

# Accessibility of Public Healthcare Services in Mysore City- A GIS Approach

Minutha. V<sup>1</sup>

<sup>1</sup>UGC Post Doctoral Fellow, Department of Studies in Geography, University of Mysore, Mysuru - 570006.

## ABSTRACT

The main theme of healthcare is to provide complete health facilities, to protect every one for physical, social, and mental health, to decrease the death rate, to increase the life expectancy of human being. The accessibility of healthcare centers is one of the most important indicators for measuring the efficiency of a healthcare system. Accessibility is a complex indicator that reflects the number of health care institutions, their geographical distribution and the impact of different types of barriers social, Economic and culture <sup>[1]</sup>. Geographers are mainly concerned with geographical accessibility for the calculation. GIS is a technique which provide a set of tools for describing and understanding the spatial distribution of healthcare facilities, evaluating accessibility and barriers to health care delivery of health facilities and Creating a map of health infrastructure. In this paper an attempt has been made to analyze the functioning of health care services and its infrastructure facilities in Mysore city using GIS techniques. To identify the gap between the availability and the accessibility of health infrastructure services in terms of prescribed norms. The present study is based on both Primary and Secondary Data. The Base Map of Study area has been Geo-referenced and digitized using GIS Software. Location of healthcare centres will be mapped with the help of Global Position System (GPS). Data is analyzed though simple quantitative techniques and the spatial disparity of health centers were measured by applying location quotient. Various Maps have been generated to show the health care services in the study area. The results show that the availability of healthcare center is unequally distributed and there is scarcity in the availability of infrastructure and workforce among the study area.

**Keywords:** Healthcare, Accessibility, Location quotient, GIS, GPS.

## INTRODUCTION

Access can be described as the 'degree of fit' between users and a service. The 'degree of fit' might be influenced by the availability, accessibility, accommodation, affordability and acceptability of a service <sup>[2]</sup>. The accessibility of healthcare centers is one of the most important indicators for measuring the efficiency of a healthcare system <sup>[1]</sup>. The population of our country suffers from many diseases in spite of the various healthcare programs. These are all because of lack of management of facilities, optimum route to the hospital, slum area development, and lack of knowledge about technologies. Health care facilities &

Utilization is concerned with all the issues that are related to the location & facilities. This include the location of hospitals & there infrastructure facilities.

GIS is becoming an important tool in HealthCare Applications covering database management, planning, risk assessment, service area mapping, location and identification etc., GIS provides a method by which geographically dependent data can be displayed in an easily understandable visual format to simply the process of decision making. GIS can be effectively used as a tool for decision making in relation to optimum location & gainful utilization of available medical resource in study area. With this background in this

paper an attempt has been made to analyze the functioning of health care services and its infrastructure facilities in Mysore city using GIS techniques. To identify the gap between the availability and the accessibility of health infrastructure services in terms of prescribed norms

