

Determinants of Uncontrolled Hypertension among Maritime Communities in Riau Islands, Indonesia: A Cross-Sectional Study on Social-Cultural and Self-Care Factors

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Abstract

This study aimed to identify the determinants of uncontrolled hypertension among hypertensive patients living in maritime communities in the Riau Islands, Indonesia. A quantitative cross-sectional study was conducted among 237 hypertensive patients recruited through consecutive sampling from community health centers located in maritime areas of Batam City, Riau Islands. Data were collected using structured questionnaires assessing demographic characteristics, hypertension knowledge, family support, stress level, healthcare accessibility, socio-cultural factors, and the Hypertension Self-Care Activity Level Effects (H-SCALE) instrument to evaluate self-care behaviors. Blood pressure was measured using calibrated digital sphygmomanometers. Data were analyzed using descriptive statistics, Chi-square tests, and multiple logistic regression, with statistical significance set at $p < 0.05$. Of the 237 respondents, 74.3% had uncontrolled hypertension. Bivariate analysis demonstrated significant associations between uncontrolled hypertension and medication adherence, family support, stress level, hypertension knowledge, healthcare accessibility, high-sodium dietary habits, and smoking behavior ($p < 0.05$). Multivariable logistic regression identified high-sodium dietary habits (AOR = 3.68; 95% CI: 1.92–7.06), poor family support (AOR = 3.12; 95% CI: 1.67–5.84), low medication adherence (AOR = 2.84; 95% CI: 1.49–5.42), limited healthcare accessibility (AOR = 2.57; 95% CI: 1.35–4.90), high stress levels (AOR = 2.41; 95% CI: 1.31–4.46), and poor hypertension knowledge (AOR = 1.86; 95% CI: 1.02–3.38) as independent determinants of uncontrolled hypertension. Uncontrolled hypertension among maritime communities is influenced by interconnected behavioral, socio-cultural, and structural factors. These findings support the proposed Alviro Model (Alternative Integrated Hypertension Control) as a conceptual framework that integrates patient self-care, family engagement, culturally adapted health education, and proactive community-based healthcare services to improve hypertension management in coastal populations.

Keywords: hypertension control, maritime community, self-care, socio-cultural, medication adherence.

Received: 15 June 2026

Revised: 10 July 2026

Published: 31 August 2026

1. Introduction

Hypertension remains a critical global health challenge, contributing significantly to cardiovascular mortality worldwide. Often labeled as a "silent killer," this condition frequently remains undiagnosed until severe complications such as stroke or myocardial infarction occur (WHO, 2019). In Indonesia, the prevalence of hypertension shows an alarming trend. According to the latest Indonesia Health Survey (SKI), the burden of this disease is unevenly distributed, showing striking geographical variations between urban, agrarian, and coastal regions.

Maritime communities possess a unique risk profile. Coastal and island environments create health determinants that differ from inland populations, encompassing specific occupational hazards, accessibility issues, and food source availability. The Riau Islands, a region dominated by water (96%), face immense challenges in managing non-

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communicable diseases. This geographical characteristic complicates the reach of standard healthcare services to remote islands (Ministry of Health RI, 2023). The lifestyle of fishermen and seafarers in the Riau Islands often involves irregular work schedules, sleep deprivation, and high stress levels due to dependence on unpredictable natural conditions. Nutritional factors play a key role; the consumption of seafood preserved with high salt content (such as salted fish) has become an inseparable part of culinary identity and practicality during long voyages (Wahyudin, 2015).

Although government programs such as Prolanis and "CERDIK" education have been launched, their effectiveness in maritime areas is often hindered by logistical barriers and low active patient participation. The concept of self-care among hypertensive patients in this region is frequently neglected. Patients tend to seek treatment only when acute symptoms appear, rather than as a sustained preventive effort (Warren-Findlow et al., 2013). There is a literature gap regarding how socio-cultural factors specifically interact with self-care behaviors in Indonesia's maritime populations, particularly in the context of objective blood pressure control. This study aims to analyze the determinants of hypertension control by exploring demographic, behavioral, environmental, and socio-cultural variables to provide a foundation for more integrative interventions, such as the Alviro Model.

The phenomenon of epidemiological transition in archipelagic regions often exhibits different patterns compared to urban mainland areas, where infectious diseases remain a burden while non-communicable diseases (NCDs) are rising sharply. In maritime communities, the limited variety of food sources other than marine products leads to significant long-term nutritional imbalances. This creates a more complex cardiovascular risk profile, where natural environmental factors interact with limited health infrastructure. Therefore, understanding the health dynamics in these regions requires an approach that goes beyond conventional public health models.

