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Original Article

Access to Adequate Sanitation and Public Health Conditions in Indonesia: Analysis of Secondary Data at the Provincial Level, 2023-2025

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Abstract

Adequate sanitation is an environmental determinant closely related to public health status, yet its achievement in Indonesia still shows wide gaps between provinces. This study aims to describe the achievement of household access to adequate sanitation by province in Indonesia for the 2023-2025 period and to descriptively juxtapose it with an overview of public health indicators, namely the percentage of the population with health complaints and the percentage of the population with health insurance. This study is a quantitative descriptive study using secondary data officially published by Statistics Indonesia (BPS) and the Health Policy Agency (BKPK) of the Indonesian Ministry of Health, analyzed descriptively and comparatively without inferential statistical tests. The percentage of households with access to adequate sanitation nationally increased from 82.36% (2023) to 83.60% (2024) and 85.37% (2025), but the range between provinces remains very wide, from 16.34% (Highland Papua, 2025) to 98.2% (Bali, 2025). Provinces with low access to sanitation tend to also show a low proportion of health insurance ownership, as seen in the Papua region. Conversely, provinces with high sanitation achievement do not always have a low percentage of health complaints, as seen in West Nusa Tenggara and Central Java, which recorded the highest percentages of health complaints even though their access to sanitation was at a moderate level. The data show a pattern of spatial inequality in sanitation and public health indicators that do not always move in the same direction, so their interpretation requires caution and cannot be construed as a causal relationship.

Keywords: Adequate Sanitation, Indonesia, Interprovincial Inequality, Public Health, Secondary Data.

1. Introduction

Sanitation is one of the pillars of environmental health that determines the quality of life and health status of a community. The availability of adequate sanitation facilities, namely defecation facilities used by one's own household or shared with certain other households, with a goose-neck toilet and final disposal of feces through a septic tank or a Wastewater Treatment Plant (IPAL), plays an important role in breaking the chain of transmission of environment-based diseases, particularly diseases transmitted through the fecal-oral route such as diarrhea, helminthiasis, and several other communicable diseases. Inadequate sanitation contributes to the contamination of water sources, the spread of disease vectors, and the decline in the overall quality of the residential environment. As an archipelagic country with highly diverse geographic, social, and economic conditions, Indonesia faces major challenges in the equitable distribution of access to adequate sanitation. Data from Statistics Indonesia show that nationally the percentage of households with access to adequate sanitation continued to increase from 77.39% in 2019 to 82.36% in 2023 and 85.37% in 2025

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(BPS, 2025). Although the national trend shows improvement, this achievement conceals very wide variation between regions: in 2025, provinces such as South Sulawesi had reached more than 94% of households with adequate sanitation, while Highland Papua had reached only about 16% (BPS, 2025). The gap between the highest and lowest provinces thus reached roughly 82 percentage points in 2025 (Bali, 98.2%, versus Highland Papua, 16.34%), even as the national figure approached 85%.

Spatial inequality of this kind is important to map because sanitation is directly related to environmental health, which in turn reflects the general condition of public health. In addition to sanitation, public health conditions are also reflected in other indicators routinely published by BPS through the National Socioeconomic Survey (Susenas), namely the percentage of the population who had health complaints in the past month and the percentage of the population who have health insurance. These two indicators describe the demand side (the illness felt by the population) and financial protection against health risks, which together with sanitation form a more complete picture of public health. Inequality is also visible in financial protection: only 72.38% of the population had health insurance in 2023, far below the 98% target set by Bappenas for 2024 (Nazli & Usman, 2025), and 55.4% of the population in Highland Papua had none (BKPK, 2023).

A number of previous studies have examined the relationship between sanitation and public health in Indonesia using BPS secondary data. Kurniawan et al. (2024) used data from 34 provinces to model the relationship between the percentage of access to adequate sanitation and the prevalence of malaria morbidity using the Least Square Spline estimator approach, and found that the national average access to adequate sanitation during their study period was 81%, with Special Region of Yogyakarta the highest (96.21%) and Papua the lowest (40.34%), while the highest malaria prevalence occurred in Papua; the model showed that increased access to adequate sanitation has a significant effect on reducing malaria prevalence, except in provinces whose access was already above 80% (Kurniawan et al., 2024).

On the broader environmental side, Yumanda and Vidriza (2022) grouped 34 provinces based on similarities in the characteristics of access to adequate drinking water, access to adequate sanitation, the Water Quality Index, and poverty level using k-means clustering, and found that Papua consistently occupied the cluster with the worst sanitation and poverty achievements, while most provinces outside Papua and West Papua were in clusters with much better sanitation achievements (Yumanda & Vidriza, 2022). On the health insurance policy side, Nazli and Usman (2024) examined health insurance ownership among the poor population of Indonesia in 2023 using data from the March 2023 Susenas with binary logistic regression, and found that nationally only about 72.38% of the population had health insurance, far from the 98% target set by Bappenas for 2024, with an ownership gap between the upper economic group (83.08%) and the poor population (63.19%); age, number of household members, and health complaints that interfere with daily activities were found to affect the health insurance ownership status of the poor population (Nazli & Usman, 2025).

