

Review

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Review

Association Between Hospital Bed Supply and Health Outcomes: An Ecological Analysis and Narrative Review with Insights from Japan

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Abstract

Japan has achieved universal health coverage and one of the highest life expectancies worldwide. However, rapid population aging, workforce decline, fiscal pressures, and marked regional disparities threaten system sustainability. Despite a comparatively lower physician-to-population ratio among OECD countries, Japan maintains one of the highest hospital bed densities among OECD countries, reflecting a hospital-centered care model associated with prolonged stays and high inpatient expenditures. This narrative review with an ecological analysis examines the association between hospital bed supply and health outcomes, with insights from Japan. The quantitative analyses are explicitly hypothesis-generating and exploratory rather than causal. Publicly available national datasets from 2021–2022 were used to examine international differences in hospital bed and physician densities and to assess associations between hospital bed supply, per capita medical expenditure, life expectancy, and healthy life expectancy across Japan's 47 prefectures. Descriptive statistics and Pearson correlation analyses were performed, with outcomes stratified by sex. Higher hospital bed density was consistently associated with increased inpatient expenditure but showed no positive relationship with life expectancy or healthy life expectancy. Among men, both indicators were negatively correlated with bed density, whereas no significant associations were observed among women. A case study of Yubari City, Hokkaido, suggests that large-scale bed reduction did not worsen mortality indicators and was accompanied by reduced medical expenditures and greater reliance on community-based and long-term care. Overall, these ecological, hypothesis-generating findings highlight potential inefficiencies of excess inpatient capacity. They also underscore the need for regionally tailored bed planning and strengthened primary and generalist care in Japan's super-aged society.

Keywords: population aging; health outcomes; primary care physicians; generalists; community-based care

Introduction

Japan's healthcare system has achieved universal health coverage, low infant mortality, and one of the highest life expectancies worldwide, reflecting long-standing efforts by healthcare professionals and policymakers. Its accessibility and quality are often cited as a global benchmark.

However, rapid population aging, workforce decline, fiscal constraints, and persistent regional disparities now threaten system sustainability. Since the COVID-19 pandemic, excess mortality has increased and life expectancy has stagnated, potentially accelerating population decline and raising concerns about economic vitality and international competitiveness [1–3]. These trends underscore the need to reassess the organization and delivery of healthcare services.

The Japan Hospital Association has acknowledged that reductions in hospitals and inpatient beds are unavoidable, advocating regional reorganization of care delivery and clearer institutional roles. Given projected demographic and workforce changes, maintaining the current hospital-centered model is increasingly difficult, necessitating strategic downsizing and stronger inter-institutional collaboration [4,5]

Japan relies heavily on hospitals. According to the Organization for Economic Co-operation and Development (OECD), it has the highest per capita numbers of total and acute care beds among member countries, combined with relatively long hospital stays and limited long-term care capacity. This structure encourages prolonged hospitalization of patients who could be managed in community or long-term care settings, contributing to inefficiencies and rising inpatient expenditures, particularly in regions with surplus beds [6]

Japan has a disproportionately high number of psychiatric beds per capita among OECD countries [7,8]. This is partly attributable to the large number of long-term care beds within hospitals, which inflates reported bed density, as well as the prevalence of “social hospitalization,” whereby patients remain hospitalized for non-medical reasons [9]. Consequently, beds that would be classified as long-term care or nursing home beds in other countries are often categorized as hospital beds in Japan [10].

Population aging further strains public finances, with concerns about equity for socioeconomically disadvantaged populations. Nevertheless, evidence suggests that residential socioeconomic status does not substantially affect access to certain surgical services, indicating a degree of resilience within Japan’s universal healthcare system [11].

Despite a relatively low physician-to-population ratio, Japan maintains exceptionally high hospital bed density, especially in rural areas, leading to mismatches between infrastructure, medical need, and utilization. Structural reform is therefore required to optimize resource allocation and control costs.

This narrative review compares Japan’s hospital bed and physician densities with international benchmarks and examines prefecture-level associations between bed supply and key health indicators, including per capita healthcare expenditure, life expectancy, and healthy life expectancy. It further draws on the case of Yubari City, Hokkaido—where hospital closure following municipal bankruptcy was accompanied by stable health outcomes and reduced costs—to explore how population health may be maintained despite substantial reductions in inpatient capacity [12].

We first present an international comparison demonstrating that Japan has a markedly higher number of hospital beds per capita than other countries. We then conduct an ecological analysis of health outcomes at the prefectural level using life expectancy and healthy life expectancy as primary indicators. In addition, the Yubari case—an extreme example of rapid bed reduction—provides an opportunity to examine whether decreased bed supply necessarily leads to worsening health outcomes. Based on these findings, we consider the potential role of generalist physicians in supporting a transition from a hospital-centered model of care to a community-based system.

Although these components—international comparison, ecological analysis, and the Yubari case study—may appear distinct, they are integrated within a unified framework that questions the assumption that greater healthcare resource supply, particularly hospital beds, directly improves health outcomes. From this perspective, the review maintains logical coherence while offering policy-relevant insights to enhance the sustainability, equity, and quality of Japan’s healthcare system under ongoing demographic and economic pressures.

Methods

Study design

This study is a narrative review incorporating secondary ecological analyses using aggregated prefecture-level data. Quantitative analyses were exploratory and hypothesis-generating, and were not intended to establish causality.

Data Sources, Variables, and Statistical Analyses

This study utilized publicly available national and prefectural datasets. International comparisons of hospital bed and physician densities were based on data from the OECD, using the most recent available figures, primarily from 2021–2022 [13,14].

Hospital bed data were obtained from official prefectural statistics compiled by the Ministry of Health, Labour and Welfare (MHLW) [15]. The number of physicians per 100,000 population by prefecture were obtained from official prefectural statistics compiled by the Ministry of Health, Labour and Welfare (MHLW) [16].

Per capita medical expenditure data were sourced from MHLW national health insurance expenditure reports [17]. Life expectancy and healthy life expectancy data were derived from national statistics and governmental reports [18,19].

Primary variables included hospital beds per 100,000 population, per capita medical expenditure (JPY), life expectancy at birth, and healthy life expectancy. Life expectancy outcomes were stratified by sex to account for known gender differences.

All analyses were conducted at the prefectural level using data from the 47 prefectures in Japan. Descriptive statistics were used to summarize national patterns. First, univariate analyses were performed to examine associations among healthcare resources (physicians and hospital beds per 100,000 population), per capita medical expenditure, and socioeconomic indicators, including prefectural income per capita [20], population density [21], and aging rate (proportion of the population aged 65 and over) [22].

Pearson correlation coefficients (r) were calculated, and scatter plots were used for visualization. Subsequently, linear regression analyses were conducted to assess factors associated with life expectancy and healthy life expectancy. In Model 1, univariate (simple) regression analyses were performed. In Models 2 and 3, multivariate linear regression analyses were conducted including selected independent variables. Standardized regression coefficients (β) were calculated to evaluate the strength of associations.

All analyses were conducted at the ecological level, and potential confounders such as health behaviors were not controlled for. JMP version 19.1 was used for data analysis. All statistical tests were two-tailed, and statistical significance was set at $p < 0.05$.

Data Aggregation and Analytical Framework for Demographic, Mortality, and Healthcare Expenditure Trends in Post-Bankruptcy Yubari City

All statistical data used in this analysis of Yubari are publicly available open data obtained from the Hokkaido Government and Yubari City Office, accessible to anyone, and the URLs of the websites referenced for each indicator are provided in Table 1. Temporal line graphs were constructed to depict trends in total population and aging rate (proportion aged ≥ 65 years) for Hokkaido (all municipalities) and Yubari City. In addition, the number of older adults (≥ 65 years) in Yubari City was estimated from the total population and aging rate, and plotted concurrently.

Furthermore, crude mortality rates were calculated for both Hokkaido (all municipalities) and Yubari City by combining annual total deaths with corresponding population data, and their temporal trends were illustrated using line graphs.

Table 1. Data sources and corresponding URLs for demographic, socioeconomic, and healthcare indicators used in the analysis of Yubari City. (in Japanese) Accessed March 26, 2026.

