© 2017 IJSRST | Volume 3 | Issue 8 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

# Accessibility to Higher Order Public Health Centers a Study of District Pulwama (J&K)

**Javaid Ahmad Tali[1], Asima Nusrath[1] Aasif Nengroo[2]**
[1]Department of Studies in Geography University of Mysore, India
[2]Department of Economics, Central University of Kashmir, India

## ABSTRACT

The provision of equal and easy access to health centers is the fundamental right to all the citizens. This paper reviews the spatial accessibility to higher order health care facilities in terms of travel distance and travel time using service catchment areas and closest facility. Analysis of variance has been used to measure the variation in accessibility among the medical blocks of the district in both the dimensions (time & distance). Time and distance accessibility was further overlaid to measure the overall accessibility. Furthermore ordinal regression has been used to determine the impact of elevation, road density and distribution of health centers on accessibility to health centers of the district. The results revealed that the time accessibility to CHC and DH at medical blocks level varies significantly and in case of distance the accessibility also varies among medical blocks but only DH accessibility varies significantly. Over 14.63 percent of population has poor access to such health centers. It is necessary to underscore the necessities of area-specific strategies including increase the increase in number of health centers and also up gradation of infrastructure facilities as well as to increase of manpower.

**Keywords:** Spatial Accessibility, Distance, Time, Service Area, Closest Facility

## I. INTRODUCTION

It is a fundamental human right to have access to health care services when needed. It is desirable for a government to ensure high quality provision and equal and easy access to fundamental health care services to all citizens. Varying spatial distribution of the population, health care facilities and transportation infrastructure in an area often lead to spatial variations in accessibility to health care facilities, which in turn will result in disadvantaged locations and communities having poor spatial accessibility to needed health care facilities [1]. In a general sense, the term 'access' refers to an entrance into, the right of entry to, or the use of facilities, and the term 'spatial accessibility' refers to the physical accessibility one possesses to a preferred location, or the ease at which individuals in one location can reach another location [2,3]. Accessibility to healthcare facilities has generally been identified as a major indicator of development, and the existing spatial pattern of distribution of healthcare facilities play very prominent role in gauging the level of efficiency or otherwise of the existing level of provision of these facilities within any region [4]. Accessibility to health services is not only an important factor for a well-functioning society but is even a basic human right [5]. Physical accessibility is termed as a measurement of opportunities available to people in a geographical region. Access should be seen as a function of several factors, availability of services, characteristics of users and outcomes (such as change in health status or uptake of interventions of known effectiveness), while taking into account the complex and non-linear relationships between these elements [6, 7]. Physical accessibility largely depends on quantity and quality of connectivity which determines the travelling time, travelling distance and speed. Those are in turn determined by road and surface condition like sinuosity, matter of choice for travelling as per road condition. Thus health care policies are essential in terms of the quality and quantity of services available and its associated effects on access with respect to utilization and the sustenance of the facility for continuous increase and ever-changing need of the population [8]. Geographical access to be linked to people, exhibits a method for estimating the geographical accessibility of health facilities by population coverage, average travel time and distance to

the closest hospital [9]. GIS-based algorithm for measuring physical accessibility is based on concepts of space–time prisms that can identify feasible opportunities under different scenarios of complex travel behavior to determine if a location can be physically reached or not. If a facility is not available on the shortest path, it can be assumed out of reach within the budgeted time [10]. GIS is a well-suited approach to evaluating patient access to health care facilities. The defining of catchment areas for health care can be done in different ways for example; health authorities evaluate the distribution of supply versus demand within a region, often expressed as a ratio of population to health resources [11].