These previous studies generally focus on a single type of analysis, namely inferential statistical modeling between sanitation and one specific disease, the grouping of provinces based on environmental indicators without directly juxtaposing them with broader public health indicators such as health complaints and health insurance, or studies of health insurance ownership analyzed separately from environmental sanitation conditions. There are not many descriptive studies that explicitly juxtapose three official BPS indicators, namely adequate sanitation, health complaints, and health insurance, at the provincial level simultaneously and across the most recent years (2023-2025) without requiring inferential statistical modeling, so that they can be used directly as policy monitoring material by

stakeholders in the regions. Critically, each approach has limits for provincial monitoring. Kurniawan et al. (2024) and Yumanda and Vidriza (2022) used 34 provinces, so they cannot describe the newly formed Papua provinces, where the lowest achievements are now recorded (Highland Papua, 16.34% in 2025). Kurniawan et al. (2024) also link sanitation to a single disease (malaria), so their findings cannot be generalized to broader health indicators, and their result that the effect weakens in provinces with access above 80% suggests that other indicators are needed to describe differences in public health once access is relatively high. Yumanda and Vidriza (2022) do not relate sanitation to health indicators, while Nazli and Usman (2025) analyze health insurance among the poor population separately from sanitation conditions.

The novelty of this study lies in three aspects: first, the use of official BPS data for the most recent period available (up to 2025) at the provincial level; second, the descriptive juxtaposition of the indicator of access to adequate sanitation with two public health indicators at once (health complaints and health insurance), which are rarely presented together in a single study; and third, the presentation of multi-year data (2019/2023/2024/2025, as far as available) for a number of provinces to describe the direction of change, rather than merely a snapshot at a single point in time. This study is not claimed to be the first study on this topic, but rather an update and descriptive complement to similar studies that already exist. Compared with the studies above, this study does not estimate effects but provides a transparent descriptive baseline, for the provinces with available data, that shows where sanitation and health protection indicators coincide and where they diverge, which models focused on a single disease or a single indicator cannot show. It therefore complements, rather than replaces, inferential studies.

Based on the above explanation, this study aims to describe the achievement and variation in the percentage of households with access to adequate sanitation by province in Indonesia for the 2023-2025 period; to describe the overview of public health indicators, namely the percentage of the population with health complaints and the percentage of the population with health insurance, by province; and to descriptively compare the distribution patterns of these two groups of indicators between provinces, without concluding a causal relationship between them.

2. Literature Review

2.1. Public Health and Environmental Health

Public health is defined as the science and art of preventing disease, prolonging life, and promoting health through the organized efforts of society. One important branch of public health is environmental health, which focuses on the physical, chemical, and biological aspects of the environment that can affect human health. Sanitation is one of the core components of environmental health because it is directly related to the management of human waste disposal, wastewater, and household waste. Recent Indonesian studies have examined sanitation and related water and hygiene conditions in relation to diarrhea among toddlers (Abidin et al., 2022; Fauziyah & Siwiendrayanti, 2023) and to stunting (Ariyanti et al., 2025), which shows that environmental conditions are treated as determinants of population health. In this study, environmental health is represented by access to adequate sanitation, while public health conditions are represented by health complaints and health insurance, so this concept provides the basis for juxtaposing environmental and health indicators at the provincial level.

2.2. Access to Adequate Sanitation

BPS defines households with access to adequate sanitation as households that have defecation facilities with a goose-neck toilet and a final feces disposal site in the form of a septic tank or a Wastewater Treatment System (SPAL), which are used by the household itself, shared with certain other households, or through communal public bathing, washing, and toilet (MCK) facilities. For rural areas, final disposal of feces in a pit in the ground is also still categorized as adequate (BPS, 2025). This definition refers to the Sustainable Development Goals (SDGs) metadata framework since 2019. Access to sanitation is not only a matter of infrastructure: Satriani et al. (2022) place facilities, community behavior, financing, and program implementation as interrelated aspects of water, sanitation, and hygiene (WASH) provision in Indonesia, Hirai et al. (2018) link the use of sanitation facilities in eastern Indonesia to social norms, perceived costs, convenience, and household characteristics, and Jalunggono et al. (2025) as well as Rizki and Saleh (2009) relate access to socioeconomic conditions and poverty. In this study, the BPS definition is used as the main indicator because it is the official measure published consistently at the provincial level, so it allows comparison between provinces and years, while the factors above are used to interpret, not to test, the differences found.

2.3. The Relationship between Environment and Health

Conceptually, inadequate sanitation increases the risk of water source contamination and the spread of pathogens that cause environment-based diseases. A modeling study by Kurniawan et al. (2024) shows a pattern of association between low access to adequate sanitation and high prevalence of malaria morbidity in several regions of eastern Indonesia, although that study used a statistical modeling approach different from the descriptive approach in this article. Other studies have placed sanitation within the context of diarrhea among toddlers in East Java (Sakti et al., 2023; Megatsari et al., 2021) and in slum settlements in Makassar City (Abidin et al., 2022), and have examined sanitation and drinking water in relation to stunting in Papua and West Papua (Astuti, 2022) and in Indonesia more broadly (Ariyanti et al., 2025). These studies generally use a specific disease or condition as the health indicator, whereas this study uses broader indicators (health complaints and health insurance) that describe the general health condition and financial protection of the population. For this reason, the relationship between the two sides is read descriptively, not causally.