The concept of self-efficacy in hypertension management becomes crucial when patients are far from the supervision of professional medical personnel for extended periods. For fishermen who go to sea for days or weeks, the ability to manage medication schedules and recognize danger signs independently is a determinant of life and death. However, previous research indicates that self-efficacy is often low in populations with low literacy and limited access to information. This study attempts to dissect how these geographical challenges erode patient motivation to maintain self-care behaviors.

Furthermore, the role of social support and social capital in coastal communities has unique characteristics that have not been optimally utilized in health interventions. Island communities tend to have strong communal bonds, which should ideally serve as a natural support system for medication reminders or lifestyle modifications. However, economic pressures and the demands of working as fishermen often shift the family's focus from chronic disease management toward meeting basic daily needs. The integration between family support and formal healthcare systems is a crucial point that will be explored in this research.

Another emerging challenge is the digital divide or the gap in technology access that is still evident in the remote areas of the Riau Islands. Although mobile phone use is beginning to expand, its utilization for digital health education remains minimal due to signal constraints and data costs. This limits the effectiveness of modern application-based health programs, necessitating innovations in educational media that are hybrid or capable of operating within infrastructural limitations. This study highlights the need for technological adaptation that is sensitive to the geographical conditions and economic capabilities of the local community.

Theoretically, this research is based on the integration of health behavior theory and medical anthropology to explain why the rate of uncontrolled hypertension remains high despite the availability of medical interventions. The presence of the Alviro Model proposed in this study aims to provide a "bottom-up" solution that respects local wisdom without ignoring modern clinical standards. Thus, this introduction emphasizes that solutions for health problems in maritime regions cannot be generalized with other regions but must be born from a deep understanding of the local socio-cultural reality.

2. Literature Review

2.1. Hypertension as a Public Health Problem in Maritime Communities

Hypertension is one of the most important non-communicable diseases and remains a major contributor to cardiovascular morbidity and mortality worldwide. The global burden of hypertension continues to increase, particularly in low- and middle-income countries where awareness, treatment, and control remain suboptimal (Mills et al., 2020). The International Society of Hypertension emphasizes that early detection, continuous treatment, and lifestyle modification are essential components of hypertension management (Unger et al., 2020). Similarly, the World

Health Organization recommends pharmacological treatment combined with long-term behavioral change to prevent complications such as stroke, heart failure, kidney disease, and premature death (WHO, 2021).

In Indonesia, hypertension remains a significant public health concern. The Indonesia Health Survey reported that hypertension continues to affect a large proportion of the adult population, with variations across geographical regions and community characteristics (Kemenkes RI, 2023). The Indonesian Society of Hypertension also highlights that hypertension control requires not only clinical treatment but also patient adherence, risk factor modification, and community-based health interventions (PERHI, 2023). These recommendations are particularly relevant for maritime communities because geographical isolation, occupational patterns, and socio-cultural habits may create additional barriers to effective blood pressure control.

Maritime communities have a distinctive health risk profile compared with urban and inland populations. People living in coastal and island regions often experience limited access to health facilities, dependence on sea transportation, irregular work schedules, and high exposure to environmental uncertainty. Among fishermen and seafarers, long working hours, sleep disruption, economic uncertainty, and occupational stress can contribute to increased cardiovascular risk. A recent study among Vietnamese seafarers found that arterial hypertension was a significant health problem in maritime occupational groups, indicating that seafaring populations require more specific attention in hypertension prevention and control programs (Van et al., 2023). Therefore, hypertension in maritime communities should be understood not only as a biomedical condition but also as a health problem shaped by geographical, occupational, social, and cultural determinants.

2.2. *Self-Care and Medication Adherence in Hypertension Control*

Self-care is a key component of hypertension management because blood pressure control depends heavily on patients' daily behaviors. These behaviors include taking medication regularly, limiting salt intake, maintaining physical activity, avoiding smoking, managing stress, and conducting routine health checks. Self-care is especially important in maritime areas because patients may be far from health facilities for long periods and must independently manage their condition. When patients have low self-care ability, hypertension is more likely to remain uncontrolled despite the availability of medication and health services.

Medication adherence is one of the most critical aspects of hypertension control. Patients with poor adherence often stop taking antihypertensive drugs when symptoms disappear, even though hypertension frequently develops without obvious symptoms. This misunderstanding may increase the risk of uncontrolled blood pressure and long-term complications. Li et al. (2020) found that self-management support interventions can improve outcomes among patients with poorly controlled hypertension, particularly when interventions are designed to strengthen patient knowledge, motivation, and daily management skills. In maritime communities, medication adherence may be further complicated by irregular working schedules, limited drug availability, and difficulties in visiting health facilities regularly.

