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SWOT Analysis of Indonesian Public Health Policy Using PCA Method

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ABSTRACT

This study aims to analyze the strengths, weaknesses, opportunities, and threats (SWOT) of Indonesian public health policies using the Principal Component Analysis (PCA). Public health in Indonesia has faced numerous challenges, including inadequate infrastructure, uneven access to health services, and emerging infectious diseases. Effective policy formulation is crucial to address these issues, but there is a need for a more structured approach to assess the dynamic factors influencing public health in the country. The purpose of this research is to employ SWOT analysis combined with PCA to provide a more comprehensive and data-driven evaluation of Indonesia public health policies. The research utilizes secondary data obtained from government reports, health surveys, and international health indexes. The data were processed through PCA to reduce dimensionality and identify the key components that most significantly affect the country health system. This statistical approach allows for a more objective identification of critical variables, which are then categorized into the four SWOT. A qualitative assessment is also used to interpret the results and suggest strategic recommendations for policy improvements. The results of the PCA revealed several key factors impacting Indonesian public health, including healthcare accessibility, funding, and the effectiveness of disease prevention programs. The analysis showed that while there are significant strengths in terms of government commitment and international partnerships, there are also notable weaknesses in infrastructure and healthcare distribution. Opportunities for improvement lie in the potential for digital health integration and public-private partnerships, while threats include the increasing burden of non-communicable diseases and natural disasters.

Keyword: SWOT Analysis, Policy Evaluation, Healthcare Systems

INTRODUCTION

Indonesia is a developing country with a very high population. In the midst of an increasingly dynamic era of globalization, special attention to public health is very important so that people can live healthy and productive lives. These considerations are needed to face the major challenges posed by urbanization,

economic growth, and increasing livelihood needs. Maintaining public health not only means providing health services but also ensuring fair and equal access for everyone, including those living in remote areas and those with economic limitations. Factors such as access to health services, socioeconomic conditions, and living conditions. Access to health services is the main concern in efforts to maintain and improve the welfare of the community in each region (Lewith et al., 2010). Health is one of the fundamental aspects that has a direct impact on the quality of life of the community, so the availability and accessibility of adequate medical services is very important (Meesala & Paul, 2018). Hospitals, as comprehensive medical service centers, play an important role in ensuring that people receive quality healthcare. However, although the role of hospitals is crucial, the challenge of achieving equitable and inclusive access to health services for all levels of society is still considerable (Sari et al., 2020). The gap in access to health facilities, both due to limited infrastructure, uneven distribution of medical personnel, and socio-economic factors, is still an obstacle that needs to be overcome (Binuko & Fauziyah, 2024)

About 26 out of 100 residents had health complaints in the last month in 2023, the percentage tended to decrease from 29.94% to 26.27%. This percentage shows that the condition of public health still needs attention (Solana, 2022). So, it is necessary to conduct research on what factors affect public health by province in Indonesia so that public health in each region can be evenly distributed. The methods used are the main component analysis method and factor analysis. Principal component analysis (PCA) is a statistical technique that transforms most of the variables that were originally correlated into a new, smaller, independent set of variables and helps reduce the data, making it easier to interpret the data (Delsen et al., 2017). The analysis of the main components can be expanded into factor analysis. Factor analysis is a technique used to find factors that are able to explain the relationship or correlation between various independent indicators observed (Wardani, 2022). Therefore, this study uses the main component analysis method and factor analysis to find out what factors can affect the level of community welfare in Indonesia in 2023.

In this study, data was obtained through website The Central Statistics Agency (BPS) which uses 6 variables that affect public health in 34 provinces in Indonesia in 2023, namely life expectancy, the percentage of infants aged <6 months who receive exclusive breastfeeding, the percentage of poverty, the prevalence of food inadequacy, the number of medical workers and the poverty depth index (P1) (Hartono, 2023). The Life Expectancy Rate (AHH) is an estimate of the life expectancy of a population since birth assuming that the pattern of death does not change with age (Ramadhani et al., 2020). The percentage of babies aged <6 months is breastfeeding only to babies up to 6 months without additional fluids or other foods (Diana et al., 2018).

