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# Spatial Analysis Of Hypertension Incidence In The Area Tuntungan Community Health Center In 2023

**Meutia Nanda[1], Delfriana Ayu Astuty[2], Faradilla Diwanta[3], Raduwi Wahyuni[4], Windi Zahrani[5], Difa Adelia[6]**

[1,2,3,4,5,6] Public Health Science, Faculty of Public Health, State Islamic University of North Sumatera

***Author's Email Correspondence: delfrianaayu@uinsu.ac.id***

***ABSTRACT***

*Hypertension is a non-communicable disease (NCD) known as a silent killer because it often shows no symptoms but can cause severe complications and death. In Indonesia, its prevalence continues to rise and has surpassed the global average. This study aims to analyze the spatial distribution of hypertension cases and their gender-based characteristics in the working area of the Tuntungan Community Health Center (UPT Puskesmas Tuntungan) in 2023 using an ecological study design with a spatial analysis approach. Secondary data were obtained from hypertension case records by village and analyzed descriptively using QGIS and GeoDa to produce spatial distribution maps and incidence rates (IR), including gender-based characteristics. The results showed 14,452 hypertension cases in 2023, with a slightly higher proportion of women (51.15%) than men (48.85%). Spatially, the highest concentrations of cases were found in Salam Tani, Namorih, Tiang Layar, Namo Simpur, and Tengah, with Salam Tani recording the highest percentage at 8.3%. Villages with the highest IR included Salam Tani, Durin Simbelang, Namo Riam, Durin Tonggal, and Lama, reaching 99.2 per 1,000 population. Unhealthy lifestyles, low physical activity, and low socioeconomic status were key determinants of high hypertension prevalence, while gender-based differences in distribution indicate the need for targeted interventions. These findings show that spatial analysis is an important tool for identifying priority areas and guiding effective promotional and preventive hypertension control strategies tailored to local demographic, geographic, and social characteristics.*

***Keywords*** *: Hypertension; Spatial Analysis; Incidence Rate; GIS; Tuntungan Community Health Center*

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## INTRODUCTION

Noncommunicable diseases (NCDs) have become the leading cause of death worldwide (1). One of the major NCDs is hypertension. This disease is often called the silent killer because it does not cause symptoms, but can lead to serious complications and even death (2). Prolonged high blood pressure can cause various complications, so efforts to control hypertension focus on lowering and controlling blood pressure (3). Pathophysiologically, hypertension is a manifestation of hemodynamic imbalance in the cardiovascular system with multifactorial mechanisms involving genetic, environmental, and hemodynamic regulation factors (4).

Globally, the prevalence of hypertension reaches 22% of the world's population. Africa has the highest rate at 27%, while the lowest is in America at 18%. Southeast Asia ranks third highest with a prevalence of 25% (5). In Indonesia, the prevalence of hypertension reaches 34.1% according to the Basic Health Research (Indonesian Ministry of Health, 2023), which is higher than the global prevalence. WHO data (2023) also states that in the Americas, there are approximately 74.5 million people over the age of 20 who suffer from hypertension, with 95% of cases having unknown causes. Based on research conducted by (7), the prevalence of hypertension in the 26–45 age group in the working area of the Medan Tuntungan Community Health Center in 2022 reached 60.2% (8).

Based on demographic characteristics, women have a higher prevalence of hypertension (36.9%) than men (31.3%) (9). Age is also a significant factor, with increases in systolic and diastolic blood pressure commonly found in the 40–49 age group (10). Thus, age and gender are non-modifiable risk factors for hypertension. Meanwhile, modifiable risk factors include smoking, lack of physical activity, obesity, and stress (11).

Various studies show that spatial analysis approaches are highly relevant in understanding disease distribution, including hypertension (2). Geographic Information

Systems (GIS) play an important role in health and epidemiology because they can identify patterns of case distribution, risk factors, and areas with high incidence rates (12). This study aims to explore the spatial dynamics and incidence of hypertension and to map potential priority areas for public health interventions in the Tuntungan Community Health Center service area. Therefore, research on the spatial analysis of hypertension incidence in the working area of the Tuntungan Community Health Center (UPT Puskesmas Tuntungan) in 2023 is important, particularly by looking at the distribution of cases, incidence rates (IR), and characteristics based on the gender affected by hypertension.

