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The Dynamics of Population Aging and Public Health Expenditure on Economic Growth: An Empirical Study in the Asia-Pacific Region

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Abstract

In recent years, empirical studies on population aging have gained significant attention as it has become a major global issue facing both developed and developing countries. Population aging has the potential to exert adverse effects by decreasing labor force participation and productivity among the elderly, as well as causing imbalances between savings and investment that may lead to economic stagnation. Meanwhile, good health plays a crucial role in enhancing human resource quality and economic productivity. The objective of this empirical study is to explore the relationship between population aging, public health expenditure, and economic growth. Utilizing a panel data regression model, this study analyzes data from 30 countries in the Asia-Pacific region over the 2008–2022 period. Based on secondary data sourced from the World Bank, the estimation results clearly demonstrate that population aging is detrimental to a country's economic growth, whereas public health expenditure yields a significant positive impact on economic growth in the Asia-Pacific region. This research is expected to serve as a reference for policymakers in designing strategies to enhance national resilience in facing demographic structural changes.

Keywords: Population Aging, Public Health Expenditure, Economic Growth, Asia-Pacific

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INTRODUCTION

Along with increasing life expectancy and declining birth rates, most countries worldwide are experiencing the phenomenon of rapid population aging (Heintz & Folbre, 2022; X. Yang et al., 2025; Yue et al., 2025). Population aging is

a condition characterized by an increasing proportion of elderly people (those aged 65 and over), while birth rates decline. Consequently, the number of individuals aged 65 and above is rising rapidly and is projected to reach 1.5 billion by 2050 (WHO, 2020).

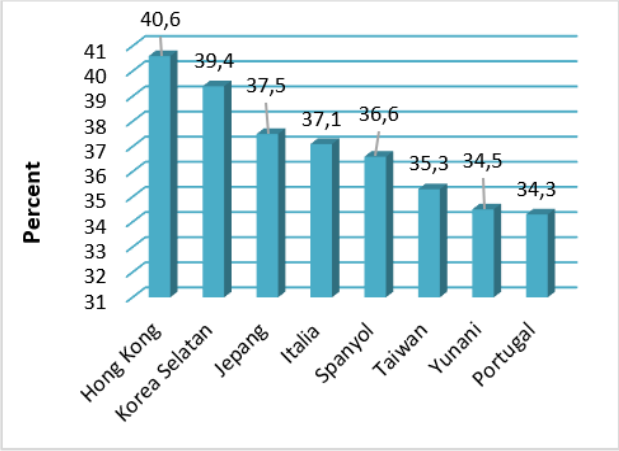

Figure 1. Projected countries with the highest number of people aged 65 and over in 2050
Source: United Nations Population Division, 2023

The decline in mortality and fertility rates has led various regions across the globe to undergo significant demographic structural changes. The Asia-Pacific region is one of the areas experiencing population aging more rapidly than any other region in the world (Economic and Social Commission for Asia and The Pacific, 2022). It is recorded that there are 630 million people aged 60 or older, representing 60 percent of the world's elderly population. By 2050, the elderly population in this region is expected to reach 1.3 billion, a threefold increase (Asian Development Bank, 2024).

Several countries, such as Japan, South Korea, Thailand, and China, are undergoing a very swift demographic transition. According to data from the World Health Organization (2024), in 2023, 29.56% of Japan's population consisted of individuals aged 65 and over, a proportion projected to rise to 38% by 2050.

Similarly, in South Korea, the demographic trend toward population aging is becoming increasingly evident, with the proportion of the population aged 65 or older predicted to increase from 15% in 2019 to 40% in 2050 (J.-W. Lee et al., 2020). For China, the population aged 65 and over is estimated to reach 35% of the total population by 2050. Meanwhile, in 2023, out of Thailand's total population of 67 million, 12 million were elderly, and this figure is expected to continue rising, reaching 28% in the next decade (WHO, 2023).

One of the major impacts of population aging is the decline in the potential support ratio. The potential support ratio is the comparison between the number of people of productive age (15–64 years) and the elderly population (65 years and over). A shrinking potential support ratio indicates that there are fewer productive-age individuals or workers relative to the non-productive population they must support.

It is undeniable that, compared to the productive-age population, the elderly participate less actively in the labor force and possess lower productivity levels. Consequently, an aging population can slow economic growth because the effectiveness of labor participation decreases, which in turn reduces investment and consumption patterns (Maestas et al., 2023; A. Mason & Lee, 2022).

Human resources are a vital component in driving sustainable economic growth. Health is a fundamental attribute that human resources must possess to stimulate economic growth during the demographic transition. The

increasing aging of the population will impact the labor market, specifically concerning productivity, as a significant portion of the workforce consists of elderly individuals (Kim & Song Lee, 2023). Elderly workers inevitably face health issues, physical limitations, and diminished cognitive abilities, all of which significantly affect their productivity.

