# Multilevel Analysis on Factors Affecting Fundus Examination Using Big Data

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## Abstract

This study was designed with a multilevel analysis, in order to examine factors affecting the fundus examination of residents living in the community, by using public health big data.

The raw data from 2017 Korean National Health and Nutrition Examination Survey and the secondary data by cities and provinces of Statistics Korea were analyzed. The data from Korean National Health and Nutrition Examination Survey can represent Korean people, as it uses the multi-stage stratified cluster sampling. Collected data were categorized through the hadoop big data platform and statistically processed by using the SAS 9.4 program. This study finally selected adults aged over 40, who responded the question, whether or not they underwent the fundus examination, as the subjects.

The results of the multilevel analysis exhibit that the fundus examination rate is higher when the subjects are: females; older; medical aid beneficiaries; diagnosed as hypertension by a physician; living in an area with many ophthalmic clinic not smoking. However, their income, marital status and level of education did not have statistically significant effects on whether or not they underwent the fundus examination.

The findings suggests that various political approaches are required to promote health projects, by comprehensively considering not only individual factors but also those of medical institute and community, in order to increase the fundus examination rate.

**Index Terms:** Fundus examination, Big data, Multilevel logistic regression analysis, Local social factor

## I. INTRODUCTION

Big Data has changed the way we manage, analyze and leverage data in any industry. One of the most promising areas where it can be applied to make a change is healthcare. Healthcare analytics have the potential to reduce costs of treatment, predict outbreaks of epidemics, avoid preventable diseases and improve the quality of life in general. Average human lifespan is increasing along world population, which poses new challenges to today's treatment delivery methods. The application of big data analytics in healthcare has a lot of positive and also life-saving outcomes. Big data refers to the vast quantities of information created by the digitization of everything, that gets consolidated and analyzed by specific technologies. Applied to healthcare, it will use specific health data of a population (or of a particular individual) and potentially help to prevent epidemics, cure disease, cut down costs, etc.

As the life expectancy of people is longer than ever, eye diseases are also increased but it is difficult to early detect, so they bring about health problems accompanied by complications. According to a meta analysis study in 2006, the annual economic loss due to blindness caused by all kinds of diseases in U.S.A is estimated as high as $3.5 billion[1][2]. Therefore, it is very important to reduce socio-economic loss due to diseases related with eyes and prevent and early detect diseases.

The fundus examination is used to observe structures within eyes through pupils, by using a fundus camera and is a test method for verifying vitreous body, retina, chorioid and vessels. It can diagnose most of ocular diseases that are likely to induce blindness, including glaucoma, macular degeneration, diabetic retinopathy, hypertensive retinopathy and retinal vascular disease, other optic neuropathy, etc[3].

The main reason why outpatients receive the fundus examination is visual loss as their subjective symptoms(46.4%), followed by health care providers' recommendations(35.7%) [4], suggesting that the regular fundus examination should be conducted before subjective symptoms occur. Not only ocular diseases but also complications of chronic diseases may lead to blindness, so early examinations and precautionary approaches are required to enhance national health.

Although some studies on fundus examinations of patients with diabetes have been conducted, there are no studies on general adults. It is very important to understand factors influencing screening rates of fundus examinations of not only patients with diseases but also people without them, in terms of prevention and management.

This study, therefore, aimed to verify factors affects fundus examinations, depending on individual and community characteristics, by using big data and provide basic data for shaping health policies of the community, in order to increase the screening rates.

## II. SYSTEM MODEL AND METHODS

The raw data from 2017 Korean National Health and Nutrition Examination Survey and the secondary data by cities and provinces of Statistics Korea were analyzed. The data from Korean National Health and Nutrition Examination Survey can represent Korean people, as it uses the multi-stage stratified cluster sampling. Collected data were categorized through the hadoop big data platform and statistically processed by using the SAS 9.4 program.

This study finally selected adults aged over 40, who responded the question, whether or not they underwent the fundus examination, as the subjects. It examined whether or not they underwent the fundus examination, according to the subjects' individual characteristics and then, the multilevel regression was conducted by dividing factors influencing whether or not they underwent the fundus examination into individual and disease-related characteristics and health status.

## III. RESULTS

The findings show that the screening rate of all fundus examinations was 70.2%: 63.5% for males and 75.2% for females, indicating that the screening rate of females is higher than that of males. The screening rate of fundus examinations was highest for people in

their 70s, followed by those in their 80s, and then 60s, 40s and 50s. It is also higher for patients diagnosed with hypertension or diabetes, nonsmokers and those without high risk for drinking.

The results derived from multilevel analysis are shown in Table 1. The results of the multilevel analysis exhibit that the fundus examination rate is higher when the subjects are: females (β=0.55); older (β=1.04); medical aid beneficiaries (β=1.75); diagnosed as hypertension by a physician (β=1.22); diagnosed as diabetes by a physician(β=1.73); not smoking(β= 0.74); living in an area with many ophthalmic clinic(β= 1.00). However, their income, marital status and level of education did not have statistically significant effects on whether or not they underwent the fundus examination.

**Table 1.** Multi-level analysis between individual and community factor

| **Variable** | | **OR(95% CI)** | ***p-value*** |
|---|---|---|---|
| Intercept(Standard error) | | -1.716(0.3604) | 0.0003 |
| Individual-level | | | |
| Sex | Male(reference) | | |
| | female | 0.553(0.46-0.666) | <.0001 |
| Age | | 1.037(1.028-1.047) | <.0001 |
| Income | Low(reference) | | |
| | Middle-low | 0.918(0.704-1.197) | 0.5272 |
| | Middle-high | 1.051(0.795-1.391) | 0.7262 |
| | High | 1.169(0.874-1.563) | 0.293 |
| Education | ≤Elementary(reference) | | |
| | Middle school | 0.927(0.7-1.228) | 0.5979 |
| | High school | 0.989(0.778-1.258) | 0.9293 |
| | ≥College | 1.291(0.989-1.686) | 0.0608 |
| Spouse | Yes(reference) | | |
| | No | 1.1(0.884-1.369) | 0.3932 |
| Disease-related level | | | |
| Hypertension | Yes(reference) | | |
| | No | 1.22(0.999-1.488) | 0.0506 |
| Diabetes Mellitus | Yes(reference) | | |
| | No | 1.734(1.303-2.308) | 0.0002 |
| Health Behavior | | | |
| Smoking | Yes(reference) | | |
| | No | 0.742(0.588-0.937) | 0.0122 |
| Drinking | Yes(reference) | | |
| | No | 1.114(0.85-1.459) | 0.4344 |
| Community characteristics | | | |
| Ophthalmic clinic | | 1.002(1.001-1.002) | <.0001 |

## IV. DISCUSSION AND CONCLUSIONS

This study has an implication, in that it examined actual conditions of the fundus examination and factors affecting it, by using data representing Korean people and provided basic data to local health projects. The findings suggests that various political approaches are required to promote health projects, by comprehensively considering not only individual factors but also those of medical institute and community, in order to increase the fundus examination rate.

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