggested in that study that some differences do occur in the utilization behavior and perceptions of diabetics and asthmatics, probably reflecting the different social characteristics, health needs and geographic distribution of the two groups. Differences in the ways in which gender and employment status affect these outcomes are especially apparent between these groups. It is also evident that the determinants of utilization are not the same as those affecting perceptions of accessibility. The results illustrate the complex interplay between social and geographic factors in determining utilization of, and access to, primary health-care.(Field et al,2001) Also in as study of Australia , In Australia, (Jong et al,2004) found that people living in remote and rural areas had limited access to health services compared with those living in the metropolitan areas. Important contributing factors included geographic isolation, poor transport links, shortage of health care providers and an overall lower socioeconomic status. Complex interactions are thus seen to occur between social and locational factors. Moreover, among various factors influencing accessibility, travel distance, geographical location as well as socio-

economic factors play an important in accessibility to health care facilities. Employment activity, and occupational class, are widely regarded as important determinants both of the need for health-care and mobility(Townsend & Davidson 1982).The result of a study in UK shows a valuable insight into some of the factors which appear to influence frequency and ease of healthcare utilization. (Field et al, 2001). New South Wales population, Walker et al found that the poorest socioeconomic group had a 21% higher hospitalization rate in 1996/1997 compared with that observed in the richest sub group, an association which was reversed for private patients(Walker et al,2003).This study aimed to adjust for severity of illness by investigating groups of patients with relatively homogenous health status to evaluate the extent to which rates of hospital utilization varied across socio-economic status, locational accessibility to services and private patient status when adjusted for likely confounding factors such as age, gender, race and comorbidity. In another study, it has been examined that the independent effects of socioeconomic, locational accessibility to services and private patient status on hospital utilization rates in the last years of life in patients who died of the same underlying cause after adjustment for potential confounders. Although the study is repleted with recognizing that socioeconomic status has a marked effect on utilization of health services, the majority of studies have been subject to criticism due to potential confounding by severity of illness. (Moorin et al, 2006). Coory et al investigated the effects of socioeconomic status on utilization of invasive coronary procedures in Queensland. The authors found wide disparities in access. They concluded that free access to health care did not necessarily ensure equitable access. However, in that study there was no adjustment for severity of illness, although adjustment was made for comorbidity, for this reason the results reported by Coory et al were unable to assess equity issues definitively, given that equity requires 'equal access for equal need'. Studies that have assessed health outcome as a function of socioeconomic status have found an inverse relationship between socioeconomic status and mortality (cited in Moorin et al, 2006). Hall et al examined the influence of social, economic and locational disadvantage on lung and breast cancer case fatality in Western Australia, finding that survival was poorer in patients treated in public hospitals, rural hospitals and relatively disadvantaged socioeconomic groups. The authors acknowledged that since no staging

information was available, adjustment for severity of disease was not possible. (Moorin et al, 2006).data suggest that individuals who reside in lower SES neighborhoods may have little ability to control their physical activity in the face of inaccessible environments. Lower SES neighborhoods have fewer physical activity resources and, of the resources available, a lower proportion is free for use. Free facilities are more accessible than pay facilities because anyone can freely use them, regardless of economic means. The data herein suggest that there are not only fewer physical activity resources available in lower SES neighborhoods, but of those resources that are available (Estabrooks, 2003). In a study, wide and significant disparities in access and care experience between US adults with above and below-average incomes that persist after controlling for insurance coverage, race/ethnicity, immigration status, and other important factors. In contrast, differences in UK by income were rare. There were also few significant access differences by income in Australia, yet, compared to UK, Australians were more likely to report out of pocket costs. New Zealand and Canada results fell in the mid-range of the five nations, with income gaps most pronounced on services less well covered by national systems. In the four countries with universal coverage, adults with above-average income were more likely to have private supplemental insurance. Having private insurance in Australia, Canada, and New Zealand protects adults from cost-related access problems. In contrast, in UK having supplemental coverage makes little significant difference for access measures. Being uninsured in US has significant negative consequences for access and quality ratings. (Schoen, 2001).

This study has been conducted through following a well-structured framework containing different necessary steps to fulfill the objectives for achieving the ultimate goal. The steps followed during the research are given below:

3.1 Study area selection

For this study, area under the jurisdiction of Dhaka City Corporation boundary has been selected as study area. For being the capital and most densely populated city of Bangladesh, Dhaka is growing every day. It is the largest city of Bangladesh and world as well. It has already been recognized as world's ninth largest megacity by United Nations (United Nations, 2019). About 20.5% portion of population are living under national poverty line in which the main source of this population is Dhaka due to its socio-economic characteristics. Though Bangladesh has progressed significantly improving living condition through economic growth mostly driven by labor income (World Bank, 2019), recent report shows that progress in national poverty reduction has been slowing down in spite of economic growth especially this condition is alarming in Dhaka for being the center of attraction (Roome, Gapihan & Lee, 2019).

Always Dhaka needs to face rural-urban and economic migration for economic opportunities which accelerate squatter settlement, increasing number of floating people as well as health issues. To support this huge population, Dhaka has been developing in regular manner but still it is being difficult for her to deal with the increasing health related issues and social consequences as well.

Due to nationwide shutdown, low-income groups including day laborers and garment workers have been badly-affected in Dhaka not only from economic perspective but also from physical and mental perspective due to leading poor living condition in congested area while social distancing was the main concern (Shakib, 2020). During COVID it was clearly visible that Dhaka has limited well-equipped hospitals, inadequate testing facilities, but due to some disparity all people did not able to access those facilities in spite of having the need.

3.2 Required data list

To conduct the study and achieving the ultimate goal, two objectives have been set. To carry the research certain variables were selected considering the associated objectives. This study mainly has been done based on secondary database, no primary survey was required as we were able to get secondary data from different sources.

The objective wise variables named geographic location, list of health facilities, no. of available health facilities within boundary, ward population, route/road network, and household income were selected for pursuing the objectives (Appendix B1).

3.3 Data collection process

The data or variables such as geographic location of health facilities and administrative boundary of study area that are required for achieving the first objective have been collected from Dhaka Detailed Area Plan (DAP 2016-35) prepared by Rajdhani Unnoyon Kattripakkha (RAJUK) through field survey.

And the data required to fulfill second objective has also been collected from secondary sources. Ward population has been collected from Bangladesh Bureau of Statistics. And road network that has been used in this study was gathered from Dhaka Detailed Area Plan (DAP 2016-35) and from the road network data that has been used in Revise Strategic Transport Plan (RSTP) for Dhaka prepared by Dhaka Transport Coordination Authority (DTCA). Moreover, the data regarding household income and distribution of different income group within a ward boundary has been collected from Household Interview Survey (HIS).

3.4 Data processing and analysis

To achieve the first objective which is to identify the distribution, list of health facilities with their location in GIS and administrative boundary of study area were required. For the need of the study the facilities have been categorized in two groups: public and Private.

Location Quotient Method

To know the concentration of facilities in terms of population within the boundary, Location Quotient (LQ) value for each ward has been calculated using Location Quotient method which describes the supply of both public and private health facilities within a ward boundary compared to the supply of facilities in the city (Jahan & Oda, n.d.). It represents the disparity in distribution in terms of population distribution in the city. It has also been done to identify the spatial distribution pattern of facilities throughout the city.

$$\textbf{L.Q.} = \frac{\frac{n_i}{p_i}}{\frac{N}{P}}$$

Where, n_i= Number of facilities in ward i

P_i= Population of ward i

N= Number of facilities in DCC

P= Total population of DCC

If the value of the location quotient for this particular facility in a particular ward exceeds l (one), it indicates that the per capita availability of that facility in the corresponding ward exceeds that of the study area as a whole. And value less than l is the indication of deficiency of that facility while a value of l or close to l indicates self-sufficiency.

Kernel Density (Spatial-Analyst Tool)

To understand the existing distribution pattern, spatial analysis has been done in ArcGIS. It represents the density of features in a neighborhood around those features. It mainly works based on the count of the features within a specific area. It calculates a magnitude-per-unit area from point features using a kernel function to fit a smoothly tapered surface to each point.

To achieve our second objective which is to identify the equity in accessibility in terms of population and their socio-economic condition, household income has been collected from secondary sources and has been categorized into three categories: high-

, middle- and low-income group just to compare the distribution of public and private facilities against ward population and distributed income group within ward boundary.

Though this study has been done in recent year, but the population survey was done in 2011. And most of the wards of Dhaka City Corporation area have renamed, reformed, and changed in terms of area and population. So, the population used for this study has been adjusted according to the change of recent years and the population of newly generated wards has also been projected or calculated considering the previous areas and statistics.

Also, the household income data that has been collected from secondary sources has been processed and readjusted according to the requirement of this study. The income data was mainly available for Traffic analysis zones (TAZ) which was made for the purpose of urban transport network development within RAJUK area. But as our study area is Dhaka City Corporation, 96 TAZs has been considered for this study among 141 TAZs in total. And the categorization of income group that has already been mentioned in the data source, has been used to understand the distribution of different income groups within the boundary of study area.

A relationship has been built between the distribution of facilities and income group to represent the disparity and measure the equity in accessibility to health facilities by using different tools and charts of Microsoft Excel for DNCC and DSCC. Also, the ownership type of corresponding health facilities will be considered in this analysis to understand the access of different classes of people during their need. To measure the accessibility buffer analysis has been done using ArcGIS. The buffers have been made from ward centroid to understand the access area of a household indirectly the service area of health facilities within buffer area for that ward.

CHAPTER FOUR: STUDY AREA PROFILE

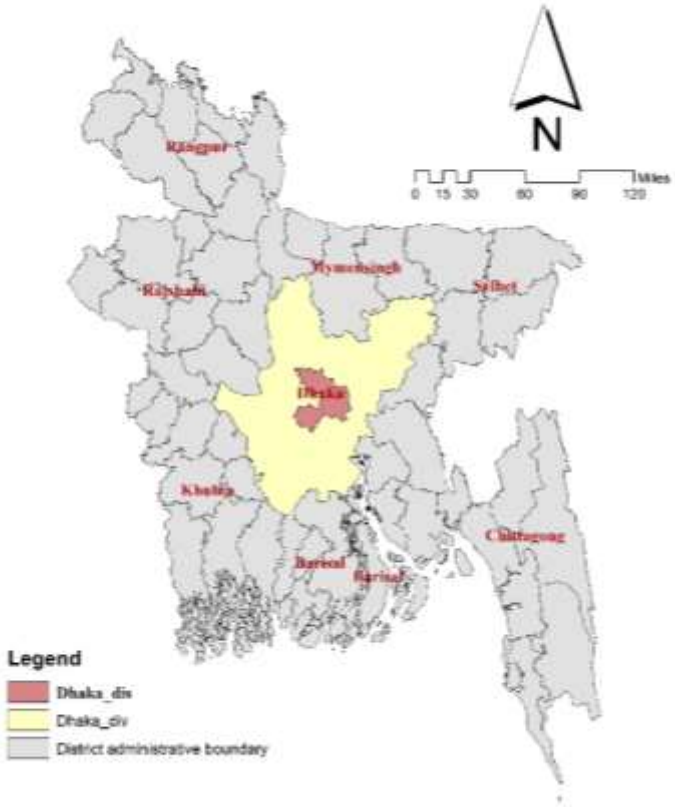
4.1 Introduction

For this study, area under the jurisdiction of Dhaka City Corporation boundary has been selected as study area which is subdivided into two City Corporation: Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC).

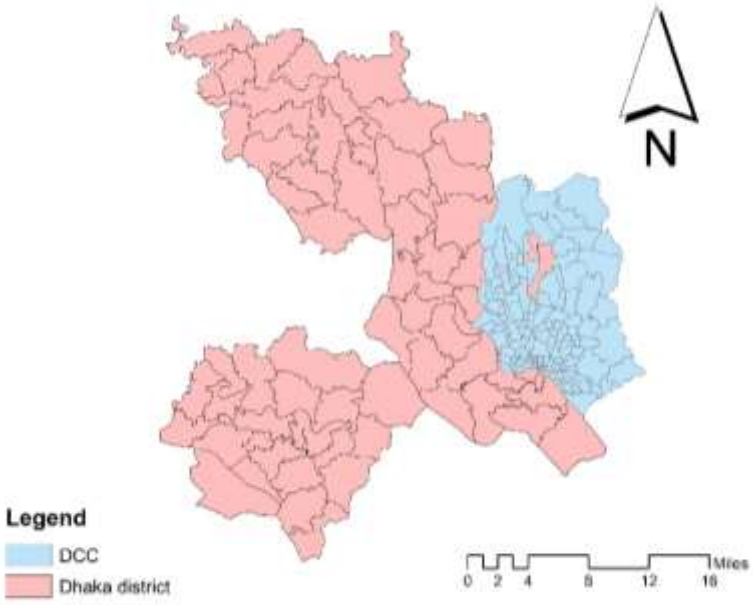
4.2 Area and Location

At present the Dhaka metropolitan area consists of the inner city which is almost built up with semi-built-up surrounding areas. During the period from 1981 to 2000, the greater Dhaka population grew at an average rate of 5.5% from about 3.44 million to 10.0 million. During the same period the built-up area increased from 104 sq.km (39% of the city area) to 150 sq.km (55%). By the year 2015 the expected population of the city is forecasted to be as high as15.7 million. It is expected that Dhaka will become one of the ten largest cities of the World by the year 2020 with a population as high as 20 million and to make provision for accommodation and comfortable living of this large population, creation of new satellite towns adjacent to the city and also new towns around the cosmopolitan city will be necessary. The state of Dhaka's infrastructure is inadequate and unable to keep up with growing urban pressures (Mohiuddin, 2014). The present condition of Dhaka has proved the forecast of growth in both boundary and population of Dhaka.

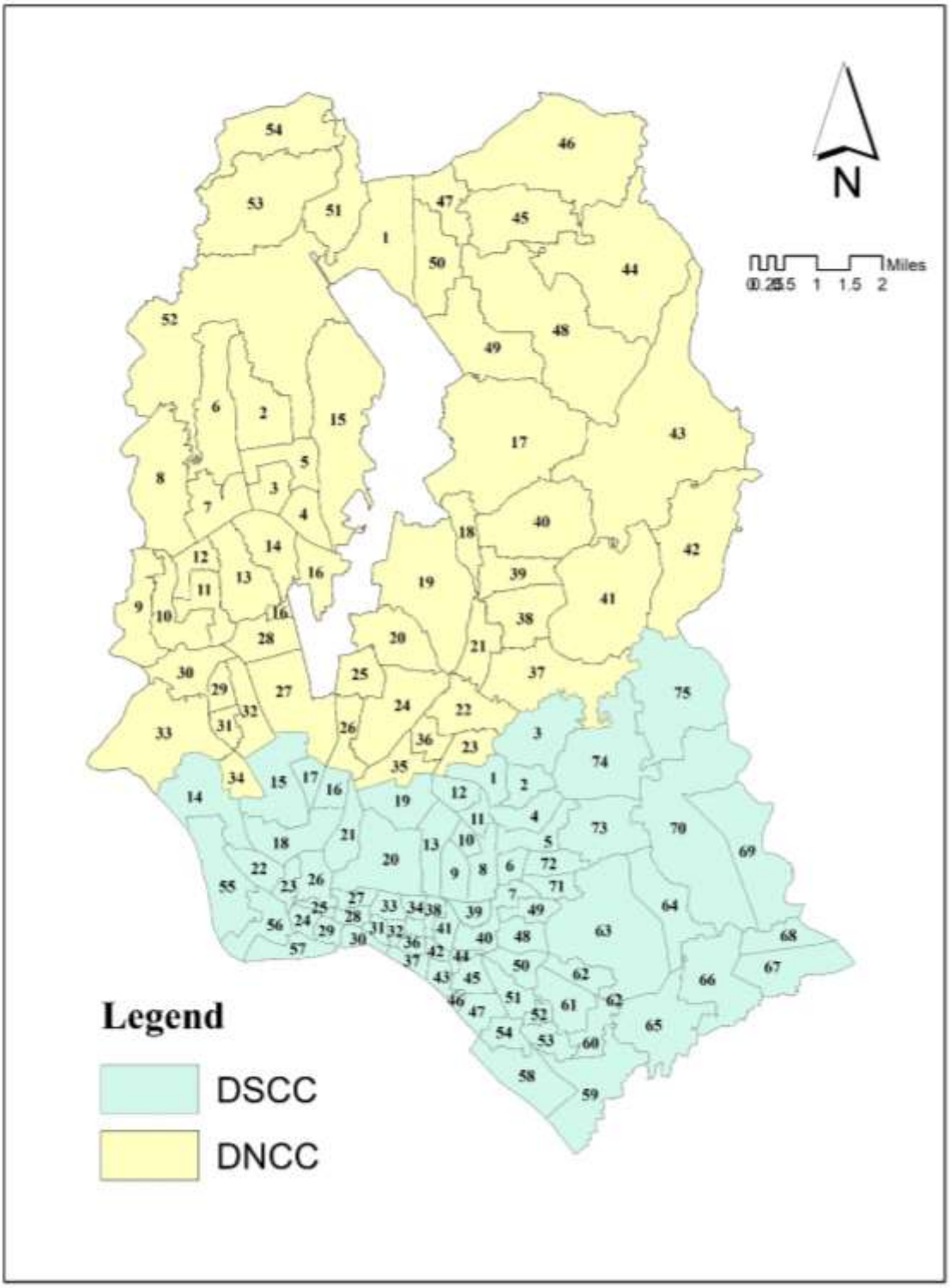
DSCC has been subdivided into 75 wards and DNCC has 54 wards adding recent extensions. Total area of DSCC is 109.251 sq.km and DNCC is 196.22 sq.km. For being the capital and largest city of Bangladesh, Dhaka is the mostly densely populated city having the population of over 18 million while the city itself has a population estimated at 8.5 million with a density of 23,234 people per square kilometer (World population review, n.d.). And now it has been recognized as world's ninth largest megacity (United Nations, 2019).



