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# Knowledge of Diabetes Mellitus 1 among Portuguese teachers and non-teaching staff: Relationship with sociodemographic characteristics

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**ABSTRACT**

Diabetes mellitus (DM) can be characterised as a serious pathology in the field of Public Health and is now considered an epidemic with considerable negative impacts on society. To analyse the relationship between teachers' and non-teachers' knowledge of type 1 DM and sociodemographic characteristics. This is a descriptive-correlational, cross-sectional, with a quantitative approach, with a sample of 85 teachers and non-teachers from Portuguese schools. In collecting data, we used a questionnaire filled out by the participants online. Data was processed using SPSS software. Of the total sample (n= 85), the majority were female (92.9%) and the majority belonged to teaching staff (52.9%). The average score for knowledge about DM1 was 61.06±14.207 points. The majority of the sample had a reasonable level of knowledge (57.6%). The DM1 knowledge score differed significantly between teaching and non-teaching staff (t-test: $p < 0.040$), with teaching staff having a higher average score. There is a relationship between knowledge of DM1 and professional group. These results imply that more support should be given to non-teaching staff, since in many situations they are the ones who provide first aid to students.

**Keywords**: Diabetes Mellitus; Education, Primary and Secondary; Knowledge; Community Health Nursing; Public Health.

# 1 INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disorder characterized by constant hyperglycemia due to a deficiency in insulin production or action, or both [1], and is a chronic pathology [2-3].

The condition can be categorized into four aetiologically distinct clinical types: Type 1 DM (absolute insulinopenia), Type 2 DM (relative insulinopenia, with a greater or lesser degree of insulin resistance), gestational DM (abnormality of glucose metabolism documented for the first time during pregnancy) and other specific types of DM (genetic defects, diseases of the exocrine pancreas, various endocrinopathies, induced by chemicals or drugs) [4].

People with type 1 DM (DM1) don't produce insulin and therefore have high blood sugar levels. It is a form of autoimmune disease because the person's own immune system attacks the beta cells, where insulin is produced. This is why this type of diabetes is usually diagnosed in childhood. These patients become dependent on insulin and medication, which must be accompanied by a proper diet and physical activity.

Type 2 DM, on the other hand, alters the body's ability to convert the sugar in the blood into energy, i.e. the body has insulin resistance and/or doesn't produce enough of the hormone. Treatment for this type of diabetes can include medication, diet and physical activity.

To make a diagnosis of DM, at least two of the following criteria are required: fasting plasma glucose greater than or equal to 126 mg/dl, blood glucose two hours after ingesting 75 g of glucose equal to or greater than 200 mg/dl or HbA1c greater than or equal to 6.5%. If only one of these criteria is altered, the analysis should be repeated to confirm the diagnosis [5-6].

Complementary tests should only be requested in cases of atypical presentations since the differential diagnosis between DM1 and DM2 can only be detected clinically [7].

Symptoms of DM1 include polyuria, polydipsia, weight loss with hyperglycemia and ketonemia, increased appetite, dizziness, weakness, fatigue, blurred vision, difficulty healing wounds and, in the most severe cases, it can trigger dehydration and diabetic ketoacidosis [8].

The main symptoms of hyperglycemia are polydipsia, polyuria, polyphagia and weight loss. Drowsiness, generalized pain, tingling and numbness, painful tiredness in the legs, cramps, nervousness and feeling unwell can also be present.

On the other hand, the main symptoms of hypoglycemia are sweating, fatigue, apprehension, tremor, hunger, dizziness, weakness, headache, confusion, coma and convulsions, which can be caused by excessive physical activity, delaying a regular meal, poor food intake and excess insulin [5].

The main acute complications of DM1 in children/adolescents are coma due to ketoacidosis and hypoglycemia [9].

As for chronic complications, they are microvascular (peripheral neuropathy, retinopathy and nephropathy) and macrovascular (coronary artery disease, cerebrovascular and peripheral vascular disease) [9].

Hypoglycemia is the most common acute complication of DM1. It is defined as a low concentration of glucose in the plasma, exposing the patient to potential harm and which can induce signs or symptoms [10]. It is essential that hypoglycemia is seen as a key component of diabetes management and that patients, their families and education professionals all have knowledge of its causes, effects, treatment and prevention [11].

Treatment involves glycemic and nutritional monitoring, physical activity and educational activities. In individuals with DM1, treatment with insulin therapy is essential.

Insulin therapy involves the administration of subcutaneous insulin with varying doses and administration devices appropriate to each case [12].

Glycemic monitoring is a daily procedure carried out using a device called a glucometer, which measures capillary glycaemia levels. A periodic assessment of glycated hemoglobin (HbA1c) is also carried out, the latter through blood tests. Blood glucose values should be between 70mg/dl and 130mg/dl before meals and up to 180mg/dl after meals. It is recommended that in the under 25 age group, HbA1c rates should be lower than 7%, as this is related to a lower likelihood of developing long-term complications [13].

According to the World Health Organization, the prevalence of DM has been increasing and is now recognized as a pandemic of the 21st century. It can also be considered a serious public health problem, with considerable negative impacts on society [14-15]. It is estimated that, over the next 20 years, it will affect more than 20% of the world's population, since the global prevalence of this disease has almost doubled since 1980, increasing from 4.7% to 8.5% in adults [14].

DM1 accounts for 5 to 10 per cent of diabetes cases in general and, in childhood or adolescence, around 90 per cent of cases [16]. The overall incidence of DM1 has been increasing by around 3-4% per year, especially in younger children. This increase is probably due to environmental factors, since the change is too rapid to be attributed to genetic factors [11]. In this context, DM1, the focus of this study, appears worldwide as one of the main chronic diseases of childhood [5].

The number of children and adolescents with DM is increasing every year, mainly at ages up to 15, with an estimated increase of 3% per year, although with strong geographical variations worldwide, with Europe, North America and the Caribbean being the regions with the highest number of children and adolescents with DM1 at ages up to 20 [16]. According to Portugal's National Diabetes Programme - challenges and strategies 2019, which records cases between 2015 and 2018, the prevalence rate for 0-14 year olds fell from 0.16% in 2015 to 0.09% in 2018. With regard to the incidence rate for 0 to 14-year-olds, there were 228 new cases in 2015, decreasing until 2018, when there were 146 [11]. Even so, these figures should worry the scientific community and those responsible for health in Portugal.

Around 90% of patients who use insulin therapy have already suffered at least one hypoglycemic event, with studies indicating that the majority of patients suffer an average of two events per week.

In turn, many of the symptoms of both hyperglycemia and hypoglycemia can be related to learning due to lethargy in thinking, weakness, tiredness, drowsiness, as well as absences from medical appointments and possible hospitalizations.

It is clear that DM1 has a considerable impact on children's quality of life. In this respect, studies have shown that children with DM have a lower quality of life when compared to healthy children [17].

Controlling DM1 in children can reduce the incidence of complications from the disease when the child becomes an adult. If the disease is not properly controlled in childhood, it can lead to chronic complications, with negative repercussions on the child's academic performance, involving cognitive function in the learning process. Knowledgeable and properly trained teachers and non-teaching staff will be able to deal safely and confidently with this type of pupil, which will help to minimize the occurrence of complications and thus contribute to a safe school environment. In this sense, the guidelines described in the document Children and Young People with DM1 at School (Guideline no. 006/2016 of the Directorate-General for Health & Directorate-General for Education, 2019) point to children and young people with DM1 progressively acquiring autonomy in the management of diabetes. Even so, it is recommended that the whole community be trained in this area [14].

Therefore, knowledge of the difficulties and needs of children with DM1, on the part of those who deal with them directly, is essential if their lives are to be as normal as possible [5].

Children with DM1, like other children, spend most of their day at school. They should therefore have the same opportunities to take part in all school activities, including physical activities, field trips and extracurricular activities. The school's involvement in the child's treatment is therefore crucial, as is training and informing the entire school community about DM1 [11].

One of the school's duties is to respect differences by practicing acceptance. This principle becomes extremely important in the context of DM, due to its clinical and psychological complexity, requiring professionals who are informed and trained to manage all the situations arising from this disease [11]. Having knowledgeable and properly trained teachers and non-teaching staff will increase their confidence in dealing with these children, reducing the possibility of acute complications, which contributes to a safe school environment [9]. Increasing knowledge about the disease not only helps to include the child, but also increases the skills of education professionals, which could be essential for future interventions [11].

This study aims to analyze the relationship between teachers' and non-teachers' knowledge of DM1 and sociodemographic characteristics.

Studies on this subject, involving this population, are scarce worldwide and practically non-existent in Portugal and in the geographical area where this study took place.

## 2 METHODOLOGY

Methodology corresponds to a set of procedures that contribute to obtaining knowledge, being the path of thought and the practice exercised in approaching reality.

This is an observational, descriptive-correlational and cross-sectional study of quantitative approach [18].

### 2.1 Participants

The population of a study is defined by the inclusion criteria [18]. The inclusion criteria were: i) 1st cycle teachers and non-teachers who belong to the staff of the school grouping of Lixa and Airães in the municipality of Felgueiras; ii) 1st cycle teachers and non-teachers from the school grouping da Lixa and Airães in the municipality of Felgueiras who are currently teaching. The target population thus consisted of teaching and non-teaching professionals who met the inclusion criteria, 64 teachers and 40 non-teachers.

The sample is the fraction or subset of a population selected and on which the study is performed, and should be representative of the population, being defined by the exclusion criteria [18]. The following exclusion criteria were defined: i) 1st cycle teachers and non-teachers from the Lixa and Airães school grouping in the municipality of Felgueiras who are on holiday during the data collection period; ii) 1st cycle teachers and non-teachers from the Lixa and Airães school grouping in the municipality of Felgueiras who are on sick leave during the same period. After applying the exclusion criteria, the sample consisted of 62 teachers and 40 non-teachers, around 98.7 per cent of the population. The sampling technique used was non-probabilistic convenience sampling, which, according to Fortin et al [19], consists of elements that are easily accessible at a specific time and place.

Of the total sample (n= 45 teachers and 40 non-teaching staff), the majority were female (92.9%), the largest group belonged to the 41 to 50 age group (48.2%), the majority

belonged to the Lixa school cluster (57.6%) and belonged to the teaching staff (52.9%) (**Table 1**).

Table 1 Sociodemographic characterization of the sample (n = 85)

| **Variables** | | | **Af** | **Rf (%)** |
|---|---|---|---|---|
| **Gender** | Female | | 79 | **92.9** |
| | Male | | 6 | 22.1 |
| **Age group** | 20-30 years old | | 3 | 3.5 |
| | 31-40 years old | | 4 | 4.7 |
| | 41-50 years old | | 41 | **48.2** |
| | ≥ 50 years old | | 37 | 43.5 |
| **School** | Airães | | 36 | 42.4 |
| | Lixa | | 49 | **57.6** |
| **Professional Group** | Teacher | | 45 | **52.9** |
| | Non-Teacher staff | | 40 | 47.1 |
| **Total** | | | 85 | **100** |

Legend**:** Af – Absolute frequency; Rf – Relative frequency.

The sociodemographic characteristics of the sample in this study are very similar to those of the participants in the qualitative study carried out with 19 teachers and non-teaching staff in a municipality in the state of São Paulo (Brazil) [5], all of whom were female (100%), most of whom belonged to the 41-50 age group (53.0%) and the professional group of teachers (58.0%).

## 2.2 Material

For data collection, we used a self-completion questionnaire designed for this purpose, adapted for online use. The questionnaire was organized into three parts: the first part of the questionnaire was made up of sociodemographic characterization questions (gender, age group, school, professional group); the second part concerned professional experience and training; the third and final part included 20 questions aimed at assessing knowledge about DM1. Five points were awarded for each question answered correctly. The final score ranged from 0 to 100 and was qualitatively based on the classification presented by Hill and Hill [20]. Thus, a score between 0 and 24 points corresponded to a "Very Poor Knowledge" level, 25 to 49 points corresponded to a "Poor Knowledge" level, 50 to 74 points corresponded to a "Fair Knowledge" level, 75 to 89 points corresponded to a "Good Knowledge" level and 90 to 100 points corresponded to a "Very Good Knowledge" level.

## 2.3 Procedures

The ethical aspects inherent in the development of any scientific research and the recommendations contained in the Declaration of Helsinki and Vancouver were taken into account, safeguarding the rights of the human person [18; 19].

The ethical principles associated with research with human beings were taken into account throughout the process. Confidentiality and anonymity of responses were guaranteed, as well as voluntary participation in the study and informed consent.

To carry out the study, permission was sought from the Lixa and Airães school group and a favourable opinion was obtained from UTAD's ethics committee (Opinion reference Doc90-CE-UTAD-2021).

The data was collected by the researcher herself online, using Google Forms, from 24-03-2021 to 31-03-2021. The researcher sent the link to the school coordinators who made it available to teaching and non-teaching staff. At the end, the data was downloaded. It was decided to administer the questionnaire online due to the COVID-19 pandemic situation experienced during the data collection period.

To process and analyze the data, a database was built using the IBM Statistical Package for the Social Sciences (SPSS 25.0) software. Descriptive and inferential statistics were used. In terms of descriptive statistics, absolute and relative frequencies and mode were calculated for all the variables. In the case of ratio variables, statistics were also calculated for measures of central tendency and dispersion. With regard to inferential statistics, the t-student, ANOVA, Mann-Whitney and Kruskal-Wallis tests were used. The significance level considered was 5% [21].

## 3 PRESENTATION AND DISCUSSION OF RESULTS

The presentation of the results focused on the professional experience and training in the area of teachers and non-teachers, the knowledge of teachers and non-teachers about DM1 and the relationship between the knowledge of teachers and non-teachers and sociodemographic variables.

### 3.1 Professional experience and training in the field

With regard to length of professional experience, the majority of the sample had been working for more than 20 years (55.3%), had no previous experience with children with DM1 (83.5%), had no knowledge of any students with this disease at their school (82.4%) and had no previous training in diabetes (92.9%) (**Table 2**).

Table 2 Characterization of professional experience and training in the area (n= 85)

| Variables | Af | Rf (%) |
|---|---|---|
| **Length of professional career** | | |
| **Less than 5 years** | 12 | 14.1 |
| **5-20 years** | 26 | 30.6 |
| **More than 20 years** | 47 | **55.3** |
| **Previous experience with children with DM1** | | |
| **No** | 71 | **83.5** |
| **Yes** | 14 | 16.5 |
| **Do you know of any students with DM1 at this school?** | | |
| **No** | 70 | **82.4** |
| **Yes** | 15 | 17.6 |

| | | |
|---|---|---|
| **Previous training in diabetes area** | | |
| **No** | 79 | **92.9** |
| **Yes** | 6 | 7.1 |

Legend: Af – Absolute frequency; Rf – Relative frequency.

The participants in the study carried out in the city of Bauru (S. Paulo, Brazil) [5] had been working in their profession for less time than those in our study, since the largest group in that study had been working in schools for 4-10 years (42.0%). However, as in the present study, the majority had no previous experience with children with DM1 (58.0%).

### 3.2. Knowledge of DM1

The questions with the highest percentage of incorrect answers were the question "Care to be taken when administering insulin with the ejector pen?", the question "Should the capillary blood glucose lancet (needle) be replaced?", the question "How should insulin be stored and preserved once the packaging has been opened?" and the question "What is hypoglycemia (blood sugar too low)?", which had 82.3%, 69.4%, 65.9% and 64.7% incorrect answers respectively. The mean score for knowledge about DM1 was 61.06±14.207 points, the median was 60.00 points, the mode was 55.00 points, the minimum was 25 points and the maximum was 95 points (data not shown in the table). It was found that the majority of the sample had a reasonable level of knowledge (57.6 %) (**Table 3**).

Table 3 Categorization of knowledge about DM1 in children (n=85)

| **Variables** | | **Af** | **Rf (%)** |
|---|---|---|---|
| **Categorization** of knowledge about Type I Diabetes Mellitus in children | Bad Level From 25-49 | 4 | 16.5 |
| | Fair Level From 50-74 | 9 | **57.6** |
| | Good Level From 75-89 | 1 | 24.7 |
| | Very Good Level From 90-100 | | 1.2 |

As for the definition of hypoglycemia, the results related to knowledge of this definition from the study carried out in Bauru (S. Paulo-Brazil) [5] converge with those of the present study, since this question is among those that obtained the third highest percentage in the first study and the fourth highest percentage of incorrect answers in our study.

Although we can't directly compare the level of knowledge with other studies in terms of percentages, we can say that the vast majority of the sample in our study has between a poor and reasonable level of knowledge about DM1. Also, in the Bauru study (São Paulo - Brazil) [5], the authors pointed out the lack of information and the lack of preparation of the participants (teachers and non-teachers) to support children and young people with this pathology. The same happened in the study carried out in Italy [22], with a sample of 292 teachers, in which the author identified that the level of knowledge about different aspects of DM was extremely superficial.

### 3.3. Relationship between knowledge of DM1 and sociodemographic characteristics

There were no statistically significant differences between the average score for knowledge of DM1 between teachers and non-teaching staff of different genders (t-test: $p \geq$

0.858), teachers and non-teaching staff of different age groups (t-test: $p \geq 0.806$) or teachers and non-teaching staff from different schools (t-test: $p \geq 0.467$).

The score for knowledge about DM1 differed significantly between teaching and non-teaching staff (t-test: $p < 0.040$), with teaching staff having a higher average score (64.00 > 57.65 points), i.e. teaching staff had more knowledge about DM1 than non-teaching staff (**Table 4**).

Table 4 Relationship between the DM1 knowledge score and the sociodemographic characteristics of the sample (n=85)

| Variables | | | Mean | Test value | df | p value |
|---|---|---|---|---|---|---|
| Score of knowledge about DM1 x **Gender** | Male<br>Female | 9 | 62,50<br>60,95 | t de Student: 0,187 | 5,373 | 0,858 |
| Score of knowledge about DM1 x **Age Group** | 20-40 years old<br>41-60 years old | 8 | 62,14<br>60,96 | t de Student: 0,254 | 7,819 | 0,806 |
| Score of knowledge about DM1 x **School** | Lixa<br>Airães | 9<br>6 | 60,10<br>62,36 | t de Student: 0,731 | 78,631 | 0,467 |
| Score of knowledge about DM1 x **Professional Group** | Teacher<br>Non-Teacher staff | 5<br>0 | 64,00<br>57,65 | t de Student: 2,086 | 82,609 | **0,040** |

Legend: df – Degree of freedom; DM1 – Diabetes Mellitus type 1; p value – Probability.

## 4 CONCLUSION

The socio-demographic profile of this sample of Portuguese teachers and non-teaching staff is female, aged between 41 and 50, working at the Lixa school and being part of the teaching staff.

The teachers and non-teachers in the sample have a lot of professional experience, but no previous experience with children with DM1 and feel they need training in the area of DM.

The sample's knowledge of DM seems to be lower in procedures related to insulin administration, lancet handling, insulin storage and the concept of hypoglycemia. The majority of the sample has a poor to reasonable level of knowledge about DM1, i.e. there are gaps.

It was found that there was a relationship between the score of knowledge about DM1 and the professional group, with teachers having the highest level of knowledge about DM.

The main limitations of this study relate to the fact that it was not a random sample and that it was a cross-sectional study. A non-random sample is less reliable than a random sample in terms of generalizing the results. Cross-sectional studies do not allow us to establish cause-effect relationships, but only to explore relationships.

The implications of this study for the professional practice of Community Nursing may lie in the warning it could provide to the Community Care Unit, which is responsible for the educational establishment where this study was carried out, about the need for intervention in this group, with the aim of promoting knowledge about DM1, especially among the professional group of non-teaching staff, in order to increase their training in supporting pupils, providing them with greater confidence in dealing with these children, reducing the possibility of acute complications and contributing to a safe school environment.

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# THE WORKLOAD PRESSURES EXPERIENCED BY NURSES AT PUBLIC SECTOR HOSPITALS, PESHAWAR

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## ABSTRACT

OBJECTIVES

The study's objective was to assess that nurses working in in-patient wards were under workload stress.

METHODOLOGY

Descriptive observational research on nurses working in the in-patient ward of a public sector hospital in Peshawar was undertaken in November 2020. Workload Indicators of Staffing Need (WISN), a tool established by the World Health Organization (WHO) to anticipate the number of health staff needed to cope with workload pressure, was used to determine nurses' workload. To ensure the successful implementation of the WISN methodology, three tiers of committees were developed, including steering, technical, and expert committees. Data were also analyzed using the tool.

RESULTS

Nurses in the hospital's in-patient unit work 1966 hours per year. Health service activities, support, and other activities account for 47.92%, 33.33%, and 18.75% of all nurses' time, respectively, during this time. Four nurses were working in the hospital during the research study; however, WISN estimated that three nurses were needed to cope with the ward's workload pressure, and one nurse was overstaffed at the time. The WISN ratio calculated was 1.33.

CONCLUSION

The study concluded that there was no workload pressure on nurses (negative), and the ward had an extra nurse who could be accommodated in any other department with greater demand.