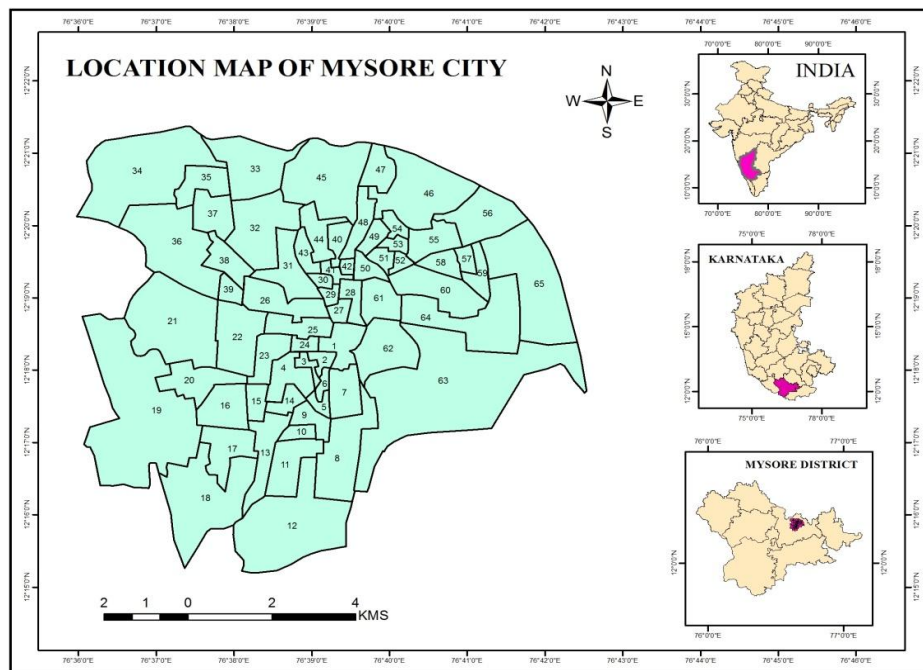
### OBJECTIVES

1. To Identify the Spatial Distribution Pattern of Public healthcare centers in Mysore city.
2. To analyze the availability of Infrastructure and health workforce of health centres in Mysore city.
3. To assess the gap between existing healthcare centres and the requirements to the population.

### STUDY AREA

Mysore City is an Ancient, historic and one of the beautiful cities of the country. It is the 2<sup>nd</sup> largest city in the state

of Karnataka, next to Bangalore. It lies about 146km (91 miles) southwest of Bangalore, the capital of Karnataka. The Mysore city is located between 12° 14' 41"N to 12° 22'25" N latitudes and 76° 34'20"E to 76° 43'23"E longitude at an altitude of 2526ft above the mean sea level (Map.1). Mysore city Spread across an area of 128.42 km<sup>2</sup> (50 sq.miles) & it is lies in the saucer shaped basin & is situated at the base of the Chamundi hills. The City of Mysore in Karnataka is one of the most visited tourist destinations of the state. City is divided into 9 Zones and they sub divided as 65 wards by MCC (Mysore City Corporation) based on 2011 data. The population is about 8, 93,062 in 2011 census, with males 4, 46,676 and 4, 46,386 females respectively. The total population of Urban Agglomeration is 9, 83,893 making it second most populous city in Karnataka state. The population density is 6,910.5 per Sq.Kms as on 2011.



Map.1 Location of Mysore City with Wards

### MATERIALS AND METHODS

The Present study used both Primary and Secondary Source data. The Secondary data related to health care are collected from various offices like District Health Office, Municipal Office, CADD-station of the

Mysore City and the Population data are collected from Census office Bangalore. The Primary source of information has been collected through the field survey by visiting all the health care centers and personal observation. The road map, ward

wise map and Zone wise map which are procured from CADD-Station has been georeferenced using the topsheets. The maps were digitized using ARC GIS 10.3 software. Location of healthcare centres will be mapped with the help of Global Position System (GPS). Thematic map are prepared to show the Zone wise distribution of public health centres and the spatial disparity of health centers zone wise was measured by applying location quotient. The collected information has been compiled and put in the form of maps and tables for further analysis.