Map 4.1: Administrative boundary of Bangladesh



Map 4.2: Administrative boundary of Bangladesh with study area



Map 4.3: Administrative Boundary of Dhaka City Corporation
(Source: Rajuk, 2015)

4.3 Population profile

Dhaka North City Corporation having an average population of 94,191 km with maximum and minimum population density of 132919.5 and 1266 per sq.km in the ward no 34 and 43 respectively.

Table 4.1: Area and Population of the wards of DNCC

Ward No.	Area sq.km	Population density per sq.km	Population	Ward No.	Area sq.km	Population density per sq.km	Population
Ward-1	3.91	46877.8	183298	Ward- 28	1.51	43815.7	65984
Ward-2	2.67	56889.9	151868	Ward- 29	0.62	88318.8	54739
Ward-3	1.04	91062.3	94664	Ward- 30	1.69	110354.5	186639
Ward-4	1.13	66670.7	75246	Ward- 31	0.57	90188.0	51384
Ward-5	1.49	79047.7	118110	Ward- 32	1.40	52286.1	72973
Ward-6	3.42	47920.6	163770	Ward- 33	4.92	23328.8	114756
Ward-7	1.83	62116.3	113750	Ward- 34	0.80	132919.5	106548
Ward-8	4.34	25640.6	111251	Ward- 35	1.23	60259.3	74069
Ward-9	2.23	31962.0	71260	Ward- 36	0.75	94911.1	70984
Ward-10	1.89	46473.2	87879	Ext_Ward-37	4.29	17201.4	73756
Ward-11	1.33	73177.3	97033	Ext_Ward-38	2.17	41451.0	89749
Ward-12	0.90	129601.9	116544	Ext_Ward-39	1.59	79632.4	126694
Ward-13	2.41	65102.5	157206	Ext_Ward-40	4.29	15311.8	65740
Ward-14	1.97	83259.6	163797	Ext_Ward-41	6.56	3608.6	23663
Ward-15	6.51	26687.9	173842	Ext_Ward-42	5.85	2553.8	14949
Ward-16	1.62	87862.2	142413	Ext_Ward-43	13.32	1266.0	16862

Ward-17	8.75	22446.0	196479	Ext_Ward-44	8.47	2690.7	22782
Ward-18	1.20	52840.9	63616	Ext_Ward-45	3.62	16323.9	59110
Ward-19	5.68	16945.6	96291	Ext_Ward-46	8.44	3909.3	32982
Ward-20	2.29	43025.8	98618	Ext_Ward-47	1.56	72589.9	112967
Ward-21	1.38	69632.2	96111	Ext_Ward-48	9.21	8809.3	81125
Ward-22	1.96	81943.0	160316	Ext_Ward-49	3.66	22800.8	83488
Ward-23	0.99	64428.5	63763	Ext_Ward-50	2.39	27067.0	64785
Ward-24	3.08	33544.3	103274	Ext_Ward-51	2.63	29253.8	76794
Ward-25	1.19	83522.3	99727	Ext_Ward-52	14.16	4808.0	68065
Ward-26	1.14	59286.9	67876	Ext_Ward-53	6.19	11996.7	74269
Ward-27	3.43	26334.7	90224	Ext_Ward-54	3.47	12157.9	42240

*Ext Ward means the newly added wards to the both DSCC and DNCC.

(Source: BBS, 2011; DAP (2016-35))

In Dhaka South City Corporation, ward no 46 and 70 have the maximum and minimum population density of 274251.7 and 2260 respectively with an average population of 55502.

Table 4.2: Area and Population of the wards of DSCC

Ward No.	**Area (sq.km)**	**Population density per sq.km**	**Population**	**Ward No.**	**Area (sq. km)**	**Population density per sq.km**	**Population**
Ward-1	0.99	69428.7	68931	Ward- 39	0.50	76222.2	38322
Ward-2	0.94	120348.1	113273	Ward- 40	0.75	61789.3	46434

Ward-3	2.61	33243.8	86931	Ward- 41	0.47	86890.9	40587
Ward-4	1.07	77648.1	82701	Ward- 42	0.23	120975.2	27882
Ward-5	1.12	54499.9	60788	Ward- 43	0.46	87201.7	40043
Ward-6	0.53	149811.0	79305	Ward- 44	0.24	111780.5	26939
Ward-7	0.50	115588.0	58316	Ward- 45	0.69	72855.0	50419
Ward-8	1.06	33015.7	34867	Ward- 46	0.15	274251.7	40267
Ward-9	0.89	47508.1	42105	Ward- 47	0.78	61514.3	48028
Ward-10	0.40	54270.5	21968	Ward- 48	0.89	66144.0	58741
Ward-11	0.49	122207.0	59999	Ward- 49	0.66	92479.9	60966
Ward-12	0.77	66746.8	51067	Ward- 50	0.85	67036.4	56766
Ward-13	1.33	44793.1	59639	Ward- 51	0.90	77050.2	69399
Ward-14	2.63	48948.7	128921	Ward- 52	0.31	143294.9	43954
Ward-15	2.66	27235.1	72449	Ward- 53	0.76	77166.2	58954
Ward-16	0.69	115973.0	79983	Ward- 54	0.74	89467.5	66637
Ward-17	0.59	99345.2	58863	Ward- 55	2.65	35736.7	94573
Ward-18	1.90	26013.0	49523	Ward- 56	1.42	57883.8	82069
Ward-19	1.68	33311.8	55920	Ward- 57	0.97	57137.6	55560

Ward-20	3.05	12516.1	38201	Ext_Ward-58	2.23	53924.6	120263
Ward-21	1.16	28887.3	33513	Ext_Ward-59	3.34	19574.3	65381
Ward-22	0.90	93600.1	84519	Ext_Ward-60	0.93	101508.7	93942
Ward-23	0.51	95488.6	48875	Ext_Ward-61	1.44	40700.7	58750
Ward-24	0.44	151973.5	66470	Ext_Ward-62	0.96	80916.2	77730
Ward-25	0.21	140152.4	29832	Ext_Ward-63	6.55	9542.1	62536
Ward-26	0.98	45254.5	44540	Ext_Ward-64	2.40	45553.5	109183
Ward-27	0.44	65467.4	28525	Ext_Ward-65	3.27	26277.0	85806
Ward-28	0.37	66888.8	24656	Ext_Ward-66	3.23	19949.6	64487
Ward-29	0.38	153282.7	58233	Ext_Ward-67	2.34	52464.4	122616
Ward-30	0.43	77590.9	33613	Ext_Ward-68	1.16	36754.2	42505
Ward-31	0.30	117463.0	35656	Ext_Ward-69	4.10	4797.3	19672
Ward-32	0.24	149057.3	36147	Ext_Ward-70	8.18	2260.0	18484
Ward-33	0.47	137884.5	65289	Ext_Ward-71	0.67	58664.4	39215
Ward-34	0.32	160564.3	50624	Ext_Ward-72	0.81	28604.6	23097
Ward-35	0.19	147069.0	28074	Ext_Ward-73	2.62	15724.8	41277
Ward-36	0.27	96928.9	26199	Ext_Ward-74	4.48	6018.5	26991

Ward-37	0.41	44641.1	18170	Ext_Ward-75	5.43	3939.0	21378
Ward-38	0.36	128301.0	46140				

*Ext Ward means the newly added wards to the both DSCC and DNCC

(Source: BBS, 2011; DAP (2016-35))

Socio-economic characteristics of population

In DNCC and DSCC, 56% and 51 % people belong to low income group respectively whereas only 13% and 15 % belong to high income group respectively.

Table 4.3: Distribution of different income groups of people in DNCC and DSCC

City Corporation	**Total population**	**No income**	**Low income group**	**Moderate income group**	**High income group**
DNCC	8155687	40778.44 (1%)	4151245 (51%)	2740311 (34%)	1223353 (15%)
DSCC	4162678	33301.42 (1%)	2322774 (56%)	1273779 (31%)	532822.8 (13%)

(Source: Household Interview Survey (HIS), 2015)

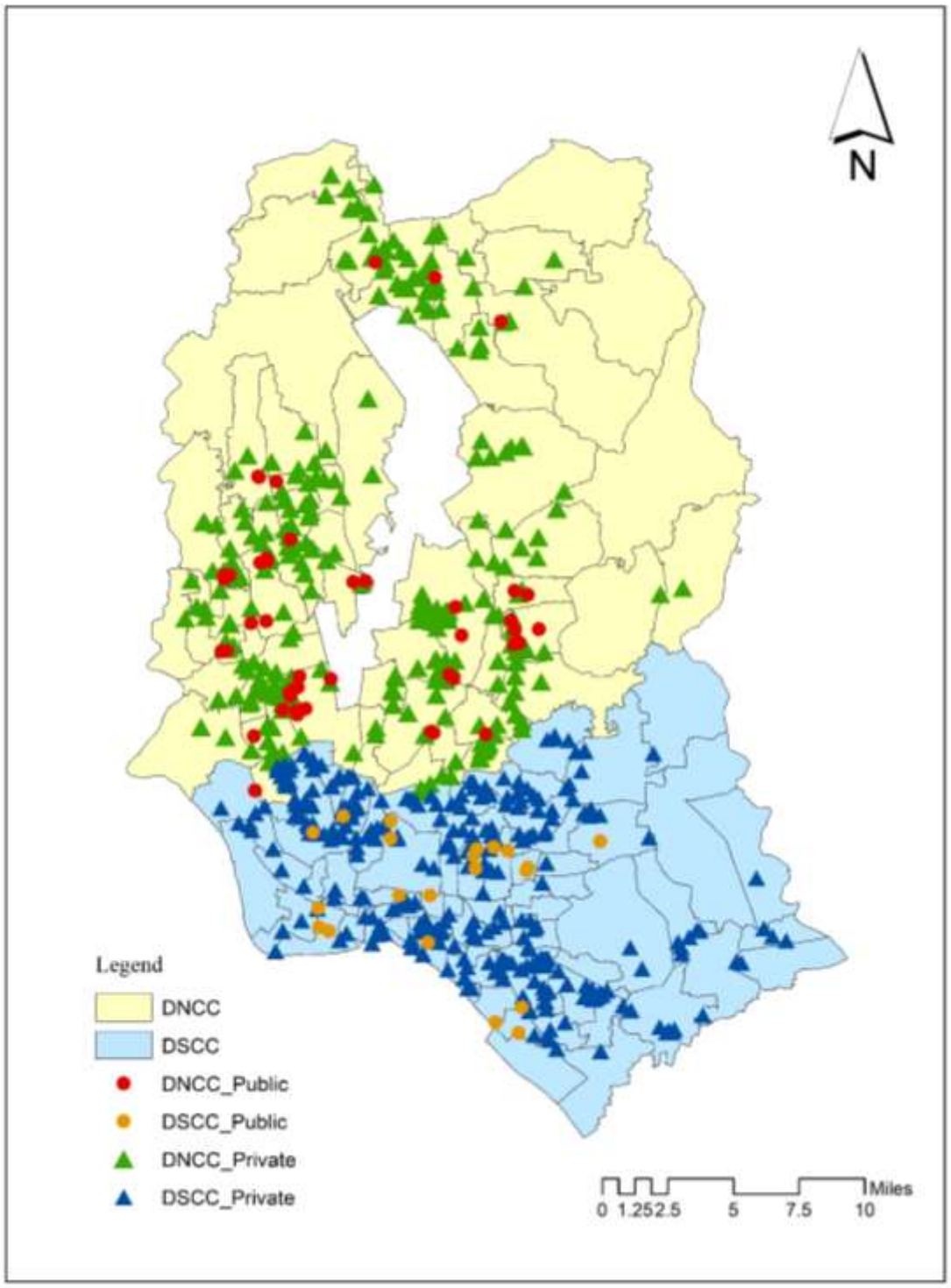
4.4 Health facilities

There are total 661 health facilities (hospitals and clinics) in the DNCC and DSCC area. For the research purpose all facilities are subdivided into two categories: public and private healthcare facilities. Among total the health facilities, 595 facilities which is almost 90% of existing health facilities are private. Ward 1 of DNCC has the highest number of private health facilities which is 21 but there is no public health facilities. Some wards such as Ward 43, 44, 46 have no health facilities in Dhaka North city corporation area. In DSCC, ward 15 has the highest number (31) of private health facilities. Along with ward no-6, 7, 34, 44, some wards have no private health facilities at all.

Table 4.4: Number of categorized hospitals in DNCC and DSCC

	DNCC	**DSCC**
Public Health facilities	45	21
Private health facilities	302	293
Total	347	314

(Source: Dhaka Detailed Area Plan (DAP 2016-35) survey, 2015)



Map 4.4: Number of categorized hospitals in DNCC and DSCC area

(Source: Rajuk, 2015)

CHAPTER FIVE: DISTRIBUTION OF HEALTH FACILITIES WITHIN DCC AREA

To understand the built in planning regarding healthcare facilities in Dhaka city, distribution of this particular facility is needed to be known. Even it is required to identify the lacking regarding distribution and supply of this service within study area and to find out the opportunities to contribute in this sector.

5.1 Concentration of health facilities in wards

To understand the concentration of both public and private health facilities in terms of population within the city corporation boundary, Location Quotient (LQ) value for each ward has been calculated using Location Quotient method which describes the supply of both public and private health facilities within a ward boundary compare to the supply of facilities in the area under the jurisdiction of city corporation area.

For better understanding two Location Quotient (LQ) values have been calculated for each ward. One is comparing to the supply of the facilities in the city corporation boundary as a whole and another has been calculated compare to the supply of that facilities in corresponding city corporation boundary.

Among two City Corporations, the population, area, number of total health facilities (both public and private) of DNCC are more than the DSCC. Even the concentration of public health facilities is self-sufficient in DNCC area considering the whole area of DCC. In spite of that the overall LQ value considering total number of health facilities and even the LQ value considering only the private healthcare facilities are more than 1 in DSCC area which indicates that the concentration of these facilities is more in DSCC area considering the supply of those facilities in the whole DCC area. Though the population and total number of facilities are less than the DNCC area, for the small area of this city corporation, the supply of the facilities have been balanced with respect to the population.

Here the analysis of city corporation wise distribution of both public and private health facilities will be shown separately for DNCC and DSCC.

Table 5.1: The Location Quotient value of DNCC and DSCC area for both public and private health care facilities

City corporation	Area Sq.km	Population	No. of Public health facilities	No. of Private health facilities	No. of total health facilities	LQ value	LQ value for public facilities	LQ value for private faciliti es
DNCC	185.13	8155687	45	302	347	0.7929	1.03	0.77
DSCC	102.85	4162678	21	293	314	1.4058	0.94	1.46

5.1.1 Location Quotient values of the wards of DNCC area

Clearly it has been shown from the figure (Figure 5.1) that there are much more private health facilities existing in this city corporation compare to the public health facilities. Ward no. 13, 27, 38 have highest public health facilities in this city corporation. And Ward 1, 19, 27, 32 have the highest number private healthcare facilities than the other wards of this city corporation. (Appendix B2)

On the other hand, there are only 20 wards where public facilities exist and among those wards most of them are old wards. And so the LQ value only exists for those wards having public facilities, the LQ values for other wards are 0 for not having that facility. Among newly extended wards, only ward no. 38 have only four public health facilities within the ward boundary (Figure 5.3).

Among 54 wards of DNCC, the LQ value of 25 wards are more than 1 for private health facilities which indicates that the concentration or the supply of that particular facilities in those wards is self-sufficient compare to the supply of that facilities within city corporation boundary. Ward no. 19, 27 and 32 are over saturated with these private health facilities and ward no. 1, 20, 23, 51, 52 are medium saturated having

the LQ values differs from two to three. And the rest of other wards are self-sufficient with that corresponding facilities (Figure 5.2).

