



## Research Article

# The Impact of Non-traditional Socioeconomic and Environmental Variables on Health Care Risk Adjustment in Nigeria: An Empirical Analysis

Adamu Daniel Kamaru\* 

Actuarial Science Department, University of Jos, Jos, Nigeria

## Abstract

Health care risk adjustment models have traditionally relied on demographic and clinical variables such as age, gender, and disease conditions to predict health expenditures. However, these conventional approaches often fail to capture the influence of broader socioeconomic and environmental factors that shape population health outcomes, particularly in developing countries. This study investigated the impact of non-traditional variables such as income level, educational attainment, housing quality, employment type, and environmental exposure on health care risk adjustment in Nigeria. Using a cross-sectional quantitative design, data were collected from both national health databases and household surveys covering 2,100 respondents across six geopolitical zones. Multiple regression and variance analyses were conducted using SPSS to determine the predictive significance of these non-traditional variables on health expenditure risk scores. The results reveal that education, income inequality, and environmental conditions have statistically significant effects on health risk adjustment, improving model accuracy by approximately 18% compared to conventional demographic only models. The findings highlight the need for Nigeria's health financing frameworks to incorporate non-traditional variables into risk adjustment algorithms to promote fairness and efficiency in resource allocation. Policymakers are encouraged to adopt a multidimensional health risk model that integrates social determinants of health to strengthen the equity of Nigeria's healthcare reimbursement system.

## Keywords

Non-traditional Variables, Health Care Risk Adjustment, Social Determinants of Health, Socioeconomic Factors, Environmental Quality, Nigeria

## 1. Introduction

Health care risk adjustment is a mechanism used to allocate financial resources equitably among health insurance providers based on the expected cost of providing care to different populations [1]. Traditionally, this model depends largely on clinical and demographic indicators such as age, gender, and

diagnosis [2]. However, in developing countries like Nigeria, the socioeconomic context significantly shapes health risk and utilization patterns [3]. Factors such as poverty, education, living conditions, and environmental exposure play critical roles

\*Correspondence: Adamu Daniel Kamaru (adamudaniel@yahoo.com), Adamu Daniel Kamaru (adamudaniel13@gmail.com)

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in determining health outcomes but are rarely captured in formal adjustment models [4].

Nigeria's healthcare financing system, anchored by the National Health Insurance Scheme (NHIS), faces major challenges in equitable risk distribution [5]. Many enrollees in rural and informal sectors remain underrepresented in data-driven models, leading to underfunding of high-risk populations [6, 8]. This study therefore extends the conventional health risk adjustment framework by incorporating non-traditional variables that reflect the social and environmental determinants of health [7, 9].

The study aimed at:

- 1). Identifying the non-traditional variables that significantly influence health care risk adjustment in Nigeria.
- 2). Evaluating the statistical relationship between these variables and healthcare expenditure.
- 3). Proposing an improved risk adjustment framework that integrates both traditional and non-traditional predictors.

## 2. Methodology

### Research Design

A cross-sectional survey design was adopted. Data were collected from both household respondents and administrative health expenditure records [10].

### Population and Sample

The study covered six geopolitical zones in Nigeria. A stratified random sampling method was used to select 2,100 respondents (350 per zone). This ensured representation of urban and rural populations [11].

### Data Collection

Primary data were obtained through structured questionnaires on socioeconomic and environmental conditions. Secondary data came from NHIS reports, National Bureau of Statistics (NBS), and World Bank health datasets [12].

### Variables and Model Specification

The dependent variable is Health Risk Adjustment Index (HRAI), measured by per-capita health expenditure risk scores.

Independent variables include:

- 1). X1: Education level
- 2). X2: Income
- 3). X3: Employment status
- 4). X4: Housing quality
- 5). X5: Environmental pollution index

A multiple regression model was estimated as:

$$\text{HRAI} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \epsilon$$

### Data Analysis

Data were analyzed using SPSS version 26, applying Pearson correlation and ANOVA to test significance. Model validity was checked through the Variance Inflation Factor (VIF) to ensure no multicollinearity [13].

## 3. Statement of the Problem

Inappropriate funding remains a major problem of health care policies globally, especially in low- and middle-income countries. Wealthier individuals often access better health services due to their financial capacity, resulting in inequity in health outcomes [14]. This imbalance underscores the need to integrate relevant socioeconomic variables into health funding models.

In Nigeria, the health care sector faces issues of imbalance, underfunding, and poor coverage, particularly in Plateau State and other northern regions [15]. These challenges have increased mortality and reduced public confidence in health insurance participation. Addressing these requires a risk adjustment system that accounts for non-traditional factors influencing health costs and access.

### Theoretical Review

Ryan m [16] "*The affordable health care Act*"

This theory states; proper financing strategy creates room for a good and affordable health care service.

The writer of this article intended to incorporate ideas and concepts from the knowledge of economic and business to create cross overs between the theoretical concepts and current real world event to create an outcome that would not only be a personal writing sample but also be an informative tool for health care adjustment the study is directed at in which the affordable health care act can provide health care for individuals adequately and at a more affordable rate. This article used 3 different approach to provide ways for more affordable rate for health care services. They are:

Funding; the hospital insurance pay-roll tax- the aspect of the law that provides the largest source of revenue should be one of the most straight forward and should have a straight forward and fixed tax on employees for the Medicare program. But that the tax should be higher for high income earners so that there can be a subsidization for low income earners, which will bring about a clear effect of redistribution of wealth.

Funding; the individual mandate penalty- this is a way of funding through the implementation of a flat fee for individuals who deliberately refuse to partake in the purchase of health insurance.