## RESULTS AND DISCUSSIONS

### Spatial Distribution of Public Healthcare Centres in Mysore City

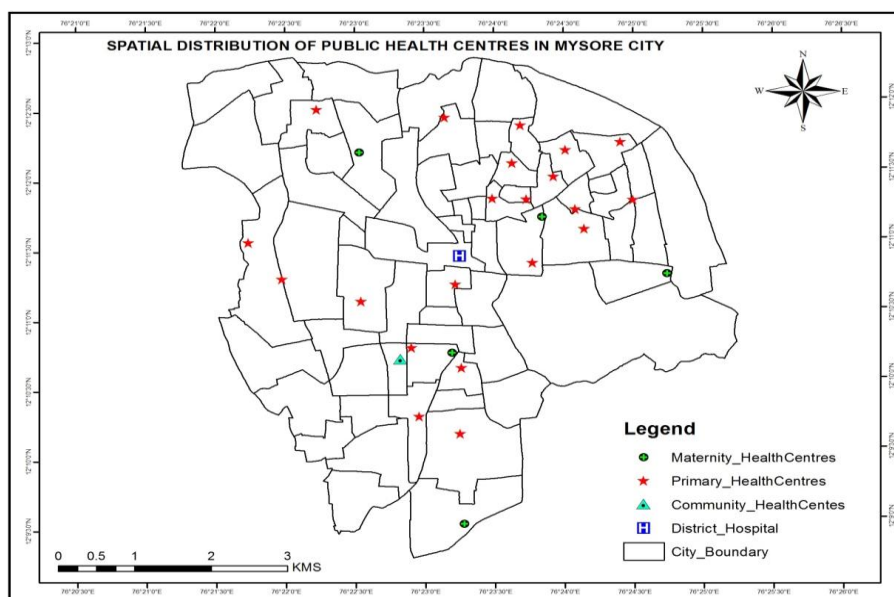
The functions of healthcare centres facilities are primarily based on the consideration of institutional size, volume of work and the range of services that they provide for people. The structure of health care services are functioning at three levels, i.e., Primary, Secondary and Tertiary level. The health care institutions are structured in a hierarchical order, in order to optimize the use of resource available. These service institutions extend the health care services at various levels and range, which the patient required. The administrations of each level of health institutions are interrelated, for e.g.: The District Hospital the higher order

service centre provide higher level services with greater administrative responsibilities. Where, the administration and function of Primary Health Unit (PHU) are consisting of lower order services with lower administrative responsibilities. The Health services are available in the area through medical institutions, either by Public/government or private/Non Government organization. Most of the Health Facilities are provided through Medical Organizations like District Hospital, Community Health care and Primary HealthCare Centers. They are located on the basis of economic feasibility and requirement by the people. Public Healthcare centers are providing health services to the people for promoting good health for all, but it depends on accessibility of healthcare centers. The Total Public health care centers of Mysore City include One District Hospital, One Community Health Centers, 21 Primary Healthcare centers, 5 maternity Public Health centres. The distribution of Public healthcare centres has been shown in Table.1 and Map. 2.

**Table: 1 Spatial Distribution of Health Centres in Mysore City**

Sl.No.	Health Institutes	Units	Percentage
1	District Hospital	1	0.96
2	Community Health Centers	1	0.96
3	Primary Health Centers	21	20.19
4	Maternity Hospital	5	4.80
5	Private Health Centres	76	73.09
Total		104	100

Source: District Health Office & MCC, Mysore.



**Map.2 Spatial Distribution of Public Healthcare Centres in Mysore City with Wards**

The present hospitals system varies in size and kinds of medical care services, where one can get all types of treatments that are needed by a patient. In the study area, the existing public healthcare centres can be structured in different hierarchical order and they are unevenly distributed. Most of the health centers are found heart of the city and remaining health centers are dispersed or scattered distributed. Hence, measuring adequacy availability of public health centers to population is a challenge.

Spatial distribution of health care centers plays an important role in maintaining the health status of the people. Therefore, Availability of the health centers are primarily influence on utilization of healthcare facilities and important factor is distance, if the increase in distance than decrease in utilization of healthcare services. Table 2 shows the Urban Public Healthcare centres distribution with ward number and population.

**Table .2 Urban Public HealthCare Centres in Mysore City**

Sl. No.	Facility Name	Name of the Health Centres	Ward Numbers	Facility Wise Population List
1	PHC	Ashokapuram	9, 13,14,15,17	61,752
2	PHC	Chamundipuram	3,4,6,7	46,242
3	PHC	Erangere	34,38,39,40	38,420
4	PHC	Giribhavanpalya	57,58	20,035
5	PHC	Gayathripuram	62, 63,56	53,486
6	PHC	Jalpuri	41,50	19,706
7	PHC	Jyothinagar	51,61	23,515
8	PHC	Krishnamurthypuram	8,16,18,19	54,273
9	PHC	Kumbarkoppalu	26, 27,28	58,614
10	PHC	Nazarbad	1,2,5,37,64,65	69,724
11	PHC	N.R.Mohalla	42,43,49	39,110
12	PHC	OLD Agrahara	31,32,33,35,36	51,293
13	PHC	Saraswathipuram	20,21	17,337
14	PHC	Udayagir	52,53	32,245
15	PHC	Vijayanagar	24,25	47,855
16	PHC	Vishweshwaranagara	10, 11, 12	47,983
17	IIP8	Bannimanatapa	29,30,44,45	50,092
18	IIP8	Kyathamarahalli	59,60	37,450
19	IIP8	Rajendranagara	46,47,48	42,157
20	IIP8	Shanthinagara	54,55	49,619
21	IIP8	T.K.Layout	22, 23	32,154
22	CHC	Jayanagara	65 wards	8,93,062
23	DH	K.R.Hospital	7 Taluks	3,01,127