Trends in population aging rates in Japan overall and in Hokkaido	https://jp.gdfreak.com/public/detail/jp010050000001001000/2
Population size and aging rate of Yubari City as of March 2026	https://www.city.yubari.lg.jp/soshiki/11/1613.html
Trends in the aging rate in Yubari City	https://www.city.yubari.lg.jp/uploaded/attachment/7828.pdf

	https://www.visualization-labo.jp/machi1.php?new_town=012092
Total population and number of deaths in Hokkaido and Yubari City	https://www.pref.hokkaido.lg.jp/ss/tuk/900brr/index2.html
Medical benefit expenditures and long-term care contributions for general insured persons in Hokkaido and Yubari City	20 https://www.pref.hokkaido.lg.jp/hf/ki/240222.html 23 https://www.pref.hokkaido.lg.jp/hf/ki/205133.html

Based on the most recent open data released by the Hokkaido Government (2022 and 2023), the total and per capita amounts of medical benefit expenditures and long-term care contributions for general insured persons, as well as their combined totals, were also presented for Hokkaido (all municipalities) and Yubari City.

Japan's Healthcare Context in International Perspective

According to 2021 OECD data, Japan has about 12.62 hospital beds per 1,000 population—the second highest among OECD countries after Korea—nearly double that of Germany (7.76) and France (5.65) (Figure 1A). In contrast, physician density is relatively low at 2.65 per 1,000, compared with Germany (4.55) and Italy (4.24) (Figure 1B). This combination of high bed availability and low physician density is unusual among developed countries and reflects Japan's distinctive historical and institutional context.

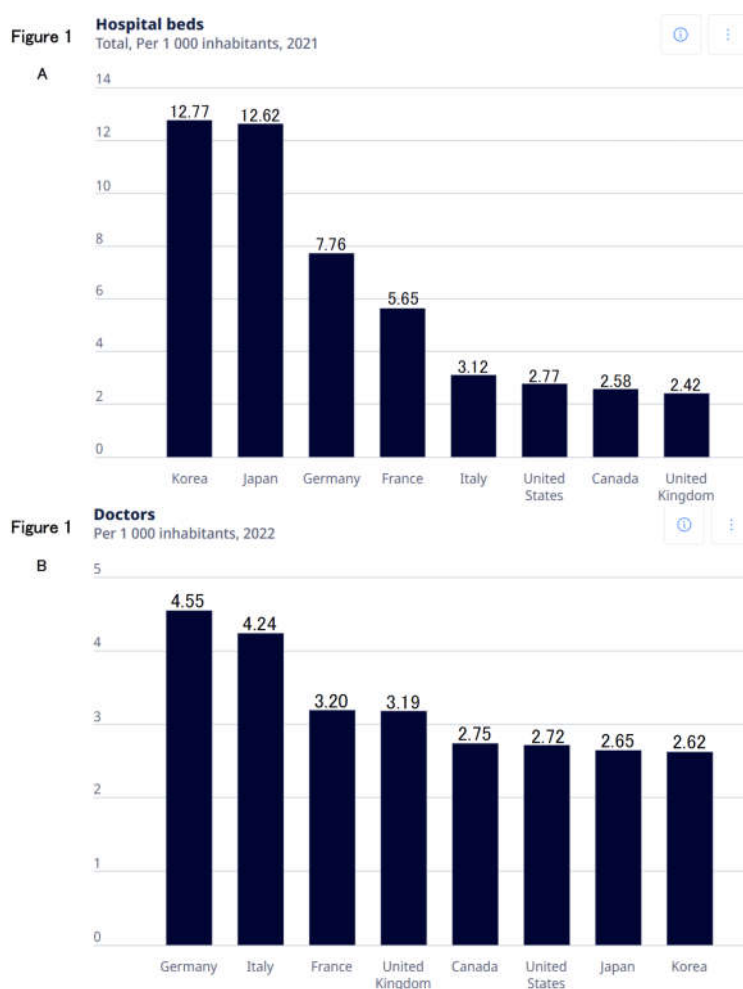


Figure 1. A: Number of hospital beds per 1,000 inhabitants in G7 countries and Korea, 2021. Data sourced from Reference 13. **B:** Number of physicians per 1,000 inhabitants in G7 countries and Korea, 2022. Data sourced from Reference 14.

Unlike many OECD countries with centralized healthcare planning, Japan has historically allowed relatively free market entry for medical facilities. Licensed physicians can establish hospitals or clinics if minimum regulations are met, and private hospitals independently secure funding. Until the 1980s, hospital bed supply was largely unregulated to expand nationwide access postwar, which improved geographic coverage but complicated resource coordination and expenditure control.

High patient choice under universal health insurance further challenges coordinated, continuous care across the spectrum from primary care to specialized treatment, home recovery, and long-term care. Recent regional planning efforts focus on strengthening family physician roles, clarifying the function of small- and medium-sized hospitals, and developing integrated community care networks through multidisciplinary collaboration. Understanding this historical balance between market-driven entry and limited regulation is key to interpreting current inefficiencies and guiding reforms for sustainability and regional equity.

Structural Factors Influencing Hospital Bed Supply and Utilization

Japan's healthcare infrastructure has been shaped by its historical development. After World War II, rapid expansion of medical access prioritized a free-entry system, with over 80% of hospitals privately owned, often by individual physicians or small family-run organizations. Under a "free-labeling" framework, private hospitals secure their own funding, and licensed physicians can establish hospitals or clinics by meeting minimal regulations [23]. This decentralized structure contributed to widespread hospital proliferation, especially in regions with stable or growing demand.

Hospital behavior is further influenced by Japan's fee-for-service national health insurance system, which incentivizes admissions, prolonged stays, and high occupancy. For example, neonatal intensive care units generate higher reimbursements, illustrating supply-induced demand [24]. Payment reforms, such as the Diagnostic Procedure Combination/Per-Diem Payment System (DPC/PDPS), have reduced resource use, but without measurable improvements in care quality [25].

Insufficient functional differentiation among hospitals adds to inefficiency. Acute care bed demand is estimated at only 40% of supply, leading to supply-sensitive utilization where hospitalization reflects bed availability as much as medical need [26]. Evidence from cardiology shows that centralizing specialists while decentralizing acute care hospitals regionally can improve quality, emphasizing the need for both concentration of expertise and appropriate distribution [27].

Unlike systems that employ global budgeting, capitation, or bundled payments to contain volume-driven care, Japan lacks strict mechanisms to cap hospital bed supply or overall reimbursed services. Consequently, hospital operators may perceive maintaining large bed capacity as a business imperative rather than a purely clinical necessity. Understanding the interplay of historical context, financial incentives, and insufficient functional differentiation is essential for addressing inefficiencies and guiding future healthcare policy reforms in Japan.

Regional Variations and Economic Influences

An analysis of 1992 national health insurance data found that Fukuoka Prefecture had 43% higher per capita inpatient expenditure than the national average, largely due to prolonged hospitalizations for stroke. Inpatient costs were more closely associated with bed supply than actual medical need, highlighting structural drivers of regional variation [28].

Data across Japan's 47 prefectures (2022) reveal substantial differences in hospital bed density and medical expenditure (Figure 2). Several rural western prefectures, including Kochi, Kagoshima, Nagasaki, and Kumamoto, exhibit the highest bed densities and per capita expenditures, despite not having worse health outcomes or markedly older populations. These differences cannot be explained by age composition alone.