Poverty percentage is the percentage of inability to meet minimum standards of basic needs, including food and non-food needs (Aprilianti et al., 2022). Inadequate food consumption as a condition in which a person regularly consumes insufficient amounts of food to provide the energy needed for a normal, active and healthy life (Booth et al., 2019). The number of medical personnel is the number of health workers whose main function is to provide high-quality health services to patients using procedures and techniques based on medical science and applied ethics and are people who can be responsible (Malingkas & Tulisan, 2018). The poverty depth index is a measure of the average gap between the expenditure of each poor person and the poverty line and provides an overview of the distribution of expenditure among the poor (Triono & Sangaji, 2023)

The significance of public health policy lies in its capacity to bridge these gaps and improve community well-being. However, the effectiveness of existing policies has not been adequately evaluated, leaving uncertainties regarding their strengths, weaknesses, opportunities, and threats (SWOT) (Chang & Huang, 2006; Humphrey, 1960; Pickton & Wright, 1998). Traditional policy analysis often lacks the ability to interpret complex and multidimensional datasets, making it difficult to identify key components that drive health outcomes. Therefore, advanced statistical tools, such as Principal Component Analysis (PCA), offer an effective approach to condense large volumes of data into meaningful insights, enabling more strategic policy decisions.

This study aims to analyze Indonesian public health policies through a combined SWOT analysis and PCA method to identify critical factors influencing health outcomes across 34 provinces. By utilizing PCA, the study reduces the complexity of interconnected variables, enabling a clearer understanding of their relationships. This method is particularly valuable for evaluating the impact of diverse indicators such as life expectancy, exclusive breastfeeding rates, poverty levels, food insecurity, medical personnel availability, and the poverty depth index. The findings aim to provide actionable insights for policymakers to address weaknesses while capitalizing on opportunities to strengthen Indonesia's public health system.

RESEARCH METHOD

This study employs a quantitative approach using the Principal Component Analysis (PCA) method to analyze Indonesian public health policies through the SWOT analysis framework (Creswell & Creswell, 2018; Neuman, 2007). PCA is a multivariate statistical technique designed to reduce the dimensionality of complex, interrelated data while preserving its essential information. By transforming the original variables into smaller, independent components, PCA simplifies data interpretation and helps identify key factors influencing public health outcomes (Maulidya et al., 2014). This research consists of several key stages, outlined as follows:

1. The first stage involves data collection. Secondary data were obtained from the Central Statistics Agency (BPS) of Indonesia, covering six critical indicators across 34 provinces for the year 2023. These variables include: (1) Life Expectancy (X1), reflecting the average estimated lifespan from birth; (2) Percentage of Infants Aged <6 Months Receiving Exclusive Breastfeeding (X2), measuring the proportion of infants exclusively breastfed for six months; (3) Poverty Percentage (X3), indicating the proportion of individuals below the poverty line; (4) Prevalence of Food Inadequacy (X4), representing the percentage of individuals with insufficient food intake; (5) Number of Medical Workers (X5), which refers to the availability of healthcare personnel; and (6) Poverty Depth Index (X6), assessing the average gap between the poor's expenditure and the poverty line. These indicators were chosen to capture key socioeconomic and healthcare factors influencing public health conditions.
2. The second stage involves data processing and analysis using SPSS software. Before applying PCA, several assumption tests were conducted to ensure data suitability. These tests include: (1) Multivariate Normality Test to confirm the data follow a normal distribution; (2) Kaiser-Meyer-Olkin (KMO) Test to evaluate sampling adequacy, with a threshold of >0.5 indicating the data are fit for PCA; (3) Bartlett's Test of Sphericity to check variable interdependence, ensuring significant correlations exist between variables; and (4) Anti-Image

Correlation Test to identify variables with low Measure of Sampling Adequacy (MSA) values (<0.5), which are subsequently excluded from further analysis.

3. The third stage involves applying Principal Component Analysis (PCA) to reduce data dimensionality and identify the most influential components. This process begins with calculating the covariance matrix to determine the relationships between variables. The eigenvalues and eigenvectors are then derived to identify the principal components, where components with eigenvalues ≥ 1 are retained for analysis. The number of components is further validated using the scree plot method and cumulative variance explained, ensuring that the retained components account for at least 80% of the total variance. Rotated factor matrices are applied to improve interpretability, with variables grouped based on their highest factor loadings within each component.
4. The fourth stage involves interpreting PCA results to align the identified components with the SWOT analysis framework. Each variable's contribution to the principal components is assessed to classify them into strengths, weaknesses, opportunities, or threats. The components are then named based on the variables they represent, enabling a meaningful interpretation of the factors influencing public health policy outcomes.
5. The fifth stage emphasizes visualization of results to enhance clarity and understanding. The analysis outputs, including boxplots, scree plots, total variance explained tables, and rotated component matrices, are presented to provide insights into the data distribution and the significance of each variable. These visual representations highlight the relationships between the variables and their contributions to the principal components.