2.4. Health Inequality between Regions

Inequality in health development between regions in Indonesia has long been a concern, given the archipelagic geographic conditions and the infrastructure disparities between the western and eastern regions of Indonesia. The compilation of the Sanitation Index by STIS researchers confirms this pattern, in which provinces in Eastern Indonesia, particularly Papua, consistently occupy the lowest positions in various indicators of sanitation and environmental health compared to the Java-Bali region. A similar pattern is also seen in the indicator of health insurance ownership, as reported by the 2023 Indonesian Health Survey (SKI), which recorded Highland Papua as the province with the highest proportion of the population without health insurance nationally (BKPK, 2023). Inequality in sanitation occurs not only between provinces but also within provinces (Afifah et al., 2018), and spatial characteristics are related to variation in access (Aprilia et al., 2024). Yumanda and Vidriza (2022) found that Papua consistently occupied the cluster with the worst sanitation and poverty achievements, while Nazli and Usman (2025) showed a gap in health insurance ownership between the upper economic group (83.08%) and the poor population (63.19%). Taken together, these studies show that inequality in basic services is multidimensional and

that provincial figures can hide differences within provinces. This study therefore uses the province as its unit of analysis to map the broad pattern of inequality, while acknowledging that variation at district/city level cannot be seen.

3. Methods

This study uses a quantitative descriptive design with secondary data officially published by Statistics Indonesia (BPS) and the Health Policy Agency (BKPK) of the Indonesian Ministry of Health. The study did not involve primary data collection or microdata processing. The data sources come from BPS RI, specifically the results of the National Socioeconomic Survey (Susenas March), as well as the BKPK of the Indonesian Ministry of Health through the 2023 Indonesian Health Survey (SKI). The data used cover the periods 2019 and 2022-2025, as far as data are available for each indicator and province. The unit of analysis in this study is the provinces of Indonesia, covering 38 provinces based on the latest administrative division. The regional coverage includes the national and provincial levels, while for certain indicators and years, provincial coverage is partial according to the availability of official data that could be traced and verified, as explained in the limitations section.

The indicators used consist of the percentage of households with access to adequate sanitation by province as the main variable, the percentage of the population who had health complaints during the past month by province as the first health variable, and the percentage of the population who have health insurance by province as the second health variable. Data collection was carried out through searching and verifying official tables on the BPS website (bps.go.id), official publications of BPS Provinces, publications of the BKPK of the Indonesian Ministry of Health, and indexed journal articles that explicitly cite BPS/Susenas data. Cross-checks were also carried out against official data portals that reproduce BPS tables, such as Databoks and GoodStats Data, to ensure consistency with the officially published national figures.

Data analysis was carried out descriptively and comparatively on the published figures. The analysis included comparing values between provinces, comparing across years to see developments or trends, and identifying provinces with the highest and lowest achievements for each indicator. This study did not conduct hypothesis testing, correlation calculations, regression, odds ratios, p-values, or other statistical modelling. The analysis proceeded in four steps. First, the published figures for each indicator were compiled into provincial tables by year (Tables 1-4), and provinces with no officially published figure for a given year were left blank, without imputation or estimation. Second, within each indicator, provinces were compared and ranked by value to identify the highest and lowest achievements and the width of the gap between them, expressed in percentage points. Third, for provinces with figures for more than one year, values were compared across years to describe the direction and size of change, while the national figures (Table 1) were used to describe the overall trend. Fourth, for selected provinces, namely those at the highest or lowest positions in at least one indicator, sanitation, health complaints, and health insurance were presented side by side using the most complete year available for each province (Table 5), and the patterns were read descriptively as moving in the same or different directions. Because the Papua region was divided into six provinces, figures before and after the division were not treated as directly comparable.

4. Results and Discussion

4.1. Research Results

This section presents the descriptive results in the order of the study objectives, starting with the national trend in household access to adequate sanitation (Table 1), followed by the provincial figures for sanitation (Table 2), health complaints (Table 3), and health insurance (Table 4), and ending with a side-by-side comparison of the three indicators (Table 5).

Table 1. Percentage of Households with Access to Adequate Sanitation, Indonesia, 2019-2025

Year	National Percentage (%)	Source
2019	77.39	BPS (cited in STIS Proceedings)
2022	-	
2023	82.36	BPS, Statistik Indonesia 2024
2024	83.6	BPS, Susenas March 2024
2025	85.37	BPS, Susenas March 2025

Source: Compiled by the author from Badan Pusat Statistik (BPS)

Table 1 shows that the percentage of households in Indonesia with access to adequate sanitation tends to increase over the 2019-2025 period. In 2019, the percentage was recorded at 77.39%, then increased to 82.36% in 2023 and 83.60% in 2024. A further increase was seen in 2025 with an achievement of 85.37%. The pace of improvement was not uniform: the 4.97 percentage point gain between 2019 and 2023 averages about 1.24 points per year, equal to the gain in 2023-2024 (1.24 points) and lower than the gain in 2024-2025 (1.77 points), indicating faster progress in the most recent year. Overall, these data show positive development in access to adequate sanitation at the national level, although some households still do not have such access. Data for 2022 are not included in the table, so they cannot be used to describe annual changes in that period. For the same reason, the average annual change before 2023 is only an approximation and not an observed yearly trend.

