International Journal in Management and Social Science
Volume 11 Issue 04, April 2023 ISSN: 2321-1784 Impact Factor: 7.088
Journal Homepage: http://ijmr.net.in, Email: irjmss@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

ACCESSIBILITY INDEX OF SUBURBAN SETTLEMENTS TO HEALTHCARE SERVICES: THE MISSING GAPS

[1]Alausa, Samuel and [2]Oloukoi, Grace

[1]Department of Estate Management, Lead City University, Ibadan

[2]Department of Urban and Regional Planning, Lead City University, Ibadan

Corresponding Author: Alausa: revalausa@gmail.com

Abstract.

The transformation of rural areas to urban and suburban settlements has socio-economic and health outcomes which vary in space, time and across different population group. Existing location theories and models in regional analysis have been adopted to explain healthcare accessibility and health outcomes. This paper which is conceptual in approach examines the limitations of the existing models with preposition of measuring indicators that captures accessibility index as a key determinant. The gap filled was in the area of providing simpler formula to measure peoples' accessibility index to healthcare facilities using the Newton Gravitational Index Approach and Gaussian Weight Index Approach. These two formula are simpler than the Three Step Floating Catchment Area (3SFCA) and Two Step Floating Catchment Area (2SFCA) approaches; and at the same time more advance than the Regional Availability Model (RAM) and Gravity Model (GM). The Newton and Gaussian models can also capture the pull factor in peoples' choice of facility utilization. The proposed methodology is situated within the context of healthcare facility catchment for adequate planning and policy development.

Keywords: Accessibility index, Healthcare facilities, Suburban Settlement, Measuring indicators.

1.0. Introduction.

The growth of human settlements from rural to urban has brought with it some challenges which constituted a great concern in the field of spatial planning, and healthcare service planning and development. The emergence of cities as a social process started from the Neolithic period when people started to have agriculture products surplus which are sold to sustain the emerging population growth (Barcelo, Pelfer and Mandolesi, 2002). According to Clark (1982), cities have urban functional roles which consist of core administrative government centers. They link hinterland and rural settlement for a functional socio-economic activities. The suburban is the mid-point between the two extremes of urban and rural settlements.

The development and growth of urban settlements generates some challenges alongside with her economic and social opportunities which include overcrowding, traffic congestion, environmental degradation and health related issues (Oloruntoba, 2021). The differences in socio-physical and economic infrastructure between the urban and rural as well as suburban settlements bring about both economic and social inequalities which may affect the health status of the different settlements across these spaces. This difference in health status is predicated by unequal access to available healthcare facilities. Researchers have adopted different methods to measure access to healthcare services within and between settlements or regions. This has attracted criticism and variations in methodology which also resulted into different healthcare outcomes (Khan, 1992; Ma et al., 2018). This paper reviews some of the methods used in healthcare service inequality measurement with the aim of identifying their advantages and limitation; and then propose another method that can be used to improve on the existing ones.

2.0. Theoretical Background

Measuring healthcare inequality requires an understanding of some theoretical backgrounds which provide framework for analysis of health outcomes. Thus, four theories will be examined to provide a solid foundation for the method to be proposed. The theories are:

2.1 The Progressive Utilization Theory (PROUT) (Prabhat Ranjan Sarkar, 1921-1990)

The Progressive Utilization Theory (PROUT) was developed by an Indian philosopher and spiritual leader Prabhat Ranjan in 1959. The theory was proposed to overcome the criticism levied against capitalism and communism as a system of resource allocation (Maheshvarananda and Branch 2010). The theory toed the line of thought of Sarkar's Neo-humanist value which aimed at providing proper care to every being on the planet including human, animals and plants. PROUT theory was based on rational and equitable allocation of goods and services to maximize the physical, mental and spiritual development of all people in a settlement or region. The theory consists of sixteen aphorisms but the last five of the aphorism are described as fundamental principles of PROUT. The last five principles are: there should be no accumulation of wealth without the permission of the society; there should be maximum utilization and rational distribution of the crude and causal resources; there should be maximum utilization of the physical, mental and spiritual potentials of the individual and collective beings; there should be a balanced adjustment of utilization among the social divide; and utilization should vary according to time, space form and should be progressive. PROUT school of thought believed that all living beings belonged to a universal family who deserved equal respect and care.