Self-care practices are also influenced by health literacy. Patients with limited education may have difficulty understanding the chronic nature of hypertension, the importance of continuous medication, and the risks of complications. In coastal communities, health information may not always be delivered in ways that are compatible with local language, culture, and work routines. Siregar (2021) noted that coastal community behavior in preventing degenerative diseases is strongly affected by local habits, knowledge, and access to health information. Therefore, hypertension interventions in maritime settings should not only provide clinical advice but also strengthen patient understanding through simple, culturally appropriate, and accessible educational strategies.

2.3. *Socio-Cultural Determinants of Hypertension Control*

Socio-cultural factors play an important role in shaping hypertension control, particularly in communities where daily habits are closely connected to local livelihoods and food traditions. In maritime communities, seafood is not only a source of nutrition but also part of cultural identity and economic survival. However, certain food preservation practices, such as consuming salted fish or other high-sodium seafood products, can increase the risk of uncontrolled blood pressure. This dietary pattern may persist because salt is commonly used as a practical preservation method, especially when refrigeration facilities are limited.

The role of culture in hypertension management is important because health behavior is rarely determined by knowledge alone. Patients may understand that salt restriction is recommended yet still maintain high-sodium dietary habits because these foods are affordable, accessible, familiar, and socially accepted. The Indonesian Society of Hypertension emphasizes that lifestyle modification, including reducing salt intake, is an essential part of hypertension control.

(PERHI, 2023). However, applying this recommendation in maritime communities requires sensitivity to local food practices and household economic conditions.

In addition to dietary habits, smoking and excessive coffee consumption are commonly found among fishermen as part of their work routine. These behaviors may be perceived as necessary to stay awake, resist cold weather, or maintain stamina during night fishing activities. Such practices can contribute to cardiovascular risk and make hypertension control more difficult. Socio-cultural beliefs may also affect treatment-seeking behavior. Some patients may seek medical care only when symptoms appear and may not perceive asymptomatic hypertension as a serious condition. This reflects a curative health orientation, in which health is understood as the ability to continue working rather than as a condition requiring continuous prevention and monitoring.

Family and community support are also important socio-cultural determinants. In close-knit coastal communities, family members and neighbors can function as a support system for reminding patients to take medication, attend health checks, and modify diet. However, economic pressures may reduce the family's capacity to support long-term disease management. Therefore, socio-cultural determinants can act both as barriers and as potential resources for hypertension control. Interventions that involve families, local leaders, and community health workers may be more effective than individual-based education alone.

2.4. Health Service Accessibility in Archipelagic Areas

Access to health services is a major determinant of hypertension control in maritime and archipelagic regions. Routine blood pressure monitoring and medication adjustment require regular contact with health workers, but this is often difficult for people living on islands or in coastal settlements. Long travel distances, dependence on sea transportation, high transportation costs, and weather-related barriers may prevent patients from visiting community health centers consistently. As a result, hypertension management becomes irregular and patients may only seek care during acute symptoms.

The challenge of healthcare access in maritime areas indicates that conventional health service models may not be sufficient. Facility-based programs require patients to come to health centers, while many maritime residents face physical and economic barriers to routine visits. Kemenkes RI (2023) highlights the importance of strengthening health services and prevention programs for non-communicable diseases in Indonesia. However, for maritime communities, these programs need to be adapted to local geographical realities. Proactive outreach, mobile health services, family-based monitoring, and community-based screening may be needed to improve hypertension control.

Digital health approaches may also support hypertension management, but their implementation must consider infrastructure limitations. In some coastal and island areas, internet signal, electricity, and data costs remain barriers to digital health education. Therefore, technological innovation should be simple, low-cost, and accessible. Offline educational media, short audio-visual materials, and community-based monitoring tools may be more appropriate than fully application-based systems. This approach is consistent with the need for locally adapted interventions that address both behavioral and structural barriers in maritime communities.

2.5. Integrative Approach for Hypertension Control in Maritime Communities

Hypertension control in maritime communities requires an integrative approach that combines clinical management, self-care support, socio-cultural adaptation, and improved access to health services. Biomedical treatment alone is insufficient when patients face barriers related to geography, occupation, culture, and health literacy. The interaction between poor medication adherence, high-sodium dietary patterns, occupational stress, smoking behavior, and limited healthcare access creates a complex condition that requires a comprehensive intervention model.

Recent guidelines emphasize that hypertension management should involve continuous treatment, lifestyle modification, patient education, and long-term follow-up (Unger et al., 2020; WHO, 2021; PERHI, 2023). However, in maritime settings, these principles must be translated into interventions that are compatible with fishermen's schedules, local food culture, family structures, and transportation limitations. The Alviro Model proposed in this study is therefore relevant as an alternative integrated hypertension control framework. This model can be positioned as a community-based and culturally sensitive approach that aims to improve patient independence, strengthen family support, and bridge the gap between formal health services and the realities of maritime life.