Table 2. Percentage of Households with Access to Adequate Sanitation by Selected Province, 2022-2025

Province	2022 (%)	2023 (%)	2024 (%)	2025 (%)
Aceh	-	-	-	82.21
North Sumatra	-	-	-	87.47
West Sumatra	69.27	70.97	-	74.59
Riau	-	-	-	91.21
Riau Islands	-	-	91.23	90.96
Bangka Belitung Islands	-	-	94.16	96.45
DKI Jakarta	92.79	-	94.01	-
West Java	74.02	74.88	-	76.2
East Java	-	83.72	85.56	88.26
DI Yogyakarta	96.21	96.42	96.71	96.94
Banten	-	-	87.93	90.71
Bali	95.94	-	96.83	98.2
East Nusa Tenggara	73.7	-	-	-
North Sulawesi	-	-	87.31	-
South Sulawesi	-	-	93.83	94.19
Southeast Sulawesi	-	-	90.62	91.96
West Sulawesi	-	-	-	85.98
Gorontalo	-	-	-	84.7
Maluku	-	-	-	83.09

Province	2022 (%)	2023 (%)	2024 (%)	2025 (%)
North Maluku	-	-	-	84.12
West Papua	-	-	-	78.55
Southwest Papua	-	-	-	79.56
Papua	40.34	43.00*	-	76.71
South Papua	-	-	60.85	65.06
Central Papua	-	-	41.44	39.73
Highland Papua	-	-	12.61	16.34
Indonesia	-	82.36	83.6	85.37

Note: The 2022-2023 figures for Papua refer to the Papua region before its full division into six provinces, so they are not fully comparable with the figure for the (new) Papua province in 2025. The provinces not listed in the table (Jambi, South Sumatera, Bengkulu, Lampung, Central Jawa, West Nusa Tenggara, all Kalimantan provinces, Central Sulawesi).

Source: BPS (2024, 2026), Susenas March various years

Table 2 shows differences in the achievement of access to adequate sanitation between provinces. In 2025, the highest percentage was recorded in Bali at 98.20%, followed by DI Yogyakarta at 96.94% and Bangka Belitung Islands at 96.45%. Meanwhile, the lowest achievements were in Highland Papua at 16.34%, Central Papua at 39.73%, and South Papua at 65.06%. East Java showed an increase from 83.72% in 2023 to 88.26% in 2025. This is a gain of 4.54 points, larger than the national gain of 3.01 points over the same period (82.36% to 85.37%). By contrast, DI Yogyakarta, which started from a high level, changed by only 0.73 points between 2022 and 2025 (96.21% to 96.94%), and the Riau Islands recorded a marginal decline (91.23% in 2024 to 90.96% in 2025). Among the Papua provinces with data for both 2024 and 2025, Highland Papua (12.61% to 16.34%) and South Papua (60.85% to 65.06%) increased, while Central Papua decreased (41.44% to 39.73%). Highland Papua remained about 69 points below the national figure in 2025 (16.34% versus 85.37%). These conditions show that the achievement of adequate sanitation still has gaps between regions, especially between provinces with high percentages and several provinces in the Papua region. These comparisons should be read with caution: only 23 of the 38 provinces have a 2025 figure in Table 2, most provinces have data for only one or two years, and the figures for Papua before and after the division are not directly comparable. The changes described above are therefore limited to provinces with figures in the relevant years.

4.1.1. Public Health Indicators by Province

Public health indicators by province include health complaints, health insurance ownership, and sanitation conditions as an overview of the health of the population in various regions.

Table 3. Percentage of the Population with Health Complaints during the Past Month

Province	2023 (%)	2025 (%)
West Nusa Tenggara	39.4	42
Riau Islands	31.75	-
East Nusa Tenggara	30.51	30
Central Java	30.16	33.34
West Sumatra	28.93	-
Bangka Belitung Islands	28.65	31.44
Bengkulu	27.81	29.95
South Kalimantan	27.76	29.55

Province	2023 (%)	2025 (%)
Aceh	27.71	-
DI Yogyakarta	-	32.74
East Java	-	30.65
West Java	-	30.5
Lampung	-	29.97
Papua (combined South Papua, Central Papua, Highland Papua)	12.64	-
Indonesia	26.27	-

Source: BPS, Susenas March 2023 and 2025 (cited by GoodStats Data, matched against BPS national figures)

Table 3 shows that the percentage of the population experiencing health complaints differs between provinces. In 2025, West Nusa Tenggara had the highest percentage at 42%, while East Nusa Tenggara was the lowest among the provinces with data for that year, at 30%. Compared to 2023, health complaints increased in West Nusa Tenggara, Central Java, the Bangka Belitung Islands, Bengkulu, and South Kalimantan, while East Nusa Tenggara experienced a slight decrease. The increases ranged from 1.79 points (South Kalimantan) to 3.18 points (Central Java), whereas the decrease in East Nusa Tenggara was only 0.51 points, so the general direction among these six provinces was upward. The figure for Papua in 2023 (12.64%, combined South, Central, and Highland Papua) is far below the national figure, even though these areas have the lowest sanitation achievement in Table 2, which suggests that self-reported complaints do not necessarily reflect actual illness. Only six provinces have figures for both years, so these changes cannot be generalized to all provinces. Nationally, the percentage of the population with health complaints in 2023 was recorded at 26.27%.