Source: District Health office & Mysore City Corporation

### Health Infrastructure and Health Workforce

In the study area we can observe The Krishna Rajendra District Hospital is located in Mysore city, it is a tertiary referral centre and teaching hospitals attached to the Mysore medical college in Mysore City. District Hospital is considered as regional hospital extending highly advanced treatment, diagnostics and intensive care facilities, which provides curative, preventative and promotive medical-health care services to the people in the Mysore district. <sup>[3][4]</sup> District hospital gives all the medical services. The total bed capacity of around 1050 beds which includes 300 beds in general medicine, 250 in general surgery and about 500 in other

specialties like ENT, Ophthalmology, Urology, plastic surgery, psychiatry and others. The district hospitals of Mysore City cater to the people living in urban as well as rural people in the Mysore District. Mysore district hospitals have good number of health workforce which serves the major portion of the population of the district.

The secondary level of health care essentially includes Community Health Centres (CHCs), constituting the First Referral Units (FRUs) of the taluk and District Hospitals. The CHCs were designed to provide referral health care for cases from the Primary Health Centres level and for cases in need of specialist care approaching the centre directly <sup>[4]</sup>. According to IPHS norms one CHC will serve 1, 20,000

populations for plain areas. But in the study area, 8, 93,062 populations are served by 1 CHC. It consists of 30 bedded hospitals with 2 wards, one Laboratory and one operation theater providing specialist care in Medicine, General Surgery, Obstetrics and Gynecology, Surgery, Paediatrics, Dental and AYUSH for both inpatients and outpatients. The Health Infrastructure of the CHC is presented in detail in the form of **Table 3**. Whereas, the availability of health

workforce in the Community Health Centres of the City are not equal to norms. The workforce of the CHC's includes 3 Doctors, 5 Nurses, 3 Health Assistants, 2 Pharmacists, 3 lab Technicians, 2 Ambulance Drivers and 15 other staffs which provide the health services to the people of their judiciary. The Health Workforce of the CHC is presented in detail in the form of **Table 4**.

**Table: 3 Public HealthCare Infrastructure Facilities in Mysore City**

SL. No	Health Infrastructure	Mysore City			
		Community Health Centre	Primary Health Centre	Maternity Hospital	Total
1	Beds	30(36.58)	41(50)	11(13.41)	82(100)
2	Wards	2 (18.18)	4 (36.36)	5 (45.45)	11 (100)
3	Laboratory	1 (11.11)	3 (33.33)	5 (55.55)	9 (100)
4	Operation Theater	1 (16.66)	0 (0)	5 (83.33)	6 (100)
5	Ambulance	1 (33.33)	1 (33.33)	1 (33.33)	3 (100)
6	108	1 (33.33)	1 (33.33)	1 (33.33)	3 (100)
7	Blood Bank Storage	1 (100)	0 (0)	0 (0)	1 (100)
Total		37 (32.17)	50 (43.47)	28 (24.34)	115 (100)