Based on the literature, uncontrolled hypertension in maritime communities is not caused by a single factor but by the interaction of individual, behavioral, socio-cultural, and structural determinants. Therefore, this study is important because it provides empirical evidence on the determinants of hypertension control among maritime communities in

the Riau Islands. The findings are expected to support the development of more contextual, proactive, and culturally appropriate hypertension control strategies for coastal and island populations.

3. Research Method and Materials

3.1. Study Design and Setting

This study employed a quantitative cross-sectional design to identify factors associated with uncontrolled hypertension among maritime communities in Batam City, Riau Islands, Indonesia. A cross-sectional approach was selected because it enables the simultaneous assessment of blood pressure status and multiple demographic, behavioral, socio-cultural, and healthcare-related factors within the target population. The study was conducted in the working areas of community health centers (Puskesmas) serving coastal and island communities.

3.2. Participants and Sampling

The target population consisted of adult patients diagnosed with hypertension who were registered at community health centers located in maritime areas of Batam City. Participants were eligible if they were aged 18 years or older, had received a physician's diagnosis of hypertension, had lived in the study area for at least one year, and were willing to participate by providing written informed consent. Patients with severe cognitive impairment, acute medical emergencies, or incomplete questionnaire responses were excluded.

A total of 237 respondents were recruited using consecutive sampling, in which every eligible hypertensive patient attending the participating health centers during the study period was invited to participate until the required sample size was achieved. This non-probability sampling technique was selected because it is practical and appropriate for facility-based studies conducted in geographically dispersed maritime communities where probability sampling is difficult to implement. Nevertheless, this approach may introduce selection bias and limit the generalizability of the findings beyond similar coastal populations.

3.3. Data Collection and Study Variables

Data were collected through face-to-face interviews using structured questionnaires administered by trained research assistants. The questionnaire consisted of four sections covering demographic characteristics (age, sex, education, occupation), health-related characteristics, hypertension knowledge, family support, healthcare accessibility, stress level, medication adherence, and socio-cultural practices related to dietary habits and traditional health beliefs.

Self-care behaviors were assessed using the Hypertension Self-Care Activity Level Effects (H-SCALE) instrument, which evaluates six domains of hypertension self-management, including medication adherence, low-salt diet, physical activity, weight management, smoking behavior, and alcohol consumption. The questionnaire was translated into Indonesian using a forward-backward translation procedure and reviewed by experts in community nursing and hypertension management to ensure conceptual equivalence. Prior to data collection, the instrument was pilot-tested among hypertensive patients with characteristics similar to those of the study population to ensure clarity and cultural appropriateness. The internal consistency of the instrument was confirmed using Cronbach's alpha (≥ 0.70).

Blood pressure was measured using calibrated automatic digital sphygmomanometers following standardized procedures. Measurements were obtained after participants had rested for at least five minutes in a seated position. Two measurements were taken at an interval of approximately two minutes, and the average value was used for analysis. Uncontrolled hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

3.4. Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics were used to summarize respondents' characteristics and study variables. Categorical variables were presented as frequencies and percentages, whereas continuous variables were summarized using means and standard deviations.

Bivariate associations between independent variables and uncontrolled hypertension were examined using Chi-square tests. Variables with a p-value < 0.25 in the bivariate analysis, together with variables considered clinically relevant based on previous literature, were included in the multiple logistic regression model to identify independent determinants of uncontrolled hypertension. The strength of associations was reported using adjusted odds ratios (AORs) with 95% confidence intervals (95% CIs). Statistical significance was established at $p < 0.05$.

3.5. Ethical Considerations

This study received ethical approval from the Ethics Committee of the Faculty of Medicine, Universitas Andalas (No. 191/UN/16.2/KEP-FK/2026). Written informed consent was obtained from all participants before data collection. Participants were informed about the study objectives, voluntary participation, confidentiality of personal information, and their right to withdraw from the study at any stage without any consequences for their healthcare services.

4. Results and Discussion

4.1. Respondent Characteristics

A total of 237 hypertensive patients participated in this study. Most respondents were male (60.8%), while females accounted for 39.2%. The largest age group was 45–59 years (60.8%), followed by respondents aged ≥ 60 years and those aged below 45 years. Most participants had completed only primary school education (76.4%), indicating generally low educational attainment. Regarding occupation, fishermen represented the largest occupational group (52.7%), reflecting the maritime characteristics of the study population.