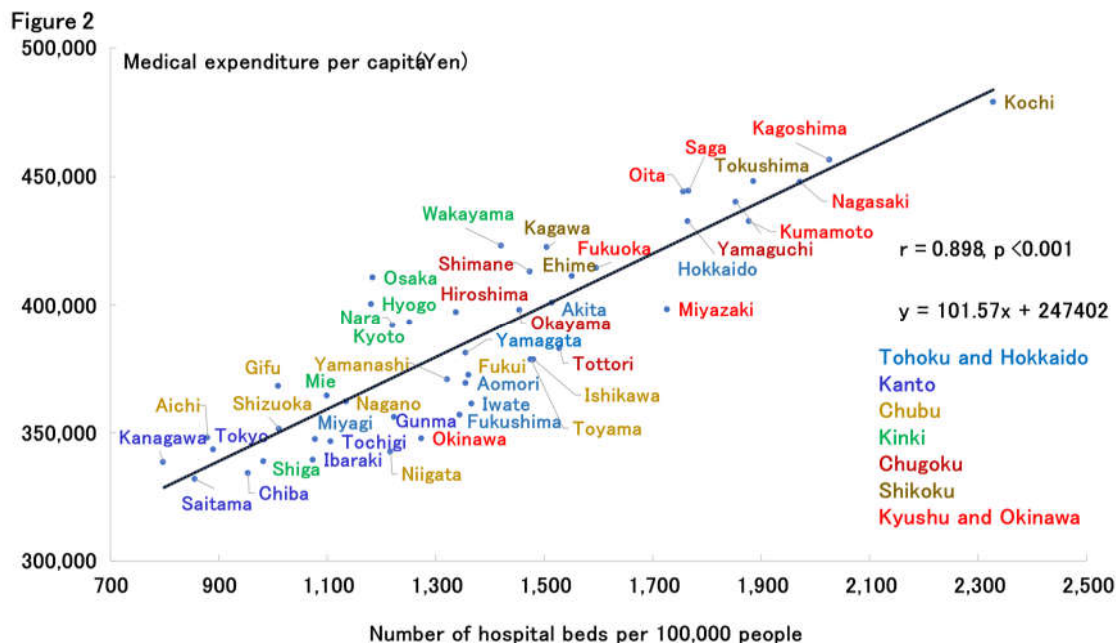


Figure 2. Association Between the Number of Hospital Beds per 100,000 People and Medical Expenditure per capita.

Economic factors play a key role. Lower land and labor costs in rural areas make hospital operation and expansion more feasible, supporting many small-scale hospitals run by local physicians where alternative care options are limited. Rural areas also have less developed home care, visiting nursing, and community-based services. Staff turnover, limited collaboration frameworks, and a shortage of highly functional home-visit nursing providers often make hospitalization the default for chronic disease management or rehabilitation, even when less intensive care could suffice [29,30].

Historical factors further contribute. Western Japan hosts numerous older medical schools founded before World War II, whose alumni networks and departmental affiliations maintain extensive hospital systems. While these institutions support continuity in education and care, they may hinder adaptation of infrastructure to evolving healthcare needs.

Impact on Health Outcomes and System Efficiency

A high number of hospital beds does not necessarily lead to better health outcomes. For example, Nagano Prefecture has low bed density and moderate healthcare spending but consistently ranks high in life expectancy and public health indicators. While bed density correlates with inpatient costs, its link to health outcomes is unclear, suggesting that abundant inpatient infrastructure is not essential for good population health.

Figure 3 presents scatter plots by prefecture, stratified by sex, showing the relationships between number of hospital beds and both life expectancy and healthy life expectancy. Among women, no significant correlation was observed between medical expenditures and either outcome. (Figure 3C, D) Surprisingly, among men, both life expectancy and healthy life expectancy were negatively correlated with the number of hospital beds. (Figure 3A, B)

Figure 3

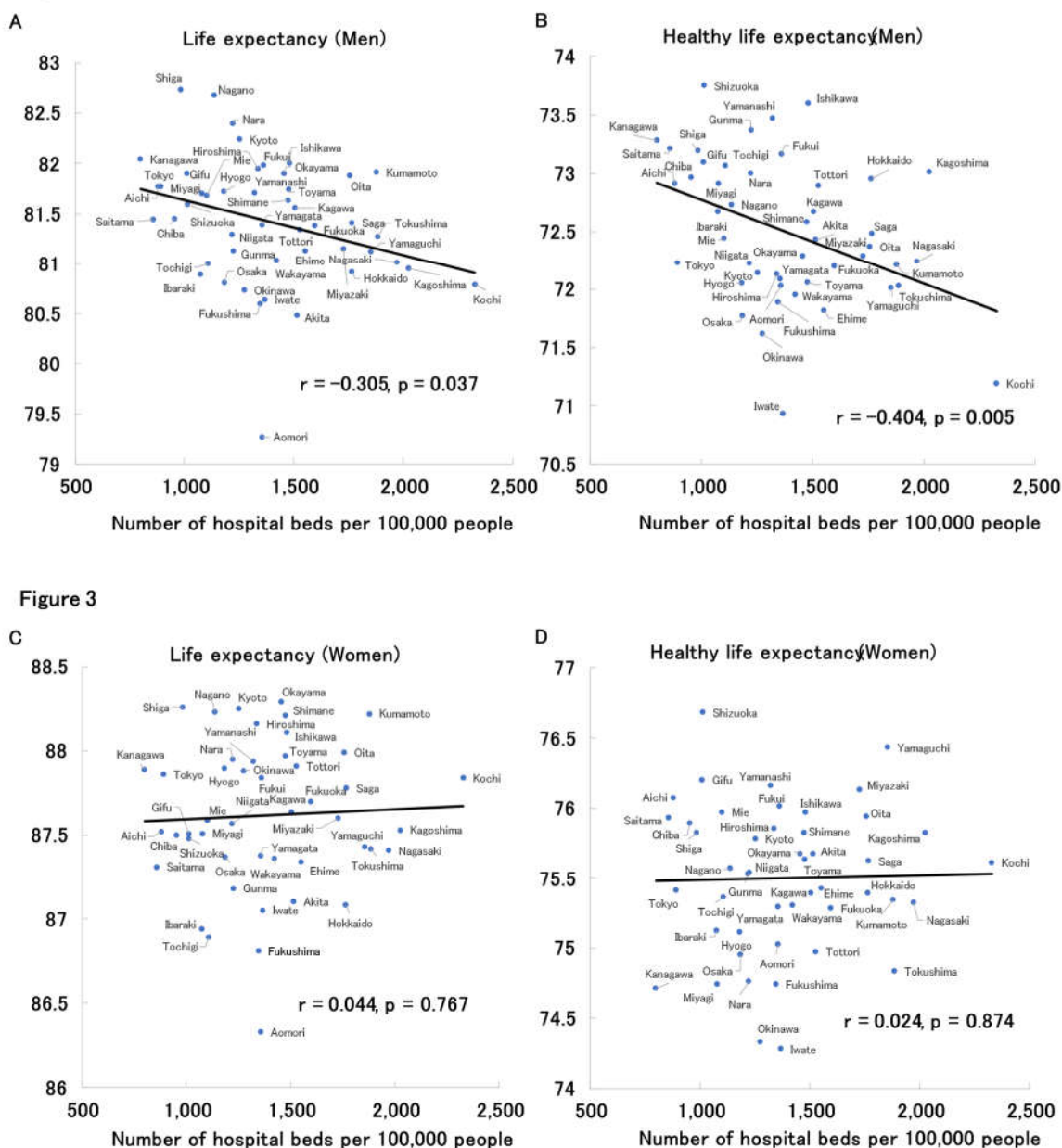


Figure 3. A: Association Between the Number of Hospital Beds per 100,000 People and Life Expectancy in Men. **B:** Association Between the Number of Hospital Beds per 100,000 People and Healthy Life Expectancy in Men. **C:** Association Between the Number of Hospital Beds per 100,000 People and Life Expectancy in Women. **D:** Association Between the Number of Hospital Beds per 100,000 People and Healthy Life Expectancy in Women.

One speculative explanation for the observed association in men—but not in women—is that women generally have longer life expectancy and healthier lifestyles, potentially making them less sensitive to healthcare system effects. In contrast, men may delay seeking care until disease is more advanced, which could contribute to higher healthcare costs despite shorter life expectancy.

Consistent with these findings, large-scale analyses among U.S. Medicare beneficiaries have demonstrated substantial interregional variation in hospital bed capacity and overall healthcare supply, with differences exceeding twofold. Regions with greater bed availability exhibited hospitalization rates up to 30% higher; however, no significant association with mortality risk was observed, a pattern that was consistent across racial and income groups [31]. Moreover, regional

differences in healthcare supply had minimal impact on major health outcomes, including mortality and hospitalization rates [32].

