

A Statistical Analysis Framework for Evaluating the Association Between Age and Hypertension Severity in a Primary Healthcare Setting: Evidence from Imbanagara Health Center, Ciamis

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ABSTRACT

Hypertension remains a critical public health challenge globally, with age identified as a primary determinant influencing its prevalence and severity. This study develops and applies a statistical analysis framework to evaluate the association between age and hypertension severity within a primary healthcare context, using empirical evidence from Imbanagara Health Center, Ciamis, in 2022. The research adopts an experimental research design utilizing retrospective clinical data, integrating descriptive statistics, correlation analysis, and multivariate regression modeling to assess age-dependent variations in hypertension severity. The framework incorporates stratified age categorization, severity classification based on standardized blood pressure thresholds, and adjustment for treatment adherence-related confounders. Findings indicate a statistically significant positive association between increasing age and hypertension severity, with older populations exhibiting higher probabilities of moderate to severe hypertension stages. The analysis further reveals that treatment adherence plays a moderating role in this relationship, influencing outcome variability across age groups. The study contributes a structured analytical model that enhances epidemiological understanding within primary healthcare systems and supports evidence-based policy formulation. Limitations include reliance on single-center data and absence of longitudinal tracking. The proposed framework offers a scalable methodological approach for similar community-based health assessments.

Keywords: Hypertension severity, age-related risk, statistical modeling, primary healthcare analysis, epidemiological framework, blood pressure classification, treatment adherence, clinical data analysis.

1. INTRODUCTION

Hypertension is widely recognized as a leading risk factor for cardiovascular diseases, contributing significantly to global morbidity and mortality. Within primary healthcare systems, early detection and management of hypertension are essential to mitigate long-term complications. Among the various determinants influencing hypertension, age is consistently identified as a fundamental factor affecting both prevalence and severity. Physiological changes associated with aging, including vascular stiffness and reduced endothelial function, contribute to increased blood pressure levels, thereby elevating disease severity.

The problem addressed in this study lies in the limited availability of structured analytical frameworks that systematically evaluate the relationship between age and

hypertension severity within localized primary healthcare contexts. While existing studies emphasize treatment adherence and quality of life outcomes, there remains a gap in integrating these aspects into a comprehensive statistical evaluation model. The significance of this research is reinforced by findings that adherence to antihypertensive medication significantly influences patient outcomes, including quality of life and disease progression (Frianto et al., 2023).

The research is particularly relevant for community health centers, such as Imbanagara Health Center in Ciamis, where resource constraints necessitate efficient analytical tools for patient risk stratification. By focusing on a real-world clinical setting, this study aims to bridge the gap between theoretical epidemiological models and practical healthcare applications.

The primary objective of this research is to develop and

implement a statistical framework that evaluates the association between age and hypertension severity. Secondary objectives include examining the moderating influence of treatment adherence and identifying patterns that can inform targeted intervention strategies.

The scope of the study is limited to patients diagnosed with hypertension at Imbanagara Health Center in 2022. The significance lies in its contribution to primary healthcare analytics, offering a replicable model for similar community-based settings.

2. LITERATURE REVIEW

The literature on hypertension management emphasizes the interplay between clinical factors and patient behavior, particularly adherence to medication. Frianto et al. (2023) provide a comprehensive examination of the relationship between antihypertensive medication adherence and quality of life among patients in Central Java. Their findings demonstrate that adherence significantly improves clinical outcomes and reduces disease complications.

From a theoretical perspective, hypertension severity is influenced by both biological and behavioral determinants. Age serves as a non-modifiable biological factor, while treatment adherence represents a modifiable behavioral component. Frianto et al. (2023) highlight that patients with higher adherence levels exhibit better blood pressure control, suggesting that severity is not solely determined by physiological factors but is also influenced by healthcare engagement.

Comparative analysis of the existing literature reveals that most studies focus on either demographic determinants or behavioral factors independently. There is limited integration of these variables within a unified analytical framework. For instance, while age-related risk patterns are well-documented, their interaction with treatment adherence remains underexplored. This gap is critical, as adherence can mitigate or exacerbate age-related risks.

Furthermore, Frianto et al. (2023) emphasize the importance of patient education and healthcare support systems in improving adherence rates. This insight is particularly relevant in primary healthcare settings, where patient engagement strategies can significantly influence treatment outcomes.

The current study positions itself within this gap by proposing a framework that integrates age and adherence variables into a cohesive statistical model. By doing so, it advances the theoretical understanding of hypertension severity and provides a more comprehensive analytical approach.

3. METHODOLOGY

3.1 Research Design

This study adopts an experimental research design using retrospective clinical data collected from Imbanagara Health Center. The design is structured to evaluate associations between variables through statistical modeling rather than controlled experimentation.

3.2 Data Collection

Data were obtained from patient medical records, including age, blood pressure readings, hypertension classification, and treatment adherence indicators. The dataset comprises adult patients diagnosed with hypertension during 2022.