2.2 Distance Decay and Accessibility Theory (Waldo Tobler, 1970)

This theory posits that interaction between two objects declines as the distance between them increases. Proponents of distance decay theory believed that distance and interaction are inversely proportional and the " rate of friction of distance" increases with distance; and relative distance is measured in terms of time, cost of travel and transferability (Fotheringham, 2021). Distance decay theory was a further development of Waldo Tobler's First Law of Geography

(1970) which stated that " Everything is related to everything else, but near things are more related than distant things. The law is applicable to various phenomena relationships such as human settlements, geo-linguistics, ecology and healthcare service utilization.

The distance decay model also reflects in the biomes which presumed that physical distance between two geographic locations is directly related to a loss of similarity between in terms of ecology and biodiversity. The theory is a veritable tool to predict location of occurrences of phenomenon. Thus, it is relevant to this discuss since the focus is on the measurement of peoples' accessibility to healthcare services. Distance filters the type of persons ready and willing to travel to consume a particular product. Thus, distance affects peoples' behavior and consumption pattern. (Macercher & Lew, 2003, Uwaoma, 2019). Distance decay affects things which consumption declines with distance from the center and such items include price of land, street quality, rental value of shops and building heights (Uwaoma, 2019).

2.3 The Gaussian Weight Theory

This law was propounded by Carl Friedrich Gauss (1777-1855) who was a German mathematician and a physicist. Gauss invented an early type of magnetometer which was used to measure the direction and strength of a magnetic field. The law stated that the total flux of the electric field E over any closed surface is equal to 1/e0 times the net charge enclosed by the surface. The law stated the relationship between the flux and the net charge enclosed within the surface (Britannica, 2022). The Gaussian law value was put at 8.85×10^{-12} C^2/ Nm^2 .

This theory helps to attach a weight in numerical term to the impact of accessibility index to the benefits people derive from using a particular facility. Therefore, the farther the healthcare facility is to the end users, the less attractive the facilities will be to the people.

2.4. The Newton's Law of Universal Gravitation

This law was propounded by Isaac Newton in 1687 was used to explain the observed movement of objects in the earth. The law was later reduced to mathematical formula by Johannes Kepler. The law stated that every particle is attracted to every other particle in the Universe with a force that is proportional to the product of their mass and inversely proportional to the square of the distance between their centers. This is represented by the formula $F = G\, m_1\, m_2/R^2$; where F is the force; G is the gravitational constant; m_1 is the mass of the object 1; m_2 is the mass of the object 2; and R is the distance between centers of the masses (Byjus, 2023).

The theory is relevant in this context since it explains the importance of "pull" factors that influence the choice of the people in using a particular facility in their region or locality. The theory presumes that an invisible force pull people to a particular location as gravitational force pulls an object down to the ground when thrown up. These pull factors are entrenched in the perceived benefits or utility people will derive from the consumption of the facility. Both Newton law of gravitation and Gaussian law are relevant to this study in two ways:

(i). Both laws explained the principle of attraction or force of attraction between two objects A and B.

(ii). The rate of attraction or magnetism is inversely proportional to the distance between the two distant objects A and B.

Thus, the laws complement the theories of Spatial Interaction (Gravity model) by Huff in 1963 and Distance Decay theory which was a further development of Waldo Tobler's First Law of Geography.

3.0. Conceptual Clarification

3.1 Healthcare Inequality

Equity and Inequality belonged to the family of words measuring differences in status or condition of an object as compared among various objects. Health equity is the human ethical and human rights principles that motivate us to eliminate health disparities or inequalities (Paula, 2017) Health equity is also viewed from the perspective of resource allocation to different sections of the population with the main purpose of achieving equity in access to the various health facilities. Health inequity or inequality denotes unjust differences between groups; and it is the process where obstacles to healthy condition such as poverty, discrimination, lack of access to good job, good housing, adequate security, and health services are removed from the process of health care delivery. It can also be described as the reduction and elimination of disparities in health and its determinants that negatively affect excluded or marginalized groups. The opportunity to be healthy is measured by assessing the determinants of health such as income, education, neighbourhood characteristics, access to health services and social inclusion. Differences in health condition are determined by quality, accessibility, affordability of health care system (Peter et al., 2007). Health inequalities are commonly examined across the global population between countries or states; and between urban and suburban settlements. There is also inequalities within geographical locations or neighbourhood as epitomized by distribution of health facilities between regions, between urban and rural areas, between rural areas, and between urban and suburban areas. There are also variations in health status between group of people which are classified by factors such as race/ethnicity, gender, education, income, and occupation (Arcaya etal, 2015).