**KEYWORDS**: Workload, Staffing, Health, Workforce, Resources, Planning, Management

## INTRODUCTION

Human resources are a critical pillar for access to health care services and universal health coverage, but they remain a persistent challenge for many countries due to disparities in their availability, composition, distribution, and productivity (Bonfim et al., 2016) (World Health Organization, 2010) (Dal Poz et al., 2010). A robust workforce is required for every health system to perform well and accomplish its objectives. Human resources have traditionally been a system's most significant asset. A major chunk of the budget is consumed by human resources. Human resource planning guarantees that aptitudes are available (Abdullah et al., 2014) (Vafaee-Najar et al., 2018). Global health workforce challenges include shortages and unequal distribution, inadequate human resource planning, ill-informed policy decisions, and inadequate personnel (Okoroafor et al., 2019) (Joarder et al., 2020). Inequalities in health worker distribution have been significantly connected to a lack of access to effective health care and poor health indices (Namaganda et al., 2015). Health care services rely significantly on healthcare personnel, and over 75 per cent of the health budget is spent on health workforce sustainability. In Pakistan, the health workforce accounts for 50-70 per cent of development investment and often more than 90 per cent of current expenditure (*Pakistan: Human Resources for Health Vision*, 2018). A crucial component of every health system is the health workforce, including clinicians, allied health professionals, social health workers, health managers and support employees. According to WHO, Pakistan is one of 57 nations with a critical shortage of Health workforce planning seeks to balance what is required to satisfy the population's health needs. The World Health Organization also anticipated improving equitable access to the health workforce would hasten progress toward meeting the Sustainable Development Goals (SDGs) (Zhu et al., 2018). Globally, there is a significant lack of health personnel, particularly in low-income nations. The health workforce problem has profoundly impacted emerging countries (Burmen et al., 2017) (Pozo-Martin et al., 2017).

The shortage of health personnel disproportionately affects developing nations such as Pakistan, and it is expected to impede Pakistan's accomplishment of the Millennium Development Goals (MDGs) and SDGs (Shivam et al., 2014). Most countries have expressed worry about the deterioration of nurse shortages. The association between nursing workloads and quality of patient care and safety is an established fact. Human resource inequality in healthcare facilities is a key factor in the allocation of resources, and it is one of the major challenges developing countries is facing in terms of health system management. Human resource planning estimates and forecasts the needed resources to accomplish organizational goals but is frequently overlooked. To address the global health workforce crisis, strategic information on human resources for health must be made available to help guide health policymaking. This implies that we needed information in order to determine the quantity of health personnel necessary. Workers in any organization face varying degrees of workload on a daily basis. If the workload changes for whatever reason, the stress level of the personnel as well as their perception of fairness in workload balance shift, especially if the adjustment is favourable. However, whether it is positive, as in the case of a rise in workload, or negative, as in the case of a decrease in workload, it has an effect; it has consequences on staff job satisfaction and eventually their performance. Whereas a positive change in workload may elicit unpleasant sentiments among the staff members, a negative change may limit their ability to utilize knowledge and abilities, resulting in inefficiency on the side of such workers (Inegbedion et al., 2020). Determining the number and composition of human health resources has been difficult because of the various methods used to define job title terms, professional categories, and worker characteristics (Beck et al., 2018). Some measures, such as the design and execution of norm estimates of human resources, have previously proven

effective in avoiding the unfair distribution of healthcare practitioners. WHO designed the Workload Indicator Staffing Need (WISN) tool in 1998 to ascertain the actual number of people required based on workload distribution. It is chosen by health practitioners since it is simple to use, technical, and accurate in determining provider workload. Many countries have used this method to improve health workforce planning (McQuide et al., 2013) (*WISN APPLYING THE WISN METHOD IN PRACTICE Case Studies from Indonesia, Mozambique and Uganda*, 2010).

WISN findings can be utilized in a variety of ways. Depending on the workload, fine-tune the personnel numbers at a health institution (*A WISN TOOLKIT*, 2009). Locate healthcare institutions that are overstaffed but underutilized. Identifying understaffed facilities and locations and creative techniques for filling empty positions. To give more exact statistics for local, provincial, and national workforce projections. The study was conducted to determine the workload pressure experienced by nurses working in the in-patient ward of a public sector hospital in Peshawar, Pakistan.

## METHODOLOGY

This descriptive observational research was conducted in a public sector hospital in Peshawar in November 2020. Khyber Medical University Peshawar approved this study's Institutional Ethical Review Board (IERB). We used the Workload Indicators of Staffing Need (WISN) approach. For this study, the already available service statistics were obtained from Peshawar's public sector hospital. After discussing with the hospital's management, it was agreed to conduct the study in the surgery in-patient ward of a public sector hospital in Peshawar, which was staffed with four nurses to oversee the ward's activities. The reason behind choosing the ward was that the management had received feedback that the nurses in the ward were overburdened. Inclusion criteria were nurses working in the surgery ward of the public sector hospital. To ensure the successful implementation of the WISN methodology, three tiers of committees were established, including steering, technical, and expert committees which established the primary workload components and activity standards for all three activities, such as health services, support, and additional activities. Following are the key definitions of terminologies used in the paper. The WISN manual has further information on all these processes and calculates. Term definitions: Activity standard; Time needed for a trained, talented and motivated employee to execute work to professional standards at a specific location. Activity standards are service standards;(World Health Organization, 2010) These are activity standards for health care services. (Annual statistics for these activities are obtained regularly). Allowance standard These are activity standards for support and additional activities. (Annual statistics for these activities are not gathered regularly). Allowance standards are classified into two types: Category allowance standard (CAS); Allowance standard for all workers of a staff category who conduct support activities. Individual allowance standard (IAS): Allowance standard for additional activities conducted by some (but not all) members of a staff category. Allowance factor: factor used to account for the personnel requirements of activities for which yearly figures are not obtained regularly. Allowance considerations are classified into two types: Category allowance factor (CAF); The multiplier calculates the number of health professionals needed for health services and support activities. Individual allowance factor (IAF); Staff requirement to cover additional activities of some cadre members. IAF is added to staff requirements of health service and support activities. Available working time (AWT); Time available to a health professional in one year to perform their duties, including permitted and unauthorized absences. Standard workload: The quantity of work that one health professional may perform in a year as part of a health service workload component (if the total working time were to be

spent on this activity only) (World Health Organization, 2010). Workload component: One of the primary work tasks consumes most of a health worker's daily working time. Workload components reclassified into three types: Health service activity; Health-related activities carried out by all staff members and for which yearly statistics are collected regularly. Support activity: Significant tasks that improve the healthcare delivery are carried out by all staff group members but for which annual statistics are not collected regularly. Additional activity: Activities performed only by a subset (but not all) of the staff group for whom yearly statistics are not collected regularly. The obtained data were entered and analysed in the World Health Organization's (WHO) WISN software to make all of the statistics easier to compute.

**RESULTS**

Our study found that the four nurses worked eight hours a day, six days a week, in the surgical inpatient section. As indicated in table 1, the average number of available working days in a year is 312 days, and the average number of working hours estimated is 1966 hours. Nurses were not required to work for 66.25 days out of the year. These days include public holidays, annual leaves, sick leaves, and other leaves, as mentioned in table 1. Table 2 describes the workload on the nurses in the inpatient ward and the service standards of the nurses in the in-patient ward of the hospital, i.e., unit time or rate of working for each service activity. Based on these figures, the category allowance standards were calculated, and the CAS% for support activities of all nurses came out to be 33.33%. The annual Individual Allowance Standard (IAS) for additional activities of some nurses was found to be 368.63 hours in a year. Using the WISN methodology, the total staff required for health service activities was 1.55. The category allowance factor for support activities of all the nurses was calculated to be 1.50. The individual allowance factor for additional activities of some nurses was calculated to be 0.37. As a result, the total needed number of nurses in the hospital's in-patient ward based on WISN was three. During the study, four nurses were employed in the in-patient ward of the hospital. The analysis of WISN results, as given in table 3, shows that the required number of nurses based on WISN was 3, which means that there was no workload pressure, and one nurse was surplus in the in-patient ward of the hospital.

Workload pressure = 1- WISN ratio x 100 Workload pressure = 1- 1.33 x 100

Workload pressure = -33%

**Table 1: The Annual Available Working Time of Nurses Working in the Ward**

| | |
|---|---|
| Total number of possible working days in a year (A) | 52 x 6 = 312 |
| Total number of weeks in a year | 52 |
| Available working days in a week | 6 |
| Total number of days not worked (B+C+D+E) | 66.25 |
| Days not worked due to public holidays (B) | 15 |
| Days not worked due to annual leaves (C) | 24 |
| Days not worked due to sick leaves (D) | 14 |
| Days not worked due to other leaves (E) | 13.25 |
| Available working days in a year (A-(B+C+D+E)) | 312 – 66.25 = 245.75 |
| Average available working hours in a day | 8 |
| Available working time (in hours) in a year (AWT) | 245.75 x 8 = 1966 |

**Table 2. Determining Nurses' Requirement in Surgery in-patient ward based on WISN**

| | | | | |
|---|---|---|---|---|
| **AWT = 1966 hours** | | | | |
| **Health service activities of all doctors** | **Workload component** | **Annual workload** | **Standard workload** | **Required number of doctors** |
| | Patient Admissions | 1953 | 5903 | 0.33 |
| | Patient Medication | 1953 | 5903 | 0.33 |
| | Patient Investigations | 1953 | 7864 | 0.25 |
| | Dressings of Post-op Patients | 667 | 5903 | 0.11 |
| | Medication of Accident & Emergency Patients | 1872 | 3932 | 0.48 |
| | Patients Referral | 578 | 11772 | 0.05 |
| **A.** | **Total required staff for health service activities** | | | 1.55 |
| **Support activities for all doctors** | **Workload component** | **CAS (Annual working time)** | | **CAS (Percentage working time)** |
| | Ward Rounds | 1 Hour / Day | | 12.5% |
| | Recording & Reporting | 1 Hour / Day | | 12.5% |
| | Giving & Taking Charge | 0.5 Hour / Day | | 6.25% |
| | Participate in Meetings | 1 Hour / Week | | 2.083% |
| | Journal club | 0.6 hour per week | | 0.86% |
| | Training Medical Officers (TMOs) presentations | 4 hours per month | | 1.47% |
| | Weekly Obstetric emergency drill | 6 hours per week | | 8.57% |
| | Prepare birth certificates/ evaluations/ disease statistics etc. | 6 hours per week | | 8.57% |
| **Total CAS percentage** | | | | 33.33% |
| **B.** | **Category allowance factor: {1 / [1 – (total CAS percentage/ 100)]}** | | | 1.92 |
| **Additional activities of certain** | **Workload component** | **Number of doctors performing the work** | **IAS (Actual working time per doctor)** | **Annual IAS (for all doctors performing activity)** |
| | Duty Roster | 1 | 2 Hours / | 81.92 Hours |

| | | | | |
|---|---|---|---|---|
| | | | Week | |
| | Supervision & Management | 2 | 1 Hour / Day | 491.5 Hours |
| | Requisition of Supplies | 2 | 2 Hours / Week | 163.83 Hours |
| **Total IAS in a year** | | | | 737 Hours |
| **C. Individual allowance factor (Annual total IAS/ AWT)** | | | | 0.37 |
| **D. Total required number of staffs based on WISN: (A x B + C)** | | | | 2.7 = 3 |

**Table 3. Nurses Requirement in the in-patient Ward in Public Sector Hospital**

| **Staff category:** | | | | | | |
|---|---|---|---|---|---|---|
| **Health facility** | **Current number of staff** | **Required number based on WISN** | **Shortage/ Excess** | **Workforce problem** | **WISN ratio** | **Workload pressure** |
| In-Patient Ward of Public Sector Hospital Peshawar | 4 | 3 | +1 | Surplus | 1.33 | None |

## DISCUSSION

The WISN approach, used to assess the number of people needed in a certain facility, is based on the amount of work needed. Many countries adopted and implemented the concept to improve human resources and ensure an equitable workload distribution (*WISN APPLYING THE WISN METHOD IN PRACTICE Case Studies from Indonesia, Mozambique and Uganda*, 2010) (Satish, 2015). According to the results of our research, there was a discrepancy between the number of nurses required and the number of nurses on the ward. Three nurses were required to manage the ward's workload, with the fourth nurse being assigned to another area with a higher need. Workload pressure was also negative in the study (no pressure). This strategy is predicated on routinely stored data about the experts under consideration (Bonfim et al., 2016). The hospital's management must assess the workload pressures of other units and adjust the staff accordingly. These efforts will contribute to the district hospitals' optimal performance in terms of service delivery. In Indonesian research, midwives said the strategy was effective because it helped them focus their work time on vital duties and examine their own work conditions (Bonfim et al., 2016). The WISN data from research in Namibia also revealed that nurses were dispersed unequally throughout various services and obviously deviated to hospitals (Bonfim et al., 2016). The application of WISN has also proved excesses in staffing levels in other countries. In a study in Uganda, one health facility had more staff than those needed to accomplish essential and support activities (Burmen et al., 2017). Likewise, in Burkina Faso, a study found that the current staff was adequate to handle the maternity services in the facility. When tailored to local settings, the WISN tool enhances the allocation of healthcare personnel across services, assists in identifying facilities with surplus/shortage, and contributes to successful human resource (Bonfim et al., 2016) (Namaganda et al., 2015) (Burmen et al., 2017) (McQuide et al., 2013). Although the WISN approach worldwide to determine workload, it has some

constraints, such as the fact that the findings cannot be generalized because certain factors such as terrain, demography, and environment play a significant role in determining staff requirements. Although the method is extensively used to determine workload, it has several shortcomings. Because topography and population are factors in deciding personnel requirements, it can't be generalized (Doosty et al., 2019).

## LIMITATION

The WISN technique relies on the data like workload and is thus impacted by its quality,

timeliness and accuracy. WISN measures workloads using annual service statistics. The

WISN method's precision is thus governed by the accuracy of the statistics themselves. WISN findings will be incorrect if a health facility keeps inadequate records. Mostly, the inaccuracies support under-recording the workload, resulting in an overestimation of the facility's staffing needs.

## CONCLUSION

According to the study, three nurses were needed to manage the ward's workload, and the fourth nurse might be reassigned to another area with greater demand. The study also found that workload pressure is negative (no pressure). Appropriate health workforce management and planning could substantially impact the productivity and efficiency of the healthcare industry. In low- and middle-income nations, the WISN technique could be extremely valuable for hospital administrators in estimating staffing demands and predicting the impact of their actions on staffing. Now that hospitals have decision-making autonomy, the hospital director should measure workload stress to recruit HRH cadres based on evidence.

## DISCLAIMER

The views expressed in this paper do not reflect the views of the institutions with which the authors worked or were affiliated. Also, it is pertinent to mention that a preliminary abstract was published in a conference proceeding, and the paper abstract in this manuscript has been revised to avoid potential conflict with published conference proceedings.

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# THE SPATIOTEMPORAL ANALYSIS OF THE DISTRIBUTION OF COVID-19 CASES IN THE PHILIPPINES IN AN ERA OF MASS IMMUNIZATION

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## ABSTRACT

Monitoring the movement of SARS-CoV-2 within the country at a time when vaccines are now widely available to the public is still imperative. This study intends to present a spatiotemporal analysis of the distribution of COVID-19 cases in the Philippines following mass vaccination campaigns to combat the virus. COVID-19 cases confirmed by the DOH's Data Drop Tracker spanning January 30, 2022, to January 14, 2023, were visualized using ArcGIS dot density and choropleth maps. Global Moran's I, Anselin Local Moran's I, and Getis-Ord Gi* were used for analyzing the distribution, clustering, and formation of hot and cold spots, respectively. Cases peaked during February and August 2022; NCR showed the highest prevalence across regions. A positive spatial autocorrelation in the distribution of morbidities was not a result of random events. Metro Manila, Cavite, and Tarlac had the most consistent High-High (HH) clustering. Conversely, Low-High (LH) outliers were found in Abra, Oriental Mindoro, and Cagayan. Numerous significant hotspots were concentrated on the island of Luzon (excluding the Bicol region), and on Central and Western Visayas. By employing geospatial tools, significant case clustering has been highlighted in this assessment. This understanding aids in disease surveillance, public health assessment, and improved pandemic management.

KEYWORDS: Clustering, GIS, mapping, pandemic, SARS-CoV-2

## [1] INTRODUCTION

With over 6 million deaths worldwide, the Coronavirus Disease 2019 (COVID-19), a highly contagious viral illness brought on by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), has been considered the most significant global health crisis since the influenza pandemic in 1918. SARS-CoV-2 spread quickly worldwide when the first instances of this primary respiratory viral illness were initially recorded in Wuhan, Hubei Province, China, late in December 2019. As a result, the World Health Organization (WHO) declared a COVID-19 pandemic on March 11, 2020. Since being deemed a global health issue, COVID-19 has devastated numerous nations and greatly challenged existing healthcare systems [1].

The Philippines was one of the countries hit the hardest by the spread of COVID-19 in the Asia-Pacific region [2]. However, it is without a doubt that the management of the COVID-19 situation in the country has already improved in comparison to the first surge of cases. Although despite transitioning to the new normal three years into this pandemic, the number of active cases continues to fluctuate, with some months having more drastic increases in figures and others with gradual declines until they spike up again.

Considering that the Philippines has already fully vaccinated more than 73.5 million, which is around 94% of the total target population [3], there is a need to evaluate the current trends in line with the recent COVID-19 morbidities being recorded. An essential part of effective monitoring and tracking of certain diseases is mapping. Disease mapping is a tool to raise awareness of the disease and a foundation for developing plans and actions to manage current and future infectious disease outbreaks. Among the emerging public health methods that align with this is spatiotemporal analysis, as it looks at objects moving in space and time [4].

At the time of writing, no specific articles have been published that explicitly address any changes in the country's spatiotemporal patterns of COVID-19 cases in the country about the national vaccination drive implemented by the local Ministry of Health since it began last March 2021. Presented with this gap in knowledge and the perceived significant contributions of spatiotemporal analysis, this study aims to establish the prevalence, determine significant clustering, and identify significant hotspots in the country within January 30,2022 to January 14,2023.

## [2] MATERIALS AND METHODS

### *A. Research Design*

The study used a quantitative geospatial-temporal epidemiological study design. It focused on deriving geographical patterns and disease distribution using geospatial methods and analyzing the correlation among variables and their effects on the trends using spatiotemporal analysis [6].

### *B. Subjects and Study Site*

Cases of the emerging COVID-19 in the Philippines were mapped spatiotemporally in classifying frequency, prevalence, and cluster from officially reported cases from January 30, 2022, to January 14, 2023. The DOH COVID-19 Tracker data (https://www.doh.gov.ph/covid19tracker) drop served as the primary source for data collection. Cases were derived on the dates mentioned above from the municipal FID codes given on the DOH Data Drop site. Meanwhile calculating the prevalence of the disease on a national scale and using spatial autocorrelational tools relied on the Philippine Statistics

Authority 2020 midyear. The vaccine availability and its acquisition in correlation with COVID-19 transmission in the Philippines were emphasized in the study.

*C. Data Measure and Instrumentation*

From the frequency distribution of COVID-19 cases, this study also looked at the bimonthly prevalence of these cases within the said time period. These values were used to create the dot-density and choropleth maps for this study.

Local spatial autocorrelational parameters like Moran's *I*, Anselin Local Moran's *I*, and Getis-Ord-Gi*were also calculated through the GIS software. The Moran's *I* statistic or global Moran's *I* index determined whether spatial patterns are dispersed, random, or clustered in the ±1.0 range. If the distribution of cases turns out to be interspersed, a negative value will be reflected. An opposite positive value indicates clustering, while a random distribution of cases where no clustering is observed at all results in a 0 value. The z-score and p-value were also calculated to assess the significance of these values.

Similarly, the Anselin Local Moran's *I* statistic, used to identify special clusters and outliers, ranges from -1 to 1. Spatial clusters were represented by high-high (HH) values, where an area is surrounded by places with high incidence rates and a high risk of forming hotspots; Low-low (LL) values, which is its opposite; High-low (HL) values, where a high risk area is surrounded by areas with low risk; And Low-high (LH) values, which are low risk areas surrounded by high risk areas. It also referred to the z-score and p-value to assess its statistical significance.

Hot spot analysis was done through the Getis-Ord Gi* statistic, which presented the intensity of clustering in an area, given a certain z-score. The spatial clustering of high values was indicated by a significant, positive z-score, whereas negative z-scores that are statistically significant reflected spatial clusters of low values termed the cold spot.

The researchers utilized ArcGIS version 10.7.1 to form geographical visualizations through maps that aided in the analysis of data gathered. ArcGIS offers a full range of tools for describing, evaluating, exploring, and visualization of interactions and linkages among the variables and trends of this study which were beneficial in terms of data measurement and analysis. The software generated choropleth maps, cluster maps, and point density maps, which were spatially analyzed using spatial autocorrelation (Global Moran's I), hotspot analysis (Getis-Ord Gi*), and cluster mapping and exception analysis.