## METHODS

This study employed an ecological study design with a spatial analysis approach to describe the distribution of hypertension cases in the working area of the Tuntungan Community Health Center, Pancur Batu District, in 2023. The data used were secondary data obtained from the health center's records, consisting of the number of hypertension cases per village and the characteristics of patients based on gender. Data collection was conducted through documentation studies of Community Health Center reports and a literature review to support the theoretical framework of spatial analysis.

Data analysis was performed descriptively using QGIS software. The analysis included calculating the incidence rate (IR) per 1,000 population for each village and creating thematic maps to illustrate the spatial distribution of hypertension cases. The results were interpreted to identify villages with the highest number and rate of hypertension cases, thereby providing an overview of areas with the greatest disease burden within the Tuntungan Health Center's working area.

## RESULTS

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Based on the results of secondary data analysis in the working area of the Tuntungan Community Health Center UPT in 2023, the following picture of the distribution of hypertension cases and gender characteristics was obtained:

**The incidence of hypertension in 2023 based on location distribution is described as follows:**

**Table 1. Hypertension Data Based on Location Distribution**

| No. | Village | Number of Cases | % |
|---|---|---|---|
| 1. | Bintang Meriah | 817 | 5.65 |
| 2. | Durin Simbelang | 841 | 5.82 |
| 3. | Durin Tonggal | 907 | 6.28 |
| 4. | Hulu | 1308 | 9.05 |
| 5. | Lama | 1189 | 8.22 |
| 6. | Namo Simpur | 947 | 6.55 |
| 7. | Namo Riam | 878 | 6.07 |
| 8. | Namorih | 958 | 6.63 |
| 9. | Pertampilen | 852 | 5.90 |
| 10. | Salam Tani | 822 | 5.69 |
| 11. | Sugau | 825 | 5.71 |
| 12. | Tuntungan I | 857 | 5.93 |
| 13. | Tuntungan II | 1292 | 8.94 |
| 14. | Tiang Layar | 883 | 6,11 |
| 15. | Tengah | 1076 | 7.45 |
| **Total** | | 14,452 | 100 |

*Source: Secondary Data from Tuntungan Community Health Center, Pancur Batu District, 2023*

Based on the data provided in Table 1, the total number of recorded hypertension cases across the 15 villages is 14,452. A clear disparity in case distribution is evident, with three villages significantly contributing to the overall total. The village with the highest number of cases is Hulu, which reported 1,308 cases, representing 9.05% of the total incidence. This is closely followed by Tuntungan II, which holds the second-highest count with 1,292 cases, accounting for 8.94%. Rounding out the top three is Lama, contributing 1,189 cases, or 8.22% of the total.

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Hulu, Tuntungan II, and Lama collectively recorded a total of 3,789 hypertension cases. This number indicates that these three villages carry the highest burden of cases. Therefore, they should serve as the primary focus areas for hypertension management and public health intervention.

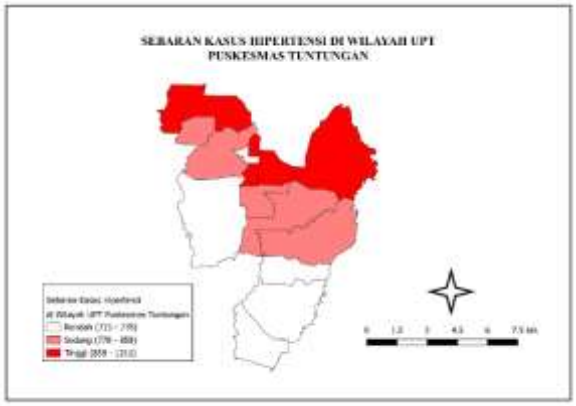


**Figure 1.** Map of Hypertension Case Distribution in The Tuntungan Community Health Center Working Area

Based on the map of hypertension cases in the working area of the Tuntungan Community Health Center, there is spatial variation in the distribution of the number of hypertension cases. The map is divided into three categories based on the number of cases, namely low (715–778 cases), moderate (778–858 cases), and high (858–1211 cases).