Table 4. Percentage of the Population with Health Insurance, 2023

Category	%		
Has BPJS Kesehatan			66.44
Has Jamkesda			5.97
Has company/office insurance			2.58
Has private insurance			0.54
Total with health insurance (national)			72.38
Does not yet have health insurance			27.62
Provinces with the highest health insurance ownership (SKI 2023)	**%**	**Provinces with the highest proportion without health insurance (SKI 2023)**	**%**
Aceh	98.5	Highland Papua	55.4
DKI Jakarta	94.1	Central Papua	42.7
North Kalimantan	92.7	North Maluku	41.5
Bali	90.3	Maluku	39.4
Gorontalo	87.9	Jambi	37

Source: BPS Susenas March 2023 (Nazli & Usman, 2025; BKPK, 2023)

Table 4 shows that national health insurance coverage in 2023 had reached 72.38%, with BPJS Kesehatan as the most dominant form of insurance at 66.44%. BPJS Kesehatan alone accounts for about 92% of all insured people. However, 27.62% of the population still do not have health insurance. Gaps between regions are also clearly visible, with the highest ownership in Aceh at 98.5%, while Highland Papua has the highest proportion of the population without health insurance at 55.4%. This means that only about 44.6% of the population in Highland Papua is insured, roughly 54 points below Aceh. This condition shows

that health insurance coverage is not yet evenly distributed between provinces. Because these data are available for a single year (2023), they describe a snapshot and cannot show changes over time.

Table 5. Descriptive Comparison of Sanitation Conditions and Health Indicators in Selected Provinces (2023-2025, most complete data available for each province)

Province	Adequate Sanitation (%)	Health Complaints (%)	Highest/Lowest Health Insurance (SKI 2023)
Bali	98.20 (2025)	-	90.3 (5th highest nationally)
DI Yogyakarta	96.94 (2025)	32.74 (2025)	-
DKI Jakarta	94.01 (2024)	-	94.1 (2nd highest nationally)
Aceh	82.21 (2025)	27.71 (2023)	98.5 (highest nationally)
West Nusa Tenggara	-	42.00 (2025, highest nationally)	-
Central Java	-	33.34 (2025)	-
Maluku	83.09 (2025)	-	39.4 (5th lowest nationally)
North Maluku	84.12 (2025)	-	41.5 (5th lowest nationally)
Central Papua	39.73 (2025)	-	42.7 (5th lowest nationally)
Highland Papua	16.34 (2025, lowest nationally)	-	55.4 (lowest nationally)

Source: Compiled by the author from Tables 2, 3, and 4 (BPS, Susenas March 2023-2025; BKPK, 2023)

Table 5 shows differences in sanitation conditions and health indicators between provinces. Bali and DI Yogyakarta have high access to adequate sanitation, at 98.20% and 96.94% respectively, while Highland Papua is at the lowest level at 16.34%. In terms of health complaints, West Nusa Tenggara recorded the highest percentage at 42.00%. Meanwhile, the highest health insurance ownership is in Aceh at 98.5%, while the highest proportion of the population without health insurance is in Highland Papua at 55.4%. Two patterns can be seen. First, Bali and DKI Jakarta combine high sanitation with high insurance ownership, while Highland Papua and Central Papua combine low sanitation with a high proportion of uninsured population. Second, the pattern is not uniform: Aceh has the highest insurance ownership although its sanitation (82.21%) is below the national figure, and Maluku and North Maluku have sanitation levels close to the national figure (83.09% and 84.12%) but are among the provinces with the highest proportion without insurance. These data show variation in health conditions between regions, especially in access to sanitation and health insurance. Since several cells in Table 5 are empty and the years differ between indicators, these patterns are indicative only.

4.2. Discussion

Differences in sanitation achievement between provinces show that the increase in access to sanitation nationally has not fully reflected equitable development between regions. DKI Jakarta, Bali, East Kalimantan, and D.I. Yogyakarta are in the group with relatively high Sanitation Index achievements, while Papua is consistently in the group with the lowest achievements from year to year. This pattern shows spatial gaps in the fulfillment of basic sanitation services. Differences between provinces in the characteristics of adequate

sanitation, adequate drinking water, environmental quality, and poverty level also show that sanitation achievement is related to uneven regional development conditions. Afifah et al. (2018) showed that inequality in access to sanitation occurs not only between provinces but also within the same province. Thus, a high provincial achievement does not necessarily reflect equity down to the district/city level. Aprilia et al. (2024) also place spatial characteristics as a part related to variation in access to adequate sanitation. Variation on the island of Java reinforces this condition because a large population is not automatically followed by higher sanitation achievement. West Java, which is below the national average in several years of observation, shows differences in the ability of regions to increase access to sanitation, while the development of East Java, which shows an increasing tendency as reported by BPS East Java Province, shows that changes in achievement proceed at different speeds between provinces. These differences are inseparable from economic conditions, poverty, income inequality, settlement characteristics, and the ability of households to provide sanitation facilities (Jalunggono et al., 2025; Rizki & Saleh, 2009).