Source: Field Survey, Figures in Parentheses indicate percentage

**Table: 4 Public Health Workforce of the Mysore City**

SL. No	Health Workforce	Mysore City			
		Community Health Centre	Primary Health Centre	Maternity Hospital	Total
1	Doctors	3 (11.53)	19 (73.07)	4 (15.38)	26 (100)
2	Nurse	5 (12.5)	21 (52.5)	14 (35)	40 (100)
3	Health Assistant	3 (10.71)	20 (71.42)	5 (17.85)	28 (100)
4	Pharmacists	2 (11.11)	14 (77.77)	2 (11.11)	18 (100)
5	Radiographer	1 (25)	2 (50)	1 (25)	4 (100)
6	Health Worker	6 (23.07)	12 (46.15)	8 (30.76)	26 (100)
7	Clerks	1 (33.33)	1 (33.33)	1 (33.33)	3 (100)
8	Technician	2 (50)	0 (0)	2 (50)	4 (100)
9	Drivers	2 (33.33)	2 (33.33)	2 (33.33)	6 (100)
10	Group D	6 (8.57)	46 (65.71)	18 (25.71)	70 (100)
Total		31(13.77)	137 (60.88)	57 (25.33)	225 (100)

Source: Field Survey, Figures in Parentheses indicate percentage

Primary Health Centre is the cornerstone of rural health services- a first port of call to a qualified doctor of the public sector in rural areas for the sick and those who directly report or referred from Sub-Centres for curative, preventive and promotive health care. A typical Primary Health Centre covers 30,000 populations in plain areas with 6 indoor/observation beds. In the study area, 8,93,062 population are served by 21 PHC. The available health infrastructure facilities of PHC's include 41 Beds, 4 Wards, 3 Laboratories and 2 Ambulance Drivers. The Health Infrastructure of the PHCs is presented in detail in the form of **Table 1**. Whereas, the availability of health workforce in Primary Health Centres of the

City are not equal to norms. The health workforce of the PHC's of the City is shown in **Table.2**. It includes 3 doctors, 5 nurses, 3 Health Assistants, 2 Pharmacists, 3 lab Technicians, 2 Ambulance Drivers and 15 other staffs which provide the health services to the people of their judiciary. The Health Workforce of the PHC is presented in detail in the form of Table 2, it includes 19 doctors, 21 nurses, 20 Health Assistants, 14 Pharmacists, 2 lab Technicians, 13 Other Staffs, 2 Ambulance Drivers and 6 Group D workers which provide the health services to the people of their judiciary.

Maternity hospital is a hospital that specializes in caring for women while they are pregnant and during childbirth. The

hospital also provides care for newborn infants. Totally, there are 5 maternity hospitals in Mysore city; the health infrastructure of the maternity hospitals in Mysore City includes 11 Beds, 5 Wards, 5 Laboratory, 2 Ambulance and 108 Services, OPD rooms, Labor Rooms and other facilities which are being utilized to provide the maternal care to the people of Mysore city. The Health Infrastructure of the maternity Hospital is presented in detail in the form of **Table 1**. Whereas, the availability of health workforce in maternity hospital of City are not equal to norms. The health workforce of maternity hospital of the City is shown in **Table.2**. It includes 4 doctors, 14 nurses, 5 Health Assistants, 2 Pharmacists, 3 lab Technicians, 2 Ambulance Drivers and 18 other staffs

which provide the health services to the people of the city.

Therefore, the analysis reveals that the number of health centres, workforce and also infrastructure are not increasing in the same proportion as the population is increasing, which results the overload of population on the existing health centres, workforce and infrastructure facilities. Currently, the world is facing the 2<sup>nd</sup> wave of COVID-19 disease. In Mysore City, District Hospital has been reserved for covid-19 patients and also both public and private hospitals are using for this disease. Since cases are increasing, but, there is a shortage of beds, staffs, infrastructure facilities and health care centres in the study area.