Rising health problems and diseases among elderly workers can lead to absenteeism and decreased performance. However, Aiyar & Ebeke (2017) suggest that population aging does not always result in a decline in productivity if it is offset by government-supported health expenditures. Thus, health expenditure can significantly influence economic growth. Integrated public health expenditure within social security systems can encourage productive labor participation, improve public health conditions, and accelerate economic development.

Tiffen (1995) and Mason & Finegold (1997) state that the demographic transition is a key factor influencing economic productivity growth. In addition to the demographic transition, public health expenditure is a significant component of economic growth. Several theories and empirical studies provide insights into the interaction between the demographic transition, public health expenditure, and GDP growth.

According to the Solow Growth Theory, economic growth is influenced by the availability of production factors, including labor, population, and capital accumulation (Todaro & Smith, 2014). This implies that changes in production factors, such as population, will affect the rate of economic growth. Furthermore, the Endogenous Growth Theory developed by Romer (1986) and Lucas (1988) contributes to the understanding of the sources of economic growth. Endogenous growth theory emphasizes human capital, such as skills and development. In this theory, investment in human and physical capital plays a crucial role in determining long-term economic growth and encourages stakeholders to be proactive in formulating public policies to spur economic development through investments in human resource quality.

To date, research findings regarding the impact of population aging and public health expenditure on economic growth have yielded varying results. Thanh Trong et al. (2024) conducted a study in seven ASEAN countries to examine the dynamic relationship between population aging and economic growth; their results indicate that a 1% increase in the elderly dependency ratio leads to a 0.91% decline in economic growth.

Furthermore, several studies utilizing the GMM (Generalized Method of Moments) method found that population aging has a significant negative impact on economic growth. This is attributed to the fact that an increase in the elderly dependency ratio has been proven to reduce working hours, ultimately suppressing GDP growth (Y. Liu et al., 2023; C.-Y. Park et al., 2020; D. Park & Shin, 2023).

Similarly, research conducted across 74 developing countries from 1990 to 2019 using static panel estimation showed consistent results, demonstrating that population aging has a significant negative influence on economic growth in these nations (Lai & Yip, 2022). H.-H. Lee & Shin (2019) performed an empirical study on 142 countries and found that population aging significantly impedes economic growth when the proportion of the population aged 65 and over exceeds 10% of the total population;

specifically, a 1% increase in the elderly proportion reduces the long-term economic growth rate by 2%.

Additionally, Huang et al. (2019) conducted research in Taiwan using the panel data OLS method, showing that the elderly dependency ratio adversely affects economic growth. Conversely, by employing 2SLS and GMM models, a study of 145 countries between 1950 and 2015 found that while population aging does slow economic growth, the impact can be mitigated through health incentives for the elderly, ensuring they remain productive and healthy (Kotschy & Bloom, 2023).

Y. Yang et al. (2021) examined the same topic across 186 countries using the Least Squares Dummy Variable (LSDV) method and TSLS; the results of the study revealed a significant inverted U-shaped relationship between population aging and economic growth. This inverted U-shaped relationship implies that in the initial stages of population aging, economic growth experiences an increase, but subsequently declines as the elderly population in a region continues to grow.

However, several other studies on the same topic have shown different results. Wang (2025) conducted research in 15 countries to explain the impact of population aging on economic growth. Utilizing ARDL and GMM methods, the study's ARDL estimates showed a positive impact of population aging on economic growth in 10 out of the 15 sampled countries, while GMM estimates yielded similar findings in 12 out of the 15 countries.

Other researchers have conducted studies in China and the Middle East to determine whether population aging yields a positive or negative impact on economic growth; the estimation results indicate that population aging has a positive influence on economic growth (Bawazir et al., 2020; Chen et al., 2022; Zhao et al., 2018). Another study conducted in Europe and the Americas using the Vector Autoregression (VAR) approach showed that Granger causality tests found a unidirectional relationship from the economy to the elderly population in Europe and North America. Conversely, in South America, economic growth was found to have a negative impact as the proportion of the elderly population continues to increase (Jayawardhana et al., 2023, 2025).

A number of studies distinguish the impact of demographic structural changes on economic growth between developed and developing countries. In developed nations, an increasing proportion of middle-aged workers tends to drive economic growth, supported by robust institutions, investment, and education. Conversely, in developing countries, an increase in the elderly age group exerts a negative, albeit insignificant, influence.

Nevertheless, population aging still holds the potential to yield positive impacts if accompanied by the strengthening of human capital. Another study of 72 countries indicates that in the short term, an increasing elderly population can stimulate economic growth; however, in the long term, this effect turns negative once the proportion of the elderly population surpasses a certain threshold (Ahmad & Khan, 2019; Emerson et al., 2024; Lobo & Falleiro, 2024; Wongboonsin & Phiromswad, 2017).