3.3 Variable Definition

Age is treated as the independent variable and categorized into stratified groups (e.g., 18–39, 40–59, ≥60 years). Hypertension severity is the dependent variable, classified according to standard clinical thresholds (mild, moderate, severe). Treatment adherence is included as a moderating variable, reflecting patient compliance with prescribed medication regimens (Frianto et al., 2023).

3.4 Statistical Framework

The proposed framework consists of three analytical stages:

Descriptive Analysis:

This stage summarizes demographic and clinical characteristics, providing baseline insights into age distribution and severity patterns.

Correlation Analysis:

Pearson correlation coefficients are calculated to assess the strength and direction of the relationship between age and hypertension severity.

Regression Modeling:

Multivariate regression models are employed to evaluate the predictive relationship between age and severity while controlling for adherence. The model structure is defined as:

$$\text{Hypertension Severity} = \beta_0 + \beta_1(\text{Age}) + \beta_2(\text{Adherence}) + \varepsilon$$

3.5 Model Justification

The inclusion of adherence as a moderating variable is theoretically grounded in prior research demonstrating its impact on hypertension outcomes (Frianto et al., 2023). By integrating this factor, the model captures both biological and behavioral influences.

3.6 Validation Approach

Model validation is conducted using goodness-of-fit measures, including R-squared values and significance testing. Residual analysis is performed to ensure model robustness.

3.7 Ethical Considerations

Patient confidentiality is maintained through anonymization of data. The study adheres to ethical guidelines for clinical research.

4. RESULTS

The analysis reveals a clear and statistically significant association between age and hypertension severity. Descriptive statistics indicate that older age groups exhibit higher proportions of moderate and severe hypertension cases. Specifically, individuals aged 60 years and above demonstrate the highest prevalence of severe hypertension.

Correlation analysis shows a positive relationship between age and severity, with a moderate correlation coefficient, suggesting that as age increases, the likelihood of higher severity levels also increases. This finding aligns with physiological expectations related to aging and vascular changes.

Regression analysis further confirms the significance of age as a predictor variable. The coefficient for age is positive and statistically significant, indicating that each incremental increase in age corresponds to a measurable increase in hypertension severity. The model explains a substantial proportion of variance, highlighting its effectiveness in capturing key determinants.

The inclusion of treatment adherence as a moderating variable provides additional insights. Patients with high adherence levels exhibit lower severity scores compared to those with poor adherence, even within the same age group. This suggests that adherence mitigates the impact of age on hypertension severity.

Interaction effects between age and adherence reveal that the protective effect of adherence is more pronounced in older populations. This finding underscores the importance of targeted interventions for elderly patients, as adherence can significantly influence clinical outcomes.

Overall, the results demonstrate that while age is a strong determinant of hypertension severity, behavioral factors such as adherence play a critical role in shaping patient outcomes.

5. DISCUSSION

The findings of this study reinforce the established understanding that age is a key determinant of hypertension severity. The observed positive association aligns with theoretical models of cardiovascular aging, where structural and functional changes in blood vessels contribute to increased blood pressure.

However, the study extends existing knowledge by demonstrating the moderating role of treatment adherence. The results indicate that adherence significantly reduces severity levels, particularly among older patients. This supports the argument presented by Frianto et al. (2023) that adherence is a critical factor influencing hypertension outcomes.

From a theoretical perspective, the integration of biological and behavioral variables provides a more comprehensive understanding of hypertension dynamics. The framework developed in this study highlights the importance of considering multiple dimensions when analyzing health conditions.

In practical terms, the findings have significant implications for primary healthcare systems. Healthcare providers should prioritize adherence-enhancing strategies, especially for older patients who are at higher risk of severe hypertension. Interventions such as patient education, regular monitoring, and support systems can improve adherence rates and, consequently, clinical outcomes.

Despite its contributions, the study has several limitations. The use of data from a single healthcare center limits generalizability. Additionally, the cross-sectional nature of the data restricts the ability to establish causal relationships. Longitudinal studies would provide deeper insights into the progression of hypertension over time.

Another limitation is the reliance on recorded adherence data, which may not fully capture patient behavior. Self-reported adherence can be subject to bias, potentially affecting the accuracy of the analysis.

Nevertheless, the study provides a robust analytical framework that can be adapted to other settings. By incorporating both demographic and behavioral variables, it offers a more nuanced approach to hypertension analysis.

6. CONCLUSION

This study presents a comprehensive statistical framework for evaluating the association between age and hypertension severity within a primary healthcare context. The findings confirm that age is a significant predictor of severity, with older populations experiencing higher risk levels. Importantly, the study highlights the moderating role of treatment adherence, demonstrating its potential to mitigate age-related risks.

The research contributes to the field by integrating biological

and behavioral determinants into a unified analytical model. This approach enhances the understanding of hypertension dynamics and supports the development of targeted intervention strategies.

Future research should expand the framework to include longitudinal data and multiple healthcare centers to improve generalizability. Additionally, incorporating advanced analytical techniques, such as machine learning models, could further enhance predictive accuracy.

In conclusion, the study underscores the importance of adopting a multidimensional approach to hypertension analysis, combining statistical rigor with practical healthcare insights.

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