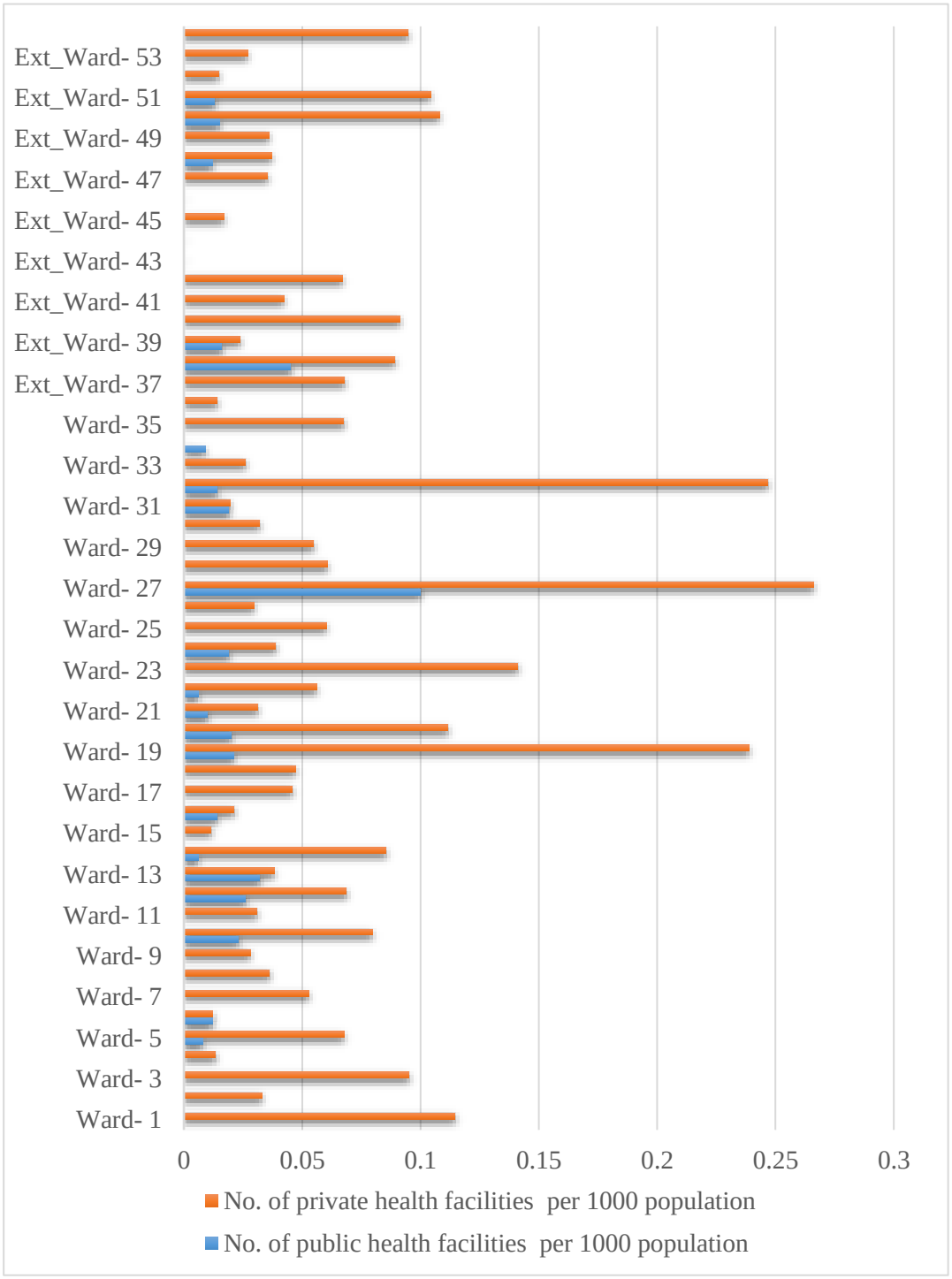


Figure 5.1: Number of total health facilities per 1000 population in DNCC

(Source: Author, 2022)

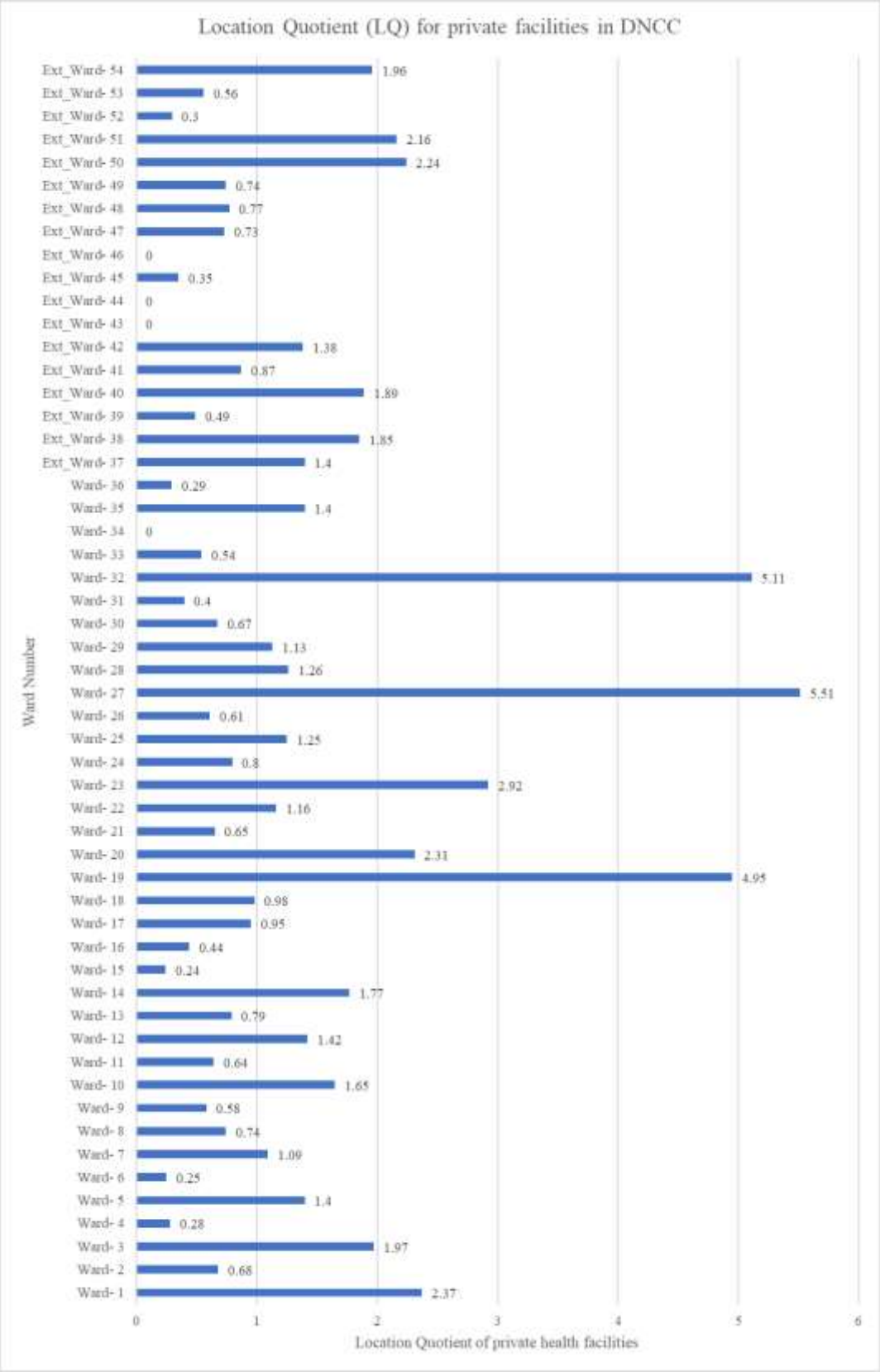


Figure 5.2: LQ values of the wards of DNCC for private health facilities (Source: Author, 2022)

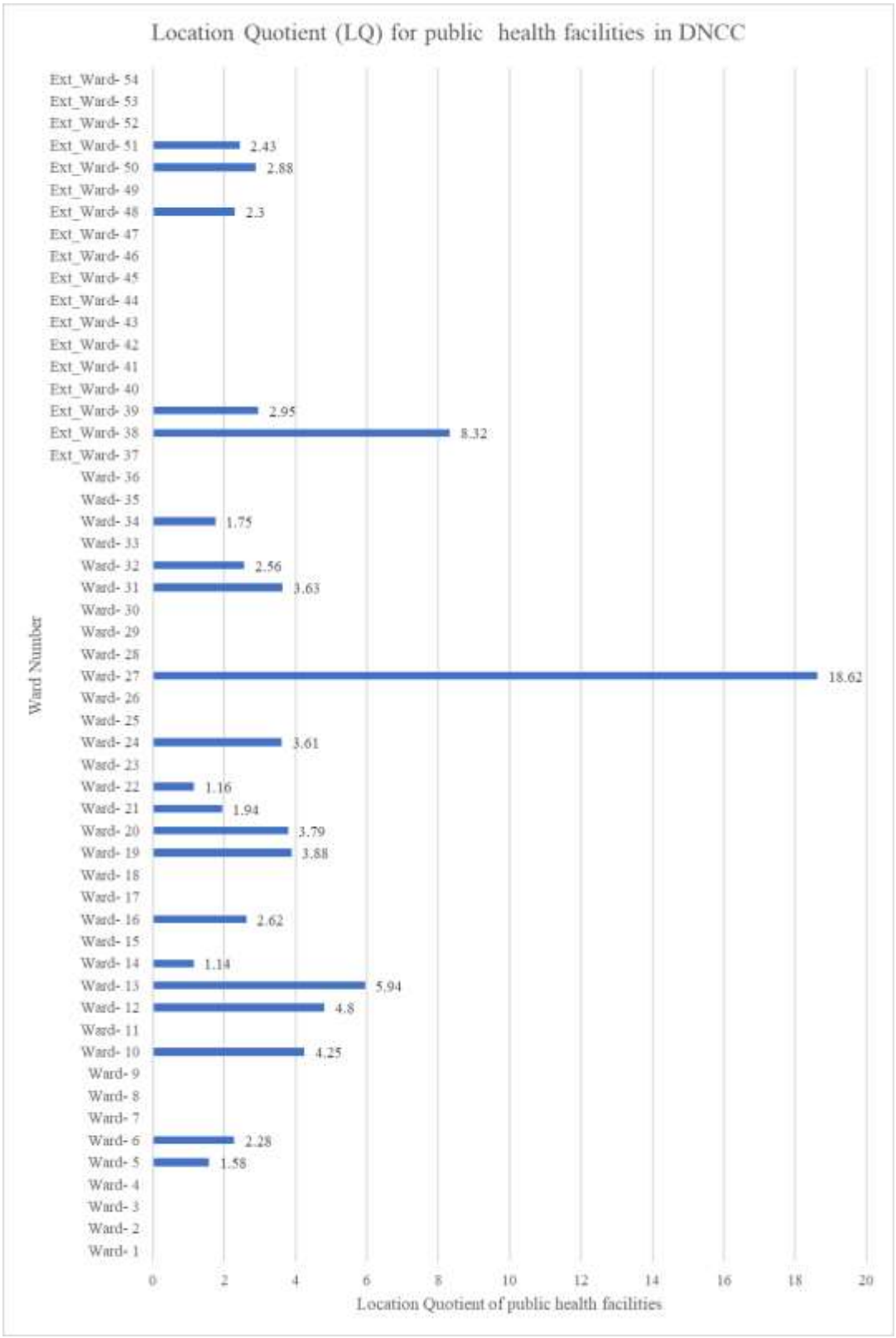


Figure 5.3: LQ values of the wards of DNCC for public health facilities
(Source: Author, 2022)

Above all those wards, Ward no.27 is more self-sufficient and self-sustainable ward in terms of the supply or concentration of both public and private healthcare facilities than the other wards of DNCC area.

But from the table (Appendix B1), the result seems different from table 5.2. If the DNCC area is considered during the calculation of LQ value of wards instead of the whole DCC area, ward-1, 20, 21, 23, 32 has become the most concentrated area regarding the distribution of private healthcare facilities. But the result remain same as table 5.2 regarding the distribution of public healthcare facilities during considering only DNCC area.

5.1.2 Location Quotient values of the wards of DSCC area

It has been clearly visible from the figure (Figure 5.4) that the number of private health facilities are much more than the total number of public facilities. Even though the total number of wards of DSCC is more than the DNCC area, the distribution of total facilities are less in this area (Appendix B3).

There is also an interesting information come indication in this figure (Figure 5.4) that though the number of private health facilities of ward 19, 21, 30, 35, 40 are more than the number of facilities of ward-37, the availability of those facilities per thousand population is much more in this ward than those wards due to its low dense population. So, it can be stated that only the total number of any facilities in any specific area cannot represent the overall condition of that facilities. Also for ward 50 and 51, though the number of private facilities are same, the availability or the saturation of that facility is more in ward-50 compare to the ward-51 due to its low population and area (Figure 5.5).

Due to emergence of new wards in this city corporation in recent years, most of these wards are deprived of public healthcare facilities. The LQ values of the wards having public facilities within the ward boundary indicate the over saturation of the availability of corresponding facilities (Figure 5.6). It’s just because the value is calculated by the ration of number of that facility and population of that ward and the

population of these wards not so much compare to the total population of DCC boundary as a whole.

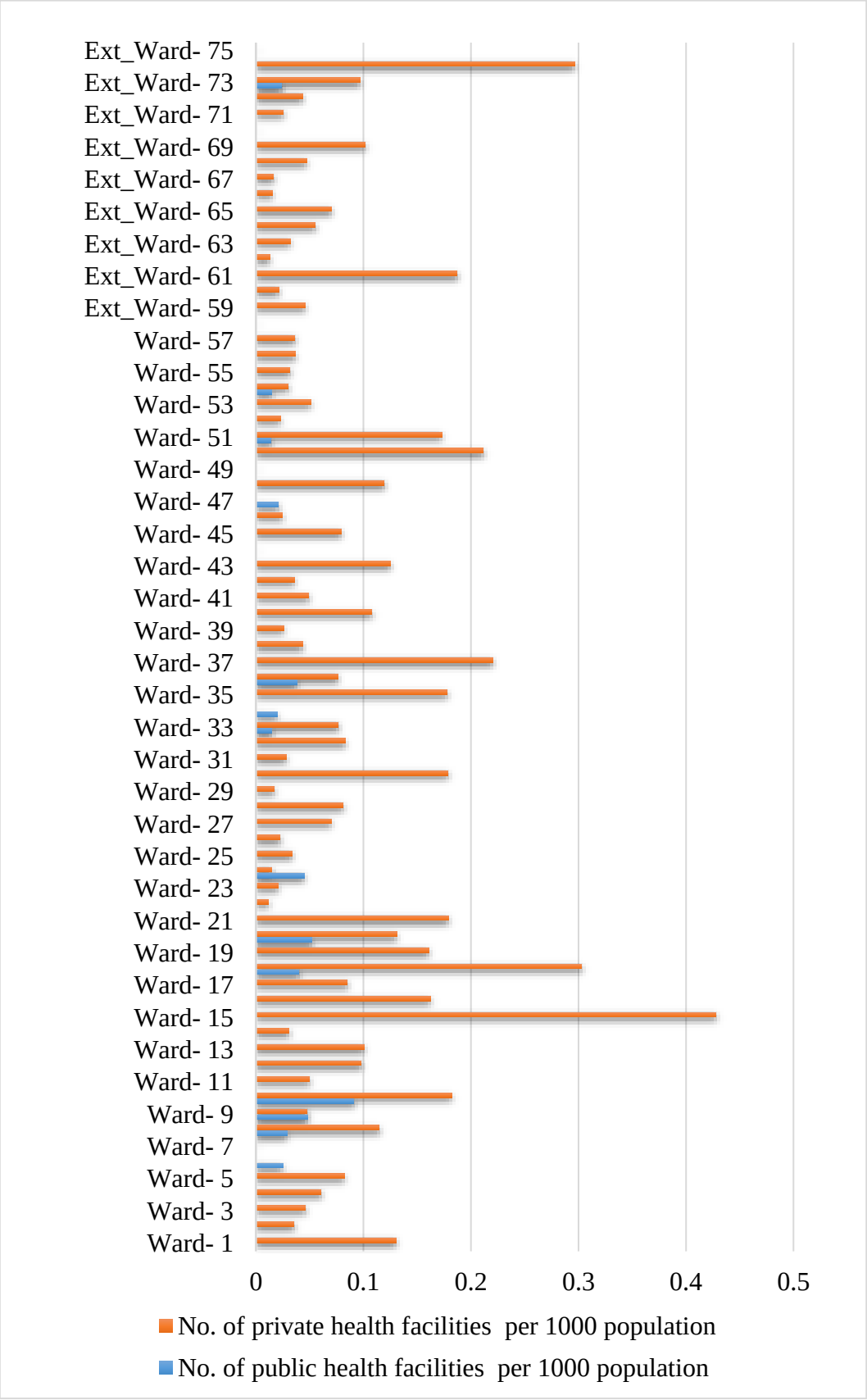


Figure 5.4: Number of total health facilities per 1000 population in DSCC
(Source: Author, 2022)