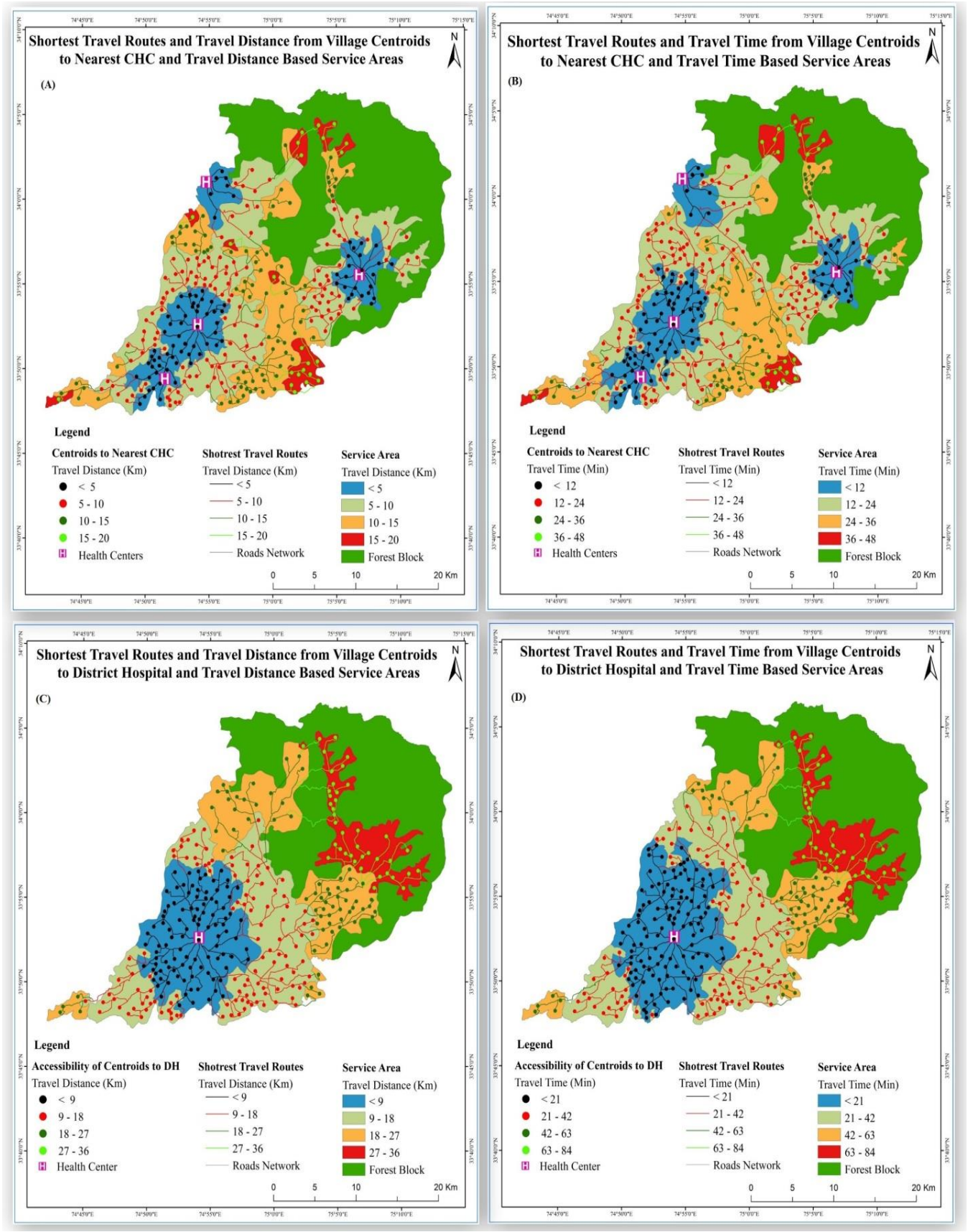
Service areas created to evaluate accessibility and is being used to measure the accessibility with varies impedance cutoff. Service area on the basis of time and distance are mostly being used to predict the travelling time and traveling distance from demand points to service centers of vice versa like as health centers, schools, fire station etc. The number of facilities within a specified travel impedance (e.g. travel distance, travel time or travel cost) is a commonly used method to measure spatial accessibility. Distance can be measured either from the supply perspective, e.g. catchment area for a specific health care service, or from the individual users perspective, e.g. distance to the closest health care service facility [12,13]. Present study was conducted to measure the disparities in healthcare access in District Pulwama and the factors influencing it.

