East African Scholars Journal of Medical Sciences
Abbreviated Key Title: East African Scholars J Med Sci
ISSN: 2617-4421 (Print) & ISSN: 2617-7188 (Online)
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-9 | Issue-1 | Jan-2026 | DOI: https://doi.org/10.36349/easms.2026.v09i01.005

Review Article

Development Statistical Framework for Understanding the Probability of using a Health Facility based on Various Transportation Factors Affecting Maternal Healthcare Services

JO Oluwoye, PhD[1*]

[1]Professor Emeritus of Transportation and Environmental Health, Director Center for Urban and Rural Research
Department of Community and Regional Planning, Alabama A&M University

Article History
Received: 17.10.2025
Accepted: 13.12.2025
Published: 24.01.2026

Journal homepage:
https://www.easpublisher.com

Quick Response Code

Abstract: Transportation deals with the movement of people and goods, using various means of locomotion (walking, bicycles, buses, trams, trains, ferries, taxis, motor cars, trucks, ships, aircraft, pipelines) on transport networks (roads, rails, waterways, airways) which have terminals (parking areas, depots, stations, ports and airports) and transfer points (bus stops, stations, goods yards). Most countries of the world seek to achieve equality in health needs of their growing population especially in the rural areas who are often at disadvantage for majority of the experienced health workers would be willing to live and work in the most populous part of the economy. Maternal mortality rate is highest in rural areas and poorer communities of the world. This paper is the first attempt to proposes a conceptual framework and describe the theoretical applied discrete-choice modeling of the probability of a specific event occurring based on various influencing factors affecting maternal healthcare services. The review of literature reveals that a large percentage of women in the rural areas assumed pregnancy and childbearing to be death zone for them due to inability to have free access and affordable means of transporting themselves to health centers and hospitals that will provide them with adequate medical care. Need to travel over a long distance to access maternity health services is one of the issues with high maternal mortality rate for the available means of transportation in such areas is always with high cost. The present study takes the approach of proposing a theoretical framework which can be applied to practical situations in address transport needs and challenges in maternal healthcare services by reviewing available literature. Such research approach is common, particularly when existing knowledge in the particular area is still somewhat narrow. The present study, hence, contributes to the advancement of the literature on transportation needs for the nonmetropolitan pregnant women. It is also hoped that this paper will highlight the appropriate methodological choice, to apply a logistic (logit) model to analyze the role of transportation in maternal healthcare. The paper concludes that theoretical analysis and empirical research falsely promise a broad and thorough framework. Furthermore, it is envisaged that this theoretical model will provides a useful tool for public health and environmental health practioners in developing a more comprehensive overall approach to modeling place of delivery, analyzing access barriers and assessing emergency care seeking behaviors.

Keywords: Conceptual Framework, Transportation, Probability, Logit Model, Maternal Healthcare, Public Health.

INTRODUCTION

Oluwoye 2003 reported that transportation deals with the movement of people and goods, using various means of locomotion (walking, bicycles, buses, trams, trains, ferries, taxis, motor cars, trucks, ships, aircraft, pipelines) on transport networks (roads, rails, waterways, airways areas who are often at disadvantage for majority of the experienced health workers would be willing to live and work in the most populous part of the economy. Maternal mortality rate is highest in rural areas and poorer communities of the world (WHO 2018).

***Corresponding Author:** JO Oluwoye
Professor Emeritus of Transportation and Environmental Health, Director Center for Urban and Rural Research
Department of Community and Regional Planning, Alabama A&M University

A large percentage of women in the rural areas assumed pregnancy and childbearing to be death zone for them due to inability to have free access and affordable means of transporting themselves to health centers and hospitals that will provide them with adequate medical care. Need to travel over a long distance to access maternity health services is one of the issues with high maternal mortality rate for the available means of transportation in such areas is always with high cost. This has made a reasonable number of women to subscribe to primitive or traditional doctors. Complications of pregnancy and childbirth cause more deaths and disability than any other reproductive health problems (EC/UNFPA, 2000). However, it should be noted that easy access to effective and affordable transport services is of great importance to prevent emergency childbirth care. Furthermore, the review of literature shows that in low income countries, particularly in the rural areas, more time is spent by women and their families waiting for affordable transportation to travel to the closest health facility centres; while seventy-five percent of maternal death could be prevented if there is quick access to essential childbirth related care. In addition, poor roads, too few vehicles and high transportation costs are major causes of delay in decisions to seek and reach emergency obstetric and postnatal care (Babinard 2006).

Furthermore, reviews have shown that inadequate vehicular transport is not allowing the potential positive impact of community health program services on maternal and child health. However, inadequate infrastructural development most especially roads and continuous cycle of poverty in the rural area makes alternative transport services for health care difficult (Nasung *et al*., 2015). Most countries of the world seek to achieve equality in health needs of their growing population especially in the rural.