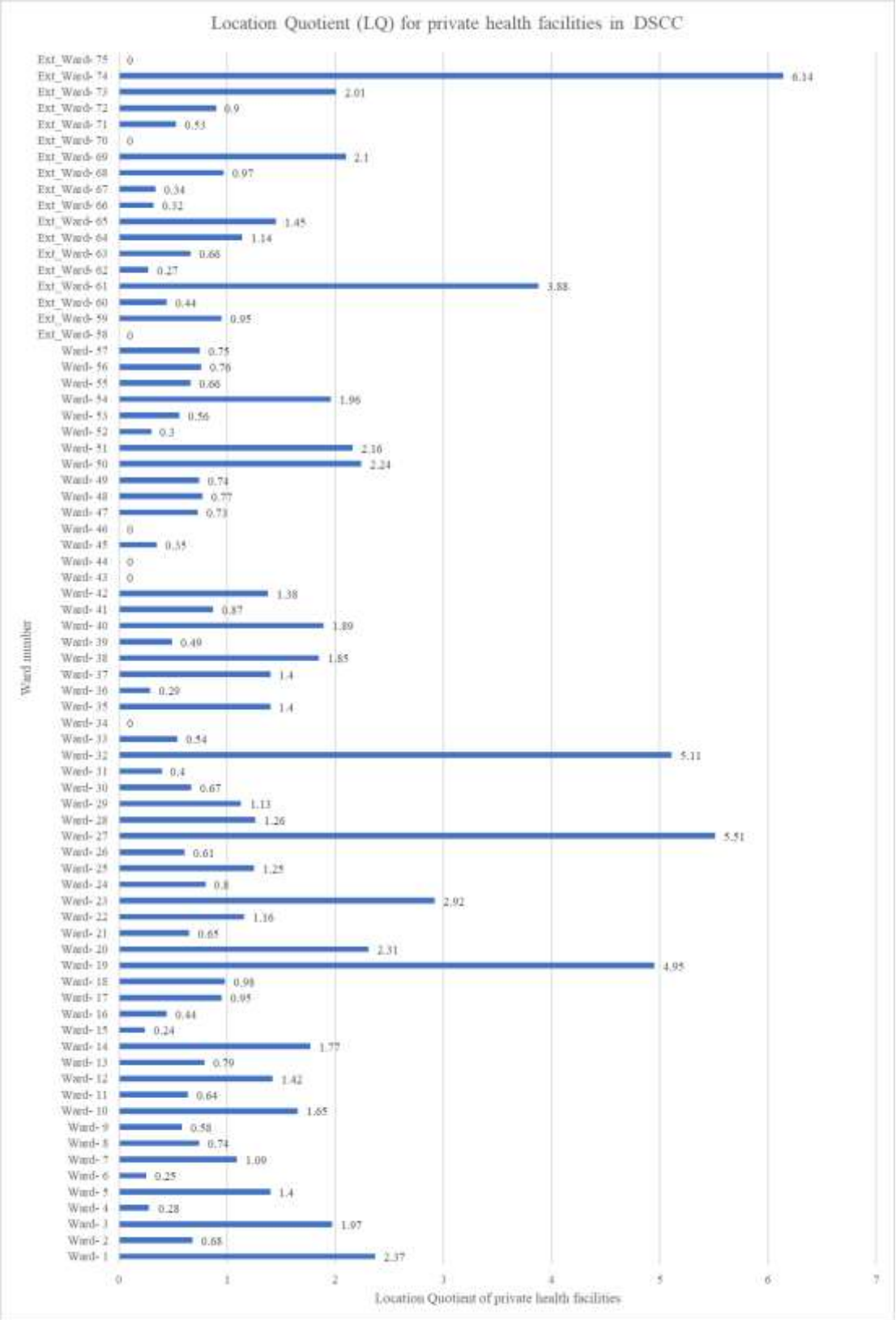


Figure 5.5: LQ values of the wards of DSCC for private health facilities

(Source: Author, 2022)

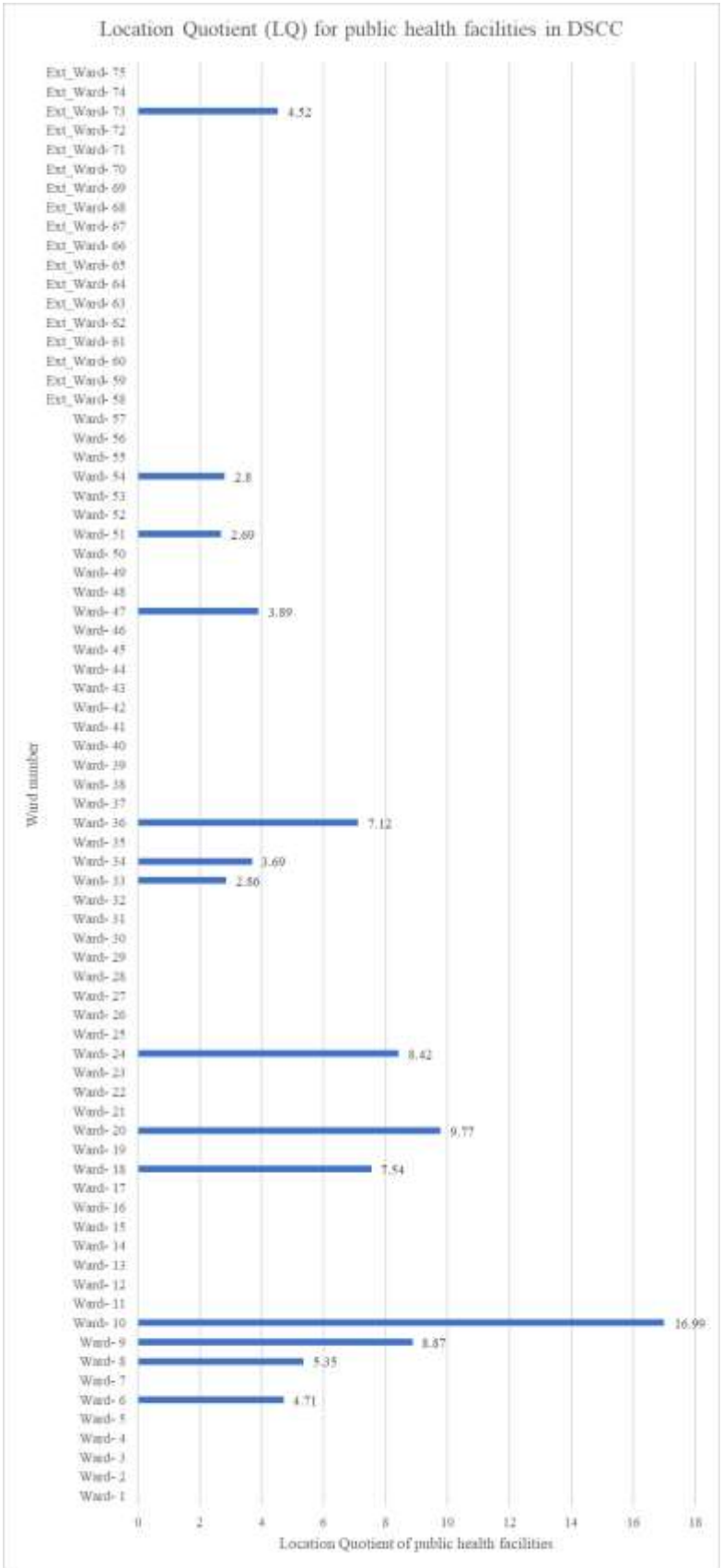


Figure 5.6: LQ values of the wards of DSCC for public health facilities

For both city corporation, it has been noticed that almost 50 percent of the wards meet the demand of the health facilities through private ownership in terms of the population of the study area. Though it is true that private facilities cannot be accessible for all. Among these city corporation DSCC is less deprived of health facilities considering all the factors such as area, population, distribution.

But from the table (Appendix B4), the result seems different from (Appendix B2). If the DNCC area is considered during the calculation of LQ value of wards instead of the whole DCC area, ward-1, 20, 21, 23, 32 has become the most concentrated area regarding the distribution of private healthcare facilities.

In case of DSCC the result remain same as (Appendix B3) regarding the distribution of both private and public healthcare facilities during considering only DSCC area.

5.2 Density of health facilities in wards within DCC boundary

Kernel density

It is an ArcGIS based spatial analyst tool which is used to understand the distribution and density of any particular facilities within a specific area through visual representation. Density (magnitude-per-unit area) of that particular facility is calculated through a built in function in ArcGIS. It represents the density through color variation categorizing the per unit density of corresponding facility. It not only represents the density but also shows up the overlapping service area of corresponding facilities. Kernel density of each type of facilities for each city corporation has been discussed here.

From the kernel density (Appendix A1, A2) for both private and public healthcare facilities within Dhaka City Corporation area, it has been clear that the concentration of this particular facilities is in south-west side of DCC boundary. It is known to all that Dhaka city is expanding to its northern side day by day. So most of its built in areas are in its older side.

5.2.1 Spatial distribution of facilities within DNCC area

- **Public healthcare facilities**

It has clearly been identified from Map 5.2 that the facilities are concentrated in some specific region and the other wards are totally deprived of these facilities. This concentration mainly is shown in the southern part of DNCC area. One of the reasons of the nonexistence of public health facilities in the wards of northern parts are that those are newly formed area which have been generated after 2011. And there is hardly number of public healthcare facilities has been developed. Moreover, due to recent pandemic, development sectors have witnessed a big pause in the work.

Ward no-27 has the high concentration of public health facilities in this city corporation. And these wards 27, 28, 29, 10 to 16, 7, 3, 22, 24, 38, and 39 will be more benefited. The residents of these wards can get the easy access to these facilities in terms of availability and road network. Due to the concentration of those facilities in such area, the people of DSCC area living near the boundary can also easily access these facilities.

- **Private healthcare facilities**

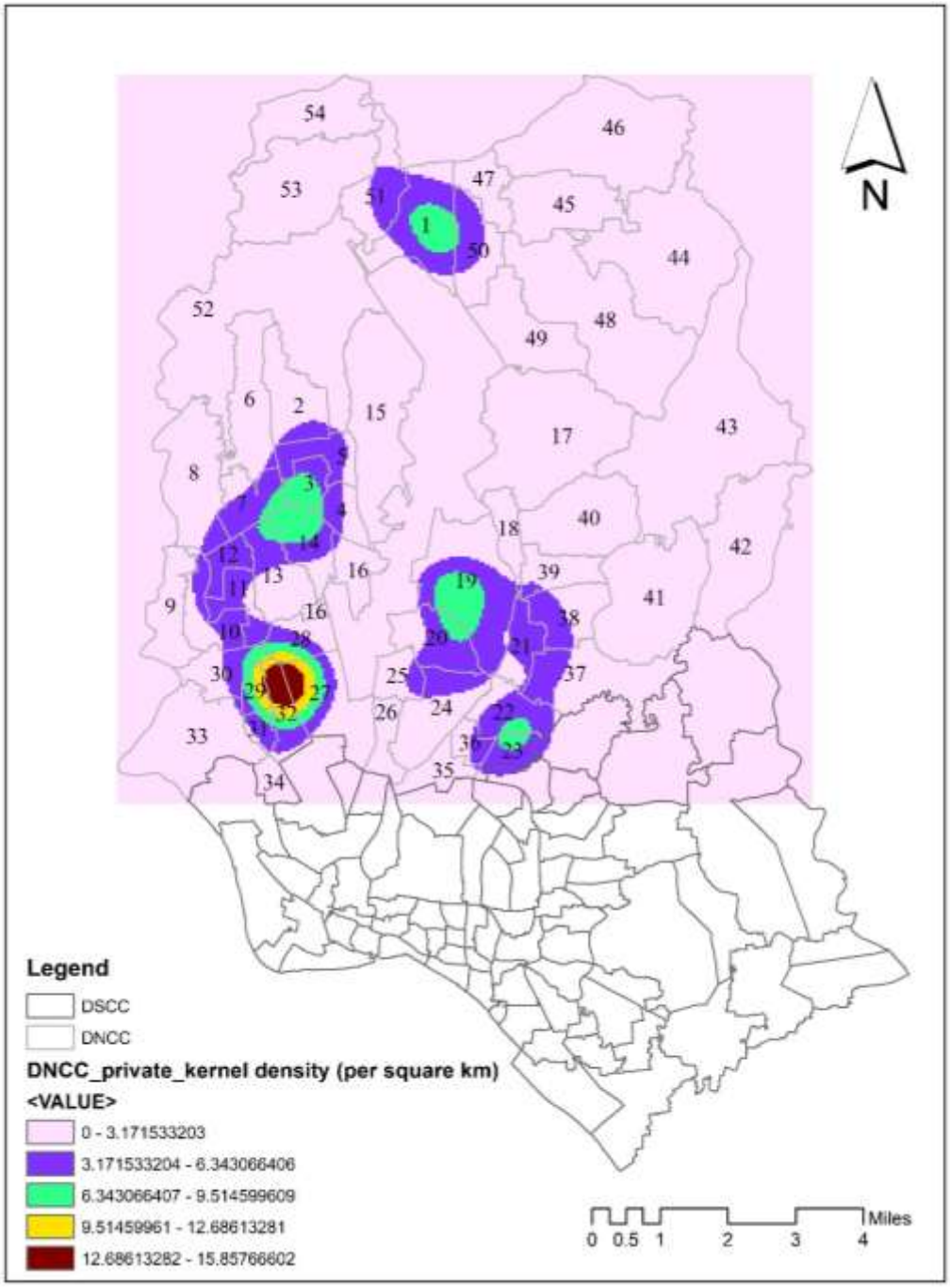
From the Map 5.1, it has been shown that the concentrated area of private facilities are more than public facilities. Even the density of private facilities is more than public facilities which varies from three to fifteen in different intervals. The dense area of private facilities is more spreader than the public one. But it is also noticeable that the distributed private and public, both facilities are almost in same area. To represent the density whole DNCC area is subdivided into five classes.

Table 5.2: Different classes of kernel density of private facilities in DNCC

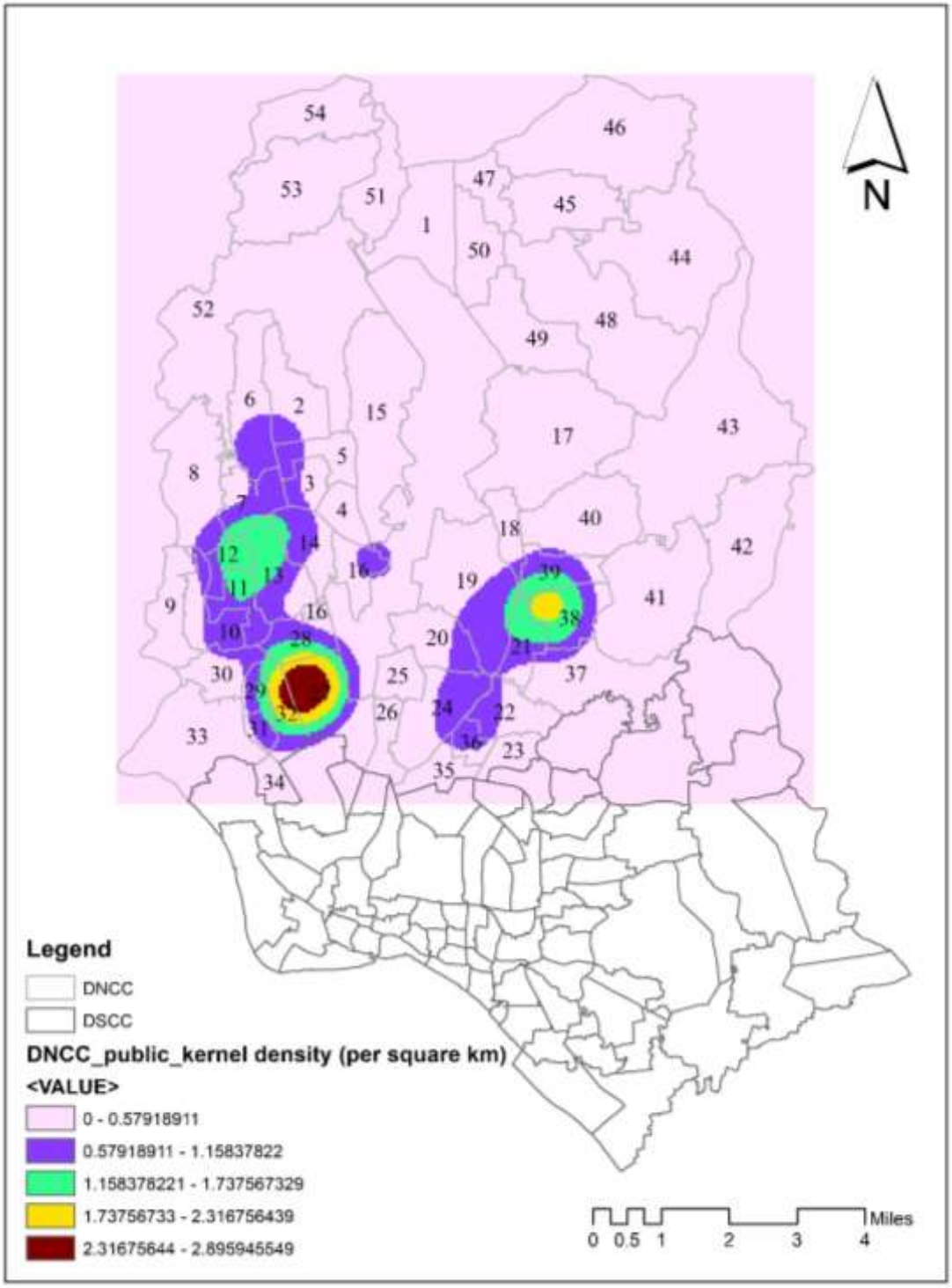
Area	**No. of private facilities**
Very high dense are	0-3
High dense area	3-6
Moderate dense area	6-9

Low dense area	9-12
Very low dense area	12-15

All these facilities were constructed in old wards such as ward-1, 3, 4, 5, 27, 28, 32 etc. which were already existed in the jurisdiction area. And so there are many opportunities to build new healthcare facilities in these extended wards.