While these indicators—life expectancy and healthy life expectancy—do not capture the full spectrum of health outcomes, the data suggest that a greater number of hospital beds does not necessarily translate into longer or healthier lives. Conversely, regions with high bed densities often report longer hospital stays, higher rates of admissions that might be avoidable, and greater patient exposure to hospital-acquired conditions. These observations imply that surplus inpatient capacity may contribute to inefficiencies and could potentially compromise care quality.

Correlation Structure of Healthcare Resources, Expenditure, and Socioeconomic Factors

Table 2A presents Pearson correlation coefficients among healthcare resources and socioeconomic factors across the 47 prefectures in Japan, including physicians per 100,000 population, prefectural income per capita (yen), population density (per km²), and the aging rate (%). As shown in Figure 2, a very strong positive correlation was observed between healthcare expenditure and the number of hospital beds ($r = 0.898$, $p < 0.001$). A positive correlation was also observed between the number of physicians and medical expenditure ($r = 0.712$, $p < 0.001$), as well as hospital beds ($r = 0.593$, $p < 0.001$), suggesting that regions with more physicians tend to have higher healthcare utilization and, consequently, higher expenditures.

Table 2.

A. Pearson correlation coefficients among healthcare resources and socioeconomic factors across the 47 prefectures in Japan.

r	Number of physicians	Medical expenditure	Prefectural income	Population density	Aging rate
Number of hospital beds	0.593*	0.898*	-0.473*	-0.433†	0.660*
Number of physicians		0.712*	-0.018	0.034	0.159
Medical expenditure			-0.338‡	-0.259	0.569*
Prefectural income				0.673*	-0.474*
Population density					-0.645*

* $p < 0.001$, † $p < 0.01$, ‡ $p < 0.05$. Pearson correlation coefficients (r) from univariate analyses of physicians per 100,000 population, per-capita medical expenditure (yen), prefectural income per capita (yen), population density (per km²), aging rate (%), and number of hospital beds across the 47 prefectures in Japan.

B. Univariate and multivariate regression analyses examining factors associated with per capita medical expenditure across the 47 prefectures in Japan are presented as Pearson correlation coefficients (r) and standardized regression coefficients (β). P-values are reported for all estimates.

	Univariate		Multivariate	
	r	p	β	p
Number of hospital beds per 100,000 people	0.898	<0.001	0.670	<0.001
Number of physicians per 100,000 people	0.712	<0.001	0.283	0.001
Prefectural income per capita (Yen)	-0.338	0.020	-0.044	0.589
Population density (/km²)	-0.259	0.079	0.155	0.092
Aging rate (%)	0.569	<0.001	0.160	0.089

The aging rate showed positive correlations with both the number of hospital beds ($r = 0.660$, $p < 0.001$) and medical expenditure ($r = 0.569$, $p < 0.001$), indicating that healthcare resources are more heavily allocated in regions with more advanced population aging. The aging rate was negatively correlated with prefectural income ($r = -0.474$, $p < 0.001$), suggesting that prefectures with older populations tend to have lower income levels. While this may reflect demand-driven resource allocation, it also points to the presence of regional disparities in the distribution of healthcare resources.

In contrast, prefectural income exhibited negative correlations with the number of hospital beds ($r = -0.473$, $p < 0.001$) and medical expenditure ($r = -0.338$, $p = 0.020$), but showed no significant correlation with the number of physicians ($r = -0.018$, $p = 0.904$), implying that economic affluence is not strongly associated with healthcare resources. This finding may reflect the relatively equitable provision of healthcare in Japan.

Furthermore, population density, a proxy for urbanization, was negatively correlated with the number of hospital beds ($r = -0.433$, $p < 0.001$), suggesting that healthcare resources are not necessarily more abundant in urban areas. In addition, population density was negatively correlated with the aging rate ($r = -0.645$, $p < 0.001$) and positively correlated with prefectural income ($r = 0.673$, $p < 0.001$), consistent with the general pattern that more urbanized regions tend to have lower levels of population aging but higher income levels.

Overall, these results suggest that medical expenditure in Japan is primarily associated with healthcare resources (physicians and hospital beds) and population aging, whereas its associations with economic indicators (income) and urbanization (population density) are relatively weak. As this was an ecological analysis based on prefectural-level data, causal relationships at the individual level cannot be inferred, and the findings should be interpreted with caution.

As shown in Table 2B, univariate regression analyses demonstrated that medical expenditure per capita was significantly associated with the number of hospital beds per capita ($r = 0.898$, $p < 0.001$), number of physicians per capita ($r = 0.712$, $p < 0.001$), prefectural income per capita ($r = -0.338$, $p = 0.020$) and aging rate ($r = 0.569$, $p < 0.001$). To determine which factors were most strongly associated with medical expenditure, a multiple regression analysis was conducted with medical expenditure per capita as the dependent variable and the number of hospital beds per capita, number of physicians per capita, prefectural income per capita, population density, and aging rate as independent variables. In this model, the number of hospital beds ($\beta = 0.670$, $p < 0.001$) and the number of physicians ($\beta = 0.283$, $p < 0.001$) remained significant predictors, whereas the other three variables were not statistically significant (Table 2B). These findings suggest that healthcare resource supply, particularly the availability of hospital beds and physicians, is the primary determinant of medical expenditure.

Multivariable Analysis of Healthcare Resources, Socioeconomic Factors, and Longevity

To account for potential confounding in the associations between hospital bed density and both life expectancy and healthy life expectancy, we performed regression analyses incorporating the healthcare resources and socioeconomic factors presented in Table 2. We performed univariable linear regression (Model 1) and multivariable linear regression analyses (Models 2 and 3). As shown in Figure 3 and Table 2, there was a very strong correlation between the number of hospital beds per 100,000 population and medical expenditure per capita ($r = 0.898$, $p < 0.001$); therefore, to avoid multicollinearity, these variables were not included simultaneously in the same multivariable model, and two separate models (Models 2 and 3) were constructed.

Table 3. Univariate and multivariate regression analyses of factors associated with life expectancy and healthy life expectancy across the 47 prefectures in Japan.**A**

Life expectancy (Men)	Model 1		Model 2		Model 3	
	r	p	β	p	β	p
Number of hospital beds per 100,000 people	-0.305	0.037	-0.578	0.019		
Number of physicians per 100,000 people	0.160	0.284	0.570	0.002	0.398	0.068
Medical expenditure per capita (Yen)	-0.158	0.288			-0.198	0.452
Prefectural income per capita (Yen)	0.241	0.102	0.163	0.366	0.269	0.158
Population density (/km ²)	0.087	0.561	-0.488	0.017	-0.471	0.033
Aging rate (%)	-0.356	0.014	-0.304	0.139	-0.484	0.032

B

Healthy life expectancy (Men)	Model 1		Model 2		Model 3	
	r	p	β	p	β	p
Number of hospital beds per 100,000 people	-0.404	0.005	-0.249	0.344		
Number of physicians per 100,000 people	-0.305	0.037	-0.097	0.619	-0.187	0.404
Medical expenditure per capita (Yen)	-0.378	0.009			-0.060	0.828
Prefectural income per capita (Yen)	0.181	0.222	0.215	0.279	0.267	0.180
Population density (/km ²)	0.006	0.970	-0.414	0.062	-0.412	0.073
Aging rate (%)	-0.279	0.058	-0.264	0.240	-0.354	0.126

C

Life expectancy (Women)	Model 1		Model 2		Model 3	
	r	p	β	p	β	p
Number of hospital beds per 100,000 people	0.044	0.767	-0.289	0.209		
Number of physicians per 100,000 people	0.486	<0.001	0.731	<0.001	0.709	<0.001
Medical expenditure per capita (Yen)	0.136	0.360			-0.201	0.402
Prefectural income per capita (Yen)	0.032	0.833	-0.081	0.636	-0.051	0.768
Population density (/km ²)	0.056	0.709	-0.304	0.114	-0.278	0.161
Aging rate (%)	-0.250	0.091	-0.410	0.040	-0.451	0.028