## [3] RESULTS

A total of 545,158 recorded COVID-19 morbidities were obtained from the DOH COVID-19 Tracker Data Drop from the mentioned period. However, several cases have yet to be used for the analysis due to missing information about their locality. From 545,158 cases, only 544,724 (99.92%) have indicated the regions they belong to, while 434 (0.08%) cases did not specify. On the other hand, 9,618 (1.76%) cases were tagged as unknown during data extraction since they did not state the provinces they belonged to. A much higher percentage of cases (29,687, 5.44%) recorded at the city and municipal levels were assigned with FID code 0, meaning no city or municipality was placed in their case information.

*A. Prevalence of COVID-19 in the Philippines from January 2022 to January 2023*

The distribution of COVID-19, measured and analyzed in terms of the prevalence at the national and regional level, in the 17 municipalities of NCR, and the provinces outside NCR were ranked. Based on the 2020 midyear population, 545,158 (0.50%) have been infected with the disease. The highest frequency of cases and the highest prevalence rate were observed between February 1 to February 15, 2022, with 82,332 (0.08%).

Fig. 1(a) presents the trend on the bimonthly frequency and prevalence of COVID-19 morbidities from January 2022 to January 2023. The most prominent peak in cases occurred during the first half of February 2022, when 82,332 out of 545,158 Filipinos were infected with COVID-19. This corresponds to a 0.08% prevalence rate. However, numbers began to drop considerably from February 16 to 28 until the first half of May, when the lowest frequency and prevalence rate were recorded. Between May 16 to 31, 2022, an increase in morbidities was observed again, later arriving at a second peak during the first half of August (0.05%, 58,372 out of 545,158).

Figure 1(b) shows the accumulated prevalence at bimonthly intervals starting January 30, 2022, to January 14, 2023. A notable increase in the prevalence was seen in the February 1 to 15 interval (from 0.03% to 0.10%) and was followed by a slight plateau, with the prevalence increasing only subtly.

*B. Dot Density and Choropleth Maps*

The Dot Density maps reflect the COVID-19 morbidities frequency in the Philippines from January 30, 2022, to January 14, 2022, represented by dots that connote the single case occurrence. Quarter 1 from Fig. 2 (a) shows most cases centered in Luzon, particularly in the NCR. To emphasize, the cities with the highest number of cases are as follows: Quezon City (*n* = 5,284), Davao City (*n* = 5,253), City of Manila (*n* = 4,912), Cebu City (*n* = 3,536), and the Iloilo City (*n* = 3,330).

Quarter 2, shown in Fig. 2 (b), had most cases clustered in Luzon. The NCR had the highest number of cases in Luzon and the entire Philippines, with Quezon City (*n* = 2,133) still having the most cases. The City of Manila (*n* = 1,529), City of Makati (*n* = 1,163), City of Parañaque (*n* = 988), and Caloocan City (*n* = 16,863) follow.

Quarter 3 (Fig. 2 (c)), had the highest frequency for COVID-19 among all quarters, with Luzon still having the majority of cases with Quezon City (*n* = 19, 475), followed by the City of Manila (*n* = 10, 636), City of Makati (*n* = 8,469), Taguig City (*n* = 6,935), and the City of Parañaque (*n* = 6, 812). From the Visayas, Cebu City (*n* = 3,587) comprised most of the cases in the region, alongside Iloilo City (*n* = 3,308) and Bacolod City (*n* = 1,636). Cities from Mindanao which accounted for the majority of the COVID-19 cases in the region include Davao City (*n* = 3,845), Zamboanga City (*n* = 1,604), and Cagayan de Oro City (*n* = 1,423).

Quarter 4, shown in Fig. 2(d), reflects the majority of cases still centered in Luzon. This includes Quezon City (*n* = 9,829) and the cities of Manila (*n* = 5,771), Pasig (*n*= 3,427), Makati (*n* = 3,232), and Taguig (*n* = 3, 137).

Consequently, Fig. 2(e) represents the cumulative frequency of the National COVID-19 morbidities from January 30, 2022, to January 14, 2023, from which the clustering of dots is centered in Luzon Island, with NCR being the most concentrated. The five cities which comprised the highest number of cases include Quezon City (*n* = 36,721), City of Manila (*n* = 22,848), City of Makati (*n* = 15 309), City of Pasig (*n* = 15,309), and City of Parañaque (*n* = 12,739). Cities outside of NCR with a high number of cases include Baguio City (*n* = 7,829), Bacoor City (*n* = 5,675), and Bacoor (*n* = 5,765). For the Visayas, the highest cases are centered in Cebu City (*n* = 9,439), followed by Iloilo City (*n* = 8,662) and Bacolod City (*n* = 4,435). Lastly, cities in Mindanao with a high frequency of COVID-19 are Davao City (*n* = 9,489), Zamboanga City (*n* = 5,362), and Cagayan de Oro (*n* = 4,461).

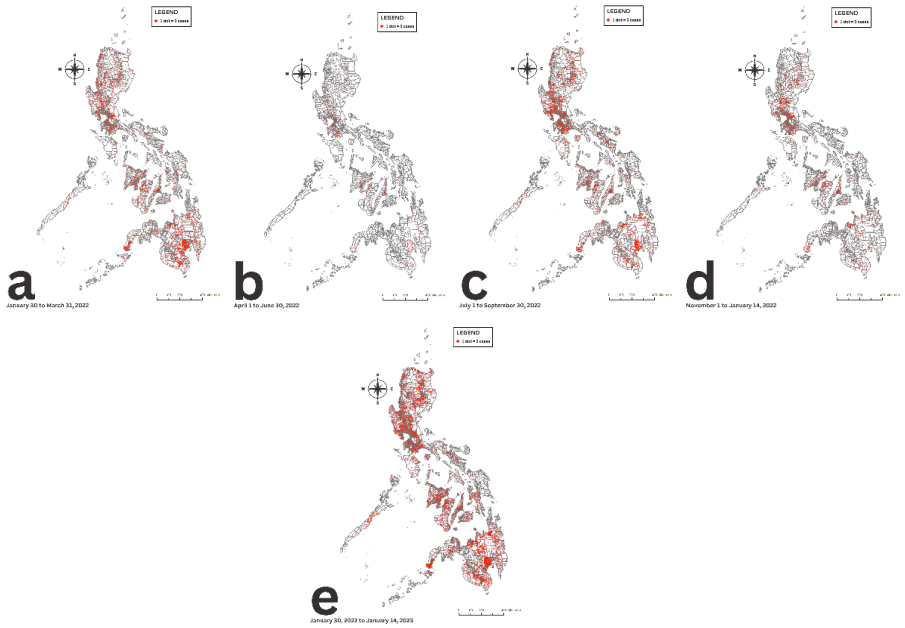



**Fig 2.** Dot Density Map of COVID-19 Morbidities per Quarter from January 30 to March 31, 2022 (a); April 1 to June 30, 2022 (b); July 1 to September 30, 2022 (c); October 1, 2022 to January 14, 2023 (d); January 30, 2022 to January 14, 2023 (e)

The researchers utilized ArcGis software to construct the Choropleth maps in Figure 3 to illustrate the prevalence per 100 cases of COVID-19 morbidities. Uniform prevalence ranges were utilized for each quarter, and the total prevalence. Figure 3 (a) demonstrates a low to high prevalence in quarter 1. High prevalence was distributed mainly in CAR of Luzon. Municipalities of low prevalence resided in the Visayas and Mindanao regions.

Fig. 3(b) shows that quarter 2 has a lower prevalence than quarter 1. However, the high prevalence was distributed mainly in NCR or Luzon. Ivana (0.213), Bataan has the highest prevalence among the municipalities. Low prevalence remains to be distributed in the Visayas and Mindanao regions.

Fig. 3(c) shows an increasing prevalence throughout the country, with high prevalence clustered in NCR. The City of Makati (1.345) has the highest prevalence of COVID-19 cases for quarter 3 in the Philippines. Pavia (0.537) has the highest prevalence in Visayas. Areas of Western Visayas and Central Luzon demonstrate moderate to high prevalence.

Fig. 4(d) illustrates a decrease in prevalence, but high prevalences are observed in NCR and CAR. The City of Makati (0.513) has the highest prevalence for quarter 4 in the Philippines. It is also evident that areas with moderate to high prevalence occur in Northern Luzon, Western Visayas, and CARAGA. Lastly, Figure 4(e) shows the total prevalence from January 30, 2022 to January 14, 2023. Moderate to high prevalence were widely distributed in Central and Northern Luzon, Western Visayas, and areas of Western Mindanao.

Among the three principal Philippine islands, Luzon has the highest prevalence. Besao (3.215), Mountain province, has the highest prevalence of COVID-19 cases in Luzon and the entire Philippines. Iloilo City (1.893) has the highest prevalence in Visayas. High prevalence in Mindanao was seen in Bayabas (0.802), the City of Koronadal (0.734), Mambajao (0.623), and Polomolok (0.621).

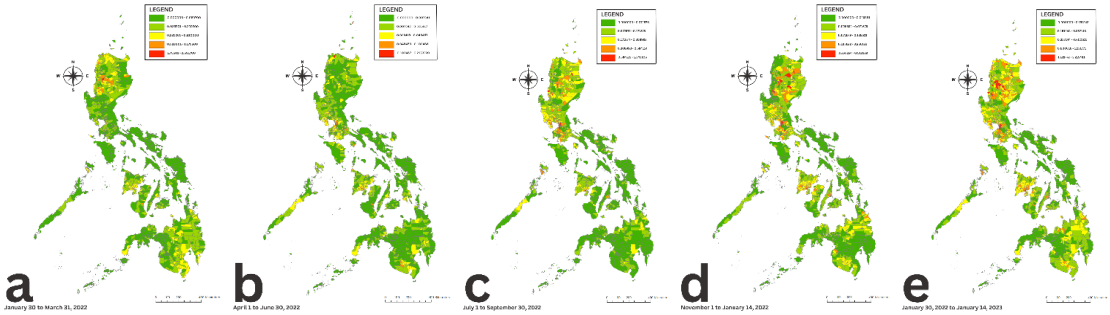



**Fig 3.** Choropleth Map of the Prevalence per 100 of COVID-19 Morbidities per Quarter from January 30, 2022 to January 14, 2023. (a) January 30 to March 31, 2022; (b) April 1 to June 30, 2022; (c) July 1 to September 30, 2022; (d) October 1, 2022 to January 14, 2023; (e) January 30, 2022 to January 14, 2023

## C. *Global Moran's I Index*

This study is analyzed using Global Moran's I to determine if spatial autocorrelation exists in the number of COVID-19 cases in all of the 1,647 municipalities within the Philippines. The total prevalence of COVID-19 cases per 100 was used to generate the Global Moran's I index, p-value, and z-score, indicating possible significant clustering of COVID-19 cases within the country. The prevalence of COVID-19 in the Philippines demonstrates significant clustering with a positive Moran's I index of 0.498488 and z-score of 124.587407 ($p = 0.000000$, $p < 0.01$). Results show a positive spatial autocorrelation throughout the entire study period (Fig. 4).

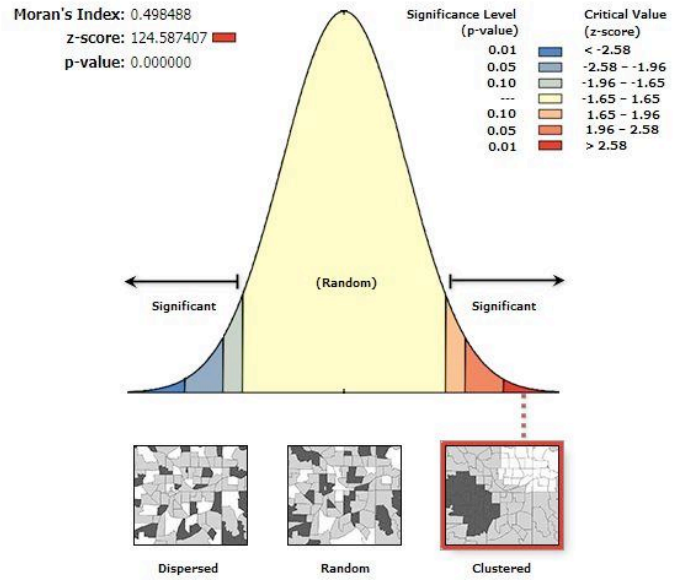



**Fig. 4.** Global Spatial Autocorrelation Analysis of COVID-19 Morbidities from January 30, 2022 to January 14, 2023

## D. *Anselin Local Moran's I*

Anselin Local Moran's I tool allowed for identifying areas with high or low prevalence and spatial outliers. A p-value of ≤ 0.05 must be met for all patterns qualifies these clusters as statistically significant.

Municipalities with a p-value of >0.05 are thus considered statistically insignificant and represented by the maps' white areas.

Fig. 5(a) shows the cluster and outlier analysis from January 30, 2022, to March 31, 2022. In this period, 329 (19.98%) municipalities were categorized as HH clusters, 596 (36.19) as LL clusters, 40 (2.43%) as HL outliers, and 146 (8.86) as LH outliers. Most HH clusters (58.97%) and LH outliers (54.11%) are found in Luzon, while majority of the HL outliers are located in Mindanao (65%), and LL clusters are predominant in Visayas (46.48%).

In Quarter 2 (Fig. 5(b)) 262 (15.91%) municipalities were considered HH clusters, 91 (5.53%) municipalities as HL outliers, 133 (8.08%) municipalities as LH outliers, and 622 (37.77%) municipalities as LL clusters. HH clusters and LH outliers are found mainly in Luzon, with 67.94% and 75.19%, respectively. Whereas HL outliers are found predominantly in Mindanao (51.65%), and LL clusters are scattered across the three regions.

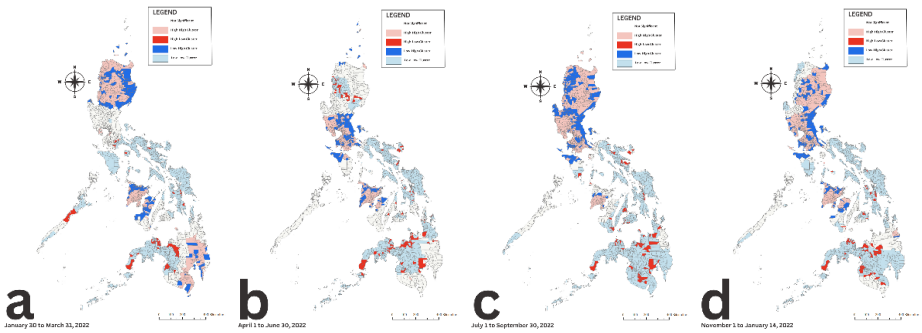
By the third quarter, as shown in Fig. 5 (c), an increase in the number of HH clusters (26.84%, 442 out of 1,647 municipalities), LH outliers (11.60%, 191 out of 1,647 municipalities), and LL clusters (47.36%, 780 out of 1,647 municipalities) were seen. In contrast, HL outliers were reduced, accounting for only 4.19% or 69 municipalities.

Lastly, Fig. 5(d) depicts the cluster and outlier analysis from October 1, 2022, to January 14, 2023. In this period, a decrease in the number of all of the clusters and outliers was observed as HH clusters accounted for 388 municipalities (23.56%), HL outliers for 55 municipalities (3.34%), LH outliers for 161 municipalities (9.78%), and LL clusters for 675 municipalities (40.98%). HH clusters and LH outliers are primarily seen in Luzon, while HL outliers are distributed across the country.

The overall cluster and outlier analysis from January 30, 2022, to January 14, 2023, is shown in Fig. 5 (e). Luzon had most of the HH clusters and LH outliers. These provinces include Abra, Apayao, Cagayan, Ilocos Norte, Isabela, Kalinga, La Union, Mountain Province, Nueva Vizcaya, Batangas, Quirino, Bataan, Bulacan, Cavite, Pangasinan, Pampanga, Rizal, Tarlac, Zambales, Laguna, and Metro Manila. On the other hand, HH clusters in the Visayas are most prevalent in the provinces of Antique, Iloilo, Capiz, Guimaras, Negros Occidental, Negros Oriental, and Aklan. Similarly, these provinces are also surrounded by LH outliers, which include some municipalities in Antique, Aklan, and Negros Occidental. Meanwhile, the HH clusters in Mindanao, which include Agusan del Sur, Davao de Oro, and South Cotabato,

In addition, HL outliers, which include Bukidnon, Lanao del Norte, Lanao del Sur, Maguindanao, Misamis Occidental, Zamboanga del Norte, Sultan Kudarat, Cotabato, and Sulu, are prevalent in Mindanao. This trend can also be seen from the second through the fourth quarter.

Finally, most of the LL clusters are found in Visayas and Mindanao. In Luzon, however, LL clusters are not prevalent as seen in the above percentages and only include a few municipalities in MIMAROPA and CALABARZON.



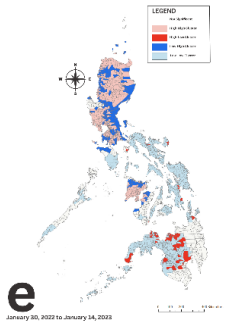



**Fig. 5.** Cluster and Outlier Analysis Using Anselin Local Moran's I statistic. January 30 to March 31, 2022 (a) ; April 1 to June 30, 2022 (b); July 1 to September 30, 2022 (c); October 1, 2022 to January 14, 2023 (d); January 30, 2022 to January 14, 2023 (e)

*E. Getis-Ord Gi**

In the maps (Fig. 6) for the quarter analysis of the prevalence of COVID-19 morbidities per 100, the color-coded areas signify the hotspot analysis created using ArcGIS. Six colors are used to represent whether the areas were a cold spot (99% confidence), cold spot (95% confidence), cold spot (90% confidence), hot spot (99% confidence), hot spot (95% confidence), and hotspot (90% confidence). Cities and municipalities deemed insignificant in this analysis are areas with no color. The p score presented along them is the probability that the hot or cold spot appearing on the map is random. Those with a p-score of point zero or lower mean that there is less than a 1% chance that the clustering of values in that specific area results from randomness and is therefore regarded as statistically significant.

Hot spots of 99% confidence level during the first quarter of 2022 were mainly concentrated in northern Luzon, Western Visayas, and Davao region (Fig. 6 (a)), as seen in areas exhibiting a bright red color. Significant cold spots of 99% confidence may first be seen in the Bicol Region and the Zamboanga Peninsula.

By the second quarter, there was a reduction in significant hotspots, as presented in Fig. 6(b), mainly on the island of Mindanao. Similarly, significant cold spots (99% confidence) still appear in the same areas—as in the first quarter— but with the addition of Misamis Occidental, Misamis Oriental, and North Cotabato, hence the expansion of blue areas in Mindanao. It is also worth mentioning that Benguet, Ifugao, Ilocos Sur, Isabela, La Union, and Mountain Province had become a mix of cold spots with 95% and 90% confidence instead.

Fig. 6 (c), representing the third quarter, shows a more significant number of hotspots (99% confidence), almost involving the entire island of Luzon. Meanwhile, significant cold spots predominate in Mindanao. Finally, a reduction in hot and cold spots may be evident for the last quarter of the year (Fig. 6(d)). Provinces that were consistently hot or cold spots during the first three quarters and are now considered insignificant.

Fig. 6 (e) is the hot spot analysis for the total prevalence of each city and municipality from January 30, 2022, to January 14, 2023. Like in other figures, it can be noticed that the majority of Palawan was neither a hot nor cold spot throughout this period. Luzon and Western Visayas had the most consistent hot spots, while the Bicol region, Eastern Visayas, and western provinces in Mindanao were often assigned as cold spots.