Changes between periods in provinces with multi-year data show that increases in sanitation achievement have not automatically narrowed the gap between regions. A province may experience an increase in the percentage of adequate sanitation, but its relative position compared to other provinces remains low if the increase proceeds more slowly. This condition means that national aggregate changes need to be read together with changes in each region. Satriani et al. (2022) place the availability of facilities, community behavior, financing, and program implementation as interrelated aspects in the provision of WASH services in Indonesia. Hirai et al. (2018) also link the use of sanitation facilities with social norms, perceived costs, convenience, and household characteristics in eastern Indonesia. Kurniawan et al. (2024) also showed considerable differences in sanitation achievement across 34 provinces in Indonesia. Therefore, the increase in national sanitation needs to be viewed from two sides, namely the increase in achievement in aggregate and the ability of regions with low achievement to narrow their gap.

The pattern of health indicators that does not always move in the same direction as sanitation shows that health complaints are not sufficient as the sole description of public health conditions. Self-reported complaints can be influenced by individual perception, the type of health disorder, the ability to recognize symptoms, access to health services, and socioeconomic conditions. The difference in pattern between sanitation and health complaints in this study is therefore more appropriately read as the complexity of health conditions rather than as a direct relationship between the two indicators. Nazli and Usman (2025) link health complaints that interfere with daily activities to health insurance ownership status. The relationship between sanitation and health becomes more focused when the health indicator used is a specific disease. Sakti et al. (2023) place adequate sanitation and environmental conditions in the analysis of diarrhea incidence among toddlers in East Java. Megatsari et al. (2021) link access to sanitation and health behavior to diarrhea prevalence at the district/city level in East Java, while Abidin et al. (2022) place water, sanitation, and hygiene as part of the environmental conditions related to diarrhea among toddlers in slum settlements in Makassar City. The condition of latrines and wastewater drains is also part of the context of diarrhea incidence (Ahyanti & Rosita, 2022; Fauziyah & Siwiendrayanti, 2023). Thus, the use of more specific disease indicators can provide a more focused interpretation than general health complaints.

The pattern of association between access to sanitation and health insurance ownership in a number of regions provides an overview of development gaps that are multidimensional. Sanitation and health insurance are two different forms of basic services, but both are related

to the ability of the community to obtain basic facilities and protection. Nazli and Usman (2025) link health insurance ownership to the economic conditions of the population. In terms of sanitation, differences between regions are also related to regional development characteristics, including poverty levels. Rizki and Saleh (2009) as well as Jalunggono et al. (2025) provide context that socioeconomic conditions are an important part of access to sanitation. In terms of child health, WASH conditions are also related to the problem of stunting in Indonesia (Ariyanti et al., 2025). The similarity in sanitation and health insurance patterns in several regions can thus be read as an overview of inequality in basic services across different dimensions. However, this pattern cannot be used to conclude a causal relationship between sanitation and health insurance ownership because both indicators may be influenced by the same socioeconomic, geographic, and institutional conditions.

Reading the three indicators together in Table 5, the relationship between them is partial and differs by indicator pair. Sanitation and health insurance move in the same direction at the extremes: Bali (sanitation 98.20%, insured 90.3%) and DKI Jakarta (94.01%, insured 94.1%) combine high sanitation with high insurance ownership, while Highland Papua (16.34%, 55.4% uninsured) and Central Papua (39.73%, 42.7% uninsured) combine low sanitation with large uninsured populations. The alignment is not consistent in between: Aceh has the highest insurance ownership (98.5%) although its sanitation (82.21%) is below the national figure (85.37%), while Maluku (83.09%) and North Maluku (84.12%) are close to the national figure yet are among the five provinces with the highest proportion without insurance (39.4% and 41.5%). Health complaints follow a different pattern from both indicators. DI Yogyakarta, with very high sanitation (96.94%), recorded 32.74% health complaints in 2025, and Central Java recorded 33.34%, both above the national figure for 2023 (26.27%, a different year), whereas Papua, the area with the weakest sanitation and the largest uninsured populations, recorded only 12.64% in 2023. This suggests that self-reported complaints reflect the ability to recognize symptoms and access to care as much as actual illness, so health complaints are weakly aligned with sanitation and insurance. West Nusa Tenggara, with the highest complaints (42.00%), cannot be placed against the other two indicators because its sanitation and insurance figures are not available in the tables. In summary, the three indicators form a consistent picture only at the extremes (Bali, DKI Jakarta, and the Papua provinces), insurance is partially aligned with sanitation, and complaints are not aligned with either. Because the years differ between indicators and several cells are empty, these readings remain descriptive and do not indicate causal relationships.

Papua's position as the region with the lowest sanitation achievement is consistent with Kurniawan et al. (2024) and the BPS data used in compiling the STIS Sanitation Index in previous years. This consistency shows that the sanitation gap in Papua tends to be persistent and does not appear only in the observation period of this study. Because Papua has been divided into six provinces, changes between periods should not be read directly as changes in sanitation conditions, but the low figures that remain in the new provinces (Highland Papua 16.34% and Central Papua 39.73% in 2025) show that the administrative change has not yet been followed by equitable distribution of sanitation services. Sanitation and drinking water conditions in Papua and West Papua are also related to child health problems (Astuti, 2022). The difference in pattern between sanitation and health complaints in this study cannot be interpreted as a lack of association between sanitation and health. Perceived or self-reported health complaints have a broad scope, so responses can differ according to individual characteristics and access to services. The use of more specific health indicators, such as diarrhea or malaria, can provide a more focused picture of the relationship between sanitation

conditions and health, as in Kurniawan et al. (2024), who specifically used malaria morbidity as the health indicator.