### Zone Wise Distribution of Healthcare Centers in Mysore City

**Table: 5 Zone Wise Distributions of Health Centers and Population Ratio**

Zones No	Name Of The Zones	No. of Wards	Population 2011	Health Centers			PHC/ Population Ratio (1:30,000)	PHCs Needed
				Public				
				MAT	CHC	PHC		
Zone 1	Akkanabalaga	1 to 6	71,433	1	0	1	71433	2
Zone 2	Jayanagara	7 to 14	110,910	1	1	3	36970	1
Zone 3	Sharadadevi Nagar	15 to 24 excluded ward-23	140,248	0	0	2	70124	3
Zone 4	Vontikoppal	30 to 33included ward 23	63,619	1	0	1	63619	1
Zone 5	Hebbal	25 to 29	76,790	0	0	1	76790	2
Zone 6	R.M.C	34 to 38	49,339	0	0	1	49339	1
Zone 7	N.R. Mohalla	39 to 45 included ward no-64	84,156	1	0	3	28052	0
Zone 8	Udayagiri	46 to 54	144,682	0	0	6	24113	0
Zone 9	Gayathri puram	55 to 65 excluded ward 64	151,885	1	0	3	50628	2
TOTAL		65	893,062	5	1	21	1:47106	12

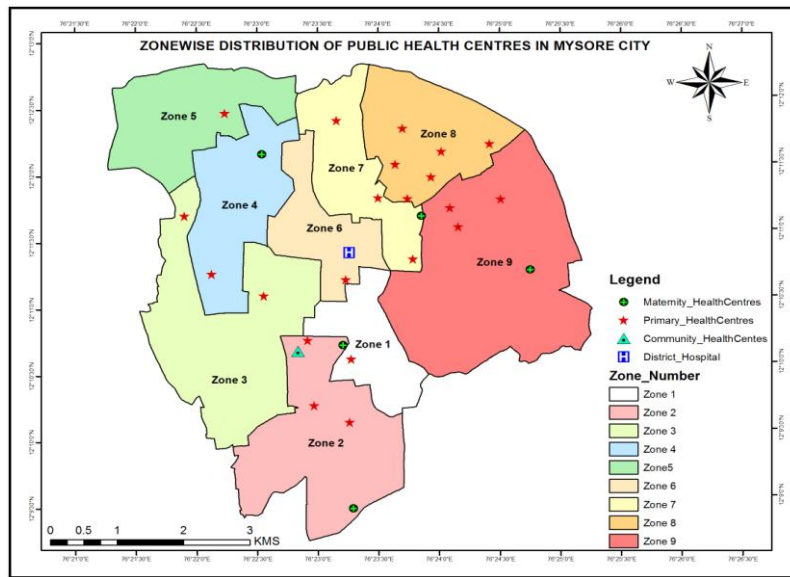
Source: Field Survey and Compiled by Author

According to the above table 5, the zone 9 Gayathripuram is the highest population 151,885 which include the wards like Kalyangiri, Yaranahalli, Vidyanagar, Ragavendranagar, Goushiya nagar, Shantinagar, Kyathmarahalli, Gayatri puram, Siddharthanagar, Ittegegudu. It consists of 3 Primary health centers and one maternity hospital, this zone as an uneven distribution of health centres. This zone having high area under slum compare to total area of the ward is relatively highly concentrated. Consequently, this zone is also more prone to diseases; it needs 2 more hospitals in future. The zone 2 Jayanagar it

had high population 110,910 which include the ward names like Jayanagar, Ashokapuram, K.M. Puram, Vidyanagar puram, J.P Nagar, Shirampura, Arvinda Nagar, Vishweshwaranagar etc, In this area is highly prone for malaria because it has slums. These zones consists one CHC, 3 PHC's and one Maternity hospital are sufficient, but healthcare infrastructure facilities are not sufficient here. So this area needs one more healthcare centers in future and improvement of the infrastructure facilities. The zone number 6 R.M.C. is having lowest population i.e., 49,339 it include the ward names like Yadavgiri,

Devaraja Mohalla, Subbarayanakere, Lakshkar Mohalla, Mandi Mohalla. This area consists of one PHC's it's a developed area but public healthcare centers are not sufficient to this population so, this area also needs one more hospitals in future. The Zone number 3 Sharadadevi Nagar it had population 140,248, these zone consists only two primary health centre and they are not sufficient for the existed population, this area also needs three more PHC's in future. . The Zone number 1, 4 and 5 each zone consists of one primary health centre and they are not sufficient for the existed population, this area also needs two more

PHCs in each zone. Zone number 8 is udayagiri with 144,682 populations it consists of 6 primary health centre with good facilities for the existed population and for the surrounding population also. According to the NRHM norms in Mysore city reveals that the each PHC is serving to a population of 47107 persons. It reveals that the study area had less number of health institutions compare to NRHM norms. Here, healthcare centers are not sufficient to this population so, study area needs more health centers in future. The Zone wise Distribution of Public healthcare centre has been shown in Map. 3.