Theoretical Application of Discrete Choice Model for Decision Making

Discrete choice modeling is a well established regression technique, that has been used extensively in several disciplines related to psychology, economics, mathematics, and transportation engineering. Several books and papers have been written on this subject (Ben-Akiva and Lerman, 1985; Henser and Johnson, 1981; Train, 1986; Rintamaki, 1980; Stopher *et al.,* 1984; Aldrich and Nelson, 1984; Oluwoye *et al*., 1999; Oluwoye, 1998).

Notwithstanding, the multinomial logit (MNL) model calculates the probabilitites of choosing different types of predicting the use of skilled birth attendants (SBA), modeling place of delivery (PD) including analyzing access barriers (AB), and assessing emergency care seeking behavior (ECSB). Model calculates the probabilities of choosing different types of maternal healthcare services. Some of the authors (Cox, 1970; Dobson, 1983; McCullagh and Nelder, 1983) have emphasized that data derived from binomial counts should be analyzed to take into account the binomial denominator, so that the proportion (percentage) can be analyzed in order to accommodate the variance, while at the same time retaining the binomial probability distribution inherent in the data.

In order to understand the logit approach as a representation of an alternative to maternal healthcare hypothesis, the author considers the case of any number of alternative outcomes. It is a reasonable hypothesis that of women choice of delivery location to maximize utility (V), and that they constantly evaluate alternative place of delivery in ways of achieving outcomes (s) consistent with this decision postulate. An alternative place of delivery outcome is closer if and only if it provides the highest (indirect) utility. That is, if:

$$Vs > \max Vj \quad \text{Eqn. (1)}$$
$$j = 1, ..., M$$
$$j \neq s$$

Where s= health facility birth (HFB) and j= home birth (HB) The probability that alternative s will be chosen is given by:

$$Ps = \text{prob}\ (Vs > \max Vj\ \forall j\ \Sigma\ Mi\ j \neq s) \quad \text{Eqn. (2)}$$

The author define:

$$ns = \max Vj - \mu s \quad \text{Eqn. (3)}$$
$$j = 1, ..., M$$
$$j \neq s$$

The alternative s is chosen if and only if $\beta_r s\ Xs > \eta s$

The unobserved effects are assumed to be independently and identically distributed extreme value. It can be shown that given a vector of exogenous variables, X, the distribution of F(ηs) of ηs is:

$$F(\eta_S) = \exp(\eta_S)/[\text{ex}(\eta_S) + \sum_{\substack{j=1 \\ j\neq s}}^{M} \exp(\beta^1_j X)] \quad \text{Eqn. (4)}$$

and the probability that the alternative HFB s will be chosen is:

$$P_S = \exp(\beta_S X) \Big/ \sum \exp(\beta^1_S X) \quad \text{Eqn. (5)}$$

In order to explain the logit method as it relates to the choice of HFB alternatives consider that the objective is to construct a model to find the probability of using health facility, P, which one can calculate in preference to another aspect of decision-making. This

probability of choice can be explained in terms of combination of explanatory variables.

However, the author decided to use women's choice of delivery with only two choice alternatives maternal delivery location:

1. Health facility birth (FHB) and
2. Home birth (HB)

It should be noted here that a major objective of choice modeling is to make aggregate conditional and extrapolative predictions in order for policy makers to assess the impact of proposed and implemented policies (see equation 6).

$$In\left[\frac{P(Health\ Facility\ Birth}{P(Home\ Birth}\ \middle|\ Women\ Choice\ of\ Delivery\right] = K \pm explanatory\ variables \quad \text{Eqn. (6)}$$

K= Constant

Example of explanatory variables=socioeconomic status, transportation access, distance.

Significance of the Conceptual Model and Conclusion

The conceptual framework and theoretical logit model of maternal healthcare above needs to be tested with real world data to statistically link the lack of reliable transportation to negative maternal healthcare outcomes. Furthermore, it will also provide insight into and add to the body of knowledge about critical factors that will predict institutional delivery or health facility birth.

The paper constructs a conceptual framework of predicting and analyzing the intricate transportation access and maternal healthcare utilization and outcomes. It is envisaged that the statistical framework will form the underlying basis toward the development for understanding the probability of a specific event occurring based on various influencing factors affecting maternal healthcare services. The present study takes the approach of proposing a theoretical framework which can be applied to practical situations in address transport needs and challenges in maternal healthcare services by reviewing available literature. Such research approach is common, particularly when existing knowledge in the particular area is still somewhat narrow. The present study, hence, contributes to the advancement of the literature on transportation needs for the nonmetropolitan pregnant women. It is also hoped that this paper will highlight the appropriate methodological choice, to apply a logistic (logit) model to analyze the role of transportation in maternal healthcare.

In conclusion, the present paper represents the starting point for more future research. It should be noted that theoretical analysis and empirical research falsely promise a broad and thorough framework. Furthermore, it is envisaged that this theoretical model will provides a useful tool for public health and environmental health practioners in developing a more comprehensive overall approach to modeling place of delivery, analyzing access barriers and assessing emergency care seeking behaviors.

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Cite This Article: JO Oluwoye (2026). Development Statistical Framework for Understanding the Probability of using a Health Facility based on Various Transportation Factors Affecting Maternal Healthcare Services. *East African Scholars J Med Sci, 9*(1), 35-38.