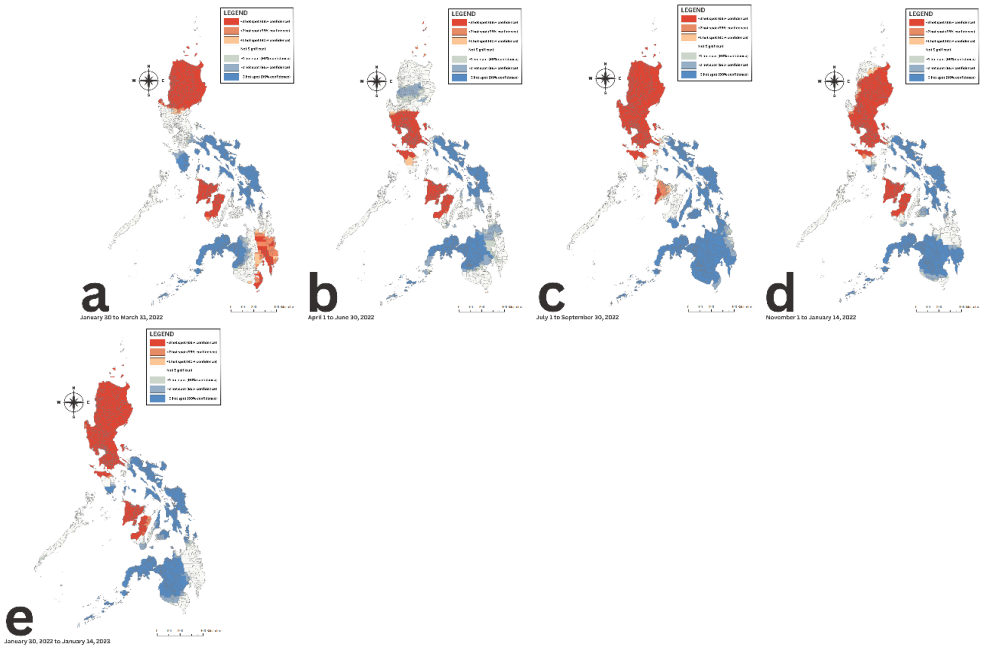



**Fig. 6**. Hotspot Analysis Using Getis-Ord Gi. January 30 to March 31, 2022 (a) ; April 1 to June 30, 2022 (b); July 1 to September 30, 2022 (c); October 1, 2022 to January 14, 2023 (d); January 30, 2022 to January 14, 2023 (e)

## [4] DISCUSSION

As per the press release of DOH, by January 27, 2022, the Variant of Concern (VOC) predominating in the Philippines is the Omicron, specifically, the BA.2 sub-lineage which is the underlying cause of the spike of COVID-19 cases by the end of January 2022 [7(World Health Organization, 2022)]. Despite more than 70 million Filipinos having been vaccinated, cases began to rise toward the end of June 2022. This continuous uptrend was anticipated until the end of August, with around 19,000 cases expected to be reported daily, accounted for by fast-spreading COVID-19 variants and further leniency with mobility [8]. Furthermore, after two years of implementing distance learning among schools, institutions slowly mandated face-to-face classes. This poses a risk to schoolchildren considering that vaccination was not a primary requirement to enroll and attend the classes [9]. NCR, having 12.37% (n=13,484,462) of the total population of the Philippines (n=109,033,245), is expected to have the highest number of cases. NCR is expected to rise in frequency as it is known to be the country's economic, social, political, cultural, and education zone.

In the entirety of the representation following the Dot Density and Choropleth Map, Quarter 3 showed the highest frequency and prevalence among all quarters followed by Quarter 1 which showed a more widespread of cases as classified cities with highest number of cases were not only centered in NCR.

Based on the analysis of the prevalence of COVID-19 cases within each municipality in the Philippines, there had been a positive spatial autocorrelation. Additionally, the p-value is statistically significant, and the z-score is positive, thus accepting the alternative hypothesis, which states that there is significant clustering of COVID-19 cases identified in the Philippines from January 2022 to January 2023. Lastly, since a z-score of 124.587407 was found, and Moran's I index of 0.498488 is closer to 1.0+; this further supports that clustering of COVID-19 cases has been observed.

Data from the Anselin Local Moran's I reveals that clusters and outliers resulting from the prevalence of COVID-19 cases suggest that the proximity of high-risk areas to other places, otherwise termed as spatial dependence, may contribute to an increase in the

prevalence of the latter. Thus, identifying the HH clusters is significant in allocating response and prioritizing health intervention to prevent the spread of the virus. Such means would maximize the efficiency of lowering incidence rates in high-risk areas nationwide.

Hotspots by Getis-Ord Gi* were able to pinpoint where high positivity rates or low vaccine coverage are still a problem. These results correlate directly with HH and LH clusters identified using Local Moran's I, focusing on specificity and intensity of clustering rather than assessing patterns of similarity or dissimilarity in values when it came to the prevalence of COVID-19. Much of Luzon was consistent hot spots across the four quarters. The Delta and Omicron variant, eventually followed by other subvariants, was responsible for the resurgence of cases from August to October 2022. Moreover, internal migration (i.e. increased mobility across provinces, resumption of rece-to-face classes) is a significant factor in the concentration of such hotspots. National events, such as the May 9 national elections [10], decline in vaccination administration [11], and ease of traveling restrictions contributed to spikes in some provinces. Meanwhile, some provinces in the Bicol region remained cold spots throughout the four quarters. Other provinces in Eastern Visayas and Mindanao (BARMM, SOCCSKSARGEN, and CARAGA) were also deemed as cold spots. These regions have low prevalence rates due to high and continuous vaccinations, including booster shots [12].

**[5]**

## [6] CONCLUSION

The dot density maps and choropleth maps represent the frequencies and prevalence of COVID-19 morbidities, respectively. Based on the dot density map, July 1 to September 30, 2022 (Quarter 3) had the highest frequency (n = 234, 979), while the City of Makati had the highest prevalence (1.345) for COVID-19 cases nationwide. The events responsible for this trend were the waning effects of primary vaccine doses, the accumulation of cases from the preceding months due to backlogs in reporting, and the relaxation of minimum health protocols.

The findings using Global Moran's *I*, a positive Moran's *I* index of 0.498488, a z-score of 124.587407, and a p-value of 0.000000 (< 0.01), it can be concluded that there is strong evidence of significant clustering of COVID-19 cases within the Philippines from January 30, 2022, to January 14, 2023. This led to the decision to reject the null hypothesis provided at the beginning of the study.

The national prevalence was 0.50% and was found to be highest among the regions of NCR (1.26%), Region IV-A (0.56%), and Region III (0.42%).

Consistent with all the maps generated, the COVID-19 spatiotemporal distribution is evident primarily in Luzon, clustered more on NCR, followed by Mindanao and Visayas. To emphasize, the dot density showing the highest frequency is in Quezon City (*n* = 36,721), and the choropleth map indicating the highest prevalence is recorded in the municipality of Besao, Mountain Province (3.26%).

From the data on Anselin Local Moran's I and the Getis-Ord Gi*, it could be deduced that areas with HH clusters and LH outliers comprised the significant hotspots centered on NCR, particularly in Metro Manila, Cavite, Laguna, Bulacan, and other provinces near the country's economic center.

Ultimately, although significant clustering of COVID-19 cases was determined albeit vaccination roll-out, with the knowledge of the varying epidemiological factors contributing to the spread of the virus, future health management and response by the healthcare and government could be appropriately implemented and distributed.

The researchers recommend to conduct further studies regarding the missing or incomplete case information from the DOH COVID Data Drop, statistical correlation

between vaccination rates and prevalence rates of provinces, other factors (e.g. geographic, socioeconomic, and/or environmental) affecting clustering, and comparison or COVID-19 prevalence rates before and after the distribution and administration of vaccines.

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**CONFLICT OF INTEREST:** Authors declare no conflict of interest.

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# Assessment of Indonesia's Health System Policy Readiness to Face Climate Change Threats: A Scoping Review of National Policies

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ABSTRACT

Climate change is expected to raise the risks to human health in Indonesia significantly. Extreme events experienced by the country, including floods and droughts, can potentially increase the prevalence and emergence of climate-related diseases. Hence, a Climate Resilient Health System (CRHS) must be developed to counteract the negative consequences of climate change. The World Health Organization (WHO) defines CRHS—outlined into ten core components—as a health system's capacity to anticipate, respond to, cope with, recover from, and adapt to climate-related shocks. Indonesia has made several policies addressing various arrangements related to climate change and health. Environmental health regulations issued by the Indonesian Ministry of Health also incorporated the ten core components of the CRHS operational framework. While certain sectors have addressed climate change adaptation, policies emphasizing multi-sectoral collaboration in mitigating climate change impacts are insufficient. Moreover, the health aspect is not adequately represented in policies and initiatives established by non-health sectors. Therefore, this study aims to evaluate Indonesia's policy readiness in mitigating and managing climate-related health issues. The Joanna Briggs Institute approach was used to develop this study using a scoping review methodology. Official government websites, Google, and six research databases (including PubMed, ScienceDirect, Web of Science, Embase, Institutional Repository Information Sharing, and the WHO) were used in the literature review, and screened based on predetermined inclusion and exclusion criteria. Policy analysis was carried out in accordance with the WHO's CRHS operational framework, and findings were described in the narrative report.

**KEYWORDS**: Climate Resilient Health System, Health System, Health Impact, Climate Change

# 1 INTRODUCTION

The previous 65 years have seen a substantial change in the global climate, and future changes due to global warming are predicted (Feliciano et al., 2022). Indonesia is ranked 47th out of 191 countries in the 2022 INFORM Danger Index for the likelihood of natural hazards (INFORM, 2022). In the 2021 ND-GAIN Country Index, Indonesia ranked 98th out of 185 countries. This ranking reflects the fact that various political, geographic, and social factors have been identified as contributing to Indonesia's vulnerability to the effects of climate change (University of Notre Dame, 2020). According to the Indonesian National Disaster Management Agency, there were 1,180 disasters in Indonesia between January and September 2023, and 98% of them were hydrometeorological disasters, which include heavy rain, strong winds, tornadoes, floods, landslides, droughts, forest and land fires. Indonesia's hydrometeorological disaster risk is increasingly threatening due to climate change, placing Indonesia in the 12th rank of 35 countries with the highest risk from multiple hazards (Global Risk Analysis by the World Bank).

Climate change, driven by global warming resulting from greenhouse gas (GHG) emissions, has led to extreme climate change, often indicated by two elements of climate, namely temperature, and precipitation, which are the primary causes of hydrometeorological hazards such as flood and drought (Milanda & Setiawan, 2019). Hydrometeorological disasters can result in loss of life, injury or other health effects, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Hydrometeorological hazards may be found in the atmosphere (meteorology), water (hydrology), or oceans (oceanography) (National Meteorological, Climatological, and Geophysical Agency, 2020). According to WHO, in a high-emissions scenario without considerable investments in adaptation, an average of 4,215,700 people will experience flooding as a result of sea level rise between 2070 and 2100 (WHO & UNFCCC, 2016).

Local health and sanitation infrastructures may be seriously damaged or even destroyed due to severe weather events. Hence, sanitation and access to clean water may be compromised, which could lead to poor hygiene and the incidence of infectious diseases. By introducing bacteria, parasites, and viruses into clean water systems, flash floods, for example, can contaminate drinking water sources and cause epidemics of diseases like cholera, typhoid fever, or hepatitis A (WHO, 2021). Extreme weather conditions, such as high temperatures and flooding, also contribute to the spread of diseases carried by pathogen vectors such as mosquitoes, ticks, and fleas (Mirsaeidi et al., 2016; WHO, 2021). In contrast, unpredictable rainfall patterns due to changes in temperature and precipitation may enhance the availability of suitable breeding sites. Increased temperature may accelerate vector and pathogen metabolism, allowing for faster replication and spread (Asad & Carpenter, 2018; Chang et al., 2014). This is in line with WHO forecasts, according to which the danger of malaria will affect approximately 308 million people by 2070 and the ability of dengue fever's vectors to spread the disease will increase (WHO, 2015).

In summary, climate change is expected to significantly increase health risks, especially in low- and middle-income countries, including those in vulnerable groups. In this regard, health systems serve as a key foundation in building individual and community resilience. A Climate Resilient Health System (CRHS) must be developed to mitigate the harmful effects of climate change. WHO in 2015, issued an operational framework of CRHS, which aims to enhance the capacity of health systems to protect and improve population health in a volatile and rapidly evolving environment. WHO defines a climate-resilient health system as a system that is capable of anticipating, responding to, coping with, recovering from, and adapting to

climate-related shocks and stresses. The framework comprises ten core key components interconnected by six health system building blocks (see the following figure 1 below). (WHO, 2015; Miranda et al., 2023)

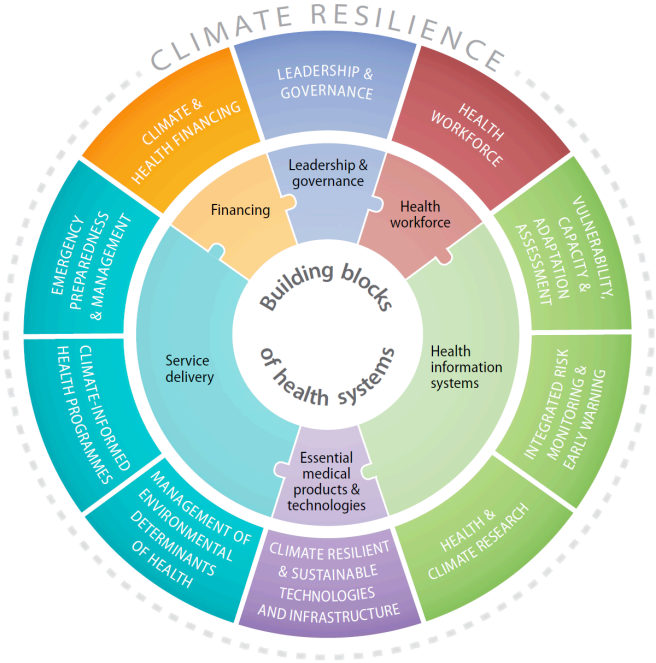


Figure 1: Ten components comprising the WHO operation framework in building climate-resilient health systems (WHO, 2015)

1. **Leadership & Governance**: addresses strategic consideration and management of climate-related stress and shocks to health systems, integrating them into strategic health policy within the formal health system and health-determining sectors
2. **Health Workforce**: refers to the enhancement of health personnel's technical and professional competence, the organizational capacity of the health system, as well as the institution's capacity to address climate-related health concerns.
3. **Vulnerability, Capacity, and Adaptation Assessment**: a wide range of assessments on population health hazard risk and vulnerability that can be used to generate evidence relevant to policy decisions as a form of climate adaptation interventions, including vulnerability and risk mapping, health system capacity and performance assessments, specific risk, events and hazards assessments, and so forth.
4. **Integrated risk monitoring and Early Warning**: refers to the use of early detection and epidemiologic surveillance tools to monitor health-related factors (such as water and air quality, variations in environmental temperature and humidity, or extreme weather occurrences) and provide information to early warning systems.
5. **Health and Climate Research**: refers to various forms of multidisciplinary research plans, involving a wide range of stakeholders in evidence-based decision-making, including providing access to research data, partnership, training, and financial resources.
6. **Climate Resilient and Sustainable Technologies and Infrastructure**: investments in specific technologies, both within and outside the traditional health sector, that can reduce climate risk vulnerability.
7. **Management of Environmental Determinants of Health**: multisectoral public health prevention programs to control environmental determinants of health, such as air pollution, water availability and quality, and others.

8. **Climate-informed Health Programs**: health programs and operational strategies that are informed by climate considerations and consider current and future climate variability.
9. **Emergency Preparedness and Management**: refers to the availability of climate-informed preparedness plans, emergency systems, and community-based disaster and emergency management
10. **Climate and Health Financing**: address health-specific climate financing, funding for sectors influencing health, and climate change funding streams.

As climate change continues to occur and health impacts are predicted to increase, a resilient health system is needed to protect the public from climate change-related diseases in Indonesia. More than 50 countries, including Indonesia, whose populations are especially vulnerable to climate change, have committed to developing climate-responsive health systems as part of the United Nations Climate Change Conference in Glasgow (COP26) Health Program. The Ministry of Environment created Indonesia's first national climate change strategy in 2007. On October 31, 2016, Indonesia accepted the Paris Agreement, and its Nationally Determined Contribution (2016) formalized its commitment. Indonesia finished its Second Biennial Update Report (2018) and Third National Communication (NC3) in 2017 (Asian Development Bank, 2021). The Indonesian government continues to pay more attention to combating climate change. This is demonstrated by the inclusion of the climate change issue under National Priority No. 6: Building the Environment, Improving Disaster and Climate Change Resilience in the 2020–2024 National Mid–Term Development Plan (RPJMN). Since the publication of Law 36/2009 on Health Protection and Environmental Management in the late 2000s, the health sector has paid particular attention to climate change through the Ministry of Health (MoH) (S D Pratiwi et al., 2022). In addition, through a publication issued by the Ministry of National Development Planning/BAPPENAS (2021), the health sector has been made one of the priority sectors in setting targets and indicators for climate resilience development actions. However, no study has precisely analyzed how Indonesia incorporates climate change into its policies and strategies. As a result, this study aims to assess Indonesia's policy readiness in mitigating and managing climate-related health issues, with an emphasis on analyzing policies linked to climate change adaptation, hydrometeorological disaster mitigation, and vector and water-borne disease control.

## 2 RESULTS

To assess Indonesia’s policy readiness in managing climate-related health issues, we collected various existing policies in Indonesia, including laws, government regulations, ministerial regulations, national strategies, official government reports or evaluations, and others. The policies were compiled into a matrix and the available information was identified, which covered the title of the document, type of document, year of publication, key climate-related issues addressed, other health and climate issues, as well as information on the ten key components of the CRHS addressed in the document. After 75 policy documents were obtained, study selection was conducted based on predetermined inclusion and exclusion criteria. As a result, 34 policies met the eligibility requirements, including policies related to the general impact of climate change (n=21), hydrometeorological disasters (n=7), and vector- and water-related disease control (n=5) (the analysis results can be seen further in Table 1 below).

From the analysis conducted, policies related to climate change impacts on health are dominated by the Ministry of Health regulations. Three policies have addressed all of the ten predefined components to build a climate-resilient health system. Meanwhile, within the

spectrum of national policies and strategies dealing with climate change impacts, three major areas of CRHS development are commonly addressed, including leadership and governance (n=17); vulnerability, capacity, and risk assessment (n=16), and integrated monitoring and early warning system (n=16). While the general impact of climate change-related policies is largely dominated by Ministry of Health regulations, hydrometeorological disaster-related policies are largely regulated by the National Disaster Management Agency (BNPB). This is due to the role of the National Disaster Management Agency in Indonesia, which is heavily involved in mitigating the impacts of various disasters, including hydrometeorology disasters. Among ten key components of CRHS development, leadership and governance (n=7); vulnerability, integrated monitoring and early warning system (n=5); and emergency preparedness and management (n=5) components are the most addressed in those policies. In addition, within the collected policies related to vector-borne and water-borne disease management, we discovered that four of the five policies were explicitly linked to vector-borne disease control regulations. This is connected to vector-borne disease risk factors, which are heavily influenced by environmental conditions, particularly those induced by climate change. Based on ten components of CRHS development, leadership and governance (n=5), management of environmental determinants of health (n=5), health workforce (n=3), and integrated risk monitoring and early warning system (n=3) are the most addressed components in vector- and water-borne related policies.