The simplest measure of health inequality is to compare the health status of those in the lowest socio-economic groups with those in the higher economic group. Comparison can be in absolute or relative terms. Health inequality can also be measured by the fundamental structures of social and economic hierarchy in which people grow, live, work and age (Marmot, 2007). This constitute the health determinants which are the socio-economic and physical environment, individual behaviours, genetics, and health care system. The complex interaction of these health care determinants defines the health inequalities of the people (Peter, 2007).

Health Equity and Inequality have been measured by using the acronym " PROGRESS" which meant to represent Place (P), Race (R), Occupation (O), Gender (G), Religion (R), Education (E) Social class (S) and Social capital (S) (Public Health Scotland, 2021). Thus the differences in health is determined by the environment, both natural and man-made. The natural factors are Location or Place, Race, Gender, Chemical and Biotic agents which are part of the total environment. The Social class, Social capital, Education, Occupation, Religion belonged to man-made factors which are causal factors in equity and inequality determination. In essence, PROGRESS focuses on environmental and socio-economic determinants of health.

3.2 Accessibility to Healthcare

Accessibility to healthcare is the ease or degree of convenience of the people to attain care when they are in need to address their ailments in a particular location and the concept has gained more attention in the last decade. (Ma et al., 2018). The degree of accessibility of people to healthcare services and infrastructure determines the level of inequality between the different socio-economic strata. The distance in location of the facilities, the human resources and the beneficiaries of healthcare services is inversely proportional to the level of inequality in healthcare provision and accessibility of the masses to the services. Thus, using the various Primary Healthcare Centers as point of contact of the people to receive healthcare; the peoples' distance to the facilities will determine inequality in the level of accessibility of the people to the healthcare service and infrastructure. The distance will have great effect when tertiary service is considered in Nigeria where tertiary health institutions are located at the state or region headquarter. The outcome of which will reflect in their health status and healthcare delivery. The inequality in healthcare delivery caused by in-accessibility of the people to healthcare services has been responsible to more of infant death not only in developing country like Nigeria, but also in developed countries such as America and Europe. **.**

3.3 Suburban Settlements.

Human settlements are agglomeration of dwellings of any type or size which accommodate human living. Human settlements are broadly subdivided into urban and rural with their distinct features and characteristics. It can be classified into hamlets, rural, suburban and urban settlements. On the basis of distribution, human settlements can be classified into scattered, nucleated and linear settlements. The suburban settlements as the mid-way between the urban and rural settings develop as a result of population and economic expansion of the urban centers which brings about subsequent incursion into rural areas. Suburban settlements is also known as sprawl, and has received increasing attention from researchers and policy makers (Waqar, 2017).

Suburban settlement or sprawl is characterized by low density single family dwellings, peoples' dependence on public transport system to commute between their homes and work place, emergence of haphazard growth from the existing urban centers, irregular and uncoordinated pattern of development, strip or ribbon development, and existence of undefined edge between the urban and rural areas.

Suburban or sprawl developments are caused by population growth of the existing urban centers which results to outward expansion of the population. This expansion comes about since weaker income groups are forced to move out of the existing urban areas which has attracted high land values.

4.0 Methodological Review.

The methodology used in this paper is an epistemological desk search into available literature on health care, inequality and accessibility conducted to gather information on the state of knowledge**.** Spatial accessibility has been noted to be measured using different approaches such as the Regional Availability Model, (RAM), Gravity Model (GM), Two-Step Floating Catchment Area Model (2SFCA) and Three- Step Floating Catchment Area Model (3SFCA) (Ma, Luo, Wan, Hu, and Peng, 2018). The RAM is the ratio of supply (the capacity of service site) and demand (population) within a given area. The method has been criticized because it makes unreasonable assumptions that people do not travel beyond the given area to seek medical services; and all people have equal access irrespective of the distance decay.