Finally, the study concludes by offering strategic recommendations based on the analysis. The findings identify key factors influencing public health outcomes, categorized into two dominant components: Social Welfare and Health and Access to Healthcare. By integrating PCA results with SWOT analysis, this study provides actionable insights for policymakers to prioritize interventions addressing weaknesses while leveraging opportunities. Recommendations include improving healthcare access, reducing poverty rates, enhancing food security, and increasing the distribution of medical personnel to ensure equitable health outcomes across Indonesia. This method offers a robust, data-driven approach to inform evidence-based policymaking for public health improvement.

RESULTS AND DISCUSSION

1. Key Components of Public Health Policy Using PCA

The results of the Principal Component Analysis (PCA) reveal two primary components that collectively account for 76.08% of the total variance in the six key variables. These components are identified based on their eigenvalues greater than 1 and their contributions to explaining data variability. The first component, which explains 55.81% of the variance, is dominated by variables such as poverty percentage (X3), prevalence of food consumption inadequacy (X4), life expectancy (X1), and poverty depth index (X6). This component is labeled as "Social Welfare and Health", reflecting the socioeconomic determinants of public health that significantly influence health outcomes across provinces. The second component, accounting for 20.27% of the variance, is predominantly driven by the variable number of medical workers (X5), with a smaller contribution from percentage of infants receiving exclusive breastfeeding (X2). This component is categorized as "Access to Healthcare", emphasizing the role of healthcare resources and service delivery systems in maintaining public health. These

findings highlight the importance of addressing both socioeconomic and healthcare infrastructure challenges as part of Indonesia's public health strategy.

An in-depth analysis of the Principal Component Analysis (PCA) results, which identify two main components explaining 76.08% of the total variance across six key variables, provides critical insights into Indonesia's public health dimensions. The first component, accounting for 55.81% of the variance, is strongly influenced by variables such as poverty percentage (X3), prevalence of food consumption inadequacy (X4), life expectancy (X1), and poverty depth index (X6). This suggests a strong relationship between social welfare and health outcomes, where higher poverty rates and food insecurity lead to poorer health conditions, including lower life expectancy and higher vulnerability to disease. Conversely, improvements in socioeconomic conditions, reflected in increased life expectancy, underline the importance of addressing poverty and food inadequacy to improve health outcomes. Policies that focus on poverty alleviation and ensuring access to adequate food will directly contribute to enhanced public health across provinces in Indonesia.

The first component is aptly labeled "Social Welfare and Health", emphasizing the role of socioeconomic determinants in shaping public health outcomes. This phenomenon is not unique to Indonesia; globally, poverty and food insecurity have long been linked to issues such as malnutrition, chronic illness, and lower life expectancy. Addressing these challenges requires robust interventions, including social welfare programs, economic empowerment initiatives, and the development of infrastructure to ensure equitable food distribution. Investing in poverty reduction strategies and ensuring food security will help bridge existing disparities and significantly impact health outcomes, particularly in vulnerable communities.

In contrast, the second component, which explains 20.27% of the total variance, is predominantly driven by the variable number of medical workers (X5), with a smaller contribution from the percentage of infants receiving exclusive breastfeeding (X2). This component reflects the dimension of "Access to Healthcare", highlighting the critical importance of healthcare infrastructure and human resources in maintaining public health. The prominence of medical worker availability in this component underscores the need for adequate and equitable distribution of healthcare professionals across regions. Disparities in healthcare worker distribution, particularly in rural or underserved areas, pose significant barriers to achieving quality healthcare delivery. While the contribution of exclusive breastfeeding is smaller, its presence underscores the role of preventive health practices in early child development, which has long-term implications for public health.

Together, these two components provide a comprehensive picture of the challenges and priorities for improving public health in Indonesia. The socioeconomic dimension, characterized by poverty and food security, and the healthcare access dimension, driven by healthcare resource availability, highlight the need for an integrated approach. Policymakers and stakeholders must combine macroeconomic strategies, such as poverty reduction and food access improvements, with targeted healthcare policies to strengthen health systems. Efforts to ensure a more equitable distribution of medical workers and promote preventive health practices, like exclusive breastfeeding, can enhance health outcomes across all regions. Overall, the PCA results reaffirm that sustainable improvements in both social welfare and healthcare infrastructure are crucial for building a resilient and inclusive public health system in Indonesia.