Table 1 Analysis of Indonesia's Policies in Mitigating and Managing Climate-related Health Risks based on Ten Component of Climate Resilient Health System (CRHS) Development

| o | National Policy | Impact of Climate Change Included | Key Component of CRHS Regulated by the Document | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | Law No. 32 of 2009 on the Protection and Management of the Environment | General Impact of Climate Change | | N/A | ✔ | N/A | N/A | N/A | ✔ | N/A | ✔ | N/A |
| | Law No. 36 of 2009 on Health | General Impact of Climate Change | ✔ | ✔ | N/A | ✔ | N/A | N/A | ✔ | N/A | ✔ | N/A |
| | Government Regulation No. 66 of 2014 on Environmental Health | General Impact of Climate Change | ✔ | ✔ | ✔ | ✔ | ✔ | N/A | ✔ | N/A | ✔ | N/A |
| | Minister of Health Regulation No. 2 of 2023 on the Implementation Regulation of Government Regulation No. 66 of 2014 on Environmental Health | General Impact of Climate Change | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Minister of Health Regulation No. 75 of 2019 on Health Crisis Management | General Impact of Climate Change | ✔ | ✔ | ✔ | ✔ | N/A | N/A | N/A | N/A | ✔ | N/A |
| | Minister of Health Regulation No. 35 of 2012 on Guidelines for the Identification of Health Risk Factors Due to Climate Change | General Impact of Climate Change | N/A | N/A | ✔ | N/A | N/A | N/A | ✔ | N/A | ✔ | N/A |
| | Minister of Health Regulation No. 1018 of 2011 on the Health Sector Adaptation Strategy to the Climate Change Impacts | General Impact of Climate Change | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Minister of Health Regulation No. 150 of 2010 on Certain Types of Communicable Diseases that Can Lead to Outbreaks and Countermeasure Efforts | General Impact of Climate Change | N/A | N/A | N/A | ✔ | N/A | N/A | ✔ | N/A | N/A | N/A |

| o | National Policy | Impact of Climate Change Included | Key Component of CRHS Regulated by the Document | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | Minister of Environment Regulation No. 19 of 2012 on the Climate Village Program | General Impact of Climate Change | ✔ | ✔ | ✔ | ✔ | N/A | ✔ | ✔ | ✔ | ✔ | ✔ |
| 0 | Minister of Health Decree No. Hk.01.07/Menkes/423/2017 on the Technical Team for Adaptation to Climate Change Impacts in the Health Sector | General Impact of Climate Change | ✔ | N/A | N/A | ✔ | N/A | N/A | N/A | N/A | ✔ | N/A |
| 1 | Indonesia's National Medium-Term Development Plan 2020-2024 | General Impact of Climate Change | N/A | N/A | ✔ | ✔ | N/A | ✔ | ✔ | N/A | N/A | N/A |
| 2 | Ministry of Health Strategy Plan 2020-2024 | General Impact of Climate Change | ✔ | ✔ | ✔ | ✔ | ✔ | N/A | ✔ | N/A | ✔ | N/A |
| 3 | Ministry of Environment and Forestry Strategic Plan 2020-2024 | General Impact of Climate Change | ✔ | N/A | ✔ | ✔ | N/A | N/A | ✔ | N/A | ✔ | N/A |
| 4 | National Action Plan on Climate Change Adaptation, Ministry of National Development Planning/BAPPENAS 2014 | General Impact of Climate Change | ✔ | N/A | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| 5 | Indonesia climate change sectoral roadmap (ICCSR) in Health Sector (2010) | General Impact of Climate Change | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| 6 | Action Plan for Disease Prevention and Control Program 2015-2019 | General Impact of Climate Change | ✔ | ✔ | N/A | ✔ | N/A | N/A | N/A | N/A | N/A | N/A |
| 7 | Enhanced Nationally Determined Contribution (NDC) Republic of Indonesia 2022 | General Impact of Climate Change | ✔ | ✔ | ✔ | ✔ | N/A | ✔ | ✔ | ✔ | ✔ | N/A |
| 8 | Executive Summary of Climate Resilient Development Policy | General Impact of Climate Change | ✔ | N/A | ✔ | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 9 | Training Module on Climate Change Adaptation in the Health Sector for Health Workers in their Work Area | General Impact of Climate Change | ✔ | ✔ | ✔ | ✔ | N/A | ✔ | ✔ | ✔ | ✔ | ✔ |

| o | National Policy | Impact of Climate Change Included | Key Component of CRHS Regulated by the Document | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 0 | Guidelines for Gender-Responsive Climate Change Adaptation in the Region) | General Impact of Climate Change | ✔ | N/A | ✔ | ✔ | N/A | N/A | N/A | N/A | N/A | N/A |
| 1 | Public Funding for Indonesia's Climate Change Control 2016 - 2018 | General Impact of Climate Change | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | ✔ |
| 2 | Law No. 24 of 2007 on Disaster Management | Hydrometeorological Disaster | ✔ | N/A | ✔ | ✔ | N/A | ✔ | N/A | N/A | ✔ | ✔ |
| 3 | Government Regulation No. 23 of 2008 on the Participation of International Institutions and Foreign Non-Governmental Organizations in Disaster Management | Hydrometeorological Disaster | ✔ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | ✔ | N/A |
| 4 | Presidential Regulation of the Republic of Indonesia No. 88 of 2012 Concerning Policy on The Management of Hydrological, Hydrometeorological, and Hydrogeological Information Systems at The National Level | Hydrometeorological Disaster | ✔ | N/A | N/A | N/A | ✔ | N/A | N/A | N/A | N/A | N/A |
| 5 | Presidential Regulation of the Republic of Indonesia No. 87 of 2O2O on the Master Plan for Disaster Management of 2O2O-2O44 | Hydrometeorological Disaster | ✔ | N/A | N/A | ✔ | N/A | N/A | N/A | N/A | N/A | N/A |
| 6 | Presidential Instruction of the Republic of Indonesia Number 4 of 2012 on Flood and Landslide Disaster Management President of the Republic of Indonesia | Hydrometeorological Disaster | ✔ | N/A | ✔ | ✔ | N/A | N/A | N/A | N/A | ✔ | N/A |
| 7 | National Disaster Management Agency Regulation No. 7 of 2022 on the National Disaster Management Plan 2020-2024 | Hydrometeorological Disaster | ✔ | N/A | ✔ | ✔ | ✔ | N/A | ✔ | N/A | ✔ | N/A |
| 8 | Regulation of the Head of the National Disaster Management Agency No.1 of 2012 on General Guidelines for Disaster Resilient Villages. | Hydrometeorological Disaster | ✔ | N/A | ✔ | ✔ | N/A | N/A | N/A | N/A | ✔ | N/A |

| o | National Policy | Impact of Climate Change Included | Key Component of CRHS Regulated by the Document | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 9 | National Disaster Management Agency Decree No. 173 of 2014 on Disaster Management National Clusters | Hydrometeorological Disaster | ✔ | ✔ | ✔ | N/A | N/A | N/A | N/A | N/A | ✔ | N/A |
| 0 | Coordinating Minister for Human Development and Culture Regulation No. 7 of 2022 on Guidelines for the Prevention and Control of Zoonoses and New Infectious Diseases | Vector- and Water-borne Related Diseases | ✔ | N/A | ✔ | ✔ | N/A | N/A | ✔ | N/A | ✔ | N/A |
| 1 | Ministry of Health Regulation No. 03 of 2014 on Community-Based Total Sanitation | Vector- and Water-borne Related Diseases | ✔ | N/A | N/A | N/A | N/A | N/A | ✔ | N/A | N/A | N/A |
| 2 | Minister of Health Regulation No. 374 of 2010 on Vector Control | Vector- and Water-borne Related Diseases | ✔ | ✔ | N/A | N/A | N/A | N/A | ✔ | N/A | N/A | N/A |
| 3 | Minister of Health Regulation No. 22 of 2022 on Malaria Control | Vector- and Water-borne Related Diseases | ✔ | ✔ | N/A | ✔ | ✔ | N/A | ✔ | N/A | N/A | N/A |
| 4 | National Dengue Management Strategy 2021 - 2025 | Vector- and Water-borne Related Diseases | ✔ | ✔ | N/A | ✔ | ✔ | N/A | ✔ | ✔ | ✔ | N/A |

*Note: N/A: Not applicable/not available.*
*Key components for each criteria are as follows:*
*C1: Leadership & Governance*
*C2: Health Workforce*
*C3: Vulnerability, Capacity, and Adaptation Assessment*
*C4: Integrated risk monitoring and Early Warning*
*C5: Health and Climate Research*
*C6: Climate Resilient and Sustainable Technologies and Infrastructure*
*C7: Management of Environmental Determinants of Health*
*C8: Climate-informed Health Programs*
*C9: Emergency Preparedness and Management*
*C10: Climate and health financing*

# 3 DISCUSSION

## 3.1 Climate Change Impact on Health

Climate change has a variety of impacts on human health, including increased mortality and diseases due to extreme weather events such as heatwaves, storms, and floods, as well as an increase in zoonotic and food-, water-, or vector-borne diseases. WHO (2015) describes that climate change's impact on health can be classified into three main categories, including (1) direct impacts, arising from damage and disease due to increased frequency and occurrence of extreme weather events; (ii) environmental system-mediated impacts, such as increased air pollution and changes in disease patterns caused by vectors, food, and water; and (iii) socially mediated effect, which occur as a result of climate change impact on the social and human system, including nutritional deficiencies related diseases, occupational diseases arising from high heat, poverty, population displacement, and many others. Figure 2 below explains an overview of climate-sensitive health risks, their exposure pathways, and vulnerability factors by WHO in 2023.

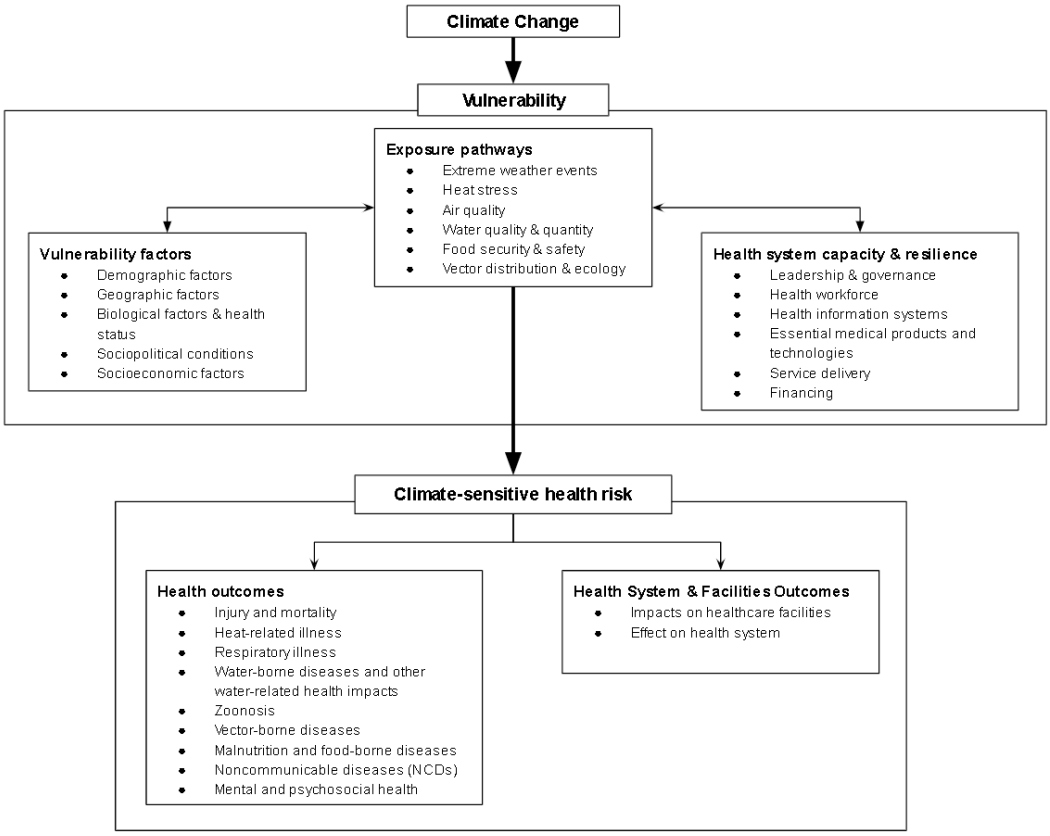


Figure 2: An overview of climate-sensitive health risks, their exposure pathways, and vulnerability factors (adapted from WHO, 2023)

The impact of climate change on health is also being felt in Indonesia. This can be seen from research conducted by the Ministry of Health in 2021 which states that there is a relationship between the climate variable and the overall number of instances of malaria, dengue, a disease spread by vectors, tuberculosis, and diarrhea, both of which are sensitive to temperature change (MoH, 2021). The number of malaria cases in Indonesia between 2010 and 2017 was estimated at 2.2 million, with the eastern region—particularly Papua, West

Papua, and Maluku—reporting the highest number of cases. In 2020, 477 districts and cities in Indonesia reported dengue incidence (MoH, 2020). Most dengue cases affect people between the ages of 15 and 44 (MoH, 2020). In 2020, Indonesia's incidence rate (IR) was 39.9 per 100,000 people. Out of 17,388 children aged 0 to 14 years, 192 died in 2020 as a result of dengue illnesses, according to data from 12 provinces (MoH, 2020). Another health issue that is also related to rainfall and humidity is diarrhea. Diarrhea is the most significant water- and sanitation-related disease, adding to the disease burden and being the second-leading cause of missed healthy time (WHO, 2008). From 2017 to 2019, Indonesia can be characterized as a nation with a high incidence rate of diarrhea, and in 2020, diarrhea cases and incidence rates decreased in Indonesia.

### 3.2 Indonesia's Health Policy Readiness in Addressing Potential Health Concerns Caused by Climate Change

This sub-section serves to identify and analyze the prevalent policy documents and regulations related to CRHS and climate change-related health risks with an emphasis on analyzing policies linked to the general impact of climate change, hydrometeorological disasters, as well as vector-borne and water-borne related diseases. In addition to addressing the content of the documents that have incorporated CRHS components, this subsection will also assess further the identified gaps in the documents by looking at some CRHS components that have not been adequately addressed.

1. Policy on the General Impact of Climate Change

The ten components of climate-resilient health system development have been addressed in several national health policies and strategies, including Minister of Health regulation No. 2 of 2023, Minister of Health regulation No. 1018 of 2012, as well as the Indonesia Climate Change Sectoral Roadmap (ICCSR) in Health Sector. The Minister of Health regulations no 2 of 2023 on the Implementation Regulation of Government Regulation No. 66 of 2014 on Environmental Health has explicitly covered the ten main components of CRHS, as one of the efforts in achieving the health sector's contribution target in realizing the Nationally Determined Contribution. This includes specific discussions on the development, principles, and activities that can be carried out in support of the above CRHS components. While the three regulations have covered the ten components of CRHS, other policies collected concerning the general impact of climate change mostly only cover some of the components of CRHS.

Leadership and governance have become one of the most addressed components in Indonesia's policies concerning the general impact of climate change. The action plan for the health sub-sector in mitigating the climate impact has been specifically addressed in Indonesia's National Action Plan for Climate Change Adaptation (RAN-API). This strategy is embodied in 4 major programs, which include: 1) Cluster of Identification and Control of Public Health Vulnerabilities and Risk Factors Caused by Climate Change; 2) Cluster of Awareness System Enhancement and Early Warning System Utilization against Infectious Diseases and Non-Communicable Diseases Caused by Climate Change; 3) Cluster of Regulation, Legislation, and Institutional Capacity Improvement in Central and Local Level against the Public Health Risks Brought by Climate Change; and 4) Cluster of Science Advancement, Technology Innovation, and Public Participation Related to Health Adaptation to Climate Change. Notably, the Decree of the Minister of Health Decree No. Hk.01.07/Menkes/423/2017 has also regulated the establishment of the technical team for climate change impact adaptation in the health sector.

Currently, a range of regulatory measures have been established to enhance the capacity of health professionals, improve the capabilities of the related organization, as well as enhance the institutional's collaborative capacity in addressing climate-related health risks. These regulations include but are not limited to Law No. 36 of 2009 on Health, Government Regulation No. 66 of 2014 on Environmental Health, Minister of Health Regulation No. 1018 of 2011 on the Health Sector Adaptation Strategy to the Climate Change Impacts, and many others. In regard to this, the Indonesia Ministry of Health has also developed a training module in climate change adaptation in the health sector for health workers in their work area. The module consists of seven core materials, which include the identification of climate change impacts on the health sector; the development of indicators for vulnerability and risk assessment; preparation of climate change scenarios; mapping the level of vulnerability and risk assessment; interpretation of the climate change vulnerability and risk analysis result in the health sector; formulation of health sector climate change adaptation options; and community empowerment in health sector climate change adaptation actions. Various policies governing health workers, institutional, and organizational capacity building have been found. However, there are still few regulations that specifically regulate capacity-building efforts in responding to climate-related health risks.

The vulnerability, capacity, risk assessment, integrated risk monitoring, and early warning system components are commonly addressed in similar documents that regulate climate change mitigation and adaptation and those concerning the disease prevention and control effort. Several instances of these include the Minister of Health Regulation No. 2 of 2023 on the Implementation Regulation of Government Regulation No. 66 of 2014 on Environmental Health, Minister of Health Regulation No. 35 of 2012 on Guidelines for the Identification of Health Risk Factors Due to Climate Change, Minister of Health Regulation No. 75 of 2019 on Health Crisis Management, Minister of Environment Regulation No. 19 of 2012 on the Climate Village Program, Action Plan for Disease Control Prevention Program 2015-2019, and other related policies. The components of vulnerability, capacity, and risk assessment related to climate change impact are specifically being addressed in the Minister of Health Regulation No. 35 of 2012 on Guidelines for the Identification of Health Risk Factors Due to Climate Change. The regulation states the stage of risk identification, which is divided into four main processes, namely: 1) Determine health risks related to climate change; 2) Determine the risk identification of each disease associated with climatic factors (e.g. the risk factor of rainfall with dengue fever and others); 3) Risk analysis (e.g. assessing the probability or likelihood of a particular impact event and the consequences of an impact that will occur; 4) Risk management; and 5) Risk response and evaluation using adaptation strategies. Meanwhile, the components of integrated risk monitoring and early warning systems are further discussed in the Action Plan for Disease Control Prevention Program 2015-2019. The epidemiological surveillance of risk factors and disease enhancement was addressed as one of the action plan policy direction and strategies. The action plans also address the development of an Early Warning and Response System (EWARS) or *Sistem Kewaspadaan Dini dan Respon (SKDR)* as an effort to improve early detection and response to the rising number of disease cases, particularly those with the potential to cause outbreaks. In addition to health-related policies, both components have been addressed in environmental policies and national strategies beyond the health sector. For example, a discussion of these two components is provided in Minister of Environment Regulation No. 19 of 2012 on the Climate Village Program.

Regarding the component of health and climate research, there are only a few policies that regulate the health and climate research component. Health and climate research are mainly being addressed in national strategies, such as the National Action Plan on Climate

Change Adaptation, the Ministry of Health Strategy Plan 2020-2024, Indonesia Climate Change Sectoral Roadmap (ICCSR) in the Health Sector, and others. The components were addressed specifically as one of the National Action Plan on Climate Change Adaptation strategy cluster 4 on science advancement, technology innovation, and public participation related to health adaptation to climate change, one of the cluster objectives is directed towards research, education, and development of technology related to climate change and adaptation related to health. This also applies to the other two strategies where strengthening climate-health research is also addressed in the strategic plan.

Only a few policies are pushing forward for climate-resilient and sustainable technologies and infrastructures. A few examples of these are the Minister of Health Regulation No.2 of 2023 on the Implementation of Government Regulation No. 66 of 2014 on Environmental Health, the Minister of Health Regulation No. 1018 of 2011 on the Health Sector Adaptation Strategy to Climate Change Impacts, and the Enhanced Nationally Determined Contribution (NDC) Republic Indonesia 2022. Most of the regulations primarily define the existing gap and the importance of climate-resilient and sustainable technologies and infrastructure—with most not specifically mentioning their development in the health system. A few strategies mentioned, include the development and utilization of an early warning system that takes into account environmental and other climate-related factors, the utilization of appropriate technology to reduce climate-related risk, revitalization of climate-related natural disaster infrastructures, improvement of water resources, soil, and energy management to cope with disaster emergency, and a general plan to utilize a more sustainable health technology. There are not many policies calling for sustainable technologies in the health sector; with limited policies pushing forward for climate and health-related research, the development of technologies and infrastructures supporting climate-resilient health systems may need further evaluation. The technology and infrastructure mentioned in the strategy focus more on disaster control infrastructure with little to no mention of efforts in enhancing health infrastructure.

Components management of environmental determinants of health and emergency preparedness and management are generally discussed in similar documents that regulate general climate change mitigation and adaptation. These include the Minister of Health Regulation No. 35 of 2012 on Guidelines for the Identification of Health Risk Factors Due to Climate Change, the Ministry of Health Strategy Plan 2020-2024, ICCSR in the Health Sector, and Law No. 36 of 2009 on Health. Identification of potential health risks as a consequence of climate change—encompassing changes in environmental determinants of health—are described in detail in the Minister of Health Regulation No. 35 of 2012. The policy outlined several health risks with their potential sequential hazards, including vector-borne diseases spread, waterborne diseases spread, foodborne diseases and nutrition, airborne diseases, noncommunicable diseases, diseases due to climate-related disasters, and climate-related mental health issues. The Minister of Health Regulation No.2 of 2023 on the Implementation of Government Regulation No. 66 of 2014 on Environmental Health provides clear indicators and strategic interventions in improving and managing environmental health through achieving the Environmental Health Quality Standard or *Standar Baku Mutu Kesehatan Lingkungan* (SBMKL)—standardized technical specifications or values on environmental mediums that relate to or have a direct impact on public health—and control of vectors and animal transmitted diseases. For both environmental determinants of health and emergency preparedness and management, existing policies emphasize the importance of collaborative works between health sectors and other climate-related stakeholders (e.g., institutions or communities involved in farming, disaster response, food supply chain, or industry and human development), enhancement of surveillance activities

and technologies for all climate-related sectors, and involvement of all levels of society. Specifically for emergency preparedness and management, the Minister of Health Regulation No. 75 of 2019 on Health Crisis Management gives detailed guidelines on actions, responsibilities of related stakeholders, information systems, financing, as well as monitoring that should be conducted before, during, and after a health emergency. Nevertheless, it should be noted that the policy does not specifically mention preparedness and management for climate-related emergencies.

Climate-informed health programs along with climate and health financing are the least mentioned components in the listed policies and strategies (see Table 1). In ensuring all strategies for climate-resilient health systems are in place and running effectively, having a robust financing strategy specifically built for the CRHS is vital. For the Health Financing component, several policies and strategies provide recommendations to build, strengthen, or ensure the sustainability of CRHS financing. These include managing and mobilizing finance from diverse public and private sources at national and international levels (Enhance NDC Republic Indonesia, 2022). However, it should be noted that most of these financing strategies are generally for all sectors supporting climate change adaptation and mitigation, and there is little to no mention of the proportions that will be allocated for CRHS. It is also particularly concerning that notable strategies that address the general impacts of climate change—e.g The Ministry of Health Strategy Plan 2020-2024, the Minister of Health Regulation No. 75 of 2019 on Health Crisis Management, and the Action Plan for Diseases Control Prevention Program—do not fulfill the climate-informed health programs and health financing components.

Based on the discussion above, it is clear that several health policies and strategies have considered the impact of climate change on the health sector, some of which have addressed the ten components of CRHS. Nonetheless, regulations issued by the health sector continue to dominate policies in managing the impact of climate change on health, with most of the interventions mentioned in strategies and policies are still too general and need to be operationalized and defined further to ensure that a more specific and actionable strategy can be created. In addition, there is no clear information on enforcement factors in the policies.

