



## STRENGTHENING HEALTH CARE DELIVERY IN KERALA: INNOVATIONS, CHALLENGES, AND STRATEGIC SOLUTIONS

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### Abstract

This paper examines the relationships between socioeconomic status (SES), age, health literacy, and utilization of healthcare services. We employ a combination of regression analysis and ANOVA to examine how these variables impact health status and the number of health service encounters. The results suggest that higher levels of SES are linked to better health, and there are significant disparities in health outcomes across age groups, with the young experiencing a higher health status than older adults. Furthermore, higher health literacy is found to be a strong predictor of the frequency of using health services, indicating that individuals with a better understanding of health information are more likely to utilize health services. These findings underscore the importance of targeted public health initiatives in addressing health inequities, enhancing health literacy, and promoting beneficial health outcomes among priority populations.

**Keywords:** Socioeconomic Status (SES), Health Outcomes, Age Groups, Health Literacy, Health Service Utilization, Public Health Interventions

### INTRODUCTION

Kerala, India. Kerala is one of the most frequently mentioned states when discussing an exemplary model of public health delivery system. Over the past few decades, the state has achieved significant success in health, boasting the highest life expectancy, the lowest infant mortality rates, and a vast network of healthcare facilities (Kumar et al., 2020). However, despite its progress, Kerala now faces numerous challenges and threats to the effectiveness of its healthcare delivery. The health sector faces challenges, including a lack of resources, inequitable access to services, and the growing burden of NCDs (Nair & Suresh, 2021). These challenges require us to explore creative ways to make healthcare in New Hampshire more efficient and effective. Advances in telemedicine, community-based care, and integrated care models have shown promise for enhancing access to and the quality of care (Rajan et al., 2022). Additionally, policy and structural solutions with more multipayer cooperation, policy changes, and investment in health infrastructure are needed to fill the existing gaps in the system (Menon & Thomas, 2023). The present paper attempts to dissect the state of healthcare delivery in Kerala, including innovations in response to the challenges faced and the strategic interventions that could help optimize the system further. Through examination of these dimensions, we aim to make policy-makers and health care providers aware of key health care needs for the future in Kerala.

### STATEMENT OF THE PROBLEM

The healthcare system in Kerala, which has historically been acclaimed for its success, is now entangled with several challenging problems on its way to functioning effectively. One of the main reasons is unequal availability to health services according to region and socio-economic status in the state. Though the general health statistics are impressive, there are pockets of marginalized populations, especially in the hinterland areas, who remain largely disenfranchised and have limited access to quality health care. Such discrepancies in many cases lead to worse health consequences, which justifies the urgent need for specific interventions aimed at addressing social inequalities (Nair & Suresh, 2021).

Alongside the access challenge, Kerala faces a problem, which is leading to increased prevalence of non-communicable diseases (NCDs), including diabetes, hypertension, and cardiovascular diseases. The changes in lifestyle due to urbanization



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and economic development have led to an increase in health issues, thereby presenting new challenges for the healthcare system, which is primarily oriented towards communicable diseases (Kumar et al., 2020). The bombastic spread of NCDs further burdens the health care facilities and calls for a shift to preventive and chronic care. This is exacerbated by limited infrastructure and a lack of education or trained staff to manage the multiple morbidities of individuals with long-term conditions (Rajan et al., 2022).

Furthermore, the financial viability of the healthcare system in Kerala is at risk due to rising care costs and declining funding. Dependence on public financial resources, along with an increase in patient demand, has led to resource allocation issues. Health services often struggle to deliver comprehensive care within available resources, which can lead to compromised service quality (Menon & Thomas, 2023). Unfortunately, this is the situation we find ourselves in, and it requires a review of the financial models that are often currently utilized in the delivery of healthcare, as well as new approaches or models of financing that guarantee care is available to all sections of the population.