Areas in the high category (shown in dark red) are concentrated in several areas of Tuntungan II, Durin Tonggal, Namo Simpur, and Hulu. This indicates the existence of clusters of hypertension cases in these areas, which may be related to environmental factors, population density, lifestyle, and access to health services.

Areas with a moderate category (pink) are scattered in the central and southern parts, indicating a relatively moderate prevalence rate compared to other areas. Meanwhile, areas with a low category (white) are located in the southern part of the map, indicating a lower distribution of hypertension cases.

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Spatially, there is a noticeable pattern that hypertension cases are higher in areas with dense population concentrations or where certain risk factors are more dominant. These results emphasize the importance of a regional-based approach in hypertension prevention and control efforts, so that health interventions can be focused on areas with high prevalence.

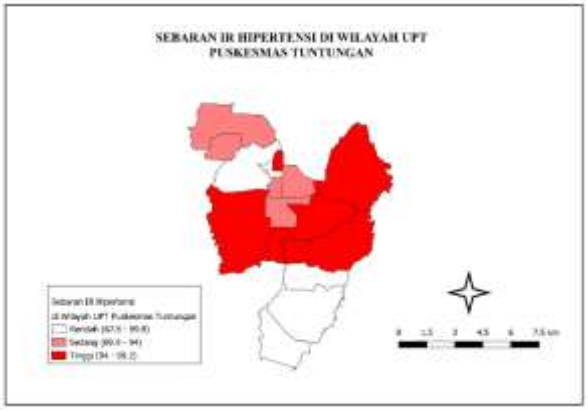


**Figure 2.** Map of Hypertension Incidence Rate per 1,000 Population in the Working Area of the Tuntungan Community Health Center UPT.

Based on the spatial analysis of the distribution of the incidence rate (IR) of hypertension per 1,000 residents in the working area of the Tuntungan Community Health Center, there are variations in the number of cases among the subdistricts and villages covered by the service. Areas with a high category are shown on the map in red, with an IR ranging from 94 to 99.2 per 1,000 residents. The villages included in this group are Salam Tani, Durin Simbelang, Namo Riam, Durin Tonggal, and Lama. This condition indicates that these villages have a significant burden of hypertension compared to other areas, thus requiring special attention and becoming a top priority in hypertension prevention and control programs.

Furthermore, areas with a moderate category are marked in pink on the thematic map, with an IR value ranging from 89.9 to 94 per 1,000 population. The villages included

in this category are Tuntungan II, Tuntungan, Hulu, Pertampilen, and Namo Simpur. Although the incidence of hypertension in these areas is not as high as in villages in the red category, there is the potential for an increase in cases if risk factors such as unhealthy lifestyles, high salt intake, and lack of physical activity are not immediately controlled. Thus, these areas need intensive promotional and preventive interventions to prevent them from shifting to the high category.

The areas in the low category are shown in white on the map, with an IR value between 67.8 and 89.9 per 1,000 residents. The villages included in this category are Bintang Meriah, Sugau, Tiang Layar, Namo Rih, and Tengah. The low number of hypertension cases in these areas is likely influenced by socio-demographic factors, environmental conditions, and relatively better access to and utilization of health services. However, low numbers do not necessarily eliminate risk, so continuous public health efforts are still needed to prevent an increase in cases in the future.

**The incidence of hypertension in 2023 based on gender characteristics is described as follows:**

**Table 2. Hypertension Data Based on Gender Characteristics Gender**

| Gender | Number of Cases | Percentage of Cases |
|---|---|---|
| Male | 7060 | 48,85% |
| Female | 7392 | 51,15% |
| **Total** | **14,452** | **100%** |

*Source: Secondary Data from Tuntungan Community Health Center, Pancur Batu District, 2023*

Based on the distribution of hypertension cases by gender, it can be seen that the number of cases in women (7,392 cases or 51.15%) is slightly higher than in men (7,060 cases or 48.85%). This difference is not very large, but it shows that women have a higher

proportion of hypertension sufferers in the working area of the Tuntungan Community Health Center.