Map 5.1: Kernel density of private healthcare facilities of DNCC area



Map 5.1: Kernel density of public healthcare facilities of DNCC area

Mainly some wards of DNCC area are filled with both public and private healthcare facilities and others are deprived of those facilities. Even the area of these deprived wards is higher in comparison to the area of other wards of DNCC. People of those wards need to travel a long distance to able these facilities which is not fair enough

5.2.2 Spatial distribution of facilities within DSCC area

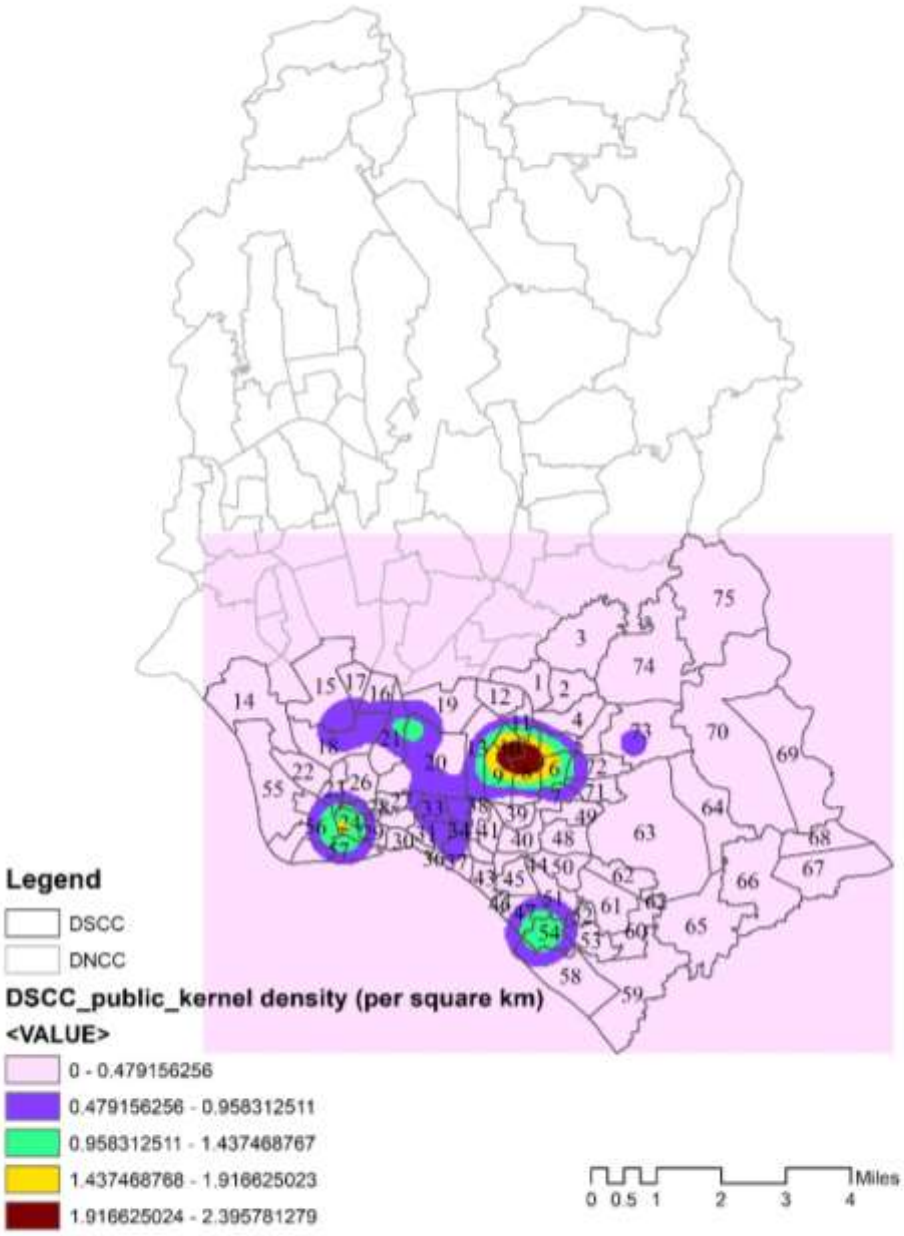
- **Public healthcare facilities**

The coverage area of distributed public health facilities considering the whole area of DSCC area is higher than the distribution of public health facilities in DNCC area. The concentration of public facilities is comparatively less in newly extended wards. The facilities near the DSCC area boundary can easily be accessible to the people of DNCC area living near the boundary.

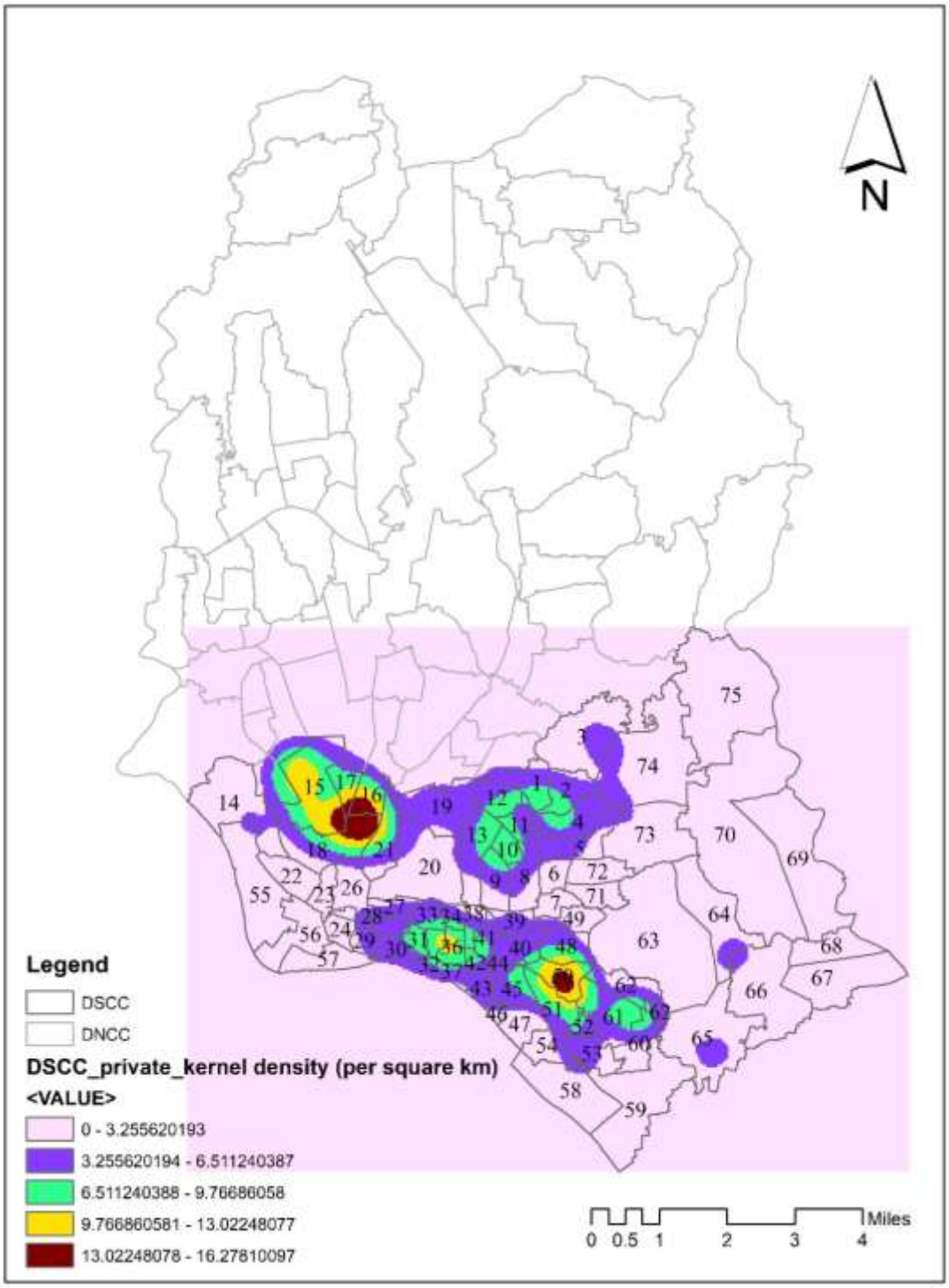
- **Private healthcare facilities**

The concentrated area of private facilities of DSCC area is more than public facilities. Even the density of private facilities is more than public facilities which varies from three to sixteen in different intervals in different wards of DSCC. These facilities almost covers 50 percent areas of DSCC. It mainly dense near the city corporation boundary at northern and southern side. The eastern side of the area is deprived of a well amount of healthcare facilities. And so the people of other wards need to travel to access those facilities. Though the number and coverage area of private healthcare facilities are high, all residents have not the ability to access them due to their socio-economic and demographic condition.

From the below Maps, it is clear that the area, number of facilities of DNCC area are higher than the area and number of facilities of DSCC area. Even the number wards of DSCC is lower than DNCC but the summation of total area of DSCC is low and its population as well. But still the coverage area of these healthcare facilities is higher in DSCC area compare to DNCC area.



Map 5.2: Kernel density of public healthcare facilities of DSCC area



Map 5.3: Kernel density of private healthcare facilities of DSCC area

6.1 Equity in accessibility in terms of socio-economic condition of residents

After analyzing the data collected from secondary source, it has been found that most of the residents are belong to the low income group. For DNCC area, the percentage is 51% which is almost half of the population of DNCC area. And the percentage of moderate income group is almost twice of the high income group (Figure 6.1).

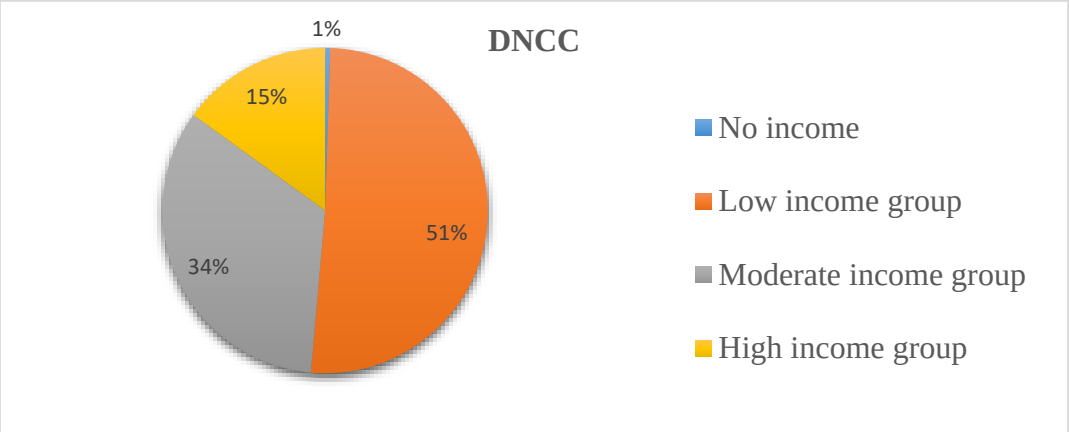


Figure 6.1: Distribution of different income group in DNCC area

On the other hand, in DSCC area, the percentage of low income group is 56% which is more than half of the population of DSCC area. And same as DNCC the percentage of moderate income group is almost twice of the high income group in DSCC (Figure 6.2).

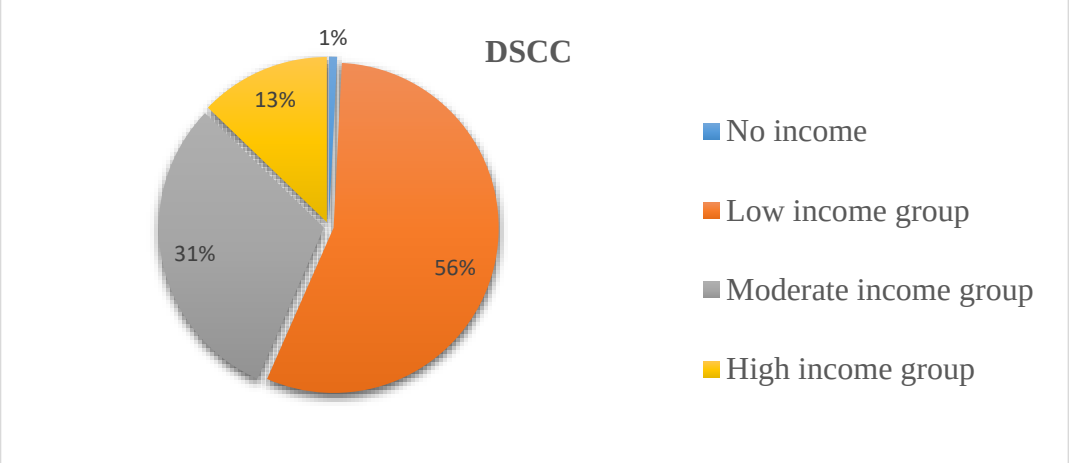


Figure 6.2: Distribution of different income group in DSCC area

In both of the area it has been found that a great number of people lead a low living standard. In both case, more than three-forth population is covered by moderate and low income group of people. And the percentage of high income group varies from 13 to 15. But if we compare the number of categorized health facilities exist within DCC area, it will be found that the number of private health facilities are much higher than the number of public healthcare facilities available in the study area.

Table 6.1: Population and number of available health facilities in DNCC and DSCC

City Corporation	Total population	No. of public health facilities	No. of private health facilities	No. of total health facilities
DNCC	8155687	45	302	347
DSCC	4162678	21	293	314

Though there are a huge difference between the area and population of two city corporations, the number of total health facilities are almost same. Even there is a huge difference in the ratio of public and private health facilities between two city-corporation. The ratio in DSCC is almost twice of the ratio of DNCC. Tough the distribution of different income groups throughout two city corporations are almost similar, the facilities are more available and accessible to the residents of DSCC compare to the residents of DNCC.

Table 6.2: Distribution of different income groups of people in DNCC and DSCC

City Corporation	Total population	No income	Low income group	Moderate income group	High income group
DNCC	8155687	40778.44	4151245	2740311	1223353
DSCC	4162678	33301.42	2322774	1273779	532822.8

After comparing the socio-economic condition of the residents of DNCC and DSCC with the number of available public and private health facilities, found result has been divided into two cases such as:

- In first case, it is taken account into that only low income groups access the public health facilities and moderate and high income group access the private health facilities.
- In the second case, it is taken account into that the low and moderate income groups access the public health facilities and only high income group access the private health facilities due to its high cost.

According to the first case, it has been found that only 1 public health facilities is available for 1 lac low income people in DNCC and 7 to 6 private facilities for each 1 lac moderate and high income people. In comparison to DSCC, there seems a huge difference. Though almost 1 public facility is available for low income group, there are 16 private facilities for each 1 lac moderate and high income people.

Considering the second case, it has been identified that for each 1 lac moderate and low income people, there are almost one public health facilities is available both in DNCC and DSCC where for each 1 lac high income people the number of available private healthcare facilities varies from 24 to 54 which is almost 25 to 55 times of the number of available public healthcare facilities for low and moderate income people.

Table 6.3: Number of available health facilities for different income group in DNCC and DSCC

City Corporation	**No. of public health facilities per 1 lac low income people**	**No. of public health facilities per 1 lac low and moderate income people**	**No. of private health facilities per 1 lac high and moderate income people**	**No. of private health facilities per 1 lac high income people**
DNCC	1.07	0.65	7.62	24.69
DSCC	0.89	0.58	16.22	54.99

It is a well-known truth to all that, the medical cost of any private health facility is very expensive for having the better and expensive medical equipment and it is almost impossible for any low income people to access them still having the need. In some

cases, it has been found that the middle or moderate income people sometimes prioritize their health issues over other needs. So they access the private facilities to get the better treatment facilities.

In above both cases, for both in DNCC and DSCC, there exists huge disparity in the distribution and equity in accessibility in terms of socio-economic condition of the population.