## 2. Policy on Hydrometeorological Disaster

Hydrometeorological hazards commonly refer to a wide range of hazards that interact and are induced by climate change impact. Based on Presidential Regulation No. 87/2020 on National Disaster Management Master Plan 2020-2044, climate change-induced hydrometeorological hazards include flooding, landslides, drought, forest and land fires, weather and climate extremes, extreme waves/dangerous sea waves, and erosion. UNDRR, based on Sendai Framework 2015-2030's terminology, specifically refers to hydrometeorological hazards of atmospheric, hydrological, or oceanographic origin. Examples are tropical cyclones, floods, droughts, heat waves, cold spells, and coastal storm surges. These hazards may cascade to other interlinked hazards such as landslides, wildland fires, locust plagues, epidemics, and in the transport and dispersal of toxic substances and volcanic eruption material (UNDRR, 2023). This study will focus primarily on the hazards induced by changes in temperature and precipitation that primarily cause disasters that burden the national health system through health risks such as flood and drought and exclude other types of hydrometeorological and hydrogeological hazards that may have been mentioned here.

Hydrometeorological hazards such as flooding occurrences may generate diseases caused by pathogens that require vehicle transmission from host to host (waterborne) or a host/vector as part of their life cycle (vector-borne). However, when it comes to drought, the health impact incurred may be channeled through water and food shortages that cause an increased risk of infectious diseases, such as cholera, diarrhea, and pneumonia. Additionally, there may be disruption of local health services due to a lack of water supplies, loss of buying power, migration, and health workers being forced to leave local areas (WHO, 2023).

Out of eight national disaster, environment, and health policy documents reviewed, all mention the management of hydrometeorological hazards and some health system resilience components. The review showcases that the leadership and governance component is the most mentioned within the documents (n=6), next are the C3 (n=4) , C4 (n=4), and C9 components; the next is C7 (n=3), and the last is C5 (n=2) whereas there are no C2, C6, C8, and C10 found within the reviewed policy documents.

The most prevalent component found within the hydrometeorological hazard and health system is the leadership and governance component. The laws and regulations that mention this particular component are the Law No. 24 of 2007 on Disaster Management, Presidential Regulation No. 87 of 2020 about Disaster Management Master Plan of 2020-2024, Presidential Regulation No. 88 of 2012 concerning Information System Management Policy on National Hydrology, Hydrometeorology, and Hydrogeology, Presidential Instruction No. 4 of 2012 about Flood and Landslide Disaster Management, Head of National Disaster Management Agency Regulation No. 7 of 2022 about National Disaster Management Plan of 2020-2024, and Minister of Public Works and Public Housing Regulation No. 4 of 2014 on Zoning regulation. As stipulated within these policy frameworks, the documents mandate to some level on strategic consideration and hydrometeorological hazard risk management on existing health systems. The policy documents mention the delegation of responsibilities and coordination clustering under the National Disaster Management Agency to the Health Cluster in cases of hydrometeorological disaster emergencies. The policies also regulate coordination flow between the commanding agency and the health department, health service and crisis center support during emergencies, and health in disaster governance enhancement to ensure community health resilience.

In terms of vulnerability, capacity, and risk assessment component, the regulations that state the component include Law No. 24 of 2007, Presidential Instruction No. 4 of 2012, National Disaster Management Plan 2020-2024, and the Minister of Public Works and Public Housing No. 28 of 2015 on Determination of River Boundary Lines and Lake Boundary Lines. The next component of hydrometeorological and health system resilience is on the integrated risk monitoring and early warning system. This component is covered under Law No. 24 of 2007, Disaster Management Master Plan 2020-2024, Presidential Instruction No. 4 of 2012, and the National Disaster Management Plan 2020-2024. Thirdly, the regulations reviewed also incorporate emergency preparedness and management within the scope of hydrometeorological hazard and health system resilience. The component is covered under Law No. 24 of 2007, Presidential Instruction No. 4 of 2012, the National Disaster Management Plan 2020-2024, and the Minister of Public Works and Public Housing Regulation No. 27 of 2015 about Dams. In terms of the management of environmental determinants of health components, it is covered under Law No. 24 of 2007, the National Disaster Management Plan 2020-2024, and the Minister of Public Works and Public Housing Regulation No. 27 of 2015. Lastly, the health and climate research component is covered under Presidential Regulation No. 88 of 2012 and the National Disaster Management Plan 2020-2024.

The health system has been considered, particularly within the hydrometeorological disaster emergency response and preparedness. Some documents refer to the need to incorporate public health risk management plans and services for vulnerable groups such as people with disabilities (PWD) and the elderly, which include social protection program and health workforce for health to enhance local village disaster preparedness against hydrometeorological hazards as poured within the Head of the National Disaster Management Agency Regulation No. 1 of 2012 concerning General Guidelines for Disaster Resilient Villages.

Nevertheless, some of these policy documents only generally indicate indicators and guidelines linked to health systems in hydrometeorological disaster risk management. Furthermore, most of these interventions are limited to plans and procedures for emergency and post-disaster situations without any mention of specific regulations to involve the Ministry of Health in pre-disaster risk management efforts such as risk mitigation in the form of climate-health research, climate-health data integration in hydrometeorological hazard risk context, disaster-health financing, and integrated health and hydrometeorological hazard risk analysis and early warning system.

Furthermore, the Ministry of Health and its related departments within the context of hydrometeorological disasters are assigned specific roles within the National Disaster Management Cluster on Health based on the National Disaster Management Agency Decree No. 173 of 2014 on National Disaster Management Clusters. The Decree specifies the roles of health units such as the Ministry of Health and the Health Crisis Center to include health services, disease control, environmental health, preparation of clean water and sanitation, nutritional health, disaster medicine management, preparation of reproductive health, mental health, management of death victims, and the management of health information. Although the duties mentioned put more focus on emergency and post-disaster management, some functions such as environmental health, WASH, and health information management are essential to be extended forward and be used for further pre-disaster risk management processes, a stage the health system in hydrometeorological disaster management is still found to be lacking. There is also an underlying issue in which the ministries and agencies within the Disaster Management National Cluster are still working in silo and have not been able to mainstream the roles further in the pre-disaster management efforts such as hydrometeorological hazard risk mapping and early warning systems that use integrated climate and health data.

For instance, in the National Disaster Management Plan 2020-2024, the Ministry of Health is involved in identifying the level of potential hydrometeorological hazards and vulnerability problems indicator. However, it is nowhere to be found within the data collection on potential hydrometeorological hazards process, disposing of any possibilities of multi-hazard interactions that may also include the climate and health factors, making the effort to improve the current early warning system that takes into account potential acute public health events incomplete. Within the same Plan, concerningly, the Ministry of Health or its related unit is not specified as one of the core agencies to develop an integrated multi-hazard early warning system and hydrometeorological data center. Furthermore, the National Disaster Management Master Plan focuses more on public health infrastructure without further mentioning other climate-resilient health system components. Specifically on the hydrometeorological hazard regulation within the Presidential Regulation No. 88 of 2012 concerning Policy for Management of Hydrometeorology Information Systems, an absolute

lack of mention of any public health-related aspects is of particular concern, a deviation from the national disaster management mission of integrating climate, hazard, and health data and information management.

This signifies that the current pathways towards achieving the integrated risk monitoring and early warning system component of the CRHS, particularly to devise an impact-based forecasting system based on climate, hydrometeorological hazard, and health data, need to be enhanced. Achieving a climate-resilient health system to prevent hydrometeorological disaster-related diseases is challenging without addressing disaster risk management and coordination plans that extend beyond emergency preparedness and immediate humanitarian response. Incomplete policy mandates to strengthen the health system in hydrometeorological disaster risk mitigation and preparedness efforts will ensure that the health system will be more resilient. The importance of this dimension is also laid out within the focus of the National Disaster Management Plan 2020-2024, which states the need to strengthen the integration of disaster data, information, and literacy as well as increased understanding of disaster risk, landscape, and climate change adaptation, as well as efforts to strengthen social resilience and public health resilience. This issue must be addressed within the next National Disaster Management Plan of 2025-2029. Additionally, the lack of mentions of the climate and health financing component as well as the health-climate resilience research is particularly concerning, especially when current national and local disaster and health budgets such as the on-call funds, recovery and rehabilitation funds, and the Ministry of Health budgets are constrained, barely enough to fulfill the needs for emergency responses and disaster recovery and rehabilitation efforts. Due to this, there is no specific allocated budget to develop a public health early warning system and climate-health research to serve the purposes of these CRHS components.

## 3. Policy on Vector- and Water-borne Related Diseases

The genesis and spread of infectious diseases are governed by interactions between people, the environment, and other species. These interactions occur within ecological systems (Nova et al., 2022). Climate variables impact the epidemiological triangle, which consists of the host, disease, and transmitting agent. At different stages of their development, temperature, precipitation, and humidity have different effects (Okoro et al., 2023; Wilcox et al., 2019). A warmer environment offers more favorable conditions for the vector's survival and successful completion of its life cycle, even hastening it as in the case of mosquitoes. Because rising temperatures speed up the development cycle, egg production, density, and dispersal of the tick population, tick-borne diseases have risen in recent years in colder places. Leptospirosis, campylobacter infections, and cryptosporidiosis cases have increased as a result of the devastating floods. Global warming impacts water heating, which accelerates the spread of water-borne illnesses. Pathogens carried by vectors are particularly vulnerable to climate change because they spend much of their life cycle in a cold-blooded host invertebrate whose temperature is equal to the environment (Rossati, A., 2017).

To cope with the consequences of climate change related to vector and water-borne diseases, the Ministry of Health has developed specific regulations and programs. Regulations that have been made include (i) Minister of Health Regulation No. 374 of 2010 on vector control, (ii) Minister of Health Regulation No. 3 of 2014 concerning community-based total sanitation, (iii) Minister of Health Regulation No. 22 of 2022 on Malaria Management, and (iv) National Dengue Management Strategy 2021 - 2025. Existing regulations and guidelines cover both general and vector-specific management. In fact, regulations related to vector-borne disease management are not only issued by the MoH but

also come from the Coordinating Minister for Human Development and Culture through regulation No. 7 Year 2022 on Guidelines for the Prevention and Control of Zoonoses and New Infectious Diseases, which contains almost all CRHS components except the resilient-health workforce component. From these facts, it can be seen that efforts to increase the health system's resilience are carried out by the MoH and in collaboration with other ministries that can help strengthen existing efforts. The Ministry of Health also collaborates with regional offices, the private sector, NGOs, CSOs, and the wider community in carrying out various vector control efforts. The regulations and efforts made by the government reflect a commitment to increase the resilience of the Indonesian health system to deal with climate change that impacts vector and water-borne diseases.

The Minister of Health Regulation No.22 of 2022 on malaria control and the National Dengue Management Strategy 2021 - 2025 have clearly regulated the management of these two diseases. Matters discussed include the division of tasks and responsibilities of the health workforce and efforts to improve their technical capabilities, the existence of Malaria Surveillance and vector surveillance, and dengue cases carried out in stages and real-time so that observations on humans and risk factors can be carried out systematically, and encourage the implementation of research and studies that can be used as a consideration for making regulations and programs in the future. Both documents also include ways to modify the environment in which disease-causing vectors live. This aims to break the life cycle and suppress the development and proliferation of vectors. The intervention strategy the government will carry out in dengue prevention efforts in Indonesia is also presented.

Of all the regulations related to vector and water-borne disease discussed above, none of the regulations contains a climate-resilient and sustainable technologies and infrastructure component, considering that the existence of good technology and infrastructure will be very influential in overcoming the health impacts of climate change, in this case, specific to water and vector-borne disease prevention efforts. In addition, financial arrangements and allocations are also essential in running a program. Some regulations have ordered the allocation of vector handling funds from the national and regional (district/city) budgets, with the proportion of the national budget being greater than the regional budget. The National Dengue Management Strategy 2021 - 2025 also projects possible sources of additional financing for the program. However, it is important to keep in mind that this funding is allocated to specific programs.

### 3.3 Indonesia’s Health Policy Readiness Enhancement Measures in Mitigating and Coping with Climate-related Health Risks

Based on the Enhanced Nationally Determined Contribution 2022, there are three main focuses of Indonesia's resilience program in achieving adaptation goals, namely: economic resilience, social and livelihood resilience, and ecosystem and landscape resilience. The three areas of resilience have been elaborated in the Enhance NDC Adaptation Roadmap 2022 which is operationally prioritized into several areas, namely food, water, energy, health, and ecosystems. In general, the main adaptation programs, strategies and actions are carried out with the aim of a) reducing vulnerability drivers to climate change impacts, b) responding to climate change impacts and managing risks, c) increasing community capacity and sustainability of ecosystem services, d) increasing stakeholder engagement at all levels in building climate resilience. In enhancing Indonesia’s policy readiness in mitigating and coping with climate-related health risks, several measures need to be taken. This measure can be divided into two main actions, which are 1) ensuring health is used as a baseline in all climate change mitigation and adaptation policies through adopting the Health in All Policies

(HiAP), and 2) emphasizing the importance and adoption of the climate-resilient health system in all health policies and strategies. WHO (2015) explains HiAP as a collaborative approach which aims to improve community health by integrating and articulating health considerations into policymaking across sectors. The approach recognizes that health is formed by a variety of factors beyond healthcare and the scope of traditional public health activities. To push forward for HiAP, Indonesia will need to define and strengthen a sustainable collaboration framework with all sectors related to climate change mitigation and adaptation sectors. In terms of the adoption of CRHS into health policies, there are a few components that need to be addressed and strengthened, such as pushing forward for climate-informed health programs, increasing funding and support for health research, engaging with health stakeholders to ensure commitment and involvement for CRHS, identify innovative financing analysis such as Cost -Benefit Analysis (CBA) and others, further investigating the potential to implement climate-resilient infrastructure and technology, especially in the area most vulnerable to climate change.

## 4 METHODOLOGY

In analyzing Indonesia's health system policy's preparedness to mitigate, cope, react, and recover from the impact of climate change, we will identify national policies and strategies on the health system and measure the sufficiency of existing regulations against the WHO operation framework in building climate-resilient health systems. We used the Miranda et al. (2003) methodology as a baseline, whereas the Joanna Briggs Institute (JBI) approach was used to develop the study using a scoping review methodology. The policies included in the study were analyzed based on the WHO's operational framework for building climate-resilient health systems.

### 4.1 Identifying the Research Question

How prepared is Indonesia's policy to deal with potential health concerns brought on by climate change?

Sub-questions:

1. How does climate change affect the health system and its building blocks?
2. Is Indonesia's health policy resilient enough to handle potential health concerns brought on by climate change, especially hydrometeorological disasters and vector and water-related diseases?
3. What should be addressed to enhance Indonesia's health policy in mitigating and coping with climate-related hazards?

### 4.2 Research Strategy:

We will conduct a desktop search across various government websites, Google, and six research databases, including PubMed, ScienceDirect, Web of Science, Embase, WHO WHO Institutional Repository Information Sharing (IRIS), and Google Scholar. The following combination of keywords will be used. At the same time, we conducted desktop research: "health system", "health impacts", "environmental health", "adaptation", "mitigation", "national strategy", "health sector", "disaster", "prevention", "control", "disease", "Ministry of Health", and the names of any major climate-related issues addressed (general impacts of climate change, hydrometeorological disasters, and control of vector and water-borne diseases).

### 4.3 Study Selection and Eligibility Criteria

The inclusion and exclusion criteria of this scoping review are as follows:

**Inclusion**

1. National policy and strategy on climate change and health interventions to mitigate and manage climate change impacts in Indonesia
2. The policy and strategy must be acknowledged and/or legalized by the Indonesian government
3. Legislation or strategies for which the full file can be accessed through the government website

**Exclusion**

1. Policies that already have updated versions and changes presented through other most recent and already legalized policies
2. Regional or international agreements on climate change and health ratified or agreed upon by the Indonesian government

### 4.4 Data Extraction, Summary, and Reporting

To measure policy resiliency, data from the collected documents will be compiled into a matrix that contains information on the document's title, type, year of publication, key climate-related issues addressed (general impact of climate change, hydrometeorological disaster, or vector and water-borne diseases control) as well as other health and climate issues covered in the document. Afterwards, the policy will be reviewed to determine whether it addresses the ten key components outlined by WHO for building a climate-resilient health system. The information obtained will be employed to construct a narrative summary that will outline the current national policies related to the topic as well as existing gaps that still need to be addressed.

### 4.5 Analytical Framework

Policy analysis was conducted in accordance with the WHO's CRHS operational framework, which covers ten key components for building climate-resilient health systems, including leadership and governance; health workforce; vulnerability, capacity & adaptation assessment; integrated risk monitoring & early warning; health & climate research; climate resilient and sustainable technologies & infrastructure; management of environmental determinants of health; climate-informed health programs; emergency preparedness and management; as well as climate and health financing.

### 4.6 Ethics and Dissemination

No ethical approval is required for this study as it is a scoping review protocol. The findings will be disseminated through the official ISBN conference proceedings publication. All literature search results used in this study will be openly accessible within public repositories.

### 4.7 Strengths and Limitations of this Study

This study examines Indonesia's climate-related health policies at the national level. The findings of this review will provide comprehensive information on the evaluation of climate-resilient health system policy readiness in establishing future policies, as well as recommendations for a subsequent action plan to enhance Indonesia's health system's capacity. The Joanna Briggs Institute (JBI) approach is used for a clear, replicable literature search, while the policy analysis follows the WHO operational framework for future comparative analysis. Some limitations of this study were the research was conducted only on national policies and strategies related to health and climate change that were open-sourced and available for public access during the time of the research.

## 5 CONCLUSION

Several health policies and strategies have taken into consideration the impact of climate change on the health sector. Some of them have already covered the ten components of CRHS. However, the health aspect is not adequately represented in policies and initiatives established by non-health sectors and the adoption of CRHS components is still not widely integrated into various climate-related health risk policies and strategies. Therefore, several measures need to be taken, including implementing the Health in All Policies (HiAP) approach as well as emphasizing the importance and adoption of the CRHS component in all climate-health policies and strategies.

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# Chronic Illnesses and Age Override Acute Illnesses in Determining Self-Reported Health in Rural Bangladesh

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**Abstract:**

Self-rated health can be used to identify different health risk factors. It is a valuable screening-level measure of a community's health status. A better understanding of the factors that influence SRH (Self-Reported health) is time demanding and challenging. This study aims to examine the determinants of SRH by investigating health morbidities, demographic and socio-economic factors in Bangladesh perspective.

This is a cross sectional study, which was conducted in Manikganj district under Dhaka division of Bangladesh. Sample size was 908; individuals aged 18 years and above. Data was collected in between 2nd January to 13th January 2017. Chi square test was performed to test the association and binary logistic regression was performed to predict the relationship of SRH with all potential variables.

Present study reveals the balance of bad health versus good health which was 27.2% and 72.8% respectively. Considering chronic morbidity, those who had one or more chronic diseases reported 3.40 times bad health compared to those who did not have any chronic illness. This finding is statistically highly significant as p-value is 0.000. In contrast, acute morbidity was not found statistically significant for SRH as (OR is 1.379 and P is 0.063). On the other hand, depressed and old age participants (60 years and above) reported 2.05 and 3.96 times bad health than non-depressed and young participants (18 to 39 years) which was statistically highly significant as (P is 0.000) and (P is 0.000) respectively.

Chronic morbidity, older age and depression are the significant predictors of SRH. If SRH is used as a screening-level measure for rural community then the chronic disease status of the rural Bangladesh will be identified quickly and easily.

**Keywords**: Self-reported health (SRH), Chronic Morbidity, Acute Morbidity, Bangladesh

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# Penta Helix Partnership Model in Increasing Knowledge about the Healthy Living Community Movement (GERMAS) in Indonesia (case Study in Nanggalo Village, Tarusan Sub-District, Pesisir Selatan District, west Sumatra)

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ABSTRACT

GERMAS is a government program to overcome triple burden diseases in Indonesia. However, since its launch, the GERMAS message has not been socialized to all levels of society, especially in underdeveloped rural areas. Social intervention by applying the Penta helix Partnership model initiated by the Team of the Faculty of Health Sciences, State Islamic University-Syarif Hidayatullah Jakarta and the Ministry of Health of the Republic of Indonesia was carried out to increase understanding and healthy living behavior. Therefore, this study was conducted to determine the increase in public knowledge about the Healthy Living Community Movement after social interventions with Penta helix concept by main actors (Traditional leaders, religious figure and scholar figure) and supported by others Penta Helix element. The operational study was applied community of Nanggalo Village and five element of Penta Helix in Tarusan Sub District, Pesisir Selatan District, West Sumatra. Knowledge interventions are driven by community leaders as the main actors of the GERMAS movement with support from the other four elements of the Penta Helix. Before and two weeks after the implementation of the social intervention, interviews were conducted to obtain family knowledge about the steps of the Healthy Living Movement. Descriptive statistical analysis is performed to see changes in knowledge. The results showed an increase of 10.8% in the number of families who received information about GERMAS. In addition, around 8.76% of families experienced increased knowledge about the steps of GERMAS. Overall, the intervention carried out went well and received a positive response from both the local government and the Nanggalo's community. Community leaders, universities and government play an active role, while private enterprise and the media are still lacking. The role of local government as the regional authority is absolutely necessary in attracting the other four elements to maintain the spirit and encourage community leaders in implementing the GERMAS program.