The findings have several concrete implications, which are indicative because the study is descriptive and does not evaluate programs. First, sanitation investment should be prioritized for Highland Papua (16.34%), Central Papua (39.73%), and South Papua (65.06%), which have the lowest achievements in 2025. Because Highland Papua and Central Papua also have the largest uninsured proportions, sanitation programs there can be paired with health insurance enrollment through the same local government channels, rather than being handled as separate agendas. Second, Maluku and North Maluku, where sanitation is near the national figure but the uninsured proportion is high, need priority for insurance enrollment rather than for sanitation alone. Third, West Java (76.20%) remains below the national figure, and East Java's gain of 4.54 points between 2023 and 2025 shows that faster progress is possible, so provinces with slower gains can use such provinces as comparison points. Fourth, provincial monitoring should not rely on health complaints alone, given their weak alignment with the other indicators. It should add disease-specific indicators such as diarrhea or malaria, and, where data allow, district/city-level figures, since provincial averages can hide differences within provinces. Finally, the gaps in Tables 2 to 4 indicate that BPS and the Ministry of Health need to publish complete figures for all 38 provinces each year, so that progress in every province can be monitored consistently.

5. Conclusion

Based on official BPS and BKPK data, national household access to adequate sanitation in Indonesia increased from 82.36% in 2023 to 85.37% in 2025, but the gap between provinces remains wide, from 98.20% in Bali to 16.34% in Highland Papua in 2025. Sanitation and health insurance coverage move in the same direction at the extremes (Bali and DKI Jakarta versus the Papua provinces) but align only partially elsewhere, while health complaints are not aligned with either indicator. Health complaints are therefore not sufficient as the sole description of public health conditions.

These findings suggest that sanitation efforts should prioritize the lowest-achieving provinces in the Papua region and be paired with health insurance enrollment there, while provinces such as Maluku and North Maluku, where sanitation is near the national figure but the uninsured proportion is high, need priority for insurance enrollment. Provincial monitoring should also add disease-specific indicators and, where data allow, district/city-level figures, supported by complete annual provincial data from BPS and the Ministry of Health. This study has several limitations. It uses aggregate, published provincial data, so it cannot show variation within provinces. Provincial and yearly coverage is incomplete, the indicators are available for different years, and the division of Papua limits comparability over time. Because the analysis is descriptive and uses no inferential tests, the patterns found cannot be interpreted as causal relationships. Future studies could use complete district-level or household microdata with inferential models to test these patterns.

5.1. Conflict of Interest Statement

The author declares that there is no conflict of interest regarding the publication of this paper.

5.2. Author Contributions

The author was solely responsible for the manuscript, including Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Visualization, Writing – Original Draft, and Writing – Review & Editing.

5.3. Funding Statement
No funding was received for this research.

5.4. Informed Consent
Informed consent was not required because this study did not involve human subjects and used only published aggregate secondary data.

5.5. Ethical Approval
This article does not contain any studies with human participants performed by the author. The study used officially published, aggregate provincial-level data from Statistics Indonesia (BPS) and the Health Policy Agency (BKPK) of the Indonesian Ministry of Health, and did not use individual or household microdata.

5.6. Data Availability
The data analyzed in this study are publicly available from Statistics Indonesia (BPS; Susenas March, various years) and the Health Policy Agency (BKPK), Indonesian Ministry of Health (Indonesian Health Survey 2023). The compiled provincial tables used in this article are available from the corresponding author [A.N.] upon reasonable request.

5.7. Declaration of Generative AI and AI-assisted Technologies
During the preparation of this manuscript, the author utilized Claude and DeepSeek for language editing and improving grammatical clarity. All outputs generated by the AI tool underwent rigorous critical review and thorough editing by the author to ensure factual accuracy, enhance clarity of expression, and confirm adherence to established academic standards. The author assumes full responsibility for the integrity and content of this manuscript.

6. References
Abidin, K., Ansariadi, A., & Thaha, I. L. M. (2022). Faktor Air, Sanitasi, dan Higiene terhadap Kejadian Diare pada Balita di Permukiman Kumuh Kota Makassar. *Hasanuddin Journal of Public Health*, *3*(3), 301–311. https://doi.org/10.30597/hjph.v3i3.22002

Afifah, T., Nuryetty, M. T., Cahyorini, Musadad, D. A., Schlotheuber, A., Bergen, N., & Johnston, R. (2018). Subnational regional inequality in access to improved drinking water and sanitation in Indonesia: results from the 2015 Indonesian National Socioeconomic Survey (SUSENAS). *Global Health Action*, *11*(sup1), 31–40. https://doi.org/10.1080/16549716.2018.1496972

Ahyanti, M., & Rosita, Y. (2022). Determinan Diare Berdasarkan Pilar Sanitasi Total Berbasis Masyarakat. *Jurnal Kesehatan Lingkungan Indonesia*, *21*(1), 1–8. https://doi.org/10.14710/jkli.21.1.1-8