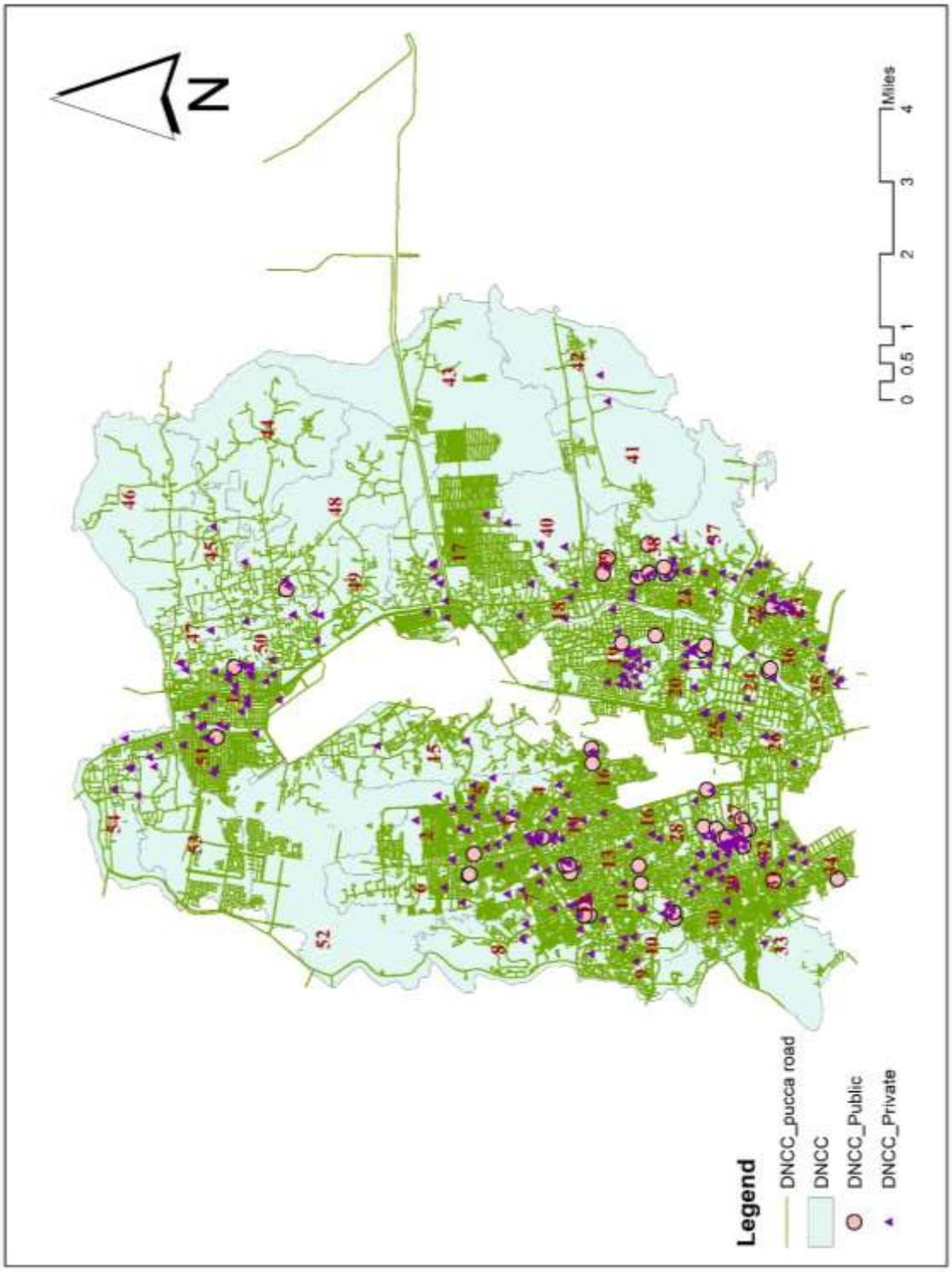
6.2 Equity in accessibility in terms of road networks

Accessibility to a facility is cannot only be represented by the economic factor but also be measured in many ways such as in terms of road network or through direct access gate or way.

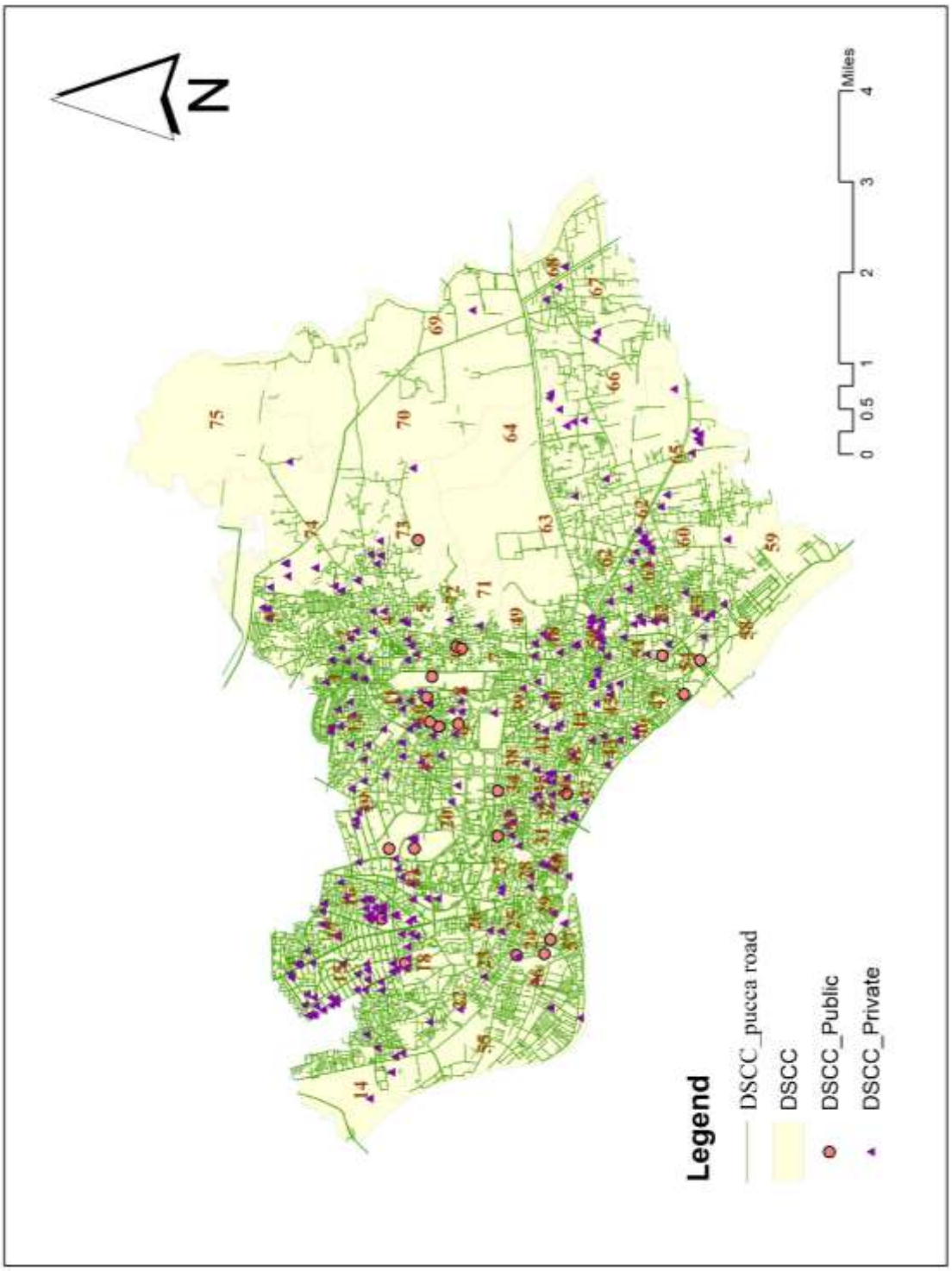
Health facility is such kind of facility that if the road network is not good enough or if they are not well connected with the neighborhood, it would not be accepted as well accessible facility. Because health related facilities need to be accessible in any kind of emergency situation and so well connected road network is prerequisite. Road type, condition or material are such kind of factors that determine the well accessible road network.

In DNCC area, it is clearly visible from the map (Map 6.1) that pucca roads only exist around the available healthcare facilities or the facilities have been built there as a result of spreading effect of the development. Also it can be identified as the result of linear development in which most of the development or construction work of facilities have been done on both side of the road. But it is also visible from the figure that ward-40, 41, 43, 52 are not well connected by pucca road with other wards and facilities near these wards as well. Mainly these roads and facilities are in the old wards and the deprived wards are the newly extended areas of DNCC.

From the Map 6.2, of DSCC area it is noticeable that more than 50 percent of the roads are pucca covering almost all the wards of DSCC but still in ward-63, 64, 70, 71, 73, and 75 there are less number of pucca road and healthcare facilities as well. So, clearly the residents of these wards need to travel to get that particular facility. And this requires well connected road network which these wards are deprived of.



Map 6.1: Pucca road of DNCC with distributed health facilities



Map 6.2: Pucca road of DSCC with distributed health facilities

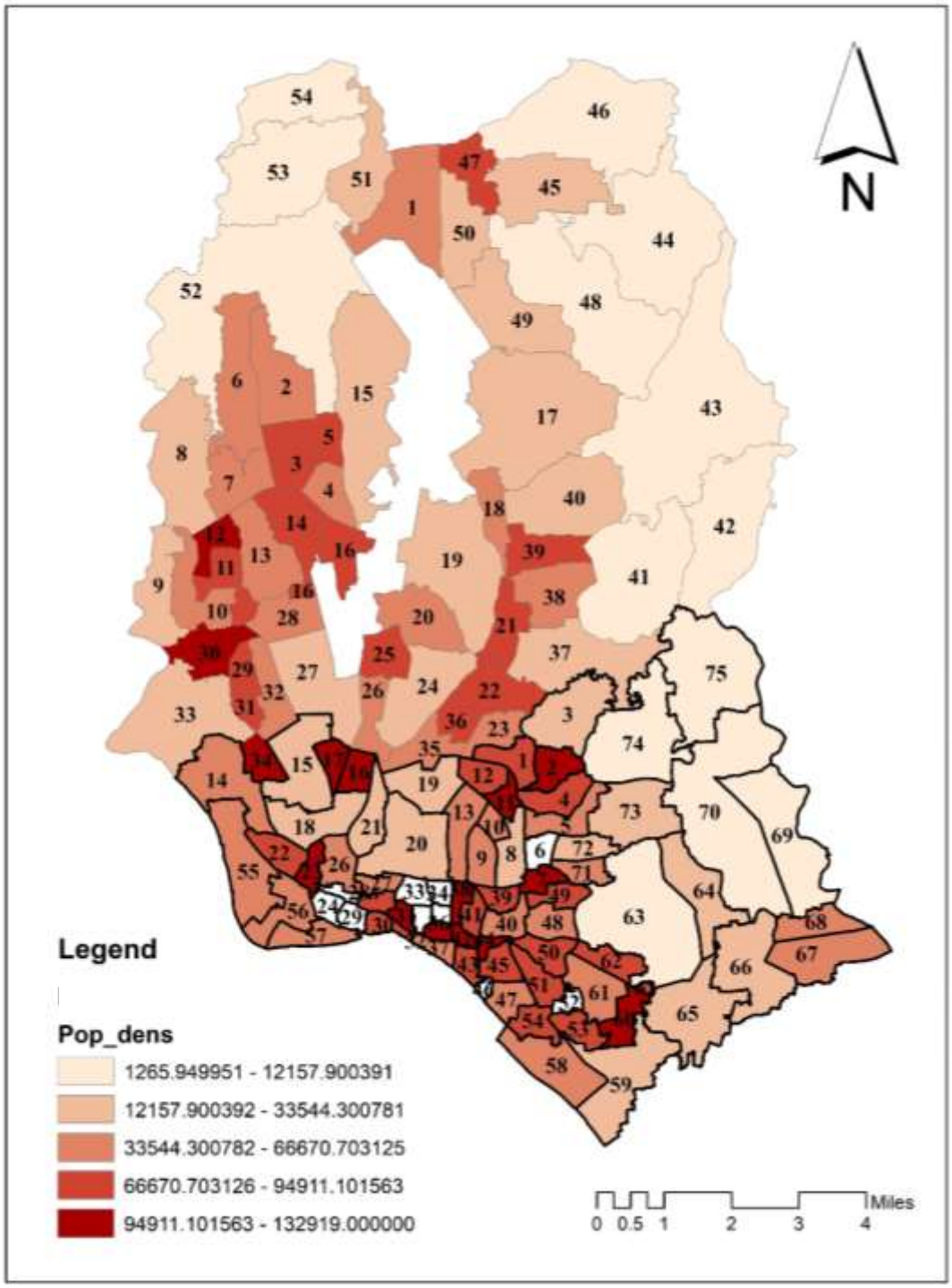
As these wards are newly extended from the old ones, the existing facilities are not well of there. But with time there is increasing opportunities in different sectors like this one.

6.3 Equity in accessibility in terms of population density

Generally, higher densely populated area is in need of higher provision of health facilities. In our study, in both city corporations (DNCC & DSCC), all wards are not evenly distributed with health care facilities, not even population in those wards are not equally distributed. It has been seen that wards with high population density do not have high density of health facilities, also some wards with high population density has poor amount of health facilities.

It has been found that ward no 27, 29 and 32 have the highest density of public health facilities. Most of the public health facilities are concentrated in some wards such as 2, 3, 4, 5, 10, 11, 12, 13, 19, 20, 21, 22, 23, 30, 31, 36, 37, 38 (Map 5.2). Apart from ward no 1, 50, 51, the concentration of private health facilities has been seen in the similar wards where public health facilities are located (Map 5.1). If the distribution of population is noticed, it has been seen ward no 12, 30 and 34 are the most densely populated where some public health facilities are located. If the second most densely populated areas such as ward no 3, 5, 11, 14, 16, 29, 31 has been analyzed, these wards have some health facilities but not as much as population density (Map 6.3).

If the concentration of public health facilities has been analyzed, in DSCC, high densely area with health facilities are ward no 6, 8, 9, 10 (Map 5.3). Unlike DNCC, differences of density of private and public health facilities has been noticed. Ward no 15, 16, 17, 18, 50 have the highest density of private health facilities in this city corporation (Map 5.4). In the comparison of population density and density of health care facilities in this city corporation, it has been demonstrated that some wards such ward no 16, 17 have both the highest density of population and health care facilities. Some wards such as ward no 2, 11, 23, and 31 have high density of population but not high density of health facilities (Map 6.3).



Map 6.3: Map showing population density in DCC area

7.1 Major Findings

The study's primary objectives are to explore the distribution of health facilities and identify the equity in accessibility in terms of residents' socio-economic condition and population throughout the Dhaka City Corporation area.

For being health one of the most significant basic needs and most crucial topics, healthcare facilities should be accessible to all the people of different areas. But still due to socio-economic condition, people do not get the access. To measure this accessibility to health facilities, the distribution and equity measurement are needed to be done.

This chapter concludes the research by proposing some recommendations based on the significant findings. Major findings of the study are described as follow:

7.1.1 Distribution of health facilities in DCC (both in DNCC and DSCC)

- Among the city corporations, DNCC has the lower LQ value than DSCC of total health facilities which means DSCC has more health facilities concentrated than DNCC. Though DNCC area has more population and total number of facilities than DSCC, for the small area of this city corporation, the provision of the facilities have been balanced with respect to the population in that area. Dhaka, being a city of many problems, traffic jam is one of the problems. So concentrated facilities specially, health facilities will not that much helpful to the city dwellers. So the facilities should be accessible at the shortest distance from dwellings.

- DNCC has sufficient public health facilities according to the LQ value whereas the area is lack of enough private health facilities. On the other hand, though DSCC has enough private health facilities but it is lack of the provision of public health facilities. In most of the cases, having many private health facilities is not a benefit. Because many people do not have the access to those facilities due to their socio-economic condition.

- Some wards such as ward no 1, 19, 27, and 32 of DNCC and ward no 35, 37, 50, and 51 are highly saturated with health facilities. The reason working behind might be the trend of concentrated development of facilities in Dhaka city. It has been seen, when any Development of any facilities happens in this city or in our country, it happens in a particular area. It is also known as the spreading effect of development. That's how CBDs like Motijheel, Banani have been emerged. Sometimes this uneven distribution becomes very useful in any way for city dwellers.

- Some wards such as ward 34, 43, 44, 46 of DNCC, ward-6, 7, 34 of DSCC and many other wards don't have minimum health facilities, not even public and private health facilities. Investors may not be willing to invest for private health facilities in those area due to less profit, geographical location and less development potential which may not give them advantages to earn much profit.

- As Ward no-27 of DNCC has the high concentration of public health and other wards such as 28, 29, 10 to 16, 7, 3, 22, 24, 38, and 39 will have easier access to public facilities in terms of availability and road network.

- Newly extended Wards have been found to have less provision of public healthcare facilities than old ones.

- The eastern portion of DSCC has been deprived of the provision of health facilities. So the dweller of those wards have to travel more.

7.1.2 Disparity in equity in accessibility to health facilities within study area

- For not having health facilities within the area the demand of health facilities of those newly extended wards need to be fulfilled by the facilities from other wards which require well connected road network to have the access.

- The demand of health facilities of 50% of the wards have been meet up through private ownership. But according to many studies, private health facilities are not accessible to all income group. Being a developing middle income country, low income people are highly dependent on public health facilities. And a huge

number of population are living under poverty line. Though the overall economy is growing, there is a break in the economic growth from an individual perspective. And recently more people have faced financial crisis due to pandemic.

- There is only one public health facility available for one lac low income people in DNCC and 7 to 6 private facilities for each 1 lac moderate and high income people. On the other hand in DSCC, for low income group, there area one public health facilities. But there are 16 private facilities for each 1 lac moderate and high income people.
- It has been explored in this study, in DNCC and DSCC, each one lac moderate and low income people, almost one public health facilities can be provided whereas for each 1 lac high income people the number of available private healthcare facilities differs from 24 to 54 which is almost 25 to 55 times of the number of available public healthcare facilities for low and moderate income people.
- Though there has been found pucca roads around most of the health facilities, some wards such as ward no 40, 41, 43, 52 DNCC and ward no ward-63, 64, 70, 71, 73, and 75 of DSCC are not well connected with surrounding area and health facilities which creates disparity in accessibility of people to the health facilities.
- Areas which are already have high population density might not have enough space for the provision of health facilities .So it has been found that not all wards with high population density have high density of health facilities to fulfill the demand of the dwellers.