Funding; the cuts of Medicare- even with the above funding it is likely that there would not be adequate funding for the Medicare program. Therefore, another solution is that Medicare beneficiaries can simply pay more into the system for the same care. This means that seniors will see increased cost through co-payments deductibles and others out of pocket expenses for the same services. Through this method, seniors are directly paying for the funds that have been lost under the Affordable Care Act.

Emamverdi, P Ahmadi [17]

"Adverse selection and moral hazards in supplementary health insurance"

The theory states; the supplementary health insurance and its proper coordination cannot be without considering the

moral hazard.

The main reason for this study was to find out the existence of two phenomena of adverse selection and moral hazard in the supplementary health insurance market.

First a demand model for the use of complementary health care services was defined under the least assumptions about how the insurance companies repay the policy, the distribution of the hidden health status of hospital clients and also the type of their supplementary insurance, despite the two phenomena of unfavorable choice of moral hazards.

The main model was estimated from GMM method and existence of those two phenomena was tested using the non-parametric statistical methods. The data used in this study were collected through questionnaire and randomly from clients of two hospitals in the two groups of supplementary and uninsured treatment.

The result showed that risk aversion for the consumption of composite goods and this amount is more for the insured than the uninsured, which indicates the low level health status of the insured compared to other people. The Kolmogorov-Smirnov test also confirmed the different health distributions of the two groups. In addition, according to the results, there are small moral hazard in the insurance market. Moral hazards are lower for people with higher incomes and the more insurance is demanded from people with higher incomes, the lower the moral hazards will be, and the lower the health of person the greater the moral hazards.

In conclusion, there is always a problem in the health care insurance in the aspect of equity and the distribution of Medicare services.

Pham, D. Simmons (May, [18] “Randomization and health care”

This theory states; it is important to control for differences in known risk factors before comparing groups so that the outcomes demonstrated represent the true impact of an intervention between population.

The writer of the journal above wrote with the main objective of determining the effects of various health care intervention which also include different variables on clinical, economic and humanistic outcome in patient population so as to provide a guide to many stakeholders including health care providers, patients, policy makers, for decision making.

This research focused on studying and observing the difference which are to a lack of randomization. These difference which are also known as variables are: age, sex, previous illness, prior treatment, biological differences which all categories under non-traditional variables. The study used the technique of the direct and indirect standardization. This technique is of the opinion that, “it is important to control for differences in known risk factors before comparing groups so that the outcomes demonstrated represent the true impact of an intervention between population.” Therefore, in conducting outcomes research, especially studies that involves comparing populations, differences in risk factors for an outcome can distort the

results. Multiple techniques are made available to adjust risk factors and even though each has its benefits and drawbacks, the adjustment of health care funding is nondependent on how to settle the health care funding but it is much more dependent on the risk factors or variables and creating a balance of those factors among population of patients.

### 3.1. Theoretical Review

Affordable Health Care Act Theory [16] emphasizes that appropriate financing strategies improve affordability and access to health care through redistributive funding mechanisms [16].

Adverse Selection and Moral Hazard Theory [17] posits that without proper risk coordination, supplementary insurance markets suffer from inefficiencies arising from moral hazard and information asymmetry [17].

Randomization and Health Care Model [18] stresses controlling for differences in known risk factors to ensure true comparisons between populations aligning with this study’s approach to integrating multiple determinants [18].

### 3.2. Theoretical Foundation

This study is grounded in the Social Determinants of Health (SDH) Theory [19], which posits that health is influenced by conditions in which people are born, grow, work, and live [19]. It also aligns with Grossman’s Health Capital Theory [20] which conceptualizes health as a form of human capital influenced by socioeconomic investment [20].

Prior studies in developed countries [21, 22] demonstrated that adding socioeconomic variables improves predictive power in risk models [21, 22]. However, most of these studies were based on structured datasets unavailable in developing nations. In Nigeria, empirical work remains scarce, focusing more on expenditure control than on risk equity [23].

Recent findings [24, 25] highlight that low education, environmental hazards, and informal employment strongly predict adverse health outcomes and expenditure [24, 25]. Despite this, these determinants remain excluded from Nigeria’s NHIS [25] adjustment mechanisms.

### 3.3. Conceptual Gap

Existing models emphasize medical utilization and demographics, neglecting socioeconomic and environmental determinants. This study fills that gap by empirically testing their impact on risk adjustment accuracy.

## 4. Results and Discussion

### Descriptive Statistics

Mean education: 10.7 years; average monthly income: ₦92,000; 36% of respondents resided in high-pollution areas [26].

### Correlation Analysis

Correlation results indicated:

- 1). Education and health risk adjustment:  $r = 0.61$ ,  $p < 0.01$
- 2). Income and health risk adjustment:  $r = 0.54$ ,  $p < 0.01$
- 3). Environmental pollution and health risk adjustment:  $r = -0.48$ ,  $p < 0.01$

### Regression Results

**Table 1.** Multiple Regression Results for Non-Traditional Socioeconomic and Environmental Variables Affecting Health Care Risk Adjustment in Nigeria.

| Variable  | Beta   | Std. Error | t-Value | Sig.  |
|-----------|--------|------------|---------|-------|
| Education | 0.371  | 0.045      | 8.24    | 0.000 |
|           | 0.292  | 0.057      | 5.12    | 0.001 |
|           | 0.118  | 0.033      | 3.61    | 0.004 |
| Income    | 0.074  | 0.028      | 2.65    | 0.009 |
|           | -0.261 | 0.061      | -4.28   | 0.000 |

Statistic = 19.82,  $p < 0.001$ ; Adjusted  $R^2 = 0.43$ , implying non-traditional variables explain 43% of variations in risk adjustment accuracy.

### Interpretation

Education and income improve prediction accuracy, while poor environmental quality increases expenditure risks. Incorporating these factors enhances fairness by accounting for socioeconomic disadvantages often ignored in standard models [27].

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