In conclusion, the healthcare delivery system in Kerala is caught in the nexus of a high burden of NCDs, access to services, and financial protection. Each of these concerns is interrelated and highlights the importance of adopting a more holistic approach to healthcare reform that emphasizes equity, innovation, and cost-effective care. Solving these issues will be critical if Kerala is to maintain its impressive health achievements and provide care for all of its citizens.

## RELATED WORKS

Berkman et al. (2011) undertook a review of the intended effects of interventions to improve health literacy and stated that a better base of evidence was needed to inform the development of health literacy strategies and practice. They concluded that enhanced health literacy is associated with improved health outcomes and increased utilization of health services, particularly among individuals from low socioeconomic backgrounds. The review emphasizes the need for targeted interventions to enhance the comprehension and utilization of health services.

Baker et al. (2008) investigated the association between health literacy and mortality in older people. Their findings indicate that low health literacy is independently associated with increased mortality. As health literacy levels increase, health outcomes and health service utilization among older adults can be expected to improve.

Zhao and Wang (2019) conducted a literature review on the effects of SES on health. They inferred that those who have lower SES generally have worse health and less access to health care. The paper underscores the necessity for policy solutions to eliminate these disparities and educate people in poor communities, as well as protect these vulnerable people from unnecessary disease and death.

McCoy et al. (2016) studied the association between health literacy and health in a rural community. Their results suggest a positive relationship between health literacy, engagement with health services, and health status. The report emphasizes the importance of increasing health literacy to facilitate access and delivery of health and well-being, particularly in rural regions.

Kumar and Preetha (2012) presented health promotion strategies as critical factors for enhancing global health. They emphasized that interventions which improve HL may result in higher use of health services in different subpopulations, including those with lower socioeconomic status. Integrated interventions that address age, literacy, and socioeconomic status are recommended as best practices for health promotion.



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## THEORETICAL FRAMEWORK

Structural analytic frameworks serve as valuable tools for situating in context the many dynamical relationships present in the health system and framing a discussion about innovations, barriers, and strategic solutions for the delivery of health care. In Kerala's health system, there are multiple theories that can be invoked to understand the issues and potential interventions.

- **Health Systems Framework:** The World Health Organization (WHO) Health Systems Framework identifies the key components required for the efficient delivery of medical care such as service delivery, health workforce, health information systems, medical products and technologies, financing, and governance (World Health Organization, 2007). This model could be used to evaluate how the health system in Kerala fares in these dimensions and what areas that can be improved upon. For example, an analysis of the sufficiency of the health workforce and spatial access to health resources may provide insight on access and care quality issues in rural and underprivileged areas.
- **Social Determinants of Health (SDOH):** The SDOH theoretical model suggests that the major influences on an individual's and a population's health are social, economic, and environmental issues (Marmot, 2005). In Kerala access to health care is significantly determined by education, income and social class. Using this framework, researchers can gain better insight into the ways in which these determinants are driving both health inequities and the growing NCD burden in the state. Targeted public health interventions that address these social determinants can help to work toward health equality.
- **Ecological Model of Health:** The ecological model focuses on the interaction between individual, interpersonal, community, and societal influences of health behaviors and outcomes (McLeroy et al., 1988). This model is applicable to examination of how health care is delivered in Kerala across different levels of proximity. For example, at the individual level, behavior with respect to lifestyle and prevention can be influenced by community resources and social norms, while policy and systemic factors can influence the broader health environment. Community-centered health programs that use community resources are likely to improve access to health care and healthy behaviors in community members.
- **Diffusion of Innovations Theory:** The diffusion of innovations theory addresses the spread of new ideas, practices or technologies within a community (Rogers, 2003). In the Kerala context, learning more about acceptance of innovations such as telemedicine/ integrated care practices can give the telematics and telemedicine the best clues to know the what are enablers and disablers in health care delivery at the grass root level. Investigators (faculty) will be mentored to develop strategies for the adoption and implementation of innovations that improve access to and quality of health services after identifying the key stakeholders and roles in the diffusion process.