## II. METHODOLOGY

This paper reviews the spatial accessibility to higher order health care facilities measured in terms of travel distance and travel time in 2016. Spatial accessibility to such facilities are measured and characterized using two related approaches: (1) in terms of the shortest travel distance between health care facilities and the locations of their potential users and (2) in terms of the shortest travel time between health care facilities and the locations of their potential users using service catchment areas and closest facility. Both the categories of health centers (Community health centers (CHC) and District Hospital (DH)) were taken into consideration for accessing the accessibility to CHCs because a DH provides all facilities which are available CHCs. The raster overlay analyses were applied for time and distance accessibility for each health center. Analyses of variance were applied to predict the variation in the accessibility at medical block level to health centers both on time and distance. Ordinal logistic regression was used to measure the impact of elevation, distribution of health centers and road density on the accessibility to health centers.

## III. RESULTS

The spatial accessibility indicated by travel (driving) time may not represent actual spatial accessibility of the residents in the study area since many residents may not have a car or may not be able to drive a car at the time they need to visit a specific health care facility. The service area and closest facility for CHC's within the impedance cutoff of 5, 10, 15, and 20 and for travel time within the impedance cutoff of 12, 24, 36 and 48 min and for DH service area of and the closest facility has been generated based on Travel distance of 9, 18, 27 and 36 km and travel time (min) within the impedance cutoff of 21, 42, 63 and 84 min.


Shortest Travel Routes and Travel Distance from Village Centroids to Nearest CHC and Travel Distance Based Service Areas
(A)
Shortest Travel Routes and Travel Time from Village Centroids to Nearest CHC and Travel Time Based Service Areas
(B)
Shortest Travel Routes and Travel Distance from Village Centroids to District Hospital and Travel Distance Based Service Areas
(C)
Shortest Travel Routes and Travel Time from Village Centroids to District Hospital and Travel Time Based Service Areas
(D)
Legend
Centroids to Nearest CHC
Travel Distance (Km)
< 5
5 - 10
10 - 15
15 - 20
Health Centers
Shotrest Travel Routes
Travel Distance (Km)
< 5
5 - 10
10 - 15
15 - 20
Roads Network
Service Area
Travel Distance (Km)
< 5
5 - 10
10 - 15
15 - 20
Forest Block
Centroids to Nearest CHC
Travel Time (Min)
< 12
12 - 24
24 - 36
36 - 48
Health Centers
Shotrest Travel Routes
Travel Time (Min)
< 12
12 - 24
24 - 36
36 - 48
Roads Network
Service Area
Travel Time (Min)
< 12
12 - 24
24 - 36
36 - 48
Forest Block
Accessibility of Centroids to DH
Travel Distance (Km)
< 9
9 - 18
18 - 27
27 - 36
Health Center
Shotrest Travel Routes
Travel Distance (Km)
< 9
9 - 18
18 - 27
27 - 36
Roads Network
Service Area
Travel Distance (Km)
< 9
9 - 18
18 - 27
27 - 36
Forest Block
Accessibility of Centroids to DH
Travel Time (Min)
< 21
21 - 42
42 - 63
63 - 84
Health Center
Shotrest Travel Routes
Travel Time (Min)
< 21
21 - 42
42 - 63
63 - 84
Roads Network
Service Area
Travel Time (Min)
< 21
21 - 42
42 - 63
63 - 84
Forest Block
0 5 10 20 Km
N