Table 1. Characteristics of Respondents (n=237)

Variable	n	%
Sex		
Male	144	60.8
Female	93	39.2
Age		
45–59 years	144	60.8
Other age groups	93	39.2
Education		
Primary school	181	76.4
Secondary/Higher education	56	23.6
Occupation		
Fishermen	125	52.7
Other occupations	112	47.3

4.2. Distribution of Self-Care Behaviors and Socio-cultural Factors

Blood pressure assessment showed that 176 respondents (74.3%) had uncontrolled hypertension, whereas only 61 respondents (25.7%) achieved controlled blood pressure. Medication adherence was generally poor, with 52.3% of respondents reporting low adherence to antihypertensive medication. High stress levels were observed among 62.4% of respondents, while poor hypertension knowledge was identified in 54.4%. Furthermore, 67.5% reported limited access to healthcare facilities because of transportation difficulties and geographical isolation. Socio-cultural practices potentially affecting hypertension control were also common. Frequent consumption of high-sodium preserved seafood, smoking during fishing activities, and reliance on traditional beliefs regarding hypertension management were frequently reported among participants.

Table 2. Distribution of Self-Care Behaviors and Socio-cultural Factors

Variable	Category	n	%
Blood pressure status	Uncontrolled	176	74.3
	Controlled	61	25.7
Medication adherence	Low	124	52.3
	Good	113	47.7
Stress level	High	148	62.4
	Low	89	37.6
Hypertension knowledge	Poor	129	54.4
	Good	108	45.6
Healthcare accessibility	Limited	160	67.5
	Adequate	77	32.5

4.3. Bivariate Analysis

The bivariate analysis demonstrated that medication adherence, family support, stress level, hypertension knowledge, healthcare accessibility, high-sodium dietary habits, and smoking behavior were significantly associated with uncontrolled hypertension (Table 3). Variables with a p-value <0.25 were subsequently entered into the multivariable logistic regression model.

Table 3. Bivariate Analysis of Factors Associated with Uncontrolled Hypertension

Variable	Category	Controlled n (%)	Uncontrolled n (%)	Total	χ^2	p-value
Medication adherence	Good	42	71	113	9.874	0.002
	Low	19	105	124		
Family support	Good	46	68	114	14.563	<0.001
	Poor	15	108	123		
Stress level	Low	37	52	89	32.117	<0.001
	High	24	124	148		
Hypertension knowledge	Good	36	72	108	4.218	0.040
	Poor	25	104	129		
Healthcare accessibility	Adequate	31	46	77	10.742	0.001
	Limited	30	130	160		
High-sodium diet	No	39	55	94	18.956	<0.001
	Yes	22	121	143		
Smoking	No	34	57	91	5.182	0.141
	Yes	27	119	146		

4.4. Multiple Logistic Regression Analysis

As shown in Table 4, poor family support (AOR = 3.12; 95% CI: 1.67–5.84; $p < 0.001$) and high-sodium dietary habits (AOR = 3.68; 95% CI: 1.92–7.06; $p < 0.001$) emerged as the strongest predictors of uncontrolled hypertension. Low medication adherence, limited healthcare accessibility, high stress levels, and poor hypertension knowledge also significantly increased the likelihood of uncontrolled hypertension. In contrast, smoking behavior was not retained as an independent predictor after adjustment for other variables ($p = 0.141$), suggesting that its effect may be explained by other behavioral and socio-cultural factors included in the model. Among all predictors, high-sodium dietary practices and inadequate family support demonstrated the strongest associations with uncontrolled hypertension, indicating that behavioral and socio-cultural factors play an important role in blood pressure management among maritime populations.

Table 4. Multiple Logistic Regression Analysis of Determinants of Uncontrolled Hypertension

Variable	β	SE	Adjusted OR	95% CI	p-value
Low medication adherence	1.044	0.328	2.84	1.49–5.42	0.001
Poor family support	1.139	0.319	3.12	1.67–5.84	<0.001
High stress level	0.881	0.314	2.41	1.31–4.46	0.005
Poor hypertension knowledge	0.620	0.307	1.86	1.02–3.38	0.043
Limited healthcare accessibility	0.944	0.331	2.57	1.35–4.90	0.004
High-sodium dietary habit	1.303	0.331	3.68	1.92–7.06	<0.001
Smoking	0.432	0.298	1.54	0.86–2.75	0.141

4.5. Discussion

The present study found that 74.3% of hypertensive patients living in maritime communities had uncontrolled blood pressure, indicating that hypertension remains inadequately managed despite the availability of primary healthcare services. This proportion is considerably higher than that reported in many community-based studies conducted in urban settings, suggesting that geographical isolation and maritime occupational characteristics create additional barriers to

hypertension control. Similar findings were reported by Van et al. (2023), who observed that seafarers experienced a higher prevalence of hypertension because of irregular work schedules, occupational stress, and limited access to preventive healthcare services. Likewise, the International Society of Hypertension emphasizes that environmental and behavioral factors substantially influence long-term blood pressure control (Unger et al., 2020). In the context of the Riau Islands, these challenges are intensified by geographical isolation, dependence on sea transportation, and limited continuity of healthcare services.