D

Healthy life expectancy (Women)	Model 1		Model 2		Model 3	
	r	p	β	p	β	p
Number of hospital beds per 100,000 people	0.024	0.874	0.250	0.355		
Number of physicians per 100,000 people	-0.052	0.727	-0.156	0.439	-0.360	0.107
Medical expenditure per capita (Yen)	0.071	0.637			0.531	0.055
Prefectural income per capita (Yen)	0.193	0.195	0.598	0.005	0.649	0.002
Population density (/km ²)	-0.149	0.318	-0.507	0.028	-0.592	0.010
Aging rate (%)	0.077	0.608	-0.108	0.640	-0.243	0.284

A: Life expectancy (men), **B:** healthy life expectancy (men), **C:** life expectancy (women), and **D:** healthy life expectancy (women). Model 1 shows univariate (simple) regression analyses, presented as Pearson correlation coefficients (r). Model 2 and Model 3 show multivariate linear regression analyses, presented as standardized regression coefficients (β). Independent variables included the number of hospital beds per 100,000 population, number of physicians per 100,000 population, medical expenditure per capita, prefectural income per capita, population density, and aging rate. All analyses were conducted at the prefectural level (n = 47). p-values are shown for all estimates.

Table 3A presents the results for male life expectancy. In the univariable analysis, both hospital bed density (r = -0.305, p = 0.037) and aging rate (r = -0.356, p = 0.014) showed significant negative correlations with life expectancy, indicating shorter life expectancy in more aged regions. In the

multivariable analyses, Model 2 showed that the number of hospital beds remained negatively associated with life expectancy, consistent with the univariable analysis ($\beta = -0.578$, $p = 0.019$), whereas the number of physicians was positively associated with life expectancy ($\beta = 0.570$, $p = 0.002$). In Model 3, the aging rate remained independently and significantly negatively associated with life expectancy after adjustment for other covariates ($\beta = -0.484$, $p = 0.032$). In addition, population density was significantly negatively associated with life expectancy in both Model 2 ($\beta = -0.488$, $p = 0.017$) and Model 3 ($\beta = -0.471$, $p = 0.033$), suggesting a potential disadvantage in more urbanized areas.

Table 3B shows the results for male healthy life expectancy. Similar to life expectancy, univariable analyses demonstrated significant negative correlations with hospital bed density ($r = -0.404$, $p = 0.005$) and medical expenditure ($r = -0.378$, $p = 0.009$). However, these associations lost significance in the multivariable analyses, suggesting substantial confounding effects. This indicates that the observed relationships may reflect underlying demographic or regional characteristics rather than healthcare resources per se.

Table 3C presents the results for female life expectancy. In the univariable analysis, physician density showed a significant positive correlation ($r = 0.486$, $p < 0.001$), indicating longer life expectancy in regions with greater physician availability. This association remained significant in the multivariable analyses after adjustment for covariates, both in Model 2 ($\beta = 0.731$, $p < 0.001$) and Model 3 ($\beta = 0.709$, $p < 0.001$). Women are more likely to utilize healthcare services and adhere to treatment, enabling them to derive greater benefit from increased physician availability. In addition, female mortality is more strongly driven by chronic conditions that are amenable to medical care, which may amplify the impact of physician density on life expectancy. The negative association with aging rate was consistent with the findings in males, underscoring the importance of population structure.

Table 3D presents the results for female healthy life expectancy. While no variables were significant in the univariable analysis, multivariable analyses (Models 2 and 3) revealed that prefectural income per capita was positively associated, whereas population density was negatively associated with healthy life expectancy. These findings suggest that economically advantaged regions tend to have longer healthy life expectancy, whereas more densely populated areas may have shorter healthy life expectancy. In contrast, healthcare resources (physician and hospital bed density), medical expenditure, and aging rate were not significantly associated.

Overall, aging rate emerged as a key factor negatively associated with life expectancy in both sexes. Among females, socioeconomic factors (income) and urbanization (population density) were associated with healthy life expectancy.

The observed inverse association between aging rate and life expectancy is likely not causal but reflects underlying demographic and structural factors. Regions with higher aging rates often experience selective outmigration of younger, healthier individuals, resulting in a residual population with poorer health profiles. In addition, distortions in population structure and small population sizes may introduce statistical instability in life expectancy estimates. Furthermore, aging regions are frequently characterized by limited socioeconomic and healthcare resources. Taken together, these findings suggest that the negative association primarily represents an ecological artifact rather than a direct effect of population aging.

These findings are based on prefecture-level analyses and do not imply causality; moreover, they may be subject to ecological fallacy and cannot be directly applied at the individual level. Residual confounding from unmeasured variables may also persist. Taken together, regional differences in longevity may appear to be more strongly associated with population structure (aging) and socioeconomic factors than with the quantity of healthcare resources per se.

The Role of Primary Care Physicians and Hospital Generalists in Addressing Bed Oversupply

Primary care physicians and hospital generalists, who manage a broad spectrum of inpatient cases, are well positioned to address challenges from Japan's oversupply of hospital beds. Unlike narrowly focused specialists, hospital generalists provide comprehensive, patient-centered care, particularly suited to multimorbid and aging populations common in high bed-density hospitals.

Japanese hospitalists and generalists prioritize inpatient management, geriatric care, and diagnostic, therapeutic, and safety oversight, enabling them to care effectively for older patients and those with multiple comorbidities [33]. In many rural and suburban hospitals, they oversee daily inpatient care—including admissions for ambulatory care-sensitive conditions, rehabilitation, or extended observation—allowing them to identify avoidable or unnecessarily prolonged hospitalizations and promote community-based alternatives.

Hospital generalists also serve as clinical leaders in small- and medium-sized hospitals, influencing governance, quality improvement, and staff education. They can advocate for programs such as hospital-at-home care, post-discharge follow-up, and strengthened collaboration with home care providers, thereby reducing reliance on inpatient beds. Evidence supports their impact on efficiency: patients with aspiration pneumonia managed by hospitalists show shorter stays, lower costs, and optimized care practices, including reduced unnecessary testing [34].

Increasingly, Japan is evaluating generalist and hospitalist roles by hospital size and regional characteristics, institutionalizing their contributions to healthcare reform and resource redistribution [35]. Their perspectives are critical for informed decisions on bed consolidation, ensuring that reductions do not compromise care for vulnerable populations.

However, several limitations exist. Nationwide optimization of hospital bed use through generalist involvement is uncertain due to variability in hospital size, regional context, patient populations, physician availability, and financial structures. Definitions, training, and role allocation for hospitalists and generalists remain inconsistent, and most evidence comes from single-disease or individual-facility studies, limiting generalizability.

Case Study: Yubari City's Hospital Closure and Its Impact on Health Outcomes and Expenditures

Yubari City in Hokkaido, once a prosperous coal-mining town in the early to mid-20th century, experienced a dramatic population decline following mine closures and declared municipal bankruptcy in 2007. Consequently, its only advanced medical facility—a 171-bed municipal general hospital—was downsized to a 19-bed inpatient clinic and a 40-bed long-term care facility, effectively reducing inpatient hospital capacity to near zero.

Despite rapid population aging, no substantial change in total mortality was observed before and after the hospital closure (Figure 4A). Emergency transports declined significantly (Figure 4B). Sex-specific standardized mortality ratios (SMRs) for all-cause mortality, cancer, and heart disease remained stable or slightly decreased (Figures 5A and 5B). Although cerebrovascular mortality increased slightly in both sexes, pneumonia-related mortality declined notably, possibly due to increased pneumococcal vaccination and improved oral care for aspiration pneumonia prevention, promoted by local dentists and community health initiatives [36]. These preventive efforts appear to have intensified after the hospital closure.