Map 1

**Table 1.** Percentage of population within specified travel Distance (km) and travel Time (min)

| | Pulwama | Pampore | Tral | Total |
|---|---|---|---|---|
| **COMMUNITY HEALTH CENTERS** | | | | |
| **Distance** | | | | |
| > 5 | 35.16 | 22.62 | 33.29 | 30.66 |
| 5 to 10 | 36.75 | 39.23 | 49.89 | 40.81 |
| 10 to 15 | 19.06 | 35.34 | 13.92 | 23.03 |
| 15 to 20 | 9.03 | 2.81 | 2.9 | 5.5 |
| Average Distance | 7.80 | 9.23 | 7.59 | 8.15 |
| F Value = 4.653 | | | | |
| **Time** | | | | |
| > 12 | 36.23 | 29.86 | 32.21 | 33.18 |
| 12 to 24 | 33.27 | 54.07 | 49.06 | 43.89 |
| 24 to 36 | 22.74 | 14.31 | 13.74 | 17.79 |
| 36 to 48 | 7.76 | 1.76 | 4.99 | 5.14 |
| Average Time | 18.43 | 17.77 | 18.67 | 18.31 |
| F Value = 0.207 | | | | |
| **DISTRICT HOSPITAL** | | | | |
| **Distance** | | | | |
| > 9 | 52.48 | 25.09 | 0 | 30.62 |
| 9 to 18 | 40.95 | 34.07 | 9.8 | 30.99 |
| 18 to 27 | 6.58 | 40.65 | 49.56 | 28.22 |
| 27 to 36 | 0 | 0.19 | 40.64 | 10.17 |
| Average Distance | 9.42 | 13.13 | 26.01 | 14.60 |
| F Value = 282.159 | | | | |
| **Time** | | | | |
| > 21 | 54.08 | 30.03 | 0 | 32.9 |
| 21 to 42 | 38.05 | 46.95 | 9.8 | 33.89 |
| 42 to 63 | 7.87 | 22.83 | 46.47 | 22.28 |
| 63 to 84 | 0 | 0.19 | 43.73 | 10.93 |
| Average Time | 21.95 | 26.79 | 60.76 | 32.98 |
| F Value = 274.547 | | | | |

Accessibility to CHC and DH based on Travel Distance (km) and Travel Time (min)

The shortest travel distance and route from village centroids to nearest health center and travel distance based service areas for CHCs are shown in Map 1 (A). Table 1 show the number of villages and population and their percentage located within accessible zones based on travel distance from the village centroids to health center. The table reveals that 30.66% of the population of 85 villages have access within the travel distance of < 5 km; whereas 26.91% of the population (n=46243) of 7 villages even have access by walk within the travel distance of < 2 km. At the block level the highest percentage of population in this zone of accessibility is from Pulwama with 35.16% followed by Tral and Pampore with 33.29 and 22.62% respectively. Majority of the population of the district 40.81% has access within the travel distance of 5 to 10 km. The highest percentage of population is from Tral 49.89%; Pampore 39.23% and Pulwama 36.75%. There are 24.92% (n=81) of villages with 23.02% of the population have access within the travel distance of 10 to 15 km. Highest population in this zone of accessibility is from Pampore block which accounts the population of 49.40% followed by Pulwama and Tral with 35.57 and 15.02% respectively. A very less count of villages 7.08% which holds the 5.50% of total population of the study area have access to the nearest CHC within the travel distance of 15 to 20 km. In this zone of accessibility the highest population of 70.50% is from Pulwama, Pampore share 16.41% of population and 13.09% of population is from Tral.

Shortest travel routes and spatial variations in travel (driving) time from village centroids to nearest CHC and corresponding service areas are presented in Map 1 (B). The number and percentages of villages and population located within specified travel (driving) time are summarized in table 1. The data reveals that 29.23% of villages which accounts 33.18% population of the district have access within the driving travel time < 12 minutes; whereas 22.89% of population even have access such facility by walk within the travel time of < 20 minutes. Among blocks the highest percentage of population in this zone of accessibility is from Pulwama with 36.32% followed by Tral and Pampore with 32.21 and 29.86% respectively. Majority of population of district 43.89% have access within the travel driving time of 12 to 24 minutes; Out of that 54.07% population is from Pampore, Tral block and Pulwama block constitutes 49.06% and 33.27% of population. There are

19.69% of villages accounts 17.79% of population of the district have access within driving travel time of 24 to 36 minutes. Highest population in this zone of accessibility is from Pulwama with 22.74% followed by Pampore and Tral with the population of 14.31 and 13.74% respectively. 6.46% of villages with 5.14% of the total population of the study area have access to the nearest CHC within the travel time of 36 to 48 minutes. In this zone of accessibility the highest population of 7.77% is from Pulwama, Tral block encompasses 5% and the 1.76% of population is from Pampore.