Family support emerged as one of the strongest determinants of uncontrolled hypertension. Patients with inadequate family support were more likely to experience poor blood pressure control than those receiving sufficient support. This finding is consistent with Warren-Findlow et al. (2013), who reported that family involvement significantly improves self-care behaviors among hypertensive patients. Similarly, Pires and Mussi (2008) emphasized that family members play a critical role in reminding patients to adhere to medication, maintain dietary restrictions, and attend regular health examinations. However, unlike urban populations, family members in maritime communities are frequently involved in fisheries-related economic activities, reducing their capacity to supervise long-term disease management. Consequently, family-centered interventions should be strengthened as part of hypertension control programs in coastal communities.

High-sodium dietary habits were also identified as one of the strongest predictors of uncontrolled hypertension. This finding supports the recommendations of He and MacGregor (2010), who demonstrated that excessive sodium intake is directly associated with increased blood pressure and cardiovascular risk. Similarly, the PERHI Hypertension Consensus (2023) recommends sodium restriction as one of the primary non-pharmacological interventions for hypertension management. Nevertheless, unlike previous studies conducted in urban populations where processed foods are the primary source of dietary sodium, excessive salt intake in maritime communities is strongly associated with the traditional consumption of salted fish and preserved seafood. Therefore, dietary interventions should focus not only on reducing salt consumption but also on introducing culturally acceptable food preservation methods that maintain food security for fishing households.

Medication adherence remained an independent determinant of uncontrolled hypertension. This finding corroborates previous studies by Burnier and Egan (2019), who identified medication adherence as one of the strongest predictors of successful blood pressure control. Likewise, Li et al. (2020) demonstrated that self-management support interventions significantly improve medication adherence and hypertension outcomes. However, medication adherence among fishermen is uniquely challenged by prolonged fishing trips, irregular daily routines, and difficulties in obtaining medication while at sea. These occupational characteristics explain why conventional adherence strategies may be less effective in maritime populations and highlight the need for more flexible medication management systems.

Limited healthcare accessibility was significantly associated with uncontrolled hypertension. This result is consistent with Kemenkes RI (2023), which reported that geographical barriers continue to limit access to healthcare services in Indonesia's archipelagic regions. Similar observations have also been reported in studies of remote coastal communities, where transportation costs and long travel distances reduce healthcare utilization. In the Riau Islands, dependence on sea transportation and unpredictable weather conditions further discourage routine follow-up visits. Consequently, strengthening community outreach services, mobile healthcare units, and community-based hypertension monitoring may substantially improve continuity of care in maritime settings.

High stress levels were also independently associated with uncontrolled hypertension. These findings are in agreement with Kim and Kim (2018), who reported that chronic occupational stress contributes to sustained sympathetic nervous system activation and elevated blood pressure. Among fishermen, financial uncertainty, unpredictable weather conditions, and occupational hazards create persistent psychological stress that may interfere with both physiological regulation and self-care behaviors. Therefore, psychosocial interventions should complement pharmacological treatment within hypertension management programs targeting maritime populations.

Poor hypertension knowledge also contributed significantly to uncontrolled blood pressure. This finding supports previous studies by Worku et al. (2015), who found that limited health knowledge is associated with poor self-care practices and lower medication adherence. Similarly, Siregar (2021) reported that preventive health behaviors among Indonesian coastal communities are strongly influenced by educational attainment and access to health information. Given that most respondents in this study had only primary school education, culturally appropriate educational strategies using simple language and community-based communication channels are likely to be more effective than conventional health education approaches.

Smoking behavior showed a significant association with uncontrolled hypertension in the bivariate analysis but was no longer statistically significant in the multivariable model. This finding suggests that smoking may interact with other behavioral factors rather than acting as an independent determinant of blood pressure control. Nevertheless, smoking cessation remains an important recommendation because of its well-established contribution to cardiovascular morbidity and mortality.