The Gravity Model assumes that peoples' access to medical services decreases with the increase of its distance to the service sites in a gravitational manner. This is theoretically reasonable and sound. The weakness of the method is the requirement for mathematical computation of gravitational pull and the complex interpretation of results. The two-step floating catchment area is an improvement on the gravitational model and can be interpreted intuitively (Joseph and Bantock, 1982). The three-step floating catchment area model has been an extension of the two-step model and was used to take care of the Impedance function and to control over estimation of population demand on sites. The three-step floating area method divides the catchment areas into 4 sub-zones (10, 20, 30 and 60 min) and assigns a Gaussian weight to each service site based on the sub-zone in which it lies. The selection weight is computed as:

as:

$$G_{ij} = \frac{T_{ij}}{\underset{k \in \{Dist(i,k) \leq d0\}}{\Sigma} T_{ik}}$$

Where G_{ij} indicates the probability of selection on a service site T_{ij} and T_{ik} and the predefined Gaussian weights for service site j and k, respectively. The Gaussian weight is calculated using the formula: The Gaussian formula (Gw) is represented mathematically below:

$$: Gw = \mathrm{E.dS} = \left(\frac{q}{4\Lambda\in_0} \cdot \frac{\hat{r}}{r^2}\right) . (\hat{n}.ds)$$

Where:

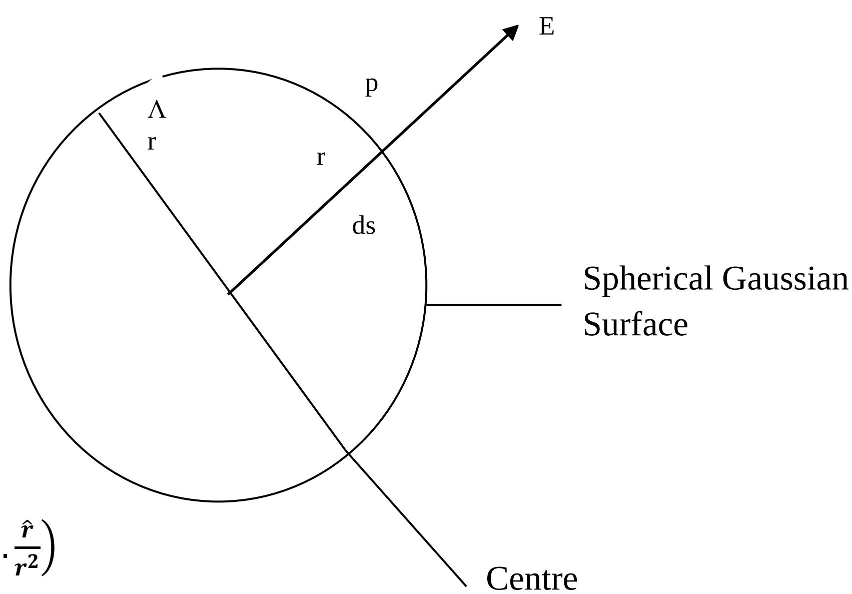
n^ = peoples' population in the settlements,

q= 1, where the flux is greatest at the origin O,

r= the distance of the people to the site of the facility in the location,

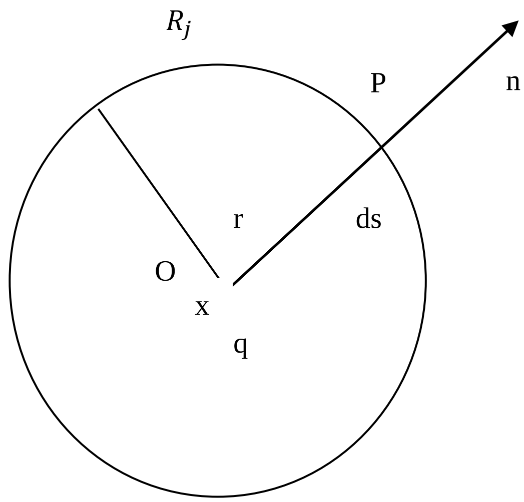
$r^{\wedge}$ = is the distance of the people to the next alternative(possible) site of the facility in the location. See the Figure 1 below:

Figure: 1



$$\mathbf{E} = \left(\frac{q}{4\Lambda\in_0} \cdot \frac{\hat{r}}{r^2}\right)$$

International Journal in Management and Social Science
Volume 11 Issue 04, April 2023 ISSN: 2321-1784 Impact Factor: 7.088
Journal Homepage: http://ijmr.net.in, Email: irjmss@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal



$$d\emptyset_E = \mathrm{E.dS} = \left(\frac{q}{4\Lambda\epsilon_0}.\frac{\hat{r}}{r^2}\right).(\hat{n}.ds)$$

The next step is to calculate the adjusted supply-to-demand ratio K_j :

$$K_j = \frac{S_j}{\underset{r=1,2,3,4}{\Sigma}\ \ \underset{k\in D_r}{\Sigma}\ G_{kjP_kW_r}}$$

The third step is to calculate the Spatial Access Index (SPAI) of population location I by summing up the physician-to population ratios of service site j within the catchment area of population location i(Ma Lan etal, 2018).

$$A_i^F = \underset{r=1,2,3,4}{\Sigma}\ \ \underset{k\in D_r}{\Sigma}\ G_{ij}\ R_j\ W_r$$

The 3SFCA method minimizes the overestimation of the healthcare demand; but the selection weight utilized was based on the travel time alone. This is not realistic in actual life situation since selection of site is also influenced by other factors such as price of product, capacity of site, stigma and attitude of the people to the service on the site and information dissemination process. This brings about the need to develop a method that will be simpler and be capable of capturing two other accessibility variables such as population of the people, population of facility, distance of the people to the facilities, and the gravitational force that propelled people to decide to move to utilize the facilities. Thus, a mathematical formula is suggested as a method to capture these variables. Two approaches are proposed using the Newton Gravity Index and Gaussian Weight Index. This is discussed one after the other.

4.1. The Newton Gravity Index Approach (NGIA). As discussed earlier theoretical review section of this paper, the law states that every particle is attracted to every other particle in the universe with a force that is proportional to the product of their masses and inversely proportional to the square of the distance between their centers. This is represented by the formula below:

$F = \mathbf{G\ m_1\ m_{2/}\ R^2}$ where F is the force; G is the gravitational constant; m_1 is the mass of object 1; m_2 is the mass of object 2; and R is the distance between centers of the masses. i.e $R_2 – R_{1.}$ In the equation F is equal to G which is the gravitational constant held as a universal constant figure by scientists. The gravitational constant is $9.81g/S^2$ according to Newton gravitational law. The gravitational constant is then applied to the Accessibility Gravity Model to determine the rate of attraction of the suburban residents to the healthcare infrastructure. A simpler version of the Gravity model explains that the interaction between two places can be determined by the product of the population of both places divided by the square of their distance from one another. It is mathematically represented below:

$G = \frac{(P_1)(P_2)}{(D_2 - D_1)^2}$ Where G is the gravity velocity; P_1 is the population of the first variable; P_2 is the population of the second variable; D_2 is the distance of the second variable; D_1 is the distance of the first variable. Here the distance D1 will be zero (0) at the origin.

Gravitational Model as depicted in this formula was modified to incorporate the effect of the Newton's gravity force on the rate of attraction of the people to the facilities. The formula is then transpose to be in this format: $G = \frac{(P_1)(P_2)}{(D_2 - D_1)^2}$ ($1/p_1x9.81g/s^2$). (Author's conceptualization).

Where P_1 is the current population of the residents in the study area; P_2 is the facility provided per 1000 population (already determined) $9.81g/s^2$ is the Newton's gravitational pull which is a universal constant value.

4.2. The Gaussian Weight Approach (GWIA). As discussed in the early part of this paper, the law states that the total flux of the electric field E over any closed surface is equal to 1/e0 times the net charge enclosed by the surface. The law shows the relationship between the flux and the net charge enclosed within the surface. When the charge is at the center of the sphere, the electric field is everywhere normal to the surface and constant in magnitude. This means the farther the charge is moving away from the center to the surface of the object, the electric field will no more be normal and the magnitude (intensity) will be reducing. The Gaussian Weight has been given a constant figure of 8.854×10^{-12} This constant figure postulated by Gaussian will be used to transpose the Gravity formula as done above. Thus, the transposed formula will now be as below:

G = $\frac{(P_1)(P_2)}{(D_2 - D_1)^2}$ (1/p_1x8.854 x 10^{-12}). (author's conceptualization).