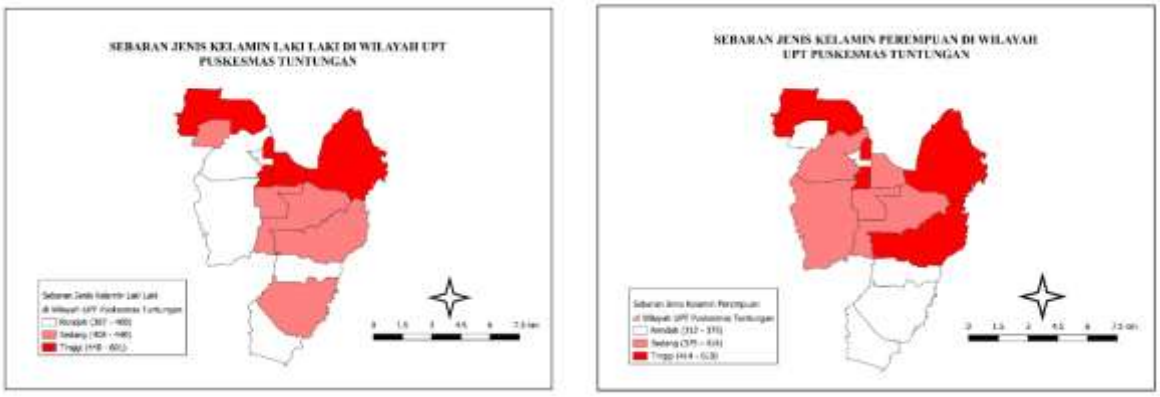


**Figure 3**. Map of Hypertension Case Distribution Based on Gender Characteristics

Spatial analysis results show that the distribution of hypertension cases in the working area of the Tuntungan Community Health Center in 2023 varies significantly between villages, both for men and women. In general, villages in the high category are marked in red and bear a greater burden of cases than other areas. In the male group, villages in the high category with 440–601 cases were Tuntungan II, Tuntungan, Lama, Hulu, Namo Simpur, and Durin Tonggal. Meanwhile, in the female group, the villages included in the high category with 414–610 cases are Tuntungan II, Lama, Hulu, Durin Sitonggal, and Namo Riam. This condition indicates that these villages are significant centers of hypertension, so they can be considered a top priority for health interventions.

In the moderate category, indicated by pink, the number of hypertension cases in men ranged from 408 to 440, with the villages included being Tuntungan, Pertampilen, Durin Simbelang, Namo Riam, and Sugau. Meanwhile, in the female group, villages in the moderate category with 375–414 cases include Namo Rih, Salam Tani, Namo Simpur,

Pertampilen, and Durin Simbelang. Villages in this category can be referred to as transition areas with a significant burden of cases and the potential to shift to the high category if risk factors are not immediately controlled.

Villages in the low category are indicated in white. In the male group, villages with 387–408 cases include Namo Rih, Tengah, Salam Tani, Tiang Layar, and Bintang Meriah, while in the female group, villages in the low category are Tuntungan, Tengah, Tiang Layar, Sugau, and Bintang Meriah. The low number of cases in these villages may reflect relatively more controlled risk factors.

## DISCUSSION

### Spatial Pattern

The spatial distribution of hypertension in the working area of the Tuntungan Community Health Center shows quite clear variations, with the highest concentration of cases in the north and east, while the south is relatively lower. Several villages demonstrated notably elevated incidence levels, with rates approaching nearly 100 cases per 1,000 residents. These consistently high figures indicate that certain areas experience a disproportionately greater burden of hypertension. Such patterns emphasize the need for targeted attention and resource allocation in these high-incidence communities. Meanwhile, villages in the moderate category, such as Tuntungan II, Tuntungan, Hulu, Pertampilen, and Namo Simpur, still have the potential to experience an increase in cases if the risk factors are not immediately controlled. As for villages in the low category, such as Bintang Meriah, Sugau, Tiang Layar, Namo Rih, and Tengah, although they show better figures, they still need to maintain promotional and preventive efforts so that they do not shift to a higher category.