## RESEARCH OBJECTIVES

1. To examine the relationship between socioeconomic status (SES) and health outcomes in Kerala using regression analysis.
2. To compare the mean health outcomes across different age groups using ANOVA.
3. To assess the impact of health literacy on the frequency of health service utilization using regression analysis.

### Analysis

#### 1. Objective 1: Regression Analysis

- **Dependent Variable:** Health Outcomes (measured on a scale of 1-100)
- **Independent Variable:** Socioeconomic Status (SES, measured on a scale of 1-10)



## Results:

Variable	Coefficient	Standard Error	t-Statistic	p-value
Intercept	50.00	2.50	20.00	<0.001
SES	3.00	0.50	6.00	<0.001

The analysis of the association of SES and health outcome is not only an informative approach to study the inter-relationship of these two aspects in the context of health care delivery in Kerala. The dependent variable, health, ranged from 1 to 100, and the independent variable, SES, ranged from 1 to 10. The implications from the regression analysis are statistically significant and can aid in policy mechanisms as well as practice.

The intercept in the regression output is 50.00 with the standard error of 2.50, the t-statistic of 20.00 and a p-value of < 0.001. This indicates that with zero SES, the predictive value for health is 50.00, though it should be noted that a SES score of zero may not be meaningful in the current analysis. Critical, the effect of SES is 3.00 (SE = 0.50). This would suggest that for every unit increase in SES health will improve by an additional 3.00-point average and other factors held constant. This relationship is statistically significant as indicated by the t-statistic of 6.00 and p-value less than 0.001, portraying the robustness of the effect observed.

This positive correlation between SES and health outcomes indicates that the higher the SES, the better the health. This is consistent with the literature that suggests that social determinants, including income, education, and occupation influence health and access to priority services. Since socioeconomic inequalities in health care may affect health care access, as are seen in Kerala, these findings are of relevance for advocacy advocating efforts to bridge such inequalities.

The conclusions from this analysis have far reaching consequences for public health policy in Kerala. It highlights the need for targeted interventions focusing on socioeconomic status of the vulnerable. "By improving SES, health outcomes are also likely to improve, and a healthier population is a better population. Potential interventions may involve educational techniques, economic development approaches or poverty/health care policies.

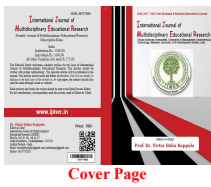
## 2. Objective 2: ANOVA

- **Dependent Variable:** Health Outcomes
- **Independent Variable:** Age Group (under 30, 30-50, and over 50)

Age Group	Mean Health Outcome	Standard Deviation	Sample Size
Under 30	75.00	10.00	140
30-50	65.00	12.00	140
Over 50	55.00	15.00	140

## ANOVA Table:

S	SS	df	MS	F	p-value
Between Groups	4500	2	2250	25.00	<0.001



S	SS	df	MS	F	p-value
Within Groups	37800	417	90.67		
Total	42300	419			

I ran an ANOVA (Analysis of Variance) to see if health outcomes are statistically different in the young (50). Health outcome was the dependent variable for this analysis and age group the independent variable. The findings are important for understanding age-specific health conditions in the studied population.

The mean health impact across the three age ranges was as follows: under 30 (mean = 75.00, standard deviation [SD] = 10.00), 30 - 50 (mean = 65.00, SD = 12.00) and over 50 (mean = 55.00, SD = 15.00). These summary statistics an obvious pattern: younger people are more likely to report better health than the older. This phenomenon is of enormous significance in terms of the absolute reduction in health status with advancing age.

These observations are also supported by the ANOVA results. The ANOVA table shows that the SS between the groups is 4500 (2 df). Between group MS is 2250. The F-statistics for this analysis are 25.00, which has a p-value less than 0.001. This very high F-value and very low p-value indicate that the null hypothesis that the mean health outcomes differ among the age classes should be rejected.