The Gaussian weight formula can also be used to measure the impact of non-discrete phenomenon such as social goods like roads, water projects, pollution etc

5.0. Empirical Application of the formula.

To operationalize the Newton Gravity Index and Gaussian Weight Index formula, Ibadan where University College Hospital situated was chosen as the Healthcare Tertiary Institution. Ibadan has been the state capital of old and new Oyo state. Ibadan has also been the third largest city in Nigeria with total population of 3, 649, 000 people. (escaledenuit.com, 2022).

Then, four suburban settlements areas were selected in Oyo state, Nigeria. These are Afijio Local Government (Jobele), Kajola Local Government (Okeho), Ibarapa North Local Government (Ayete) and Oluyole Local Government (Idi- Ayunre).

The Accessibility Index for the Four Selected Local Government for the study using both the Newton Gravity Index Approach (NGIA) and Gaussian Weight Index Approach (GWIA) is as presented in the Table below:

Table 1: Residents Accessibility Index Using both Newton's Gravity Index (NGI) and Gaussian Weight Index (GWI) Approaches.

S/N	Local Government	Population Projected (2022)** Using 2006 as base year	Distance of Residents to Facility (UCH)	Travel Time of Resident to Facility	Newton Gravity Index Approach	Gaussian Weight Index Approach
1	Afijio (Jobele)	193, 782	43km	1 Hr 27min	3.146x 10^{-7}	0.348 x 10^{-12}
2	Kajola (Okeho)	293, 974	118km	2Hrs 26min	8.618 x 10^{-17}	1.022 x 10^{-15}
3	Ibarapa North (Ayete)	147, 030	112km	2Hrs 48min	5.695 x 10^{-11}	0.630 x 10^{-15}
4	Oluyole (Idi-Ayunre)	298, 274	22km	42minutes	1.233 x 10^{-6}	0.136 x 10^{-14}

Source : Author's Field Work and Analysis, 2023.

****** The population projection was done using the formula $P_t = P + (1 + i)^n$. Where, P_t is the projected population, P is the population for the base year, i is the rate of growth of the population, and n is the number of years to which the population was projected.

From the table above, the most accessible to University College Hospital, Ibadan, Nigeria which was used as point of reference for the tertiary level healthcare service is Oluyole local government (Idi- Ayunre) with forty two (42) minutes travel time . The least accessible is Ibarapa North local government (Ayete) with 2Hrs 48minutes travel time. Using the Newton Gravity Index (NGIA) approach the most accessible is Oluyole local government with 1.233x 10^{-6} value. Using the Gaussian Weight Index approach, the most accessible is Afijio local government.

Based on the suggested time standard to be considered appropriate catchment location for people to have good healthcare accessibility and utilization; a thirty (30) minutes has been recommended for maximum travel time for the residents to the farthest healthcare center. (Ma et al., 2018). A research conducted by Ma etal in Shaanxi province, China showed that Urban residents living farthest from healthcare facilities and travels more than 30 minutes to enjoy the service will have a higher probability of health service utilization than a resident that has to travel less than five (5) minutes. In this case studied as shown in table above, only Oluyole local government has the lowest travel time to University College Hospital to utilize tertiary healthcare service, even with forty two (42) minutes. This did not even fall within the thirty minutes maximum travel time as recommended. This could further be interpreted to mean that the further the people to the location of the facility, the less is the degree of accessibility to the facilities; and consequently, the less the degree of utilization of the facilities by the people. Where A_i is the rate of accessibility; d is the difference of people to the accessibility indicators; Gw is the Gaussian weight; and Dt is the total distance of the people to the facility. The distance is usually characterized by travel time or the Kilometer covered between the two different objects. The settlement with the lowest travel time or Kilometer is the most accessible while the one with the highest travel time or Kilometer is the least accessible to the site of the facility in question. Healthcare capacity, population demand, and geographic impedance have been noted to be essential factors to measure spatial accessibility (Kan, 1992). Geographic impedance is represented as a function of travel time.