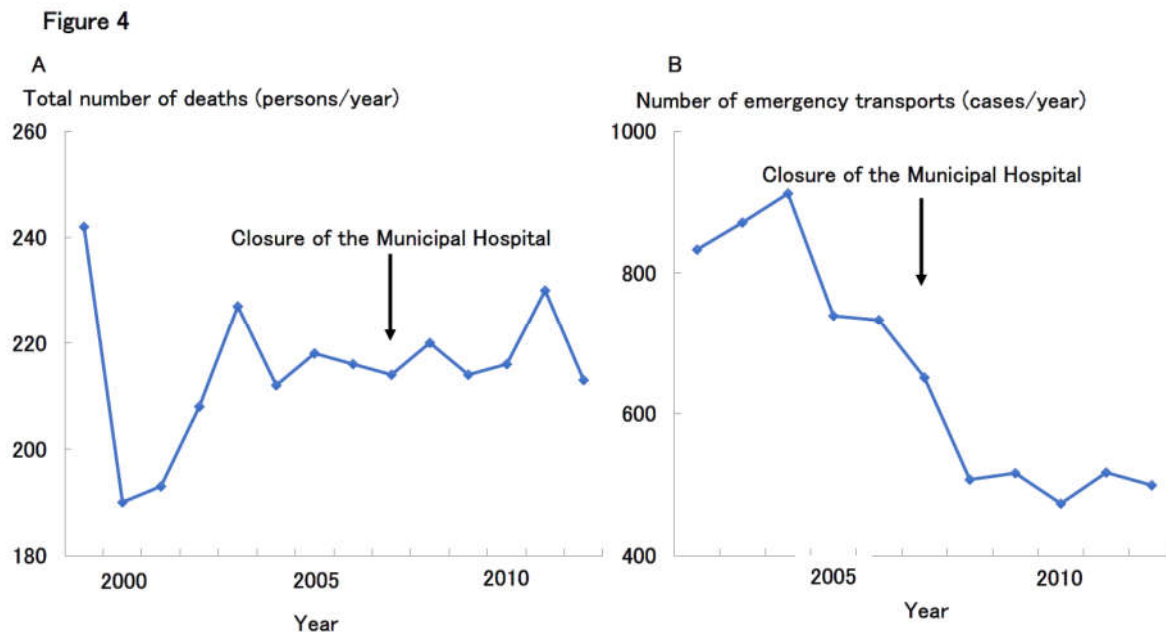


Figure 4. Cited from Reference 12. **A:** Trends in the Total Number of Deaths Before and After the Closure of the Municipal Hospital. **B:** Trends in the Number of Emergency Dispatches Before and After the Closure of the Municipal Hospital.

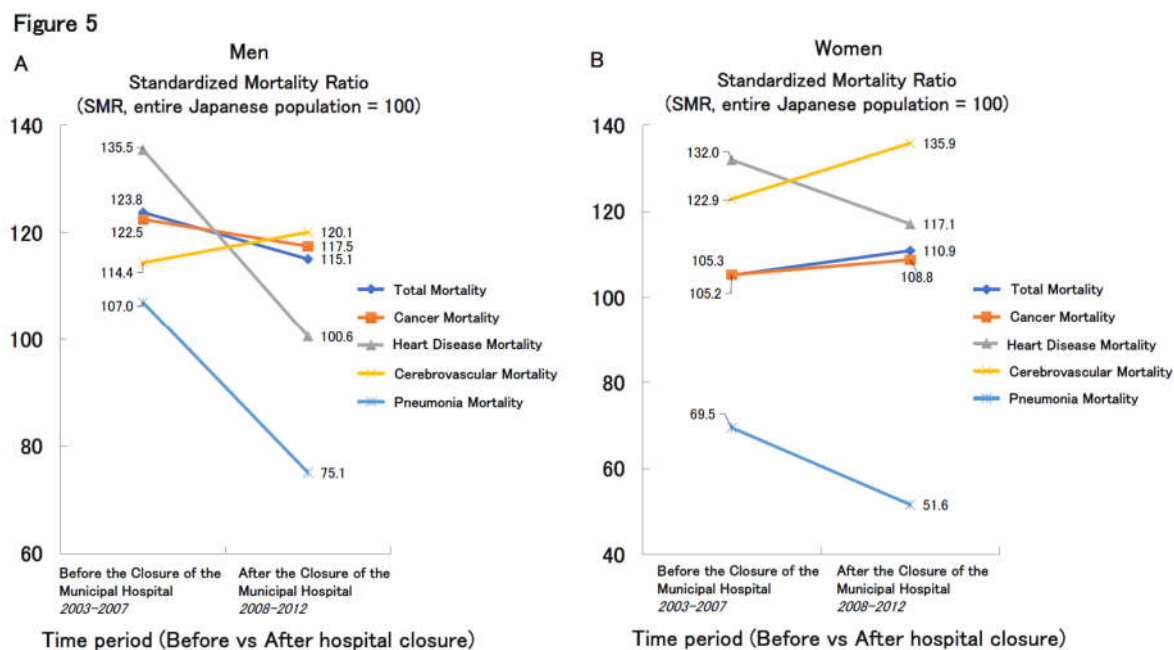


Figure 5. Cited from Reference 12. Changes in standardized mortality ratios (SMRs) before and after hospital closure in Yubari City. Standardized mortality ratios (SMRs) for major causes of death in men (A) and women (B) before and after hospital closure in Yubari City. SMRs were calculated using the entire Japanese population as the reference (SMR = 100).

Figure 6 shows trends in per capita medical and long-term care expenditures for older adults in Yubari relative to the Hokkaido average. Medical expenditures declined sharply following the closure, while long-term care costs increased, indicating a shift from hospital-based care to community-based services. Overall, combined per capita expenditures decreased relative to the regional average.

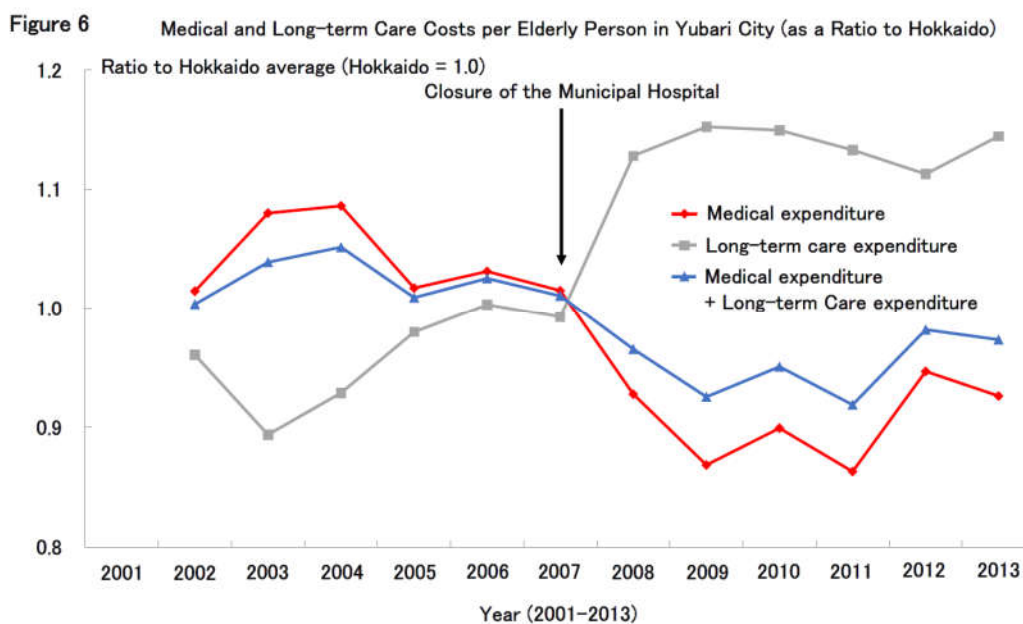


Figure 6. Cited from Reference 12. **Trends in medical and long-term care expenditures per elderly person in Yubari City.** Trends in per capita medical and long-term care expenditures among elderly residents (aged ≥ 65 years) in Yubari City from 2000 to 2012. Values are expressed as ratios relative to the Hokkaido average (Hokkaido = 1.0). The vertical dashed line indicates the hospital closure in 2007.

In summary, despite the near-elimination of inpatient beds, SMRs for all-cause, cancer, cardiovascular, and pneumonia mortality remained stable or decreased. At the same time, healthcare expenditures and emergency transports declined, suggesting a reduced societal burden of healthcare.