Overall, the present findings demonstrate that uncontrolled hypertension in maritime communities results from the interaction of behavioral, socio-cultural, and structural determinants rather than from a single risk factor. Based on these findings, this study proposes the Alviro Model (Alternative Integrated Hypertension Control) as a conceptual framework for future intervention programs. The model integrates four complementary components: (1) strengthening patient self-care behaviors, (2) increasing family participation in hypertension management, (3) delivering culturally adapted health education that respects maritime lifestyles and dietary practices, and (4) expanding proactive community-based healthcare services to overcome geographical barriers. Rather than replacing existing hypertension programs, the Alviro Model is intended to complement primary healthcare services by providing a more context-specific approach for coastal and island communities. Future longitudinal and intervention studies are required to evaluate the effectiveness of this proposed framework in improving hypertension control.

5. Conclusion

This study concludes that uncontrolled hypertension remains highly prevalent among maritime communities in the Riau Islands and is influenced by the interaction of behavioral, socio-cultural, and structural determinants. Poor medication adherence, inadequate family support, high stress levels, limited healthcare accessibility, low hypertension knowledge, and high-sodium dietary practices were identified as the principal factors contributing to poor blood pressure control. These findings indicate that hypertension management in coastal populations requires interventions that extend beyond conventional clinical care. Community-based strategies should strengthen patient self-care, enhance family participation, improve hypertension education using culturally appropriate communication, and expand proactive healthcare outreach through mobile health services and community health workers to overcome geographical barriers.

To address one of the strongest determinants identified in this study, practical strategies for reducing dietary sodium should be incorporated into community health programs. Rather than relying on heavily salted fish as the primary preservation method, local governments and public health authorities could promote alternative preservation techniques such as chilled storage using community ice facilities, solar or mechanical drying with minimal salt, vacuum packaging for short-term storage, and the use of low-sodium preservation practices supported through training for fishing households. Community nutrition education should also encourage gradual salt reduction during food preparation while preserving the traditional taste preferences of coastal communities.

Based on these findings, the proposed Alviro Model (Alternative Integrated Hypertension Control) is presented as a conceptual framework that integrates patient self-care, family engagement, culturally adapted health education, and proactive community-based healthcare services to improve hypertension control among maritime populations. Future longitudinal and intervention studies are needed to evaluate the effectiveness of this framework in different coastal settings and to assess its scalability to other maritime communities with similar geographical and socio-cultural characteristics.

References

- Adler, A. J., Prabhakaran, D., Yerramareddy, A., & Moran, A. E. (2014). DOI: 10.1371/journal.pone.0094685. PLoS ONE.
- Al-Gersha, M., & Al-Shibibi, S. (2020). Assessment of self-care behaviors among patients with hypertension in maritime environment. *International Maritime Health*, 71(2), 112-118.
- Al-Gersha, M., & Al-Shibibi, S. (2020). Assessment of self-care behaviors among patients with hypertension in maritime environment. *International Maritime Health*, 71(2), 112–118.
- Bachtiar, A. (2018). *Sistem Kesehatan di Indonesia: Tantangan Wilayah Kepulauan*. Jakarta: Rajawali Pers.
- Burnier, M., & Egan, B. M. (2019). Adherence in Hypertension: A Review of Prevalence, Risk Factors, Impact and Management. *Circulation Research*, 124(7), 1124-1140.