Keywords: Penta Helix Partnership Model, the Healthy Living Community Movement (GERMAS), Knowledge, Indonesia

## 1. INTRODUCTION

Indonesia is currently facing a triple burden disease, where there are still high cases of infectious and non-communicable diseases and the emergence of new diseases. To control this, the Indonesian government has made preventive efforts by developing the GERMAS (Healthy Living Community Movement) program through Presidential Instruction no. 1 of 2017. GERMAS is a movement that aims to socialize a culture of healthy living and abandon old unhealthy habits with seven indicators, namely doing physical activity, consuming fruits and vegetables, not smoking, not consuming alcoholic beverages, conducting periodic health checks, maintaining environmental hygiene and using latrines. GERMAS is a systematic and planned joint movement that involves all elements of society with awareness, willingness and ability to behave in a healthy way to improve the quality of life.

Some research shows the fact that there are still many people in rural areas in Indonesia who do not understand how to behave in a clean and healthy life, such as in the Japanrejo Blora area, Blora district shows that there is still a high incidence of infectious diseases and non-communicable diseases in the community, the main cause is the lack of knowledge, attitudes and behavior of the community in the application of clean and healthy living (1). The same results were also obtained from research conducted in Rambah Hilir Village, Rokan Hulu Regency (2).

Decree of the Minister of Villages, Development of Disadvantaged Regions, and Transmigration of the Republic of Indonesia Number 126 of 2017 concerning the Determination of Priority Villages for Village Development, Development of Disadvantaged Regions, and Transmigration, there are several areas that are still underdeveloped and residents who are still lagging behind both economically, socially, health and education compared to other areas. One of them is Pesisir Selatan Regency. The Health Profile of West Sumatra Province states that Pesisir Selatan Regency ranks sixth highest for infant mortality cases, eighth highest for under-five mortality cases, and ninth highest for malnourished under-fives. In addition, Pesisir Selatan also has the second highest number of pneumonia cases in children under five, the third highest number of pulmonary tuberculosis cases, the second highest number of diarrhea cases and the third highest number of dengue cases. As for non-communicable diseases, Pesisir Selatan Regency has the second highest number of obese people and the second highest number of hypertensive people.

One of the areas categorized as underdeveloped in Pesisir Selatan is Nagari Nanggalo. Based on preliminary studies in Nagari Nanggalo, it was found that only 18.7% of the community received information about GERMAS. This means that the GERMAS promotion carried out by the government has not reached all levels of society in Nangari Nanggalo. Therefore, it is necessary to determine an effective strategy to increase public knowledge about GERMAS, in this study the strategy used uses the Penta Helix concept. The Penta Helix concept is a multi-stakeholder concept where there are elements of government, academia. business entities, communities and media that synergize with each other to achieve the same goal. Each element contributes according to their respective capacities in order to convey the GERMAS message in the Nanggalo community.

## 2. METODOLOGI

This study is an operational research. The study population was the entire community of Nagari Nanggalo along with local government, business entities, local universities, media and community leaders. The intervention began with an initial measurement of community knowledge about GERMAS in Nagari Nanggalo. The sample in this study were Nanggalo villagers who were randomly selected using the WHO cluster method where from 4 RTs in

Nanggalo Village, 30 gathering points were determined, then each gathering point was taken 7 samples so that the total sample was 210 families. Data collection was conducted using a structured interview technique. Enumerators will visit respondents' homes to conduct interviews using a structured interview guideline instrument containing a list of questions regarding variables related to respondents' characteristics, knowledge about GERMAS and GERMAS indicators. Respondents' answers will be filled in by the enumerator on the answer sheet. The time needed for one interview is approximately 20 minutes. The data that has been collected is then processed and descriptive analysis is carried out, the results of which are used as the basis for implementing the next stage.

After the initial measurement, intervention activities are then carried out. At this stage, each element of the Penta Helix carries out its role according to its respective capacity. The final stage is the re-measurement of community knowledge about GERMAS after the intervention with the same method as the initial measurement. The measurement results after this intervention will later be compared with the initial measurement to determine the effectiveness of the intervention activities. The conceptual framework of this research can be seen in the following diagram:


Chart 1: The concept of operational research

The role of each element in the Penta Helix during the intervention activities can be seen in the following diagram:

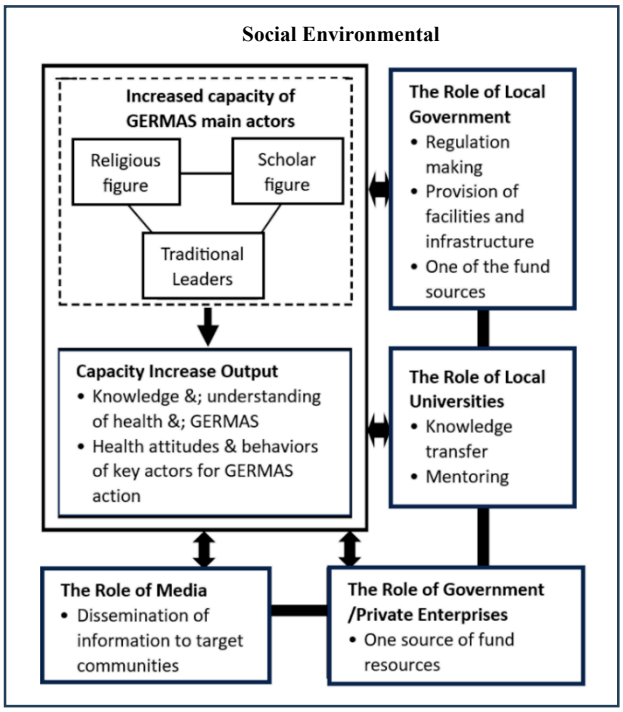



Chart 2: Penta Helix concept in the intervention to increase knowledge about GERMAS in Nagari Nanggalo

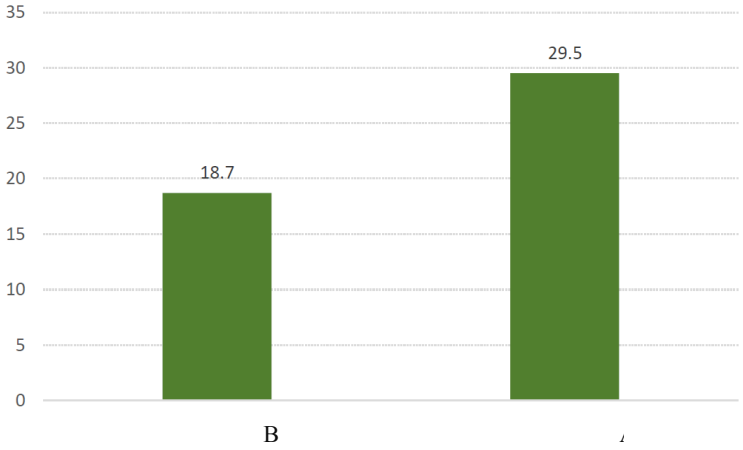
The diagram above shows that the main actors in increasing knowledge in the community are community leaders (religious figures, scholar figures and traditional leaders). Intervention programs carried out by scholar figures include conducting socialization to schools with methods tailored to the level of education, such as through counseling, screening

GERMAS videos, hand washing movements, planting fruits and vegetables in schools, quizzes, games, posters, holding healthy lunch activities once a week, waste deposit movements, healthy canteens, GERMAS ambassadors, GERMAS songs created by community leaders and others. Religious figures convey GERMAS messages in every majelis taklim activity by examining GERMAS from a religious aspect. While traditional figures convey GERMAS messages during traditional meetings and carry out simultaneous mutual cooperation actions to clean the environment.

The local government in accordance with its authority will establish policies on the implementation of GERMAS, one of which is to form a GERMAS forum and establish non-smoking areas in schools and government institutions. In addition, the government also plays a role in providing infrastructure such as providing clean water sources, providing plant seeds, preparing periodic health check facilities along with health workers and holding healthy gymnastics activities regularly once a week. In addition, the government is also one of the sources of funding. Local universities transfer knowledge about GERMAS to community leaders through capacity building activities and guide during the implementation of GERMAS socialization activities by community leaders. The media plays a role in disseminating GERMAS messages.

## 3. RESULTS

After the implementation of the intervention, measurements were taken again to determine the level of community exposure to GERMAS information. The data showed an increase in the number of residents who received information about GERMAS by 8.66%.

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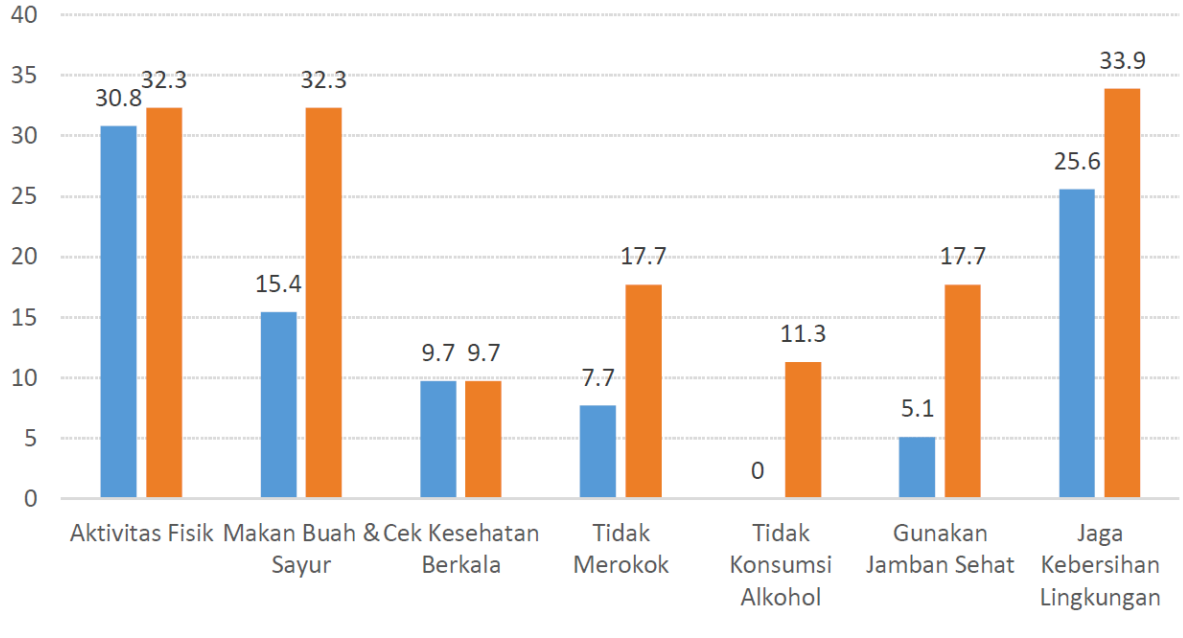

Chart 4: Description of the Increase in the Number of Households
About Knowledge of the Seven Steps of GERMAS in Nagari Nanggalo, 2019

The chart above shows an increase in community knowledge in Nanggalo Village about GERMAS indicators, including physical activity, fruit and vegetable consumption, not smoking, not consuming alcohol, using healthy latrines and maintaining environmental hygiene.

## 4. DISCUSSION

GERMAS was launched by the Indonesian government through Presidential Instruction no. 1 of 2017, in which the President instructed all levels from the central government to local governments to work together in socializing and providing support and necessary actions in order to accelerate the GERMAS program in the community. Ideally, GERMAS has become a health culture for Indonesian citizens. However, various obstacles and challenges in implementation cause the GERMAS program to still not be optimal, especially in rural areas. This can be seen from the results of a situation analysis conducted by researchers in Nanggalo village, Pesisir Selatan district, West Sumatra province. Most of the people there still have not received information about the GERMAS program. Although the local government has issued a circular letter about GERMAS, the realization has not yet reached all levels of society.

### Characteristics Nagari Nanggalo

Nanggalo is one of the underdeveloped villages in the Tarusan sub-district of Pesisir Selatan Regency, West Sumatra. Geographical position in the coastal area has marine products and fertile land to improve the fulfillment of the nutritional needs of its people. For the people, Nagari Nanggalo has unique cultural characteristics where there are three elements that play an important role in the order of community life called "Tigo tungku sajarangan" which means that there are three figures who play an important role in regulating the government and the norms of social life, consisting of traditional leaders, educational leaders and religious leaders. This uniqueness is certainly a huge potential in the socialization of GERMAS in order to increase knowledge and even behavior change in the community. These community leaders can become agents of change because they gain trust and even become role models for the community (4). According to Griffin and Pareek, a change agent is a professional whose role is to help the community or group in developing a development plan or forming new goals, focusing on the problem, looking for possible solutions, organizing assistance, planning actions, which are intended to improve the situation, overcome difficulties, and evaluate the results of planned efforts (5).

### Community Leaders Roles

The community leaders involved in the intervention activities had high enthusiasm and motivation in participating in the capacity building and intervention implementation. These leaders already have basic skills in communicating and interacting with the community. This is a very valuable asset for Nanggalo village that must continue to be nurtured so that it can become a driver of change. Their creative ideas combined with local wisdom make their messages more easily accepted by the local community. The characteristics of the people in Nanggalo village are that they trust and accept what the respected community leaders say. Change agents have several important roles in the movement of change in the community, including creating information exchange relationships, analyzing community problems, fostering the intention to change in the

community, translating the intention to change in clients into action and creating sustainable relationships (6).

The enthusiasm of the community leaders was reflected in the various intervention programs they developed during the training. Each figure, according to their expertise, developed an intervention program in accordance with their role in the community. The Traditional leaders commit to not smoking during meetings. Conducting gotong royong activities on a regular basis. provide healthier food during traditional gatherings, etc. The religius figures would inserting GERMAS messages in giving lectures, by examining GERMAS from a religious perspective. Meanwhile, the Scholar figures intervene in schools from low to middle level, with several activities such as appointing GERMAS ambassadors in each school, holding "fill my plate" lunch activities once a week, separating organic and inorganic waste, collecting recyclable waste, planting fruits and vegetables in schools, smoke-free areas in schools, making GERMAS songs, quiz competitions, hand washing movement, and so on.

**University Roles**

Another potential factor is the support of academics who are willing to provide training, guidance and promotional equipment during the intervention. Implementing the intervention, community leaders were supported by academics by providing knowledge transfer about GERMAS to community leaders through training activities. Academics played an active role in supporting the implementation of the intervention. The involvement of academics starts from the initiation process of the penta helix elements, debriefing community leaders with knowledge about GERMAS and communication techniques as well as the preparation of intervention activities by community leaders to their community. Academics conducted monitoring during the activities until the evaluation process. Academics also expressed their willingness to support the sustainability of the GERMAS program in Nagari Nanggalo, such as sending student representatives to conduct community service activities in Nagari Nanggalo.

**Government Roles**

The Nanggalo village government also gave full support to the success of the actions by the GERMAS forum by issuing a Decree on the Establishment of the GERMAS Forum and participating in all GERMAS actions carried out by the forum. In addition, the village government also stipulated non-smoking rules in the school environment and village government offices. The local government also provides a place, assigns health workers and supporting equipment needed for periodic health checks. For supporting cunsume fruit and vegetables, vegetable seedlings has provided to be planted in people's homes. Other support is established a smoke-free area policy in several public places, such as schools and government offices.

The local government is also committed to preparing budget allocations for the procurement and improvement of facilities and infrastructure to support the improvement of public health in Nagari Nanggalo, such as the provision of clean water sources, provision of waste management sites, provision of fruit and vegetable seeds, and so on.

**Private Entrerprices Roles**

Private enterprice have a role as financial supporters in GERMAS activities through Corporate Social Responsibility (CSR) funds. However, business entities only participate during the initiation of the five helix elements, while during the activities business entities have not shown a significant role. This is because the currently available CSR funds have been allocated for other programs. However, the Business Entity element is committed to

helping the sustainability of the GERMAS program in the future by adding this program in the CSR budget allocation plan in the next period.

**Media Roles**

Media as one of the elements of the penta helix, ideally has a role in disseminating information and news about GERMAS in Nagari Nanggalo. However, in practice, media involvement is still lacking. The media attended the initiation process of the penta helix publicizing and socialize the training of community leaders by academics but did not cover or publish other GERMAS activities or share information about GERMAS. On the community side, there is a lack of interest in media such as local newspapers and radio. People prefer to watch national television broadcasts.

The results of the intervention carried out by community leaders showed a change in knowledge of information about GERMAS and an increase in knowledge about GERMAS. Some of the methods used are quite effective in increasing community knowledge and motivation about the importance of healthy living, such as through quiz competitions, posting posters in strategic locations and giving lectures. The results are in line with experimental research conducted by Bilqis, which states that the lecture method and the GERMAS game method are quite effective for increasing GERMAS knowledge (7).

During the research in Nanggalo village, researchers found several obstacles in creating healthy living, including the limited availability of clean water to support healthy latrines, lack of places/sports facilities for physical activity, lack of availability of fruit and vegetable seeds, and lack of availability of health examination services and finally the absence of an effective waste management system to create a healthy environment. This complaint is the basis for follow-up for government elements in coordination with business entities to provide facilities needed by the community, such as the provision of clean water and sports facilities by the Public Works and Spatial Planning Office and the provision of vegetable and fruit seeds by the Agriculture Office. In terms of the community itself, there are still local customs and habits that have been going on for generations and are not in accordance with healthy living behavior, such as the habit of smoking, for the people of Nanggalo, smoking has become a kind of unwritten rule for residents, especially men when gathering even at official events.

In addition to the above, another factor that also affects the sustainability of the GERMAS program is the lack of real support between each element, such as support by business entities that support funding, local government support in the policy implementation process, funding support by business entities and media support in disseminating information.

## 5. CONCLUSION

Overall, the intervention carried out by the research team went well and received a positive response from both the local government and the Nanggalo's community. However, for the success of sustainable GERMAS actions, strong support and synergy between Penta Helix elements are needed, and in this intervention it seems that it is still not optimal. Community leaders, universities and government play an active role, while private enterprise and the media are still lacking.

The role of local government as the regional authority is absolutely necessary in attracting the other four elements to maintain the spirit and encourage community leaders in implementing the GERMAS program such as conducting regular coordination meetings, providing training to improve knowledge and skills as well as supporting infrastructure and funding activities.

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**CONFLICT OF INTEREST:** Authors declare no conflict of interest

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# The Relationship of Lifestyle and Obesity with Hypertension among Adolescents: A Cross-sectional study in Indonesia

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## Abstract

**Objective:** The prevalence of hypertension among Indonesian adolescents in 2018 reached 10.8%. Hypertension experienced by adolescents will persist into adulthood and contribute to increased mortality and morbidity rates. As a result, the role of adolescents in Indonesia's demographic bonus, which is projected to occur in 2045, cannot be maximized. Therefore, an assessment of the determinants of hypertension among adolescents is necessary. This study aims to investigate the relationship between lifestyle and hypertension among adolescents aged 18-24 years in Indonesia.

**Methods:** This quantitative cross-sectional study used data from the 2018 Basic Health Research, consisting of 75,640 adolescents aged 18-24 years. Multiple Logistic Regression analysis was made to find out the relationship between lifestyle and hypertension status.

**Results:** The study results showed that 10.8% of the surveyed adolescents had hypertension. Lifestyle factors, particularly the habits of consuming salty foods, smoking, and alcohol consumption, were found to be associated with Indonesian adolescents' hypertension status.

**Conclusion:** Cross-sector collaboration is needed to strengthen health promotion programs, especially for adolescents, in order to encourage healthy lifestyles such as maintaining a healthy diet, avoiding smoking, and refraining from alcohol consumption. Additionally, a family-based health approach is necessary to cultivate healthy lifestyle , considering that the family is the smallest unit within the community where adolescents spend most of their time.

**Keywords**: Hypertension, Adolescent, Lifestyle, Obesity

## INTRODUCTION

Hypertension has become a health issue among adolescents in Indonesia due to the increasing number of cases. The 2013 Basic Health Research showed a prevalence of hypertension in Indonesia among individuals aged ≥18 years at 25.8%, with adolescents aged 18-24 years contributing 8.7% of the cases. In 2018, the basic health research results indicated an increased prevalence of hypertension in Indonesia among individuals aged ≥18 years, reaching 34.11%, with adolescents aged 18-24 years accounting for 13.22% of the cases.

Hypertension is part of lifestyle-related diseases as its main causes are closely related to an individual's daily habits. Unhealthy lifestyles can lead to hypertension (1). Lifestyle factors that contribute to hypertension among adolescents include physical inactivity, smoking habits, alcohol consumption, vegetable intake, salt consumption, processed meat consumption, and red meat consumption (2).