This phenomenon—where a reduction in healthcare supply does not necessarily worsen health outcomes—has been termed the “Yubari paradox” and has attracted attention within Japan’s medical community. However, it has been criticized for insufficient adjustment for confounders and the possibility that severely ill patients were transferred outside the city. Despite these limitations, the Yubari case remains a rare and instructive example of healthcare delivery under constrained resources.

Several factors may explain the maintenance of health outcomes, including the development of an integrated 24-hour medical and long-term care system, strengthened community social networks, and increased health awareness and preventive behaviors. The transition from hospital-centered acute care to community-based supportive care was supported by primary care and generalist physicians, who played a central role in sustaining local healthcare.

A potential counterargument is that improvements in outcomes and cost reductions reflect the out-migration of high-dependency patients. To assess this, dialysis patient trends were examined using two indicators: the number of residents certified with renal impairment (2006–2012) and new dialysis initiations (1999–2009). Both remained largely unchanged before and after the bankruptcy. Although further research is needed to evaluate other high-dependency populations, these findings suggest that large-scale out-migration of severely ill patients was unlikely.

It is also important to note that Yubari is a small municipality with a tightly knit community, which may have facilitated collective action. Its proximity to Sapporo may also have allowed access to tertiary care when needed, limiting generalizability to other settings.

Finally, while mortality indicators remained stable, they may not fully capture broader health impacts, such as chronic disease progression, quality of life, or unmet healthcare needs. Nevertheless, Yubari’s experience provides important insights for Japan’s future healthcare system, particularly in the context of hospital downsizing and strategic withdrawal, and may serve as a model for healthcare delivery in a super-aged society.

Demographic Aging, Mortality Trends, and Healthcare Expenditures in Post-Bankruptcy Yubari City

Nearly two decades have passed since the fiscal bankruptcy of Yubari City in 2007. Since then, the city's population has continued to decline steadily, falling below 6,000 as of March 2026. In contrast, the decline in the population aged 65 years and older has been more gradual than that of the total population, thereby accelerating the increase in the aging rate (Figure 7A).

Figure 7

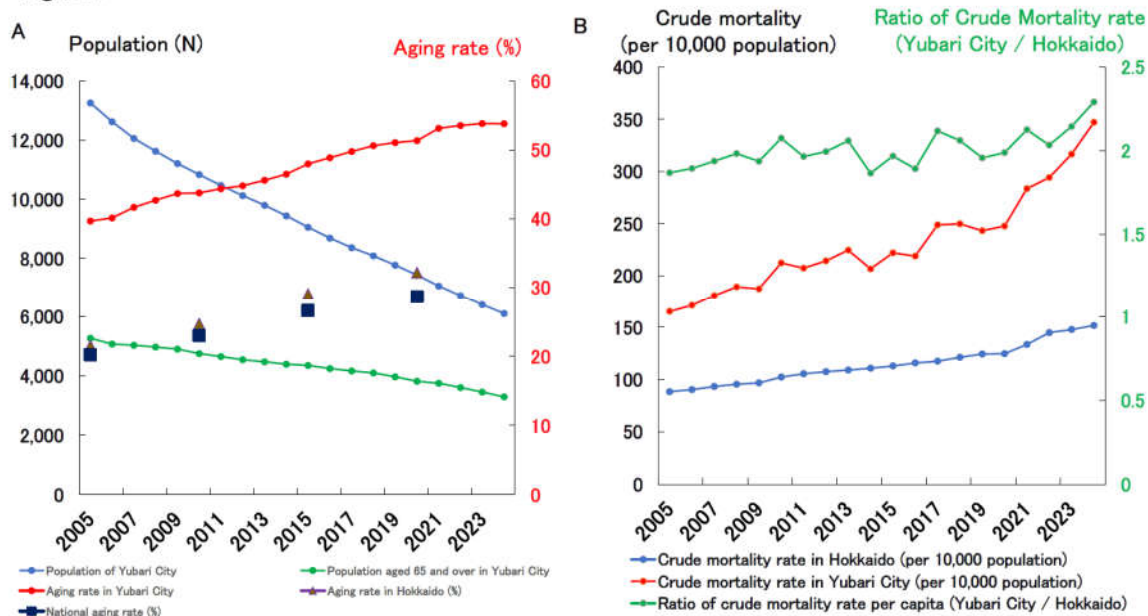


Figure 7. A: Trends in population in Yubari City and aging rates in Yubari City, Hokkaido, and Japan. **B:** Trends in crude mortality rates in Yubari City and Hokkaido.

Following the fiscal collapse, Yubari City has experienced substantial population decline and depopulation. It has been argued that the relatively stable number of deaths, along with the decreasing trend in healthcare expenditure, can be attributed simply to population outflow. However, the present analysis suggests that older adults—who generally require more medical care—have not migrated out of the city to the same extent as the working-age population. This may reflect a tendency for older individuals to remain in familiar environments where they have lived for many years.

Although the data are plotted at 5-year intervals, the graph also includes the aging rate for all of Japan and for Hokkaido as a whole. In comparison with these broader populations, the aging rate in Yubari City is markedly higher. Indeed, Yubari is among the municipalities with the highest aging rates in Japan.

Figure 7B shows the trends in crude mortality rates per 10,000 population in Hokkaido and Yubari City. With advancing population aging, crude mortality rates have increased steadily in both Hokkaido and Yubari. However, the magnitude of this increase is more pronounced in Yubari, where the aging rate is exceptionally high. Notably, since the onset of the COVID-19 pandemic in 2020, the upward trend in crude mortality has accelerated in Yubari, consistent with patterns observed across Japan^{1,2}.

However, when examining the ratio of crude mortality rates (Yubari City / Hokkaido), no clear upward trend is observed despite some fluctuations. Taking into account the effects of population aging, these findings suggest that mortality in Yubari may not have increased disproportionately following the closure of the municipal hospital. A more precise evaluation would require comparison of age-standardized mortality rates; however, such analysis was not feasible due to the lack of available age-specific mortality data for Yubari City. Future studies should aim to assess age-standardized mortality trends in this population.

How have medical and long-term care expenditures in Yubari City evolved in recent years? Table 4 presents the total and per capita amounts of medical benefit expenditures from general insured persons and long-term care contributions from general insured persons, as well as their combined totals, for both Hokkaido (all municipalities) and Yubari City, based on the most recent open data released by the Hokkaido Government (2022 and 2023).

Table 4. Total and per capita medical benefit expenditures and long-term care contributions from general insured persons in Hokkaido (all municipalities) and Yubari City.

		2022	2023
Medical benefit expenditures from general insured persons (Yen)	Hokkaido (all municipalities)	68,911,448,627	67,874,712,242
	Yubari City	90,377,489	96,897,490
	Hokkaido (all municipalities, per capita)	13,407	13,324
	Yubari City (per capita)	13,431	15,114
Long-term care contributions from general insured persons (Yen)	Hokkaido (all municipalities)	7,204,505,233	7,170,705,555
	Yubari City	12,380,413	13,357,637
	Hokkaido (all municipalities, per capita)	1,402	1,408
	Yubari City (per capita)	1,840	2,084
Medical benefit expenditures + long-term care contributions from general insured persons (Yen)	Hokkaido (all municipalities)	76,115,953,860	75,045,417,797
	Yubari City	102,757,902	110,255,127
	Hokkaido (all municipalities, per capita)	14,809	14,732
	Yubari City (per capita)	15,271	17,198
Per capita ratio of medical benefit expenditures to long-term care contributions	Hokkaido (all municipalities)	9.57	9.47
	Yubari City	7.30	7.25

For medical benefit expenditures, no clear difference was observed between Hokkaido (all municipalities) and Yubari City. In contrast, long-term care contributions tended to be higher in Yubari City. Accordingly, the per capita ratio of medical benefit expenditures to long-term care contributions (medical benefit expenditures/long-term care contributions) was approximately in the around 9 for Hokkaido (all municipalities), whereas it was in the around 7 for Yubari City. This indicates a relatively greater share of long-term care expenditures in Yubari City, suggesting that the pattern observed in Figure 6 has persisted over time.