2. SWOT Analysis of Indonesian Public Health Policy

The integration of PCA results with SWOT analysis categorizes the identified components into strengths, weaknesses, opportunities, and threats. The strengths include the commitment to improving life expectancy and government programs promoting exclusive breastfeeding, which positively impact maternal and child health. The relatively high average life expectancy of 70.75 years reflects progress in overall health indicators, supported by targeted national health programs. However, significant weaknesses remain, including the unequal distribution of medical workers and high poverty rates in certain provinces.

a. Strengths
   - Government Commitment: Strong government commitment to improving life expectancy through targeted health policies and programs.
   - Exclusive Breastfeeding Promotion: Government programs promoting exclusive breastfeeding contribute positively to maternal and child health.
   - High Life Expectancy: The relatively high average life expectancy of 70.75 years reflects significant progress in national health indicators.
   - Targeted National Health Programs: Implementation of specific national programs aimed at improving overall public health outcomes.

b. Weaknesses
   - Unequal Distribution of Medical Workers: Disparities in the distribution of medical professionals, particularly in remote areas like Papua, hinder healthcare access.
   - High Poverty Levels in Some Provinces: Regions with high poverty rates, such as Papua Province, experience limited access to adequate healthcare services.
   - Food Inadequacy: Food scarcity in certain regions exacerbates health and nutrition issues, especially among vulnerable populations.

c. Opportunities
   - Utilization of Technology (Telemedicine): Advancements in technology, such as telemedicine, can be leveraged to improve healthcare access in rural and remote areas.
   - Public-Private Partnerships: Expanding public-private partnerships offers opportunities to enhance healthcare quality and delivery.
   - Innovations in Healthcare Infrastructure: There is potential to develop and upgrade healthcare infrastructure to ensure more equitable access across regions.

d. Threats
   - Rising Prevalence of Non-Communicable Diseases (NCDs): Increasing cases of NCDs, such as diabetes, hypertension, and cancer, pose a growing burden on the healthcare system.
   - Limited Infrastructure in Remote Areas: Insufficient infrastructure in rural and remote regions restricts equitable healthcare delivery.
   - Economic and Social Inequalities: Persistent economic and social disparities among regions create significant gaps in healthcare access and quality.

This SWOT analysis highlights the Indonesian government's strengths in improving health indicators, particularly life expectancy and maternal-child health programs. However, challenges such as unequal healthcare access and poverty in certain regions remain significant weaknesses. Opportunities lie in technological advancements like telemedicine and public-private partnerships, but threats such as the rising burden of NCDs and infrastructure limitations must be addressed to achieve equitable and sustainable healthcare improvements.