The comparison test of travel distance accessibility (km) to CHCs among the Medical Blocks in Table 1 identifies the variation in accessibility to CHCs among the three medical blocks of the district. The P-value (0.010) of the test reveals that the accessibility of villages at medical blocks level to CHCs is different from each other and the difference is significant at one percent level of significance. Based on time the accessibility to CHCs among the medical blocks of the district is more or less equal to each other as the P-value indicates that the difference in accessibility to such facilities is not significant even at five percent level of significance.

Map 1 (C) shows the shortest travel distances and routes from village centroids to nearest health care facilities and travel distance based service areas for District Hospital facility. The number of villages, population and their percentage located within accessible zones based on travel distance from the village centroids to health center are shown in Table 1 which reveals that 30.62% of population of 103 villages have access with the travel distance of < 9 km; whereas 10.90% of (n=18712) even have access to such facility by walk within the travel distance of < 2 km. In this zone of accessibility the Pulwama constitutes 52.48% and Pampore with 25.09% of population. People in Tral medical block do not have access to such facility within the travel distance of < 9 km. 115 villages which holds 30.99% of population of the district have access within the travel distance of 9 to 18 km. in this zone of accessibility Pulwama holds the population of 40.95% followed by Pampore with 34.07% and 9.80% from Tral. 28.22% of population have access within the travel distance of 18 to 27 km. Highest population in this zone of accessibility is from Tral with 49.56% followed by Pampore and Pulwama with 40.65 and 6.58% respectively. 12.31% villages with the population of 10.16% of the district residing in the North West part of the district have very less access as these villages have to travel more than 27 km to access such facility in which 40.64% are from Tral and 0.19% from Pampore.

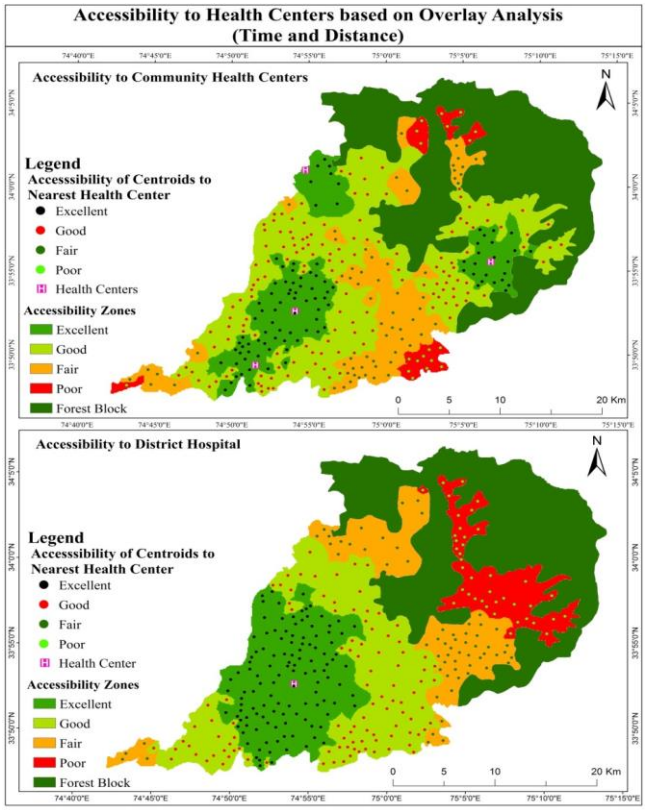
The accessibility zones to DH based on driving traveling time from village centroids using shortest traveling routes and traveling time based service area catchment has been presented in Map 1 (D). The population residing in different villages and their percentage located within different accessible zones based on driving travel time is shown in Table 1. The data reveals that 32.90% of population of 120 villages have access within the driving travel time of < 21 minutes; whereas 10% population even have access to such facility by walk within the travel time of < 20 minutes. In this zone of accessibility the highest proportion of population is from Pulwama with 54.08% and 30.03% is from Pampore. The residents of Tral don't access such facility within the travel time of 21 minutes. 31.40% of villages with 33.89% population have access within the driving travel time of 21 to 42 minutes. The large proportion of population 46.95% have access in this zone is from Pampore followed by Pulwama with 38.05% and 7.85% is from Tral. There are 18.46% of villages with the population of 22.28% have access within the driving travel time of 42 to 63 minutes. Highest population in this zone of accessibility is from Tral with 46.48% of population followed by Pampore and Pulwama with the population of 22.83 and 7.87% respectively. 13.23% villages with the population of 10.93% residing in the North West part of the district have very less access as these villages have to travel for 63 to 84 minutes to have access to such facility in which 43.73% is from Tral and 0.19% is from Pampore.