Regarding the combined total of medical and long-term care expenditures, Yubari City shows higher values than Hokkaido (all municipalities), likely reflecting its substantially higher aging rate, as illustrated in Table 4. However, further analysis using age-standardized measures is warranted to more accurately assess these differences.

Policy Considerations for Sustainable and Equitable Care

Ensuring the sustainability and equity of Japan's healthcare system in the face of demographic and economic challenges requires a multifaceted policy approach.

Evidence-Based Regional Bed Planning

The adoption of analytical tools and planning frameworks to determine appropriate hospital bed numbers based on regional population demographics, disease burden, and service utilization patterns is essential to better align supply with actual need. Several international examples provide useful models. In France, each region develops a Schéma régional de santé (SRS), a regional health plan that organizes healthcare delivery according to local needs, including authorization, bed allocation, and functional differentiation. The SRS represents a prototypical mechanism for implementing regional bed planning and service reorganization [37]. In Germany, substantial reforms are underway that restructure hospital planning through functional designation, coupled with financial support for maintenance costs and diagnosis-related groups [38]. In Canada, provincial governments are investing in and evaluating initiatives aimed at strengthening home- and community-based care while reducing reliance on hospital-based inpatient services [39].

Promoting Hospital Consolidation and Service Diversification

Financial and administrative incentives can encourage small hospitals—particularly in rural areas—to merge or transition toward outpatient, rehabilitation, or long-term care functions. Such restructuring has the potential to optimize resource utilization while preserving access to essential healthcare services.

Strengthening Community-Based and Outpatient Care

Reducing dependence on inpatient services requires sustained investment in home care providers, public health nursing, primary care clinics, and integrated care platforms. The training and deployment of community health workers can further support chronic disease management and health promotion. In recent years, technology-enabled inpatient-level care delivered at home has been rapidly implemented. A systematic review encompassing 69 studies demonstrated that technology-enabled home care models do not increase the risk of hospital readmission compared with conventional hospital-based inpatient care [40]. In addition, systematic reviews of Hospital-at-Home (HaH) programs have reported that, relative to standard inpatient treatment, HaH may achieve comparable or even superior clinical outcomes [41].

Reforming Payment Systems

A gradual transition from volume-based fee-for-service reimbursement toward value-based or bundled payment models can better incentivize quality, efficiency, and patient-centered outcomes, while mitigating the tendency toward unnecessary service volume.

Collaborative Stakeholder Engagement

Successful healthcare reform depends on the active involvement of medical associations, hospital leadership, policymakers, and local communities. Transparent data sharing, consensus-building, and shared decision-making processes are essential to ensure that reforms are contextually appropriate, feasible, and broadly supported.

Functional Differentiation as a Pathway to Sustainable Regional Healthcare

A constructive way forward is not complex but rather rests on a clear functional differentiation within regional healthcare systems. Highly time-sensitive and resource-intensive conditions—such as acute ischemic stroke, major trauma, and advanced cardiovascular emergencies—should be centralized in large, well-equipped regional hub hospitals operating 24 hours a day with full specialist coverage. Attempting to provide comprehensive emergency services in numerous small- or medium-sized hospitals with 100–200 beds is neither clinically realistic nor efficient. When supported by coordinated emergency transport systems, including physician-staffed helicopters, centralization can improve survival even when geographic distances increase.

In contrast, the majority of healthcare needs in aging societies—management of chronic diseases, minor acute illnesses, rehabilitation, and end-of-life care—are better addressed outside hospitals. These services should be delivered through community-based primary care, home care, and integrated long-term care systems, as exemplified by practical experiences in rural areas such as Yubari. Strengthening primary care and supporting everyday living environments allows healthcare systems to maintain quality of care while reducing unnecessary hospitalizations and prolonged inpatient stays.

Public discourse in Japan frequently emphasizes “physician shortages” or “maldistribution of physicians” without adequately addressing the underlying structural issue of excessive hospital bed capacity. Such framing risks obscuring the core problem: the persistence of a hospital-centered model sustained by historical arrangements and entrenched interests rather than by current population needs. Without confronting bed oversupply and clarifying functional roles across care settings,

discussions focused solely on workforce numbers are unlikely to produce meaningful or sustainable reform.

Limitations

This study has several limitations. First, the analyses are based on aggregated prefecture-level data, which precludes individual-level inference and introduces the risk of ecological fallacy. Moreover, the very strong correlation between hospital bed density and healthcare expenditure indicates substantial structural and demographic confounding, necessitating caution in causal interpretation. In particular, the observed associations cannot distinguish whether population aging leads to increased healthcare resource allocation or whether regions with greater resources preferentially retain older populations. Potential confounding due to population movement—especially the outmigration of younger individuals—was not directly assessed. In addition, the use of prefectural units may obscure within-region heterogeneity, including urban–rural disparities and variations at the level of secondary healthcare areas.

Second, the associations between hospital bed density, healthcare expenditure, and health outcomes should not be interpreted as causal. Reverse causation is plausible, as regions with higher healthcare demand may maintain greater inpatient capacity. Furthermore, observed relationships may reflect differences in healthcare delivery systems rather than resource scarcity per se; for example, lower hospital bed density in urban areas may be attributable to shorter lengths of stay or a greater reliance on outpatient care. The strong correlation between healthcare expenditure and hospital bed supply may also be driven by supply-side factors, including reimbursement systems and regulatory frameworks, rather than demand alone.

Third, the analyses were not fully adjusted for important confounders, such as socioeconomic conditions, health behaviors, disease prevalence, healthcare workforce distribution, and regional policies. Observed sex-specific associations may therefore reflect differences in healthcare-seeking behavior or broader social determinants rather than direct effects of healthcare supply. In addition, the cross-sectional design limits the ability to assess temporal relationships and causal pathways. Future studies incorporating age-adjusted healthcare expenditure, disease structure, and longitudinal data would allow for more robust causal inference.

Fourth, the case of Yubari City represents an extreme and context-specific example of hospital downsizing following municipal bankruptcy and should be interpreted as an illustrative policy experiment rather than a generalizable model. Its small population, strong community cohesion, and proximity to tertiary care facilities may partly explain the relative stability of mortality indicators. However, the lack of age-adjusted mortality rates is a critical limitation; increases in crude mortality may reflect population aging rather than true deterioration in health outcomes, substantially weakening the strength of the conclusions. In addition, the study does not adequately account for selection bias due to population movement. Patterns of migration among healthier older adults and those requiring long-term care could substantially influence observed mortality and expenditure trends, yet such effects—including the “healthy migrant effect” and selective survival—were not examined. The absence of a formal comparison group further limits causal interpretation, as observed changes may be attributable to broader national trends, demographic shifts, or other unmeasured factors.

Finally, the analysis of healthcare and long-term care expenditures does not sufficiently consider institutional and structural determinants, such as differences in benefit coverage, insurance systems, and service provision. Simple comparisons of expenditure proportions are therefore insufficient to explain the relatively higher share of long-term care costs observed in Yubari.

Therefore, our findings should be interpreted as hypothesis-generating rather than conclusive evidence, given the ecological design and potential residual confounding.

Conclusion

This narrative review suggests that an oversupply of hospital beds, particularly in regions with limited physician availability, may lead to inefficiencies without clear health benefits. The experience of Yubari City illustrates that well-coordinated, community-based care supported by hospital generalists can sustain population health even after substantial hospital downsizing, although its unique context warrants cautious interpretation.

In Japan, policy initiatives such as the Regional Healthcare Vision provide a framework for rural bed planning through functional differentiation of hospitals. Our findings indicate that regionally tailored strategies, combined with strengthened primary and generalist care, may help maintain health outcomes while reducing reliance on excess inpatient capacity. Future studies using more robust designs and quantitative data on generalist physicians are needed to clarify system-level effects.

Importantly, healthcare policy should move beyond a narrow focus on cost containment and infrastructure preservation toward approaches that emphasize access, quality, and population needs. Refining data-driven, region-specific strategies in collaboration with frontline professionals may enhance sustainability in Japan and offer lessons for other aging societies.

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