Regarding the influence of public health expenditure on economic growth, previous studies have also yielded diverse findings. Sosvilla-Rivero et al. (2025) utilized the ARDL approach to investigate the short-term and long-term impacts of public spending on economic

growth. Conducted across 28 European countries, the estimation results indicate that health spending contributes positively to the increase in economic output in the long run. In the context of China, a study employing the Spatial Durbin Model conducted an analysis using three types of spatial weight matrices: economic distance-based, 0-1 spatial weight, and geographic distance.

The findings demonstrate that government health expenditure has a significant positive effect on economic growth when using economic distance weights, compared to 0-1 spatial weights or geographic distance weights. The resulting direct effects consistently exhibit the same pattern (Zhang et al., 2020). Other research utilizing the Vector Error Correction Model (VECM) in Saudi Arabia and Turkey also showed similar results, indicating a long-term relationship between GDP per capita and health expenditure per capita.

Conversely, the Granger causality test results produced different relationships: a unidirectional short-term relationship was found in Turkey, while no significant direct short-term causal relationship was found in Saudi Arabia (Esen & Çelik Keçili, 2022; Islam et al., 2023). These findings stand in contrast to the study by Hu & Wang (2024) involving 33 OECD countries.

Using a Dynamic Panel Threshold Model as the analytical tool, the estimation results revealed that the impact of public health expenditure on economic growth is significantly negative; however, when consumption exceeds a threshold of 9.63%, the impact becomes positive. Similarly, when employee wages are below the 10.57% threshold, the impact of public health expenditure on economic growth is significantly negative, turning positive once the threshold exceeds 10.57%.

Based on the findings of previous studies and the existing discrepancies in research results, as well as the fact that research on population aging and public health expenditure has primarily focused on developed nations, developing countries, the European region, and specific Asian countries, the author is inspired to conduct a similar study focusing on 30 countries in the Asia-Pacific region.

According to data from the United Nations (2025), there are 55 countries in the Asia-Pacific region; however, this study selects only 30 countries due to data availability constraints. Furthermore, the novelty of this research lies in the inclusion of institutional factors as a control variable, using the Worldwide Governance Indicators (WGI) as a proxy.

The author believes that institutional factors also play a significant role in driving economic growth. Utilizing panel data regression analysis, this study aims to explore the relationship between population aging, public health expenditure, and economic growth. The results of this study are expected to provide valuable insights for policymakers in formulating strategies to strengthen national resilience in facing demographic shifts.

RESEARCH METHODS

The method employed in this study is panel data regression analysis, specifically a static panel analysis. According to Gujarati & Porter (2009), compared to time-series and cross-sectional data, panel data analysis provides greater data variation and lower collinearity among variables. In panel data analysis, there are two primary models: the Fixed Effect Model (FEM) and the Random Effect Model (REM). The FEM assumes that individual differences are captured through variations in the intercept,

whereas the REM assumes that individual intercept differences are stochastic or random in nature (Widarjono, 2018). This study utilizes secondary data sourced from the World Bank, focusing on 30 countries in the Asia-Pacific region over the period from 2008 to 2022. The data processing for this research was conducted using Stata 17 software. Gross Domestic Product (GDP) per capita growth, as a proxy for economic growth, serves as the dependent variable.

Table 1. Operational Definitions of Variables

Variables	Factor	Sign	Variables	Unit	Source
Dependent Variable	Economic Growth	GDP	GDP per capita growth	%	World Bank
Independent Variables	Population Aging	AGE	Old-age dependency	%	World Bank
	Public Health Expenditure	GHE	Domestic general government health expenditure	%	World Bank
Control Variables	Trade	TO	Trade Openness	%	World Bank
	Investment	INV	Gross capital formation (% of GDP)	%	World Bank
	Institutions	INST	The average score of 6 indicators		World Bank

Source: Data processed, 2025

The independent variables include population aging, proxied by the old-age dependency ratio (% of working-age population), and public health expenditure, proxied by domestic general government health expenditure (% of GDP). Additionally, control variables include free trade, investment, and institutions, with the latter proxied by the Worldwide Governance Indicators (WGI).

This index is commonly used to measure institutional effectiveness across countries. In this study, institutional quality is measured using the six main dimensions of the WGI: Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. Each indicator ranges from -2.5 to 2.5. These six values are subsequently averaged and compiled into a single variable named INST, reflecting a country's institutional condition. A higher score indicates better governance quality. The regression model for this study is formulated as follows:

$$GDP_{it} = \beta_0 + \beta_1 AGE_{it} + \beta_2 GHE_{it} + \beta_3 TO_{it} + \beta_4 INV_{it} + \beta_5 INST_{it} + \varepsilon_{it}$$

Where GDP is economic growth, AGE is population ageing, GHE is public health expenditure, TO is trade openness, INV is investment, INST is institutions, i is cross-section, namely 30 countries in Asia-Pacific, t is the time period, namely 2008 to 2022.

In panel data regression, there are three approaches, namely the