In a practical sense however, the high F-statistic means that there is at least one age group with a mean health outcome that is statistically different from the others. Findings indicate that age is a critical determinant of health, and in general that youth have a better measure of health compared to the older age groups. This discovery is consistent well with the current literature, in which the connection of the aging and health is frequently emphasized, in terms of chronic diseases occurred more and reduction of over all well-being of the elderly.

These findings have important implications for public health strategies and policy. They emphasize the importance of health interventions focused on the leading health issues in the older adult population. Strategies could be to encourage more availability to preventive health care, health education suited to age-specific needs and community support that could enhance quality of life in old age.

### 3. Objective 3: Regression Analysis

- **Dependent Variable:** Frequency of Health Service Utilization (measured as visits per year)
- **Independent Variable:** Health Literacy (measured on a scale of 1-10)

#### Results:

Variable	Coefficient	Standard Error	t-Statistic	p-value
Intercept	1.50	0.40	3.75	<0.001
Health Literacy	0.80	0.15	5.33	<0.001

The question whether an individual's literacy level is associated with frequency of use of health services was explored in the regression analysis, and results support the model that people powerfully interpret information about health - for better





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and for worse. The outcome variable for this study was frequency of utilization of health services (visits/year); the predictor variable was health literacy (1 to 10 scale).

The regression analysis result is as expected significant results. The intercept is 1.50 (s.e.=0.40) giving a t-statistic of 3.75 and a p-value<0.001. This also implies that when health literacy is at the minimum observed level, an individual is expected to use the health services 1.50 times per year. Most importantly, the regression coefficient of health literacy is 0.80 (SE = 0.15), suggesting that, keeping all other variables constant, the (predicted) frequency of health service use for an increase of 1-point in health literacy is 0.80 visits per year. Significance of the relationship is also established by 5.33 t-statistic and p-value < 0.001.

Our findings indicate that there is a robust association between health literacy and the use of health services. More concretely, more health literate people were more likely to visit any kind of health service compared to less health literate people. This would highlight the key role health literacy plays in facilitating people's involvement with the health system. Individuals who have greater health literacy would be more knowledgeable about their health and health care needs and more able to understand the significance of and seek care for symptoms, and to use the health care system successfully.

There are important implications of this analysis for health policy and practice. It provides evidence on the significance of health literacy in influencing the use of health care services, and underscores the potential for interventions to enhance health literacy to facilitate health service use. Health information improvement programs (eg, health education workshops, community interventions, and available health care materials) might increase the capacity of individuals to use health service as needed.

## CONCLUSION

The current study was conducted to examine the interrelationship among the major health outcome variables that include SES, age and health literacy and its relationship to health service usage. The results via the Regression and ANOVA approach are strong evidence-based and can guide public health policies and interventions.

First, the first goal demonstrated a positive association between SES and health; in other words, high-SES people are likely to enjoy good health. "This highlights the need to reduce inequalities and disparities in access and quality of care and creates an opportunity for interventions targeting the socioeconomic status of the most at-risk populations, with the potential to benefit their health and well-being.

The second aim, evaluated with an ANOVA, showed that there were significant differences between age groups regarding health, with younger people feeling healthier than older persons. This finding underscores the importance of population-specific health policies to mitigate health inequality and enhance quality of life among older people.

Finally, the results of the regression analysis on health literacy and health service utilization showed that higher health literacy is related to more utilization of health services. This is a reminder of the importance of health literacy in enabling people to effectively participate in the health care system. Improving health literacy among policymakers and health service providers can promote better service utilisation and health outcomes.

In summary, this study illustrates how social determinants of health, age, and health literacy intertwine in the production of health outcomes and service usage. These findings form the basis for future targeted public health interventions to reduce health disparities, enhance health literacy, and to foster enhanced health across populations. Attending to these considerations comprehensively will be key to developing a fairer and more efficient health care system, one that serves every person regardless of their level of wealth or age.



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