Both the results of accessibility comparison test of DH based on travel distance and travel time reveals that the accessibility varies of villages of medical blocks to DH differs from each other and the difference is significant at one percent level of significance.

## IV. OVERALL ACCESSIBILITY TO HEALTH CENTERS

Overlay analysis is a technique for applying common scale of values to diverse and dissimilar inputs to create an integrated analysis. In the present study two different factors for measuring accessibility (distance and time) to

health centers were integrated to generate overall accessibility scenario of the district. Spatial accessibility of health centers based on travel time and travel distance were generated for each health center by using network analysis tool. The accessibility zones at village level were generated based on both time and distance for each health center and the each accessible zone was given weightage. The raster overlay analyses were applied for time and distance accessibility for each health center separately and finally all together.




Map 2

The accessibility to CHCs reveals that majority of the population 44.98 % of the district are availing good accessibility followed by excellent accessibility which accounts 33.70 %. The fair and poor accessibility zones constitute 16.85 and 4.47 % of population. In case of accessibility to DH, majority of population 34.18 % have good accessibility followed by excellent category with 33.16 % of population. 22.49 % of population has fair access to DH and 10.17 % of population has poor access. The overall accessibility to all the health centers of the district based on travel time and travel distance reveals that 7.32 % of population have poor access to health centers, 19.67 % have fair access. There is 39.58 % of population having good access and 33.43 % of population have excellent accessibility to the health centers of the district.

## V. ORDINAL LOGISTIC REGRESSION

We run ordinal logistic regression to understand the effect of elevation, health centers and road density on accessibility as shown in table 2

Table: 2 Ordered Logistic Regression

| Accessibility Zones | Coef. | Std. Err | z | P > \|z\| |
|---|---|---|---|---|
| Elevation | -0.4119527 | 0.1406702 | -2.93 | 0.003 |
| Health Centers | 0.3995666 | 0.3255373 | 1.23 | 0.220 |
| Road Density | 0.005814 | 0.1608219 | 0.04 | 0.971 |
| /cut 1 | -1.532753 | 0.5034592 | | |
| /cut 2 | 0.4787711 | 0.4976036 | | |
| /cut 3 | 2.649652 | 0.5725095 | | |
| Log likelihood = 0.360; Number of Observations = 325; LR chi2(3) = 10.23; Prob > chi2 = 0.0167; Pesudo R2 = 0.014 | | | | |

The estimated results are presented Table 2 indicate that all the three variables have shown the influence over the accessibility. The outcomes, odds ratios of the estimates, are also predicted. In total, one variable out of three presented in the model, is significant at one percent level. The ordered log odds ratios indicate that having an increase in elevation the likelihood of accessibility to health centers will decrease by 0.41 times. Contrarily, Health centers and road density are associated with the increase in accessibility to health centers by 0.34 and 0.0058 times.