Map.3 Zone Wise Distribution of Public Health Centres in Mysore City

### Location Quotient

It is a simple tool used to determine the spatial distribution of a phenomenon in an area compared to an entire region. Here, the spatial distribution of primary healthcare centers by zone wise compared to entire

city. Location Quotient (LQ) is calculated using the following equation.

$$LQ = \frac{\text{PHCs in a Zone} / \text{Zone Population}}{\text{PHCs in a City} / \text{City Population}}$$

Table: 6 Location Quotients of Primary Health Centers

Zones No	Name Of The Zones	Population 2011	Available PHCs	Location Quotient (LQ)	Description
Zone 1	Akkanabalaga	71,433	1	0.59	Low Spatial Concentration
Zone 2	Jayanagara	110,910	3	1.14	Equal Spatial Concentration
Zone 3	Sharadadevi Nagar	140,248	2	0.60	Low Spatial Concentration
Zone 4	Vontikoppal	63,619	1	0.66	Low Spatial Concentration
Zone 5	Hebbal	76,790	1	0.55	Low Spatial Concentration
Zone 6	R.M.C	49,339	1	0.85	Low Spatial Concentration
Zone 7	N.R..Moholla	84,156	3	1.51	High Spatial Concentration
Zone 8	Udayagiri	144,682	6	1.75	High Spatial Concentration
Zone 9	Gayathripuram	151,885	3	0.83	Low Spatial Concentration
TOTAL		893,062	21		

Source: Field Survey and Compiled by Author

The Table number 6 shows the details of zone wise distribution of PHCs and Location quotient analysis. Location quotient value with more than 1.50 is considered as high spatial concentration category. Udayagiri and N.R.mohalla zone have high concentration of PHCs compared to City as a whole. LQ value between 1.00 to 1.50 is considered as equal spatial concentration category is found in Jayanagara zone; it indicates that the health facilities are equally distributed. A value less than 1 considered as low spatial concentration category, it indicates a deficit in the services. Akkanabalaga, Sharadadevingar, Vontikoppal, Hebbal, R.M.C and Gayathripuram zones with low spatial concentration of PHCs. More PHCs should be started in these zones to attain equal distributions.

## **CONCLUSION**

The study reveals that, the spatial distribution of Public health centers are unevenly distributed among different wards of the Mysore City. In addition to this there is scarcity in the availability of workforce and infrastructure among the study area. Majority of the population in the study area use the Public Health centers due to Socio-Economic conditions. The patients of the Public health centres also avail the health services from private hospitals whenever the services are not available in government health centres. In the study it has been identified these Public health institutions of different hierarchies are inadequate in proportion to population, though the population health centres ratio is within the NRHM norms. The analysis of Location quotient of PHC's shows that in Akkanabalaga, Sharadadevingar, Vontikoppal, Hebbal, R.M.C and Gayathripuram zones with low spatial concentration of PHCs. Which need more PHC's to satisfy the service to available population. Availability of the health centers are primarily effect on utilization of healthcare facilities and important factor is distance, a large proportion of the residents

have to travel a long way to access the Public healthcare facilities. Therefore, the analysis reveals that the number of health centres, workforce and also infrastructure are not increasing in the same proportion as the population is increasing, which results the overload of population on the existing health centres, workforce and infrastructure facilities. In the study area, there is a shortfall not only in terms of physical infrastructure but also health workforce, measured against the norms prescribed by the government. In order to overcome this issue, the government should provide new Public healthcare centers for the growing population.

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