Hypertension affects adolescents' organ dysfunction. Its impacts include cardiovascular system disorders, such as myocardial infarction and the cerebrovascular accident complications (3). Furthermore, hypertension is a chronic condition with long-term effects (4), meaning that adolescents who have hypertension will continue to have it in adulthood. This situation will undoubtedly be disadvantageous for Indonesia in the future, especially considering the projected demographic bonus in 2045. Adolescents, who should be the drive of the developmental progress, potentially become the country's instead. Therefore, measures need to be taken to control the increasing cases of hypertension among adolescents.

Identifying the risk factors for hypertension in adolescents is one of the initial steps in controlling this situation. In Indonesia, which officially consists of 38 provinces as of 2022, adolescents have diverse personal characteristics and lifestyles influenced by varying geographical, demographic, economic, social, and cultural factors based on the province they reside in. Hence, this study aims to analyze the relationship between lifestyle and hypertension status among adolescents. The result of this study is expected to provide a picture of the main determinants of hypertension among adolescents, which will serve as a basis for the Indonesian government to undertake strategic measures.

## METHODOLOGY

This study analyzed data obtained in the 2018 Basic Health Research (Hereafter, Riskesdas). Riskesdas is a community-based health research conducted in 34 provinces in Indonesia, allowing its indicators to represent national-level data down to the district/city level. The population of Riskesdas 2018 consists of households representing the provinces in Indonesia. The sampling was carried out by the Indonesia Statistics (BPS), with a target sample size of 300,000 households from 30,000 census blocks. The sampling process was conducted using Two-Stage Sampling. In the first stage, census blocks were drawn using the probability proportional to size method within each rural and urban stratum per city/regency systematically. This process resulted in a list of sampled census blocks (DSBS). In the second stage, household members were selected, with 10 households chosen from each census block. The selection of households was conducted using systematic sampling with implicit stratification based on the highest level of education completed by the household head,

aiming to capture the diversity of household characteristics. All members of the selected households were samples in Riskesdas 2018.

The presentation of results in the Riskesdas report utilizes two terms, namely prevalence and proportion, where the data to depict these aspects are obtained through physical examinations, laboratory tests, measurements, interviews, and respondent information, such as perceived symptoms. The instrument used was the Riskesdas 2018 questionnaire, which has passed validity and reliability tests. Considering that the Riskesdas report only presents descriptive analysis results, this study conducted further analysis to test hypotheses, specifically to find out relationships between lifestyle variables and hypertension among adolescents in Indonesia.

Similar to Riskesdas, this study applied cross-sectional design. The research was conducted from January to May 2022. The target population was adolescents aged 18-24 years. The number of eligible interviewed samples of adolescents aged 18-24 years in Riskesdas 2018 was 88,793 individuals. However, 13,153 samples were excluded due to incomplete data, resulting in a total of 75,640 samples for further analysis in this study.

The dependent variable in this research was the hypertension status among adolescents. This variable was obtained from blood pressure measurements, which was taken twice. If the second measurement differs from the first by ≥10 mmHg, a third measurement was conducted. Adolescents were classified as having hypertension if their last blood pressure measurement shows systolic ≥140 mmHg or diastolic ≥90 mmHg (5). The independent variables in this study included physical activity, consumption of salty foods, alcohol consumption, smoking habits, and vegetable intake. These variables were obtained from questionnaire responses. The collected data were analyzed descriptively, and for hypothesis testing, Multiple Logistic Regression analysis was performed.

### Ethics Statement

This research has obtained ethical approval with the number Un.01/F.10/KP.01.1/KE.SP/03.08.014/2022 issued by the Health Ethics Commission of the Faculty of Health Sciences, UIN Syarif Hidayatullah Jakarta, on March 28, 2022. This study used data from the Health Research and Development Agency, which could be accessed with specific requirements and procedures through (6).

## RESULTS

### Respondents Characteristics

The data in Table 1 shows that out of the total sample, 8,188 (10.8%) adolescents included in this study had hypertension. More than half of them fall within the age range of 21-24 years. Furthermore, most of them had a secondary level of education, were employed, and were not married. In terms of residential area, the distribution of adolescents in both groups is relatively equal across each type of residential area. In the hypertension group, males dominate, while in the non-hypertension group, the number of respondents is roughly equal among both genders.

Table 1. Respondents Characteristics

| Variable Characteristics | Hypertension (n=8188) % | Non-hypertension (n=67452) % |
|---|---|---|
| Age | | |

| | | |
|---|---|---|
| 18–20 | 40.4 | 46.2 |
| 21–24 | 59.6 | 53.8 |
| Gender | | |
| Male | 60.1 | 47.9 |
| Female | 39.9 | 52.1 |
| Highest level of Education | | |
| Not/ Have not attended | 1.8 | 1.3 |
| school | 16.7 | 14.5 |
| Primary | 74.3 | 77.2 |
| Secondary | 7.3 | 7.0 |
| Tertiary | | |
| Employment Status | | |
| Employed | 64.8 | 65.2 |
| Unemployed | 35.2 | 34.8 |
| Marital Status | | |
| Divorced | 1.0 | 1.0 |
| Unmarried | 73.8 | 71.2 |
| Married | 25.2 | 27.8 |
| Residential area | | |
| Urban | 47.9 | 47.5 |
| Rural | 52.1 | 52.5 |

**Description of Adolescents 18-24 years of age based on Lifestyle and Obesity Status**

Most adolescents have low physical activities. However, the percentage of adolescents with hypertension is slightly higher in the group with high physical activity compared to those with moderate and low physical activity.

Regarding food consumption, the majority of adolescents consumed salty foods 1-6 times a week. The higher the frequency of consuming salty foods, the higher the likelihood of having hypertension among adolescents. This is evident from the data analysis results, which show a higher percentage of hypertension among adolescents who consume salty foods ≥7 times per week compared to those who consume them less than 7 times per week or never.

The result also indicates that most adolescents have insufficient vegetable intake. The percentage of adolescents with hypertension is slightly higher in the group with low vegetable consumption compared to the group with high vegetable consumption.

Smoking and alcohol consumption are among also unhealthy lifestyles. The data showed that one-third of adolescents have smoking habits, and nearly 7% consume alcohol. The percentage of adolescents with hypertension is higher in the group with smoking and alcohol consumption habits compared to those without such habits.

This study also identified obese adolescents. Although the number is significantly smaller compared to non-obese adolescents, the percentage of adolescents with hypertension is higher in the obese group.

Table 2. Description of Adolescents 18-24 years of age based on Lifestyle and Obesity in Indonesia 2018

| Lifestyle | n | Hypertension % | Non-hypertension % |
|---|---|---|---|
| Physical activities | | | |
| Low | 6 | 10.7 | 89.3 |
| Moderate | 2657 | 11.0 | 89.0 |
| High | 1 | 11.4 | 88.6 |
| | 173 | | |
| | 1 | | |
| | 1810 | | |
| Salty Foods | | | |
| ≥7 times/ week | 1 | 11.6 | 88.4 |
| 1- 6 times/ week | 8496 | 10.7 | 89.3 |
| | 4 | 10.0 | 90.0 |
| Never | 6855 | | |
| | 1 | | |
| | 0289 | | |
| Vegetable consumption habit | 7 | 10.8 | 89.2 |
| Poor | 3880 | 10.1 | 89.9 |
| Fair | 1 | | |
| | 760 | | |
| Smoking habit | | | |
| Yes | 2 | 12.3 | 87.7 |
| No | 5148 | 10.1 | 89.9 |
| | 5 | | |
| | 0492 | | |
| Alcohol Consumption | 5 | 13.1 | 86.9 |
| Yes | 278 | 10.7 | 89.3 |
| No | 7 | | |
| | 0362 | | |
| Obesity | | | |
| Yes | 1 | 20.5 | 79.5 |
| No | 3445 | 8.7 | 91.3 |
| | 6 | | |
| | 2195 | | |

**Contribution of Lifestyle to Hypertension Status among Adolescents**

The multiple logistic regression analysis result show a significant association between salty food consumption, smoking habits, alcohol consumption, and obesity status with the hypertension in adolescents.

Adolescents who consume salty foods ≥7 times per week have a 1.19 times (95% CI: 1.10 - 1.28) higher odds of experiencing hypertension compared to those who never consume salty foods. Meanwhile, adolescents who consume salty foods 1-6 times per week have a 1.09 times (95% CI: 1.01 - 1.17) higher odds of experiencing hypertension compared to those who never consume salty foods. This result implies that the higher the frequency of salty food consumption, the higher the odds of hypertension among adolescents.

Smoking habits are known to trigger hypertension. In this study, adolescents who smoke regularly have a 1.34 times (95% CI: 1.27 - 1.41) higher odds of having hypertension compared to non-smoking adolescents. Additionally, alcohol consumption, as found in a small percentage of adolescents, also contributes to hypertension. Adolescents who consume alcohol have a 1.14 times (95% CI: 1.04 - 1.25) higher odds of having hypertension compared to those who do not consume alcohol.

In addition to lifestyle factors, obesity has been proven to significantly contribute to hypertension in adolescents. Obese adolescents have a 2.81 times (95% CI: 2.67 - 2.96) higher odds of having hypertension compared to non-obese adolescents.

Table 3. Relationship between Lifestyle and Hypertension among Indonesian adolescents aged 18-24 years in 2018

| Independent Variable | OR ((95% CI) |
|---|---|
| Physical activities | |
| Low | 0.96 (0.90 – 1.02) |
| Moderate | 0.96 (0.79 – 1.17) |
| High | 1.00 (reference) |
| Salty Foods | |
| ≥7 times/ week | 1.19 (1.10 – 1.28) *** |
| 1– 6 times/ week | 1.09 (1.01 – 1.17) * |
| Never | 1.00 (reference) |
| Smoking habit | |
| Yes | 1.34 (1.27 – 1.41) *** |
| No | 1.00 (reference) |
| Alcohol Consumption | |
| Yes | 1.14 (1.04 – 1.25) ** |
| No | 1.00 (reference) |
| Vegetable consumption habit | |
| Poor | 1.09 (0.93 – 1.28) |
| Fair | 1.00 (reference) |
| Obesity | |
| Overweight | 2.81 (2.67 – 2.96) *** |
| Normal | 1.00 (reference) |

Description: *p<0.05, **p<0.01, ***p<0.001

## DISCUSSION

Hypertension in adolescents is usually referred to as essential hypertension, which can be detected through blood pressure measurements (7). In addition, adolescents with essential hypertension may experience symptoms such as headaches, facial flushing, nosebleed, and easy fatigue (8). Therefore, increased awareness of hypertension in adolescents is necessary.

The first step in being aware of the dangers of hypertension in adolescents is to map the cases of hypertension in this age group. The data analysis result indicates that high blood pressure is present in 10.8% of adolescents. This finding reflects that approximately 10% of Indonesia's future generation is at risk of experiencing health problems that are generative and more complex. This number may increase if early and comprehensive control measures are not implemented.

The second step in being aware of the dangers of hypertension in adolescents is to identify the factors that contribute to its development. Unhealthy lifestyles are often linked to essential hypertension. The following discussion addresses lifestyle and obesity status related to hypertension in adolescents.

### Physical activities

Physical activity is one of the lifestyle factors that can prevent hypertension. Engaging in regular physical activity, following the recommended duration and frequency, can help reduce the risk of hypertension. According to the Ministry of Health (9), physical activity should be done for 30 minutes every day to maintain stable blood pressure. Engaging in regular and appropriate physical activity stimulates the release of endorphins, which promote muscle relaxation and prevent increases in blood pressure that could lead to hypertension.

Common physical activities performed by adolescents include weightlifting, playing football, jogging, house cleaning, and cycling. The findings of this study indicate that the percentage of hypertension cases increases with higher levels of physical activity among adolescents. In other words, higher levels of physical activity among adolescents may actually trigger hypertension. This condition is also found in another study (10), which show that respondents with hypertension tend to have moderate to high levels of physical activity. This can occur when physical activity is performed for an inappropriate duration or at excessively high intensity. Engaging in physical activity with improper procedures can increase heart rate frequency, causing the heart muscles to work harder during contractions. As the heart muscles pump blood harder, it affects peripheral resistance and leads to increased blood pressure (10)(11)(12). To ensure that physical activity provides the desired benefits in preventing hypertension, it should be performed ideally and in appropriate portions (13).

**Eating Behavior**

In addition to physical activity, eating behavior is also a lifestyle factor that contributes to health problems. The eating behavior of adolescents differs slightly from other age groups, as they tend to follow the trends of the times (14). Adolescents often consume high-sodium or salty foods. Salty foods commonly consumed by adolescents include pizza, cheese, chips, and butter. The sodium content in these foods typically exceeds 700 mg (15). It is known that females tend to consume high-sodium foods more frequently than males (16). Thus, female adolescents are at a higher risk of developing hypertension compared to males (17).

In this study, it was found that adolescents who tended to experience hypertension consumed salty foods ≥7 times per week. Adolescents who consume salty foods ≥7 times per week have a 1.19 times higher risk of developing hypertension compared to those who do not consume salty foods. Furthermore, it was found that adolescents who consume salty foods 1-6 times per week have a 1.09 times higher risk of developing hypertension. These findings align with the studies conducted by Suryawan (18) and Ekarini (19), which showed that the majority of adolescents with hypertension consume salty foods more frequently.

Excessive consumption of salty foods increases sodium intake and can disrupt fluid balance. The fluid entering the cells will reduce the diameter of the arteries, causing the heart to pump harder and leading to hypertension (20). Therefore, it is advisable for adolescents to avoid excessive consumption of salty foods as it can increase the sodium content within the cells. The Ministry of Health (21) also recommends limiting sodium consumption to no more than 2000 mg of sodium per person per day, which is equivalent to approximately 1 teaspoon of salt per person per day. In addition to reducing the risk of hypertension, reducing salt intake can also prevent other non-communicable diseases such as stroke.

Insufficient vegetable consumption is also known to be associated with hypertension in Indonesian adolescents (22). The data shows that 10.8% of adolescents with insufficient vegetable consumption have been found to have hypertension. Adolescents who consume insufficient vegetables are 1.09 times more likely to experience hypertension compared to those who consume an adequate amount of vegetables. Females tend to have better food

preferences and attitudes towards consuming vegetables compared to males, making males have higher risk of hypertension due to inadequate vegetable consumption (23).

Vegetables contain Magnesium. The decreased concentration of magnesium in the blood may cause the heart muscles to function improperly, thereby affecting blood pressure . In addition to Magnesium, vegetables also contain Potassium, which can lower blood pressure by reducing the sodium content in urine. Insufficient vegetable consumption can lead to a deficiency of Potassium in the body, which can contribute to increased blood pressure (24).

**Smoking**

In this study, a portion of the surveyed adolescents had a smoking habit. The number of cigarettes smoked by adolescents reached 16 cigarettes per day. The high cigarette consumption among adolescents resulted in a higher percentage of hypertension compared to non-smoking adolescents. A similar finding was observed in the study by Umbas (25), which showed that the majority of respondents smoked ≥16 cigarettes per day and among them, there was a risk of developing hypertension. Smoking habits were most commonly found among male adolescents compared to females, making male adolescents more at risk of having hypertension (26).

Similar to the findings of the studies by Setyanda et al.(27) and Erman et al.(28), this study has also provided evidence that smoking behavior is significantly associated with the hypertension in adolescents. Adolescents who smoke have a 1.34 times higher odds of experiencing hypertension compared to non-smoking adolescents.

Smoking is considered one of the risk factors for hypertension due to the chemicals in cigarettes that stimulate the sympathetic nerves, leading to an increased heart rate and narrowing of blood vessels (25). In addition, the tobacco content in cigarettes damages the lining of the body's arteries, making the arteries susceptible to plaque buildup or atherosclerosis, which can cause hypertension (29). Adolescents in Indonesia are aware of the negative impacts of smoking, but often perceive that smoking does not affect their health (30). Therefore, intensive education is needed to change adolescents' perceptions and create a negative attitude towards smoking behavior.

**Alcohol Consumption**

In addition to smoking habits, alcohol consumption habits are also commonly found among Indonesian adolescents. In this study, approximately 8% of adolescents consume alcohol, and 13.1% of them have hypertension. This percentage is higher compared to the group of adolescents who do not consume alcohol. It is evident that alcohol consumption habits have a significant association with hypertension in adolescents. It is known that adolescents who consume alcohol have a 1.14 times higher odds of experiencing hypertension compared to those who do not consume alcohol. This finding is consistent with the research findings (31) that indicate an increased risk of hypertension with frequent alcohol consumption. Males are more likely to consume alcohol and engage in excessive drinking compared to females, making male adolescents more prone to developing hypertension (32).

Alcoholic beverages contain ethanol ($C_2H_5OH$), which has similar effects to carbon dioxide ($CO_2$) in terms of increasing blood acidity. This leads to thicker blood and forces the heart to pump blood harder, resulting in increased blood pressure. (33)(34) Alcohol consumption also increases blood cortisol levels, which causes an increase in the activity of the renin-angiotensin-aldosterone system, leading to hypertension` (35).

**Obesity**

In addition to lifestyle factors, this study also provides evidence that obesity can trigger hypertension in Indonesian adolescents. Individuals with obesity have reduced peripheral resistance and increased sympathetic nerve activity with relatively low plasma renin activity. The larger the body mass of a person, the more blood is needed to supply oxygen. Therefore, individuals with higher body weight have a higher cardiac output and blood volume circulation compared to those with normal body weight (36).

In conclusion, our research findings indicate an increasing number of Indonesian adolescents experiencing hypertension, which can threaten their future productivity. Lifestyle factors such as consuming salty foods, smoking, and alcohol consumption have been proven to contribute to hypertension in adolescents. Another risk factor is overweight, which is associated with hypertension in adolescents.

Adolescents aged 18-24 years are in the late adolescent stage, entering adulthood where not only mental readiness but also physical readiness is required to fulfill responsibilities within a family and a larger social context. Therefore, cross-sector cooperation is necessary to address the health issues faced by adolescents. Strengthening health promotion is crucial to educate adolescents about healthy lifestyles that can prevent degenerative diseases such as hypertension. Additionally, family-based health efforts need to be enhanced, particularly in creating role models for a healthy lifestyle, starting from an early age among family members.

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# Evaluating Senegal's COVID-19 Surveillance System on Early Detection and Response: Lessons from the Keur Massar District, March 03, 2020, to May 30, 2022.

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**Afiliation**:1: Centers for Disease Control and Prevention (CDC); 2: Ministry of Health, Senegal; 3: African Field Epidemiology Network (AFENET);

## 5 ABSTRACT

Senegal has implemented a COVID-19 surveillance system as part of its response to the pandemic to improve its early detection capacity and effective response. This study sought to evaluate the attributes of Keur Massar district's existing COVID-19 surveillance system.

A descriptive, transversal study and document review was conducted over two years (March 03, 2020, to May 30, 2022). Data were collected using a standardized questionnaire completed during a face-to-face interview.

The Eighteen (18) respondents had over 15 years of experience in diseases surveillance and 94% of them reported being trained and equipped to conduct COVID-19 surveillance using necessary case definition. Overall score of simplicity reached 51% (320/630) with 89% (16/18) stakeholders who had agreed with the simplicity of existing case definition. While no cases were reported through the DHIS2 aggregated platform, 1327 PCR-positive cases were reported through the national Excel sheet, and 278 PCR-positive cases were notified through the COVID-19 DHIS2 tracker during the same period. Thirty-nine percent (39%) of respondents had analyzed COVID-19 data, and 56% declared they had received national-level feedback for collected data through the weekly report. Analysis found 100% of missing values for sex, date of onset, and symptoms in the COVID-19 DHIS2 tracker.

Despite clearly defined stakeholders at all levels of the health pyramid, the system was found to not simple and had multiple tools for data management with overall poor data quality. It is essential that Senegal continues improving the quality of their surveillance systems to contain and respond to outbreaks or pandemics effectively.

**Key words**: Evaluation; surveillance system; COVID-19; Lessons learned, Senegal

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# People's Perception and Tradition of Health Care Seeking Practice in Rural Bangladesh

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Abstract

Health care system is an organized plan of health services. The term usually is used to refer to the system or program by which health care is made available to the population and financed by government, private enterprise or both. This study's aim was to explore rural peoples' perceptions about different health care facilities and what do they expect from such facilities. This was an explorative qualitative study using in-depth interviews and focus group discussion which was then thematically analyzed. This qualitative study was conducted in three different villages of Manikganj district under Dhaka division of Bangladesh. Data analysis process followed the manual qualitative data analysis. The focused group participants mentioned that when they feel sick, they consult with rural doctor or medicine seller and take medicine for a problem like fever, gastric and high blood pressure etc. All participants agreed that they consider the village physicians who have only a very short training or the medicine seller with a very basic knowledge on disease are as doctors. Due to the unavailability and higher expenditure villagers' can't afford proper medical help. Not only that gender bias is a great factor for seeking healthcare. Another interesting finding was majority of the participants suggested their friends and family to take the same medicine by which they got cured from similar kind of health problems. In our country we have so many community clinics to tertiary hospitals but still people of the villages are deprived from proper medical treatment. So to achieve sustainable goals we need to chalk out the difficulties for proper health care seeking and work on that.

Key words: Health care system, Health Care Seeking, qualitative study

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