## VI. DISCUSSION

The emphasis in this paper is on method and the usefulness of the results while calculating the physical accessibility to health centers. The data resulting from these analyses consists of 325 villages that contain both travel distance and time information plus all the demographic information from the population Census. This method has shown that physical accessibility to hospitals varies considerably at medical blocks level. There are 10.64 % of population has cover 20 km or 48 minutes to reach the CHCs. The situation is worse in case of DH in which 21.04 % of people have to travel more than one hour or have to travel distance of 36 km to visit the DH. The accessibility scenario of the district varies among the blocks. The entire region of interest

has varied and undulating terrain, slope and steepness. The physical characteristics have greatly influenced the location and nature of health centers, road density, type of roads, road conditions etc. The physical accessibility in Tral is comparatively lower as a result of its rugged and steep slopes thereby leading to a lesser number of health centers and lower road density. The contrasting situation is observed in Pulwama where the land is comparatively less undulation thereby providing better opportunity for the development of good roads and higher availability of public health centers. Therefore the physical accessibility is greatly enhanced in Pulwama block. However the moderate accessibility prevails in Pampore block as a result of moderate nature of ruggedness, thereby making the road density comparatively better than Tral facilitating the provision of public health facilities which are grossly moderate in all respects.

## VII. CONCLUSION

The spatial distribution of health centers and density of road network are the function of topography of the region which in turn indicates how resources are allocated. Among the different accessibility zones of the district the road density and number of health centers are showing the decreasing trend from excellent to poor accessibility zone; while as the elevation has shown the increasing trend. In other words the accessibility decreases with the increase in elevation (negative relation) while the accessibility increases with the increase in number of health centers and also with the increase in road density (positive relation). Therefore it is necessary to underscore the necessities of area-specific strategies including increase the infrastructure facilities at such health centers mainly at community health centers and primary health centers and other accessibility determinants as good road network, traffic flow etc. This research has emphasis to raise the awareness within the policy environment about the potential for network models to provide quantified travel time and distance data for other health services.

## VIII. ACKNOWLEDGEMENT

We are thankful for Indian Council of Social Science Research (ICSSR), New Delhi for providing us financial assistance for this study.

## IX. REFERENCES

[1] Ahmad, S. (2012). A GIS based investigation of spatial accessibility to health care facilities by local communities within an urban fringe area of Melbourne.

[2] Burns, L. D. (1979). Transportation, temporal, and spatial components of accessibility.

[3] Kwan, M. P., & Weber, J. (2003). Individual accessibility revisited: implications for geographical analysis in the twenty-first century. Geographical analysis, 35(4), 341-353.

[4] Sanni, L. (2010). Distribution pattern of healthcare facilities in Osun state, Nigeria. Ethiopian Journal of Environmental Studies and Management, 3(2).

[5] Eklund, L., & Martensson, U. (2012). Using geographical information systems to analyse accessibility to health services in the West Bank, Occupied Palestinian Territory.

[6] Aday, L. A., & Andersen, R. (1974). A framework for the study of access to medical care. Health services research, 9(3), 208.

[7] Pawson, R., & Tilley, N. (1997). Realistic evaluation. Sage.

[8] Bhatt, B., & Joshi, J. P. (2013). A geospatial approach for assessing and modeling spatial accessibility of the primary health centers in the tribal talukas of the Vadodara district. International Journal of Geomatics and Geosciences, 3(3), 582.

[9] Islam, M. S., & Aktar, S. (2010). Measuring physical accessibility to health facilities - A case study on Khulna City. World health & population, 12(3), 33-41.

[10] Lee, M. S., & McNally, M. G. (2002). Measuring physical accessibility with space-time prisms in a GIS: A case study of access to health-care facilities. Center for Activity Systems Analysis.

[11] Luo, W. (2004). Using a GIS-based floating catchment method to assess areas with shortage of physicians. Health & place, 10(1), 1-11.

[12] Maheswaran, R., Payne, N., Meechan, D., Burden, R. P., Fryers, P. R., Wight, J., & Hutchinson, A. (2003). Socioeconomic deprivation, travel distance, and renal replacement therapy in the Trent Region, United Kingdom 2000: an ecological study. Journal of Epidemiology & Community Health, 57(7), 523-524.

[13] Fortney, J., Rost, K., Zhang, M., & Warren, J. (1999). The impact of geographic accessibility on the intensity and quality of depression treatment. Medical care, 37(9), 884-893.