Aprilia, M. R., Andryani, A. P., & Indrayani, A. F. (2024). Analisis spasial faktor-faktor yang mempengaruhi akses sanitasi layak di Indonesia tahun 2023 menggunakan Geographically Weighted Regression. *Sanitasi: Jurnal Kesehatan Lingkungan*, *17*(1), 14–23. https://doi.org/10.29238/sanitasi.v17i1.3008

Ariyanti, R., Saefurrohim, M. Z., & Rahayu, E. P. (2025). The Effect of Water, Sanitation, and Hygiene (WASH) on Stunting in Indonesia Children: A Systematic Review. *Jurnal Keperawatan Malang (JKM)*, *10*(1), 18–30. https://doi.org/10.36916/jkm.v10i1.357

Astuti, Y. R. (2022). Pengaruh Sanitasi dan Air Minum Terhadap Stunting di Papua dan Papua Barat. *Poltekita : Jurnal Ilmu Kesehatan*, *16*(3), 261–267. https://doi.org/10.33860/jik.v16i3.1470

BKPK. (2023). *Survei Kesehatan Indonesia (SKI) 2023*. Badan Kebijakan Pembangunan

Kesehatan (BKPK). https://www.badankebijakan.kemkes.go.id/hasil-ski-2023/

BPS. (2024). *Statistik Indonesia 2024*. Badan Pusat Statistik. https://www.bps.go.id/en/publication/2024/02/28/c1bacde03256343b2bf769b0/statistik-indonesia-2024.html

BPS. (2025). *Persentase Rumah Tangga yang Memiliki Akses terhadap Sanitasi Layak Menurut Provinsi dan Klasifikasi Desa, 2025*. Badan Pusat Statistik Indonesia. https://www.bps.go.id/assets/statistics-table/2/ODM0IzI%3D/persentase-rumah-tangga-yang-memiliki-akses-terhadap-sanitasi-layak-menurut-provinsi-dan-klasifikasi-desa.html

BPS. (2026). *Statistik Perumahan dan Permukiman Provinsi Jawa Timur 2025*. Badan Pusat Statistik Provinsi Jawa Timur.

Fauziyah, Z., & Siwiendrayanti, A. (2023). Kondisi Sanitasi Dasar dengan Kejadian Diare. *HIGEIA (Journal of Public Health Research and Development)*, *7*(3), 430–441. https://doi.org/10.15294/higeia.v7i3.65317

Hirai, M., Kelsey, A., Mattson, K., Cronin, A. A., Mukerji, S., & Graham, J. P. (2018). Determinants of toilet ownership among rural households in six eastern districts of Indonesia. *Journal of Water, Sanitation and Hygiene for Development*, *8*(3), 533–545. https://doi.org/10.2166/washdev.2018.010

Jalunggono, G., Islami, F. S., & Hutajulu, D. M. (2025). Socioeconomic Determinants and Their Interactions in Shaping Improved Sanitation Access in Indonesia. *Efficient: Indonesian Journal of Development Economics*, *8*(3), 357–368. https://doi.org/10.15294/efficient.v8i3.38386

Kurniawan, A., Widyawati, A. Z., Pratiwi, F. A., Faizun, N., & Meliana, R. (2024). Pemodelan Prevalensi Angka Kesakitan Malaria Berdasarkan Persentase Sanitasi Layak Dengan Pendekatan Estimator Least Square Spline. *Jurnal Kesehatan Lingkungan Indonesia*, *23*(3), 287–293. https://doi.org/10.14710/jkli.23.3.287-293

Megatsari, H., Laksono, A. D., & Moelyaningrum, A. D. (2021). Diarrhea Prevalence in East Java, Indonesia: Does Access to Sanitation and Health Behavior Ecologically Related? *Indian Journal of Forensic Medicine & Toxicology*, *15*(4), 1276–1283. https://doi.org/10.37506/ijfmt.v15i4.16885

Nazli, N., & Usman, H. (2025). Kepemilikan Jaminan Kesehatan di Kalangan Penduduk Miskin Indonesia Tahun 2023. *Jurnal Kebijakan Kesehatan Indonesia*, *13*(4), 180. https://doi.org/10.22146/jkki.96626

Rizki, B., & Saleh, S. (2009). Keterkaitan Akses Sanitasi dan Tingkat Kemiskinan: Studi Kasus di Propinsi Jawa Tengah. *Economic Journal of Emerging Markets*, *12*(3), 223–233. https://doi.org/10.20885/ejem.v12i3.378

Sakti, E. S., Makful, M. R., & Tampubolon, R. D. (2023). Spatial analysis of diarrhea in toddlers and environmental factors in the East Java Province Indonesia. *BKM Public Health and Community Medicine*, *39*(6), e7973. https://doi.org/10.22146/bkm.v39i06.7973

Satriani, S., Ilma, I. S., & Daniel, D. (2022). Trends of Water, Sanitation, and Hygiene (WASH) Research in Indonesia: A Systematic Review. *International Journal of Environmental Research and Public Health*, *19*(3), 1617. https://doi.org/10.3390/ijerph19031617

Yumanda, F. C., & Vidriza, U. (2022). Pengelompokan Provinsi Prioritas di Indonesia Guna Menilai Efisiensi Proporsi Dana Alokasi Khusus Fisik Bidang Sanitasi dan Air Minum Tahun 2020. *Journal of Social Development Studies*, *3*(2), 142–159. https://doi.org/10.22146/jsds.5012