The high IR in certain areas appears to be related not only to lifestyle and socioeconomic aspects but also to physical conditions, such as population density and accessibility to

health services. Northern and eastern villages tend to have higher population density and are relatively farther from the main health service center, which may limit access to preventive examinations and early treatment. Conversely, southern areas, which are closer to main transportation routes and health facilities, tend to show lower IR values. These findings highlight the importance of area-based intervention priorities, where high-IR villages should receive more intensive health promotion, outreach programs, and mobile health services to overcome accessibility barriers.

**Gender Differences**

The distribution of hypertension by gender also shows interesting differences. The number of cases in women is higher, at 51.15%, compared to men at 48.85 %. Although this difference is not very large, the findings are in line with national research showing that women are more often diagnosed with hypertension than men. Biological factors such as hormonal changes and repeated pregnancies, as well as socioeconomic factors that limit access to healthy food, play a role in the high rate of hypertension in women. Conversely, men are more influenced by risky behaviors, such as smoking, alcohol consumption, and work-related stress.

These gender disparities suggest that gender-sensitive health policies are needed. For men, interventions can focus on controlling risky behaviors, increasing physical activity, and reducing consumption of foods high in salt and fat. Meanwhile, for women, programs should emphasize improved access to healthy food, preventive health services, and regular blood pressure monitoring.

**Determinants**

The high prevalence of hypertension in several areas is closely related to changes in the lifestyle of rural communities, which are increasingly following unhealthy lifestyle trends. Decreased physical activity due to changes in the type of work, consumption of foods high

in salt and fat, and the increasing prevalence of abdominal obesity are the dominant factors driving hypertension. Low physical activity is one of the significant risk factors for hypertension in Indonesian adults, especially in urban and semi-urban areas (13). Abdominal obesity is also strongly associated with low physical activity in rural communities (14). Thus, obesity is an important determinant in the increase of hypertension, where people with a high body mass index tend to have a greater risk of hypertension compared to those with normal weight (15).

In addition to lifestyle factors, socioeconomic conditions also play a major role in reinforcing spatial disparities in hypertension. People with low economic status often have limited access to healthy food and preventive health services, making them more vulnerable to hypertension. In women, socioeconomic factors have a greater influence on the risk of hypertension than in men, who are more influenced by risk factors such as smoking and alcohol consumption (16). Although hypertension is generally higher in urban areas, hypertension in women is more commonly found in rural areas, especially among groups with limited access to healthy food and health services (17).

These findings indicate a complex interaction between spatial, socioeconomic, health behavior, and gender factors in shaping the distribution pattern of hypertension in the Tuntungan area. Areas with low socioeconomic conditions, particularly in the north and east, show a higher concentration of cases, especially among women. Therefore, public health interventions need to be tailored to regional conditions and gender characteristics. From a policy perspective**,** regional mapping of hypertension should be used to determine priority intervention areas**,** focusing on prevention and control programs in villages with high IR and limited service access.

Thus, the spatial distribution of hypertension in the working area of the Tuntungan Community Health Center not only reflects geographical variations but also illustrates the interaction between lifestyle factors, socioeconomic conditions, and gender differences.

Region-based and gender-sensitive interventions are crucial for reducing the burden of hypertension in the community, particularly in villages with high prevalence that have historically been more vulnerable to the risks of non-communicable diseases.

## CONCLUSIONS AND RECOMMENDATIONS

The results of the study show that the spatial distribution of hypertension cases in the working area of the Tuntungan Community Health Center in 2023 has significant variations between villages, both in terms of the number of cases and the incidence rate. Villages with the highest case burden, such as Salam Tani, Durin Simbelang, Namo Riam, Durin Tonggal, and Lama, have significant incidence rates and are a top priority in hypertension control efforts. In addition, there are differences in hypertension cases based on gender, with the number of cases in women being slightly higher than in men. Factors such as unhealthy lifestyles, low physical activity, obesity, and socioeconomic conditions play an important role in shaping this distribution pattern. This study emphasizes the importance of a region-based approach and spatial analysis in mapping risks and designing more targeted intervention strategies.

Recommendations

Area-based interventions should be implemented. Local governments and community health centers need to develop health intervention programs focused on villages with high incidence rates, such as Salam Tani and Durin Simbelang, with an intensive promotive and preventive approach. In addition, the use of GIS technology needs to be further developed in disease monitoring systems at the community health center level to support data- and area-based decision making.

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