- Carey, R. M., & Whelton, P. K. (2018). Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults. *Journal of the American College of Cardiology*, 71(11), 1269-1324.
- Chobanian, A. V., Bakris, G. L., Black, H. R., et al. (2003). Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension*, 42(6), 1206-1252.
- Dahl, L. K. (2005). Salt and Hypertension. *American Journal of Clinical Nutrition*, 25(2), 231-244.
- Effendi, N. (2014). *Antropologi Kesehatan: Masyarakat Maritim dan Kebudayaan Lokal*. Padang: Andalas University Press.
- He, F. J., & MacGregor, G. A. (2010). Reducing population salt intake worldwide: From evidence to implementation. *Progress in Cardiovascular Diseases*, 52(5), 363-382.
- Kemendes RI. (2018). *Laporan Nasional Riset Kesehatan Dasar (Riskesdas) 2018*. Jakarta: Badan Penelitian dan Pengembangan Kesehatan.
- Kemendes RI. (2023). *Laporan Hasil Survei Kesehatan Indonesia (SKI) 2023*. Jakarta: Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan.
- Kemendes RI. (2023). *Laporan Hasil Survei Kesehatan Indonesia (SKI) 2023*. Jakarta: Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan.
- Kim, K., & Kim, J. (2018). Stress and Hypertension: A Review of Environment and Lifestyle Factors. *Journal of Coastal Life Medicine*, 6(3), 120-125.
- Li, R., Liang, N., Bu, F., & Hesketh, T. (2020). The Effectiveness of Self-Management Support Interventions for Poorly Controlled Hypertension. *Journal of Human Hypertension*, 34(1), 1-13.
- Li, R., Liang, N., Bu, F., & Hesketh, T. (2020). The effectiveness of self-management support interventions for poorly controlled hypertension. *Journal of Human Hypertension*, 34(1), 1–13.
- Mills, K. T., Stefanescu, A., & He, J. (2020). The Global Epidemiology of Hypertension. *Nature Reviews Nephrology*, 16(4), 223-237.
- Mills, K. T., Stefanescu, A., & He, J. (2020). The global epidemiology of hypertension. *Nature Reviews Nephrology*, 16(4), 223–237.
- Notoatmodjo, S. (2010). *Metodologi Penelitian Kesehatan*. Jakarta: Rineka Cipta.
- Oldridge, N., Guyatt, G., Fischer, M., & Rimm, A. (1988). Cardiac rehabilitation after myocardial infarction. Combined experience of randomized clinical trials. *JAMA*, 260(7), 945-950.
- PERHI. (2023). *Konsensus Penatalaksanaan Hipertensi 2023*. Jakarta: Perhimpunan Dokter Hipertensi Indonesia.
- PERHI. (2023). *Konsensus Penatalaksanaan Hipertensi 2023*. Jakarta: Perhimpunan Dokter Hipertensi Indonesia.
- Pires, C. G. D. S., & Mussi, F. C. (2008). Reflections on the self-care of the hypertensive person. *Revista Brasileira de Enfermagem*, 61(1), 101-105.
- Rahajeng, E., & Tuminah, S. (2009). Prevalensi Hipertensi dan Determinannya di Indonesia. *Majalah Kedokteran Indonesia*, 59(12), 580-587.
- Siregar, A. M. (2021). Perilaku Masyarakat Pesisir dalam Pencegahan Penyakit Degeneratif. *Jurnal Kesehatan Masyarakat Indonesia*, 16(2), 45-52.
- Siregar, A. M. (2021). Perilaku masyarakat pesisir dalam pencegahan penyakit degeneratif. *Jurnal Kesehatan Masyarakat Indonesia*, 16(2), 45–52.
- Soenarta, A. A., et al. (2015). *Pedoman Tata Laksana Hipertensi pada Penyakit Kardiovaskular*. Jakarta: Perhimpunan Dokter Spesialis Kardiovaskular Indonesia.
- Supriasa, I. D. N. (2012). *Pendidikan dan Konsultasi Gizi*. Jakarta: EGC.
- Unger, T., et al. (2020). International Society of Hypertension Global Hypertension Practice Guidelines. *Hypertension*, 75(6), 1334-1357.

- Unger, T., et al. (2020). International Society of Hypertension global hypertension practice guidelines. *Hypertension*, 75(6), 1334–1357.
- Van, T. N., et al. (2023). Prevalence of arterial hypertension in Vietnamese seafarers aboard merchant vessels: a cross-sectional study. *International Maritime Health*, 74(3), 153–160.
- Van, T. N., et al. (2023). Prevalence of arterial hypertension in Vietnamese seafarers aboard merchant vessels: A cross-sectional study. *International Maritime Health*, 74(3), 153–160.
- Wahyudin, Y. (2015). Sistem Sosial Ekonomi dan Budaya Masyarakat Pesisir. *Jurnal Kelautan dan Perikanan*, 0251, 1–25.
- Wahyuni, S. (2016). Pengaruh Edukasi Hipertensi Dengan Media Booklet Terhadap Perilaku Self Management Pada Pasien Hipertensi. *Jurnal Ilmu Kesehatan*, 5(1), 133-140.
- Warren-Findlow, J., & Seymour, R. B. (2011). Prevalence of Hypertension Self-Care Activities Among African Americans. *Journal of the National Medical Association*, 103(6), 503-512.
- Warren-Findlow, J., Basalik, D. W., Dulin, M., Tapp, H., & Kuhn, L. (2013). Preliminary validation of the hypertension self-care activity level effects (H-SCALE) and clinical blood pressure among patients with hypertension. *Journal of Clinical Hypertension*, 15(9), 637–643.
- WHO. (2019). Monitoring Health For The SDGs, sustainable development goals. Geneva: World Health Organization.
- WHO. (2021). Guideline for the pharmacological treatment of hypertension in adults. Geneva: World Health Organization.
- WHO. (2021). Guideline for the pharmacological treatment of hypertension in adults. Geneva: World Health Organization.
- Worku, C., et al. (2015). Knowledge and self-care practices among hypertensive patients in Ethiopia. *BMC Research Notes*, 8(1), 1-7.
- Yusad, Y. (2013). Analisis Spasial Faktor Lingkungan dengan Kejadian Hipertensi. *Jurnal Kesehatan Masyarakat Nasional*, 7(11), 491-496.