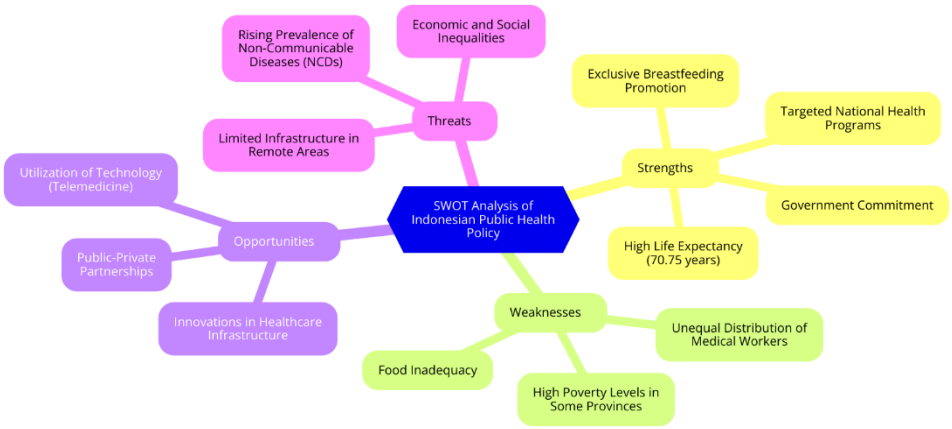

Figure 1. Mindmap SWOT Analysis
Source: Author, 2024

3. Regional Disparities and Policy Implications

The findings from the PCA and SWOT analysis underscore significant regional disparities in public health outcomes across Indonesia. Provinces with higher poverty percentages and lower availability of healthcare workers, such as Papua and East Nusa Tenggara, exhibit poorer health indicators compared to regions with better socioeconomic conditions, such as Jakarta and Bali. These disparities highlight the need for region-specific policies that address localized challenges. Improving access to healthcare infrastructure in underdeveloped areas is a critical priority. Policies focusing on healthcare worker redistribution, enhancing food security, and reducing the poverty depth index are necessary to address these inequalities. Furthermore, integrating digital healthcare technologies can serve as a solution to bridge gaps in remote areas. By addressing the identified weaknesses and threats while leveraging opportunities, Indonesian policymakers can develop a more inclusive and effective public health system that ensures equitable health outcomes for all provinces.

The Principal Component Analysis (PCA) and SWOT analysis highlight significant regional disparities in public health outcomes across Indonesia, emphasizing the sharp contrasts between underdeveloped regions like Papua and East Nusa Tenggara and more affluent provinces such as Jakarta and Bali. Provinces with high poverty percentages and a low availability of healthcare workers struggle with poorer health indicators, reflecting deeply rooted inequalities in socioeconomic and healthcare infrastructure. This imbalance demonstrates that national-level policies alone are insufficient; instead, region-specific interventions are essential to address the unique challenges faced by each area. For instance, Papua's high poverty depth index and lack of healthcare professionals require targeted programs to improve both social welfare and healthcare access.

One of the most pressing priorities is improving healthcare infrastructure in underdeveloped and rural areas. A key solution lies in the redistribution of healthcare workers, ensuring that more medical professionals are deployed to regions with critical shortages. Additionally, initiatives aimed at enhancing food security and reducing poverty depth indices can directly address socioeconomic determinants of health. Programs providing economic support, better access to nutrition, and community-based health education will be vital in uplifting marginalized populations. Policymakers must ensure that infrastructure investments are paired with social interventions to tackle the root causes of health disparities effectively.

Furthermore, the integration of digital healthcare technologies presents a transformative opportunity to bridge geographical and logistical barriers in remote areas. Telemedicine, mobile health clinics, and digital patient management systems can significantly improve access to healthcare services for underserved populations. These technologies can connect patients with healthcare professionals in real-time, overcoming challenges related to distance and resource scarcity. By leveraging digital tools, Indonesia can optimize its healthcare delivery, particularly in regions where the physical presence of medical infrastructure remains limited.

CONCLUSION

The study evaluates Indonesian public health policies using a combined SWOT analysis and Principal Component Analysis (PCA) method. This research highlights the challenges faced in Indonesia's healthcare system, such as unequal healthcare access, poverty, and food insecurity. PCA was employed to reduce data complexity across six variables—life expectancy, exclusive breastfeeding rates, poverty levels, food inadequacy prevalence, availability of medical workers, and the poverty depth index—capturing key factors influencing public health outcomes across 34 provinces. The analysis revealed two dominant components: "Social Welfare and Health" and "Access to Healthcare," explaining 76.08% of the variance.

The first component, "Social Welfare and Health," accounts for 55.81% of the variance and emphasizes the role of poverty, food insecurity, and life expectancy in shaping public health. This highlights the need for socioeconomic interventions such as poverty reduction and food security programs to improve health outcomes. The second component, "Access to Healthcare," representing 20.27% of the variance, underscores the importance of equitable distribution of medical workers and preventive health practices like exclusive breastfeeding. Disparities in healthcare worker distribution remain a significant challenge, particularly in rural and underdeveloped regions.

The SWOT analysis categorizes the findings into strengths, weaknesses, opportunities, and threats. Strengths include government commitment to improving life expectancy and exclusive breastfeeding promotion. Weaknesses involve unequal healthcare access and persistent poverty in certain provinces, while opportunities lie in leveraging technological advancements like telemedicine and fostering public-private partnerships. Threats include the rising burden of non-communicable diseases (NCDs) and infrastructure limitations in remote areas. Addressing these challenges requires integrated strategies that align socioeconomic and healthcare priorities.

Finally, the study emphasizes region-specific policy recommendations to tackle disparities in public health outcomes, particularly in underdeveloped provinces like Papua and East Nusa Tenggara. Improving healthcare infrastructure, redistributing medical workers, and integrating digital healthcare solutions are critical steps to enhance access and service delivery.

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