The gap filled was in the area of providing simpler formula to measure peoples’ accessibility index to healthcare facilities using the Newton Gravitational Index Approach and Gaussian Weight Index Approach. These two formula is simpler than the Three Step Floating Catchment Area (3SFCA) and Two Step Floating Catchment Area approaches. The Newton and Gaussian model can also capture the pull factor in peoples’ choice of facility utilization.

6.0. Conclusion.

Measuring accessibility index is fundamental to description and classification of people into various social groups and their ability to enjoy social services such as healthcare. Academicians and practitioners have shown more interest in developing methodologies that will assist in measuring of peoples access to healthcare. Some of these methods are complex and require great skill in mathematical calculations. This paper has been able to propose a more simpler method that is able to capture the necessary variables of distance and population of the people using a formula that incorporates either the Newton law of gravitational pull index or Gaussian weights index. This is the author's proposition and is subject to more criticism and improvement.

References

Barcelo. J. A. , Pelfer G., Mandolesi A. (2002). The Origin of the City from Social Theory to Archaeological Description. Archeologiae Calcolatori, 13, (2002) 41-63. Available on line https://www.archcalc.cnv.it>p 18th March, 2023.

Bartusewich Rebecca, Moffit Kimberlu, Chapel Lesley (2021). Social Inequality Examples and Types/ What is Social Inequality? Study.com. Available on line https://study.com>academy>lesson 18th March, 2023.

Britannica (2022). Gauss's Law/ fluxes. Encyclopedia Britannica. Available on line https://www.britannica.com>science ,18th March, 2023.

Byjus (2023). Newtons Law of Universal Gravitation. Available on line https://byjus.com>.......Gravitation 18th March, 2023.

Clark D. (1982). Urban Geography, Baltimore, The John Hopkin University Press, USA.

Fotheringham A.S. (2021). " 6 Theoretical Foundations of Spatial Interaction Models" in International Encyclopedia of the Social & Behavioral Sciences, 2001. Available on line https://www.sciencedirect.com , 7th October, 2021.

Joseph A.E, Bantock P.R (1982). Measuring Potential Physical Accessibility to General Practitioners in Rural Areas: A Method and Case Study. Social Science Medical, 16, 85-90.

Kan A.A. (1992). An Integrated Approach to Measuring Potential Spatial Access to Healthcare Services. Scio-Eco. Planning Science, 26, 275-280.

Maheshvarananda Dada and Branch Mariah (2010). The Progressive Utilization Theory (PROUT): Alternative Economic and Spiritual Model for the Welfare of All. The Journal of Labor and Society, 1089-7011. Vol. 13, March, 2010, Pp 31-40. Immanuel Ness and Wiley Periodicals, Inc.

Ma Lan, Luo Nianxue, Wan Taili, Hu Chunchun, Peng Mingjun (2018). An Improved Healthcare Accessibility Measure Considering the Temporal Dimension and Population Demand of Different Ages. International Journal of Environmental Research and Public Health. Available on line www.mdpi.com/journal/ijerph , 25th May, 2022.

Marmot M." Achieving health equity: from root cause to fair outcomes" Lancet, October, 2007. Center for Disease Control (CDC) (2020). FastStats- Infant Health- CDC. Available on line https://www.cdc.gov>faststats , 5th February 2021.

Oloruntoba E.O (2021). Urban Health Studies. Lecture delivered on Cross- Cutting Issues on Built Environment in the Faculty of Environmental Design and Management, Lead City University, Ibadan, Nigeria.

Paula Braveman, Elaine Arkin, Tracy Orleans, Dwayne Proctor, Alonzo Plough. Health Equity Brief #1: What is Health Equity? And what difference does a definition make? In RobertWoodJohnsonFoundation(April,2017).Available on line https://buildhealthyplaces.org>health , 10th December,2021

Peter Tugwell, Vivian Robinson, Erin Morris (2007). "Mapping global health inequalities: challenges and opportunities. Scholarship repository, 2007.

Uwaoma, Chinwe Chimezie (2019). The Distance Decay Theory. Its Application on the Nigerian Tourism Industry, Munich, GRIN Verlag. Available on line https://www.grin.com/document/106412 4th April, 2023.

Waqar Fauzia (2017). Why have the MDGs failed? (2017). International THE NEWS. Available on line https://www.thenews.com.pk>print 10th April, 2022.