7.2 Areas of Improvement and Recommendations for Effective provision of health facilities

- Being a developing middle income country, a huge amount people are living under the poverty line in spite of the increasing economic growth those are highly dependent on public health facilities as they could not afford the charge. So institutional governance and local government capacity to deliver urban

health care facilities should be strengthened in a sustainable way. Public–private partnership should be promoted in need for the provision of health care facilities to all.

- Newly extended wards and old ward having no public facilities of both city corporations should be given more emphasis to build new public health facilities as free facilities specially government owned so that they can easily be accessible by all the residents especially focusing low income people.
- The poor, women, and children should be kept providing improved accessibility, quality and utilization of health care facilities. Decertification of health facilities must be ensured with effective support of authority.
- To reduce the disparity of distribution of health facilities, building permit should be restricted after a certain number of constructions of health facilities in an area so that all developments cannot be done in centric way in a specific area and face over saturation where other areas become deprived of those particular facilities.
- As public health facilities cannot ensure quality of treatment, so private health facilities are booming up to meet up the demand. The quality of service in public health facilities must be ensured by concerned authority.
- Though private health facilities are trying to ensure treatment with quality, those services are very expensive, not affordable to all income groups. In Middle low- or middle-income group, a trend has been found to go to private health facilities for better treatment, even by selling everything they own which should not be the case. As a significant and fundamental human rights, health facilities should be accessible to all at free of cost or at as much as minimum cost. So affordable health services have to be ensured in public or private health facilities.
- In Bangladesh, there are already many health facilities with the foreign partnership such as Japan -Bangladesh Friendship Hospital, Kuwait Bangladesh Friendship Government Hospital. Such foreign partnerships should be initiated.

- Health is a profitable sector for businessmen. So Government should impose taxes or other strategies so that common citizen can have affordable services where public health facilities are lacking of.
- Not only socio-economic accessibility, but geographic accessibility should be ensured. Proper wide and pucca road should be provided around the health services so that they can be easily accessible especially at emergency situation.

7.3 Conclusion

Our study has demonstrated that the concentration of health care facilities, both private and public within the administrative boundary of DNCC and DSCC where some wards are found occupied with high concentration of health facilities and some wards are lacking minimum health facilities. The largest inequity appears to be related to socioeconomic status, while a moderate level of inequity exists in relation to private patient status. As it has been found in studies, public facilities are more accessible and affordable to low-income people. Since it appears that the magnitude and direction of socially determined differences in health care utilization and distribution are inconsistent. So, initiatives beyond Medicare should be devised and evaluated in relation to specific areas of service provision. Not only socio-economic accessibility, but our study has also intended to find out the geographic accessibility through accessibility through road network. Disparities in provision of pucca roads surrounding health facilities have also been found. Some areas are benefited with pucca roads than other area.

Long term strategy should be undertaken for a holistic and comprehensive regional planning that will incorporate other major sectors of social services such as health care facilities, existing road networks and other basic social services. From the existing practice of taking sectoral approach to planning has to be deviated, and the skills of professional regional planners should be utilized to make this plan successful. Adequate provision of basic health must be ensured such that lopsidedness in access to these facilities are eradicated. Each City corporation authority should encourage public participation right from the onset. Efforts should be on encouraging the development of the full potentials of each city corporation region collaborating with each local government unit. The government should coordinate the preparation of the

comprehensive regional plan, incorporating inputs from city corporation areas. The short-term strategy involves providing the existing shortfalls in the locational pattern of healthcare facilities and personnel in the Dhaka City corporations. To this end, it is recommended that unbiased efforts should be made to ensure their equitable distribution throughout Dhaka City Corporations.

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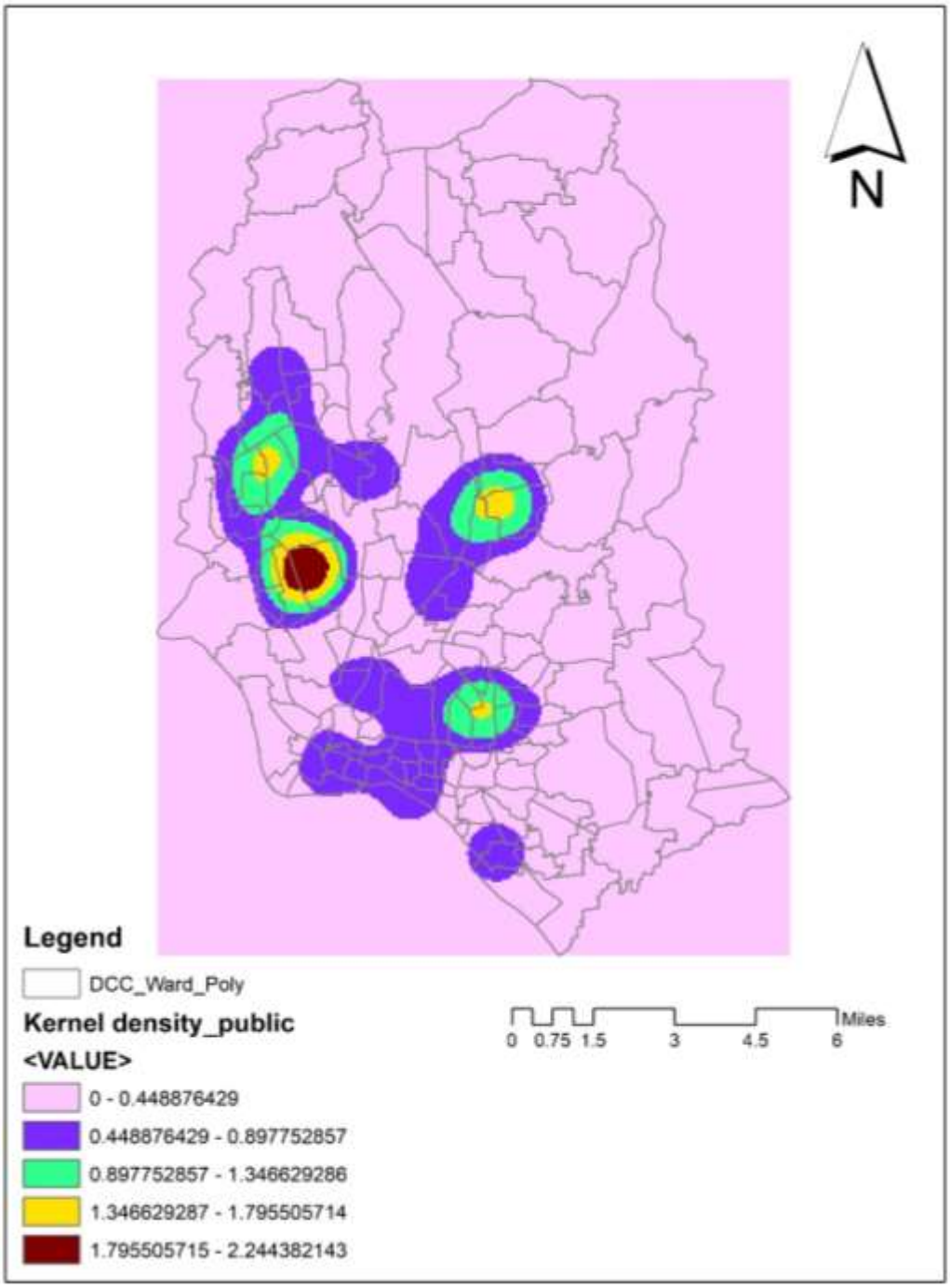
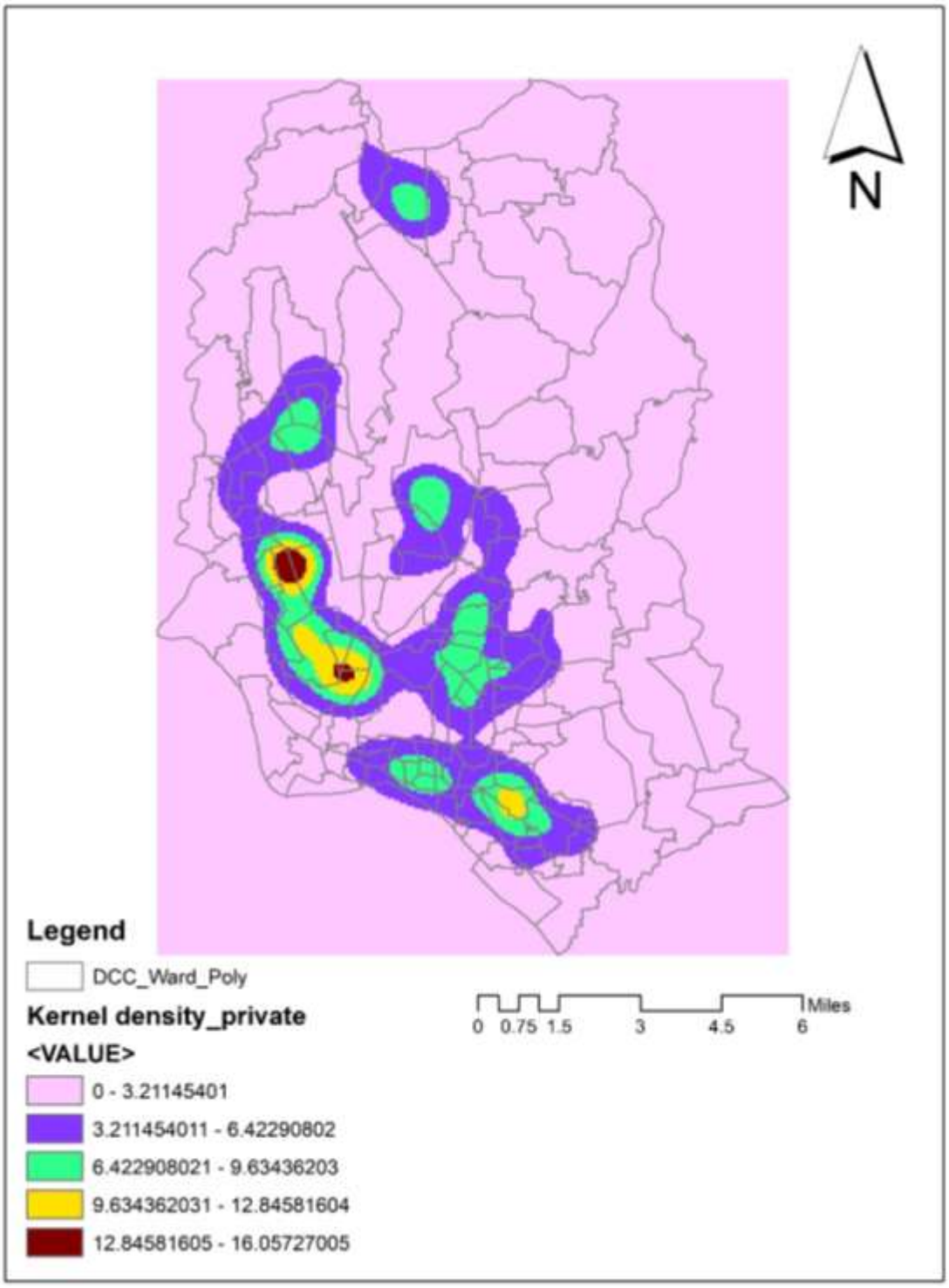
APPENDIX A



Appendix A1: Kernel density distribution of public healthcare facilities within Dhaka City Corporation boundary



Appendix A2: Kernel density distribution of private healthcare facilities within Dhaka City Corporation boundary

APPENDIX B

Appendix B1: List of variables

Objectives	Variables	List of Measurement	Source
Objective 1:	Geographic location	Nominal	Secondary
	List of health facilities	Nominal	Secondary
Objective 2:	List of health facilities available within the boundary	Ratio	Secondary
	Ward population	Ratio	Secondary
	Road network	Nominal	Secondary
	Household income	Ratio	Secondary

Appendix B2: The Location Quotient value of the wards of DNCC both for public and private health care facilities considering the whole Dhaka City Corporation area

Ward No.	Population	No. of public health facilities	No. of private health facilities	No. of public health facilities per 1000 population	No. of private health facilities per 1000 population	Location Quotient (LQ) for public facility	Location Quotient (LQ) for private facility
Ward- 1	183298		21		0.1146		2.37
Ward- 2	151868		5		0.0329		0.68
Ward- 3	94664		9		0.0951		1.97
Ward- 4	75246		1		0.0133		0.28
Ward- 5	118110	1	8	0.008	0.0677	1.58	1.40
Ward- 6	163770	2	2	0.012	0.0122	2.28	0.25
Ward- 7	113750		6		0.0527		1.09

Ward- 8	111251		4		0.0360		0.74
Ward- 9	71260		2		0.0281		0.58
Ward- 10	87879	2	7	0.023	0.0797	4.25	1.65
Ward- 11	97033		3		0.0309		0.64
Ward- 12	116544	3	8	0.026	0.0686	4.80	1.42
Ward- 13	157206	5	6	0.032	0.0382	5.94	0.79
Ward- 14	163797	1	14	0.006	0.0855	1.14	1.77
Ward- 15	173842		2		0.0115		0.24
Ward- 16	142413	2	3	0.014	0.0211	2.62	0.44
Ward- 17	196479		9		0.0458		0.95
Ward- 18	63616		3		0.0472		0.98
Ward- 19	96291	2	23	0.021	0.2389	3.88	4.95
Ward- 20	98618	2	11	0.020	0.1115	3.79	2.31
Ward- 21	96111	1	3	0.010	0.0312	1.94	0.65
Ward- 22	160316	1	9	0.006	0.0561	1.16	1.16
Ward- 23	63763		9		0.1411		2.92
Ward- 24	103274	2	4	0.019	0.0387	3.61	0.80
Ward- 25	99727		6		0.0602		1.25
Ward- 26	67876		2		0.0295		0.61
Ward- 27	90224	9	24	0.100	0.2660	18.62	5.51
Ward- 28	65984		4		0.0606		1.26
Ward- 29	54739		3		0.0548		1.13
Ward- 30	186639		6		0.0321		0.67
Ward- 31	51384	1	1	0.019	0.0195	3.63	0.40
Ward- 32	72973	1	18	0.014	0.2467	2.56	5.11
Ward- 33	114756		3		0.0261		0.54
Ward- 34	106548	1	0	0.009	0.0000	1.75	0.00
Ward- 35	74069		5		0.0675		1.40
Ward- 36	70984		1		0.0141		0.29
Ext_Ward- 37	73756		5		0.0678		1.40
Ext_Ward- 38	89749	4	8	0.045	0.0891	8.32	1.85

Ext_Ward- 39	126694	2	3	0.016	0.0237	2.95	0.49
Ext_Ward- 40	65740		6		0.0913		1.89
Ext_Ward- 41	23663		1		0.0423		0.87
Ext_Ward- 42	14949		1		0.0669		1.38
Ext_Ward- 43	16862		0		0.0000		0.00
Ext_Ward- 44	22782		0		0.0000		0.00
Ext_Ward- 45	59110		1		0.0169		0.35
Ext_Ward- 46	32982		0		0.0000		0.00
Ext_Ward- 47	112967		4		0.0354		0.73
Ext_Ward- 48	81125	1	3	0.012	0.0370	2.30	0.77
Ext_Ward- 49	83488		3		0.0359		0.74
Ext_Ward- 50	64785	1	7	0.015	0.1080	2.88	2.24
Ext_Ward- 51	76794	1	8	0.013	0.1042	2.43	2.16
Ext_Ward- 52	68065		1		0.0147		0.30
Ext_Ward- 53	74269		2		0.0269		0.56
Ext_Ward- 54	42240		4		0.0947		1.96

Appendix B3: The Location Quotient value of the wards of DSCC both for public and private health care facilities considering the whole Dhaka City Corporation area

Ward No.	**Population**	**No. of public health facilities**	**No. of private health facilities**	**No. of public health facilities per 1000 population**	**No. of private health facilities per 1000 population**	**Location Quotient (LQ) for public facility**	**Location Quotient (LQ) for private facility**
Ward- 1	68931		9		0.1306		2.70
Ward- 2	113273		4		0.0353		0.73
Ward- 3	86931		4		0.0460		0.95
Ward- 4	82701		5		0.0605		1.25
Ward- 5	60788		5		0.0823		1.70
Ward- 6	79305	2	0	0.025	0.0000	4.71	0.00

Ward- 7	58316		0		0.0000		0.00
Ward- 8	34867	1	4	0.029	0.1147	5.35	2.38
Ward- 9	42105	2	2	0.048	0.0475	8.87	0.98
Ward- 10	21968	2	4	0.091	0.1821	16.99	3.77
Ward- 11	59999		3		0.0500		1.04
Ward- 12	51067		5		0.0979		2.03
Ward- 13	59639		6		0.1006		2.08
Ward- 14	128921		4		0.0310		0.64
Ward- 15	72449		31		0.4279		8.86
Ward- 16	79983		13		0.1625		3.36
Ward- 17	58863		5		0.0849		1.76
Ward- 18	49523	2	15	0.040	0.3029	7.54	6.27
Ward- 19	55920		9		0.1609		3.33
Ward- 20	38201	2	5	0.052	0.1309	9.77	2.71
Ward- 21	33513		6		0.1790		3.71
Ward- 22	84519		1		0.0118		0.24
Ward- 23	48875		1		0.0205		0.42
Ward- 24	66470	3	1	0.045	0.0150	8.42	0.31
Ward- 25	29832		1		0.0335		0.69
Ward- 26	44540		1		0.0225		0.46
Ward- 27	28525		2		0.0701		1.45
Ward- 28	24656		2		0.0811		1.68
Ward- 29	58233		1		0.0172		0.36
Ward- 30	33613		6		0.1785		3.70
Ward- 31	35656		1		0.0280		0.58
Ward- 32	36147		3		0.0830		1.72
Ward- 33	65289	1	5	0.015	0.0766	2.86	1.59
Ward- 34	50624	1	0	0.020	0.0000	3.69	0.00
Ward- 35	28074		5		0.1781		3.69
Ward- 36	26199	1	2	0.038	0.0763	7.12	1.58
Ward- 37	18170		4		0.2201		4.56

Ward- 38	46140		2		0.0433		0.90
Ward- 39	38322		1		0.0261		0.54
Ward- 40	46434		5		0.1077		2.23
Ward- 41	40587		2		0.0493		1.02
Ward- 42	27882		1		0.0359		0.74
Ward- 43	40043		5		0.1249		2.59
Ward- 44	26939		0		0.0000		0.00
Ward- 45	50419		4		0.0793		1.64
Ward- 46	40267		1		0.0248		0.51
Ward- 47	48028	1	0	0.021	0.0000	3.89	0.00
Ward- 48	58741		7		0.1192		2.47
Ward- 49	60966		0		0.0000		0.00
Ward- 50	56766		12		0.2114		4.38
Ward- 51	69399	1	12	0.014	0.1729	2.69	3.58
Ward- 52	43954		1		0.0228		0.47
Ward- 53	58954		3		0.0509		1.05
Ward- 54	66637	1	2	0.015	0.0300	2.80	0.62
Ward- 55	94573		3		0.0317		0.66
Ward- 56	82069		3		0.0366		0.76
Ward- 57	55560		2		0.0360		0.75
Ext_Ward- 58	120263		0		0.0000		0.00
Ext_Ward- 59	65381		3		0.0459		0.95
Ext_Ward- 60	93942		2		0.0213		0.44
Ext_Ward- 61	58750		11		0.1872		3.88
Ext_Ward- 62	77730		1		0.0129		0.27
Ext_Ward- 63	62536		2		0.0320		0.66
Ext_Ward- 64	109183		6		0.0550		1.14
Ext_Ward- 65	85806		6		0.0699		1.45
Ext_Ward- 66	64487		1		0.0155		0.32
Ext_Ward- 67	122616		2		0.0163		0.34
Ext_Ward- 68	42505		2		0.0471		0.97
Ext_Ward- 69	19672		2		0.1017		2.10
Ext_Ward- 70	18484		0		0.0000		0.00
Ext_Ward- 71	39215		1		0.0255		0.53
Ext_Ward- 72	23097		1		0.0433		0.90
Ext_Ward- 73	41277	1	4	0.024	0.0969	4.52	2.01

Ext_Ward- 74	26991		8		0.2964		6.14
Ext_Ward- 75	21378		0		0.0000		0.00

Appendix B4: Location Quotient (LQ) value of wards for both public and private health facilities of DCC area considering Dhaka City Corporation area as a whole

Ward No.	**Population**	**No. of total health facilities**	**Location Quotient (LQ)**	**LQ value considering corresponding city corporation**
Ward- 1	183298	21	2.14	2.69
Ward- 2	151868	5	0.61	0.77
Ward- 3	94664	9	1.77	2.23
Ward- 4	75246	1	0.25	0.31
Ward- 5	118110	9	1.42	1.79
Ward- 6	163770	4	0.46	0.57
Ward- 7	113750	6	0.98	1.24
Ward- 8	111251	4	0.67	0.85
Ward- 9	71260	2	0.52	0.66
Ward- 10	87879	9	1.91	2.41
Ward- 11	97033	3	0.58	0.73
Ward- 12	116544	11	1.76	2.22
Ward- 13	157206	11	1.30	1.64
Ward- 14	163797	15	1.71	2.15
Ward- 15	173842	2	0.21	0.27
Ward- 16	142413	5	0.65	0.83
Ward- 17	196479	9	0.85	1.08
Ward- 18	63616	3	0.88	1.11
Ward- 19	96291	25	4.84	6.10
Ward- 20	98618	13	2.46	3.10
Ward- 21	96111	4	0.78	0.98
Ward- 22	160316	10	1.16	1.47
Ward- 23	63763	9	2.63	3.32
Ward- 24	103274	6	1.08	1.37
Ward- 25	99727	6	1.12	1.41
Ward- 26	67876	2	0.55	0.69
Ward- 27	90224	33	6.82	8.60
Ward- 28	65984	4	1.13	1.42
Ward- 29	54739	3	1.02	1.29
Ward- 30	186639	6	0.60	0.76
Ward- 31	51384	2	0.73	0.91
Ward- 32	72973	19	4.85	6.12

Ward- 33	114756	3	0.49	0.61
Ward- 34	106548	1	0.17	0.22
Ward- 35	74069	5	1.26	1.59
Ward- 36	70984	1	0.26	0.33
Ext_Ward- 37	73756	5	1.26	1.59
Ext_Ward- 38	89749	12	2.49	3.14
Ext_Ward- 39	126694	5	0.74	0.93
Ext_Ward- 40	65740	6	1.70	2.15
Ext_Ward- 41	23663	1	0.79	0.99
Ext_Ward- 42	14949	1	1.25	1.57
Ext_Ward- 43	16862	0		0.00
Ext_Ward- 44	22782	0		0.00
Ext_Ward- 45	59110	1	0.32	0.40
Ext_Ward- 46	32982	0		0.00
Ext_Ward- 47	112967	4	0.66	0.83
Ext_Ward- 48	81125	4	0.92	1.16
Ext_Ward- 49	83488	3	0.67	0.84
Ext_Ward- 50	64785	8	2.30	2.90
Ext_Ward- 51	76794	9	2.18	2.75
Ext_Ward- 52	68065	1	0.27	0.35
Ext_Ward- 53	74269	2	0.50	0.63
Ext_Ward- 54	42240	4	1.76	2.23
Ward- 1	68931	9	2.43	1.26
Ward- 2	113273	4	0.66	1.73
Ward- 3	86931	4	0.86	0.47
Ward- 4	82701	5	1.13	0.61
Ward- 5	60788	5	1.53	0.80
Ward- 6	79305	2	0.47	1.09
Ward- 7	58316	0		0.33
Ward- 8	34867	5	2.67	0.00
Ward- 9	42105	4	1.77	1.90
Ward- 10	21968	6	5.09	1.26
Ward- 11	59999	3	0.93	3.62
Ward- 12	51067	5	1.82	0.66
Ward- 13	59639	6	1.87	1.30
Ward- 14	128921	4	0.58	1.33
Ward- 15	72449	31	7.97	0.41
Ward- 16	79983	13	3.03	5.67
Ward- 17	58863	5	1.58	2.15
Ward- 18	49523	17	6.40	1.13
Ward- 19	55920	9	3.00	4.55
Ward- 20	38201	7	3.41	2.13
Ward- 21	33513	6	3.34	2.43

Ward- 22	84519	1	0.22	2.37
Ward- 23	48875	1	0.38	0.16
Ward- 24	66470	4	1.12	0.27
Ward- 25	29832	1	0.62	0.80
Ward- 26	44540	1	0.42	0.44
Ward- 27	28525	2	1.31	0.30
Ward- 28	24656	2	1.51	0.93
Ward- 29	58233	1	0.32	1.08
Ward- 30	33613	6	3.33	0.23
Ward- 31	35656	1	0.52	2.37
Ward- 32	36147	3	1.55	0.37
Ward- 33	65289	6	1.71	1.10
Ward- 34	50624	1	0.37	1.22
Ward- 35	28074	5	3.32	0.26
Ward- 36	26199	3	2.13	2.36
Ward- 37	18170	4	4.10	1.52
Ward- 38	46140	2	0.81	2.92
Ward- 39	38322	1	0.49	0.57
Ward- 40	46434	5	2.01	0.35
Ward- 41	40587	2	0.92	1.43
Ward- 42	27882	1	0.67	0.65
Ward- 43	40043	5	2.33	0.48
Ward- 44	26939	0		1.66
Ward- 45	50419	4	1.48	0.00
Ward- 46	40267	1	0.46	1.05
Ward- 47	48028	1	0.39	0.33
Ward- 48	58741	7	2.22	0.28
Ward- 49	60966	0	0.00	1.58
Ward- 50	56766	12	3.94	0.00
Ward- 51	69399	13	3.49	2.80
Ward- 52	43954	1	0.42	2.48
Ward- 53	58954	3	0.95	0.30
Ward- 54	66637	3	0.84	0.67
Ward- 55	94573	3	0.59	0.60
Ward- 56	82069	3	0.68	0.42
Ward- 57	55560	2	0.67	0.48
Ext_Ward- 58	120263	0	0.00	0.48
Ext_Ward- 59	65381	3	0.86	0.00
Ext_Ward- 60	93942	2	0.40	0.61
Ext_Ward- 61	58750	11	3.49	0.28
Ext_Ward- 62	77730	1	0.24	2.48
Ext_Ward- 63	62536	2	0.60	0.17
Ext_Ward- 64	109183	6	1.02	0.42

Ext_Ward- 65	85806	6	1.30	0.73
Ext_Ward- 66	64487	1	0.29	0.93
Ext_Ward- 67	122616	2	0.30	0.21
Ext_Ward- 68	42505	2	0.88	0.22
Ext_Ward- 69	19672	2	1.89	0.62
Ext_Ward- 70	18484	0		1.35
Ext_Ward- 71	39215	1	0.48	0.00
Ext_Ward- 72	23097	1	0.81	0.34
Ext_Ward- 73	41277	5	2.26	0.57
Ext_Ward- 74	26991	8	5.52	1.61
Ext_Ward- 75	21378	0		3.93

Appendix B5: Location Quotient (LQ) value of wards for both public and private health facilities of DNCC area considering corresponding city corporation area

Ward No.	**Population**	**No. of total health facilities**	**No. of public health facilities**	**No. of private health facilities**	**LQ value for public facilities considering corresponding city corporation**	**LQ value for private facilities considering corresponding city corporation**
Ward- 1	183298	21		21		3.09
Ward- 2	151868	5		5		0.89
Ward- 3	94664	9		9		2.57
Ward- 4	75246	1		1		0.36
Ward- 5	118110	9	1	8	1.53	1.83
Ward- 6	163770	4	2	2	2.21	0.33
Ward- 7	113750	6		6		1.42
Ward- 8	111251	4		4		0.97
Ward- 9	71260	2		2		0.76
Ward- 10	87879	9	2	7	4.12	2.15
Ward- 11	97033	3		3		0.83
Ward- 12	116544	11	3	8	4.67	1.85
Ward- 13	157206	11	5	6	5.76	1.03
Ward- 14	163797	15	1	14	1.11	2.31
Ward- 15	173842	2		2		0.31
Ward- 16	142413	5	2	3	2.55	0.57
Ward- 17	196479	9		9		1.24
Ward- 18	63616	3		3		1.27
Ward- 19	96291	25	2	23	3.76	6.45

Ward- 20	98618	13	2	11	3.68	3.01
Ward- 21	96111	4	1	3	1.89	0.84
Ward- 22	160316	10	1	9	1.13	1.52
Ward- 23	63763	9		9		3.81
Ward- 24	103274	6	2	4	3.51	1.05
Ward- 25	99727	6		6		1.62
Ward- 26	67876	2		2		0.80
Ward- 27	90224	33	9	24	18.08	7.18
Ward- 28	65984	4		4		1.64
Ward- 29	54739	3		3		1.48
Ward- 30	186639	6		6		0.87
Ward- 31	51384	2	1	1	3.53	0.53
Ward- 32	72973	19	1	18	2.48	6.66
Ward- 33	114756	3		3		0.71
Ward- 34	106548	1	1	0	1.70	0.00
Ward- 35	74069	5		5		1.82
Ward- 36	70984	1		1		0.38
Ext_Ward- 37	73756	5		5		1.83
Ext_Ward- 38	89749	12	4	8	8.08	2.41
Ext_Ward- 39	126694	5	2	3	2.86	0.64
Ext_Ward- 40	65740	6		6		2.46
Ext_Ward- 41	23663	1		1		1.14
Ext_Ward- 42	14949	1		1		1.81
Ext_Ward- 43	16862	0		0		0.00
Ext_Ward- 44	22782	0		0		0.00
Ext_Ward- 45	59110	1		1		0.46
Ext_Ward- 46	32982	0		0		0.00
Ext_Ward- 47	112967	4		4		0.96
Ext_Ward- 48	81125	4	1	3	2.23	1.00
Ext_Ward- 49	83488	3		3		0.97
Ext_Ward- 50	64785	8	1	7	2.80	2.92
Ext_Ward- 51	76794	9	1	8	2.36	2.81
Ext_Ward- 52	68065	1		1		0.40
Ext_Ward- 53	74269	2		2		0.73
Ext_Ward- 54	42240	4		4		2.56

Appendix B6: Location Quotient (LQ) value of wards for both public and private health facilities of DSCC area considering corresponding city corporation area

Ward No.	Population	No. of total health facilities	No. of public health facilities	No. of private health facilities	LQ value for public facilities considering corresponding city corporation	LQ value for private facilities considering corresponding city corporation
Ward- 1	68931	9		9		1.85
Ward- 2	113273	4		4		0.50
Ward- 3	86931	4		4		0.65
Ward- 4	82701	5		5		0.86
Ward- 5	60788	5		5		1.17
Ward- 6	79305	2	2	0	5.00	0.00
Ward- 7	58316	0		0		0.00
Ward- 8	34867	5	1	4	5.69	1.63
Ward- 9	42105	4	2	2	9.42	0.67
Ward- 10	21968	6	2	4	18.05	2.59
Ward- 11	59999	3		3		0.71
Ward- 12	51067	5		5		1.39
Ward- 13	59639	6		6		1.43
Ward- 14	128921	4		4		0.44
Ward- 15	72449	31		31		6.08
Ward- 16	79983	13		13		2.31
Ward- 17	58863	5		5		1.21
Ward- 18	49523	17	2	15	8.01	4.30
Ward- 19	55920	9		9		2.29
Ward- 20	38201	7	2	5	10.38	1.86
Ward- 21	33513	6		6		2.54
Ward- 22	84519	1		1		0.17
Ward- 23	48875	1		1		0.29
Ward- 24	66470	4	3	1	8.95	0.21
Ward- 25	29832	1		1		0.48
Ward- 26	44540	1		1		0.32
Ward- 27	28525	2		2		1.00
Ward- 28	24656	2		2		1.15
Ward- 29	58233	1		1		0.24
Ward- 30	33613	6		6		2.54
Ward- 31	35656	1		1		0.40

Ward- 32	36147	3		3		1.18
Ward- 33	65289	6	1	5	3.04	1.09
Ward- 34	50624	1	1	0	3.92	0.00
Ward- 35	28074	5		5		2.53
Ward- 36	26199	3	1	2	7.57	1.08
Ward- 37	18170	4		4		3.13
Ward- 38	46140	2		2		0.62
Ward- 39	38322	1		1		0.37
Ward- 40	46434	5		5		1.53
Ward- 41	40587	2		2		0.70
Ward- 42	27882	1		1		0.51
Ward- 43	40043	5		5		1.77
Ward- 44	26939	0		0		0.00
Ward- 45	50419	4		4		1.13
Ward- 46	40267	1		1		0.35
Ward- 47	48028	1	1	0	4.13	0.00
Ward- 48	58741	7		7		1.69
Ward- 49	60966	0		0		0.00
Ward- 50	56766	12		12		3.00
Ward- 51	69399	13	1	12	2.86	2.46
Ward- 52	43954	1		1		0.32
Ward- 53	58954	3		3		0.72
Ward- 54	66637	3	1	2	2.97	0.43
Ward- 55	94573	3		3		0.45
Ward- 56	82069	3		3		0.52
Ward- 57	55560	2		2		0.51
Ext_Ward- 58	120263	0		0		0.00
Ext_Ward- 59	65381	3		3		0.65
Ext_Ward- 60	93942	2		2		0.30
Ext_Ward- 61	58750	11		11		2.66
Ext_Ward- 62	77730	1		1		0.18
Ext_Ward- 63	62536	2		2		0.45
Ext_Ward- 64	109183	6		6		0.78
Ext_Ward- 65	85806	6		6		0.99
Ext_Ward- 66	64487	1		1		0.22
Ext_Ward- 67	122616	2		2		0.23
Ext_Ward- 68	42505	2		2		0.67
Ext_Ward- 69	19672	2		2		1.44
Ext_Ward- 70	18484	0		0		0.00
Ext_Ward- 71	39215	1		1		0.36
Ext_Ward- 72	23097	1		1		0.62
Ext_Ward- 73	41277	5	1	4	4.80	1.38
Ext_Ward- 74	26991	8		8		4.21

Ext_Ward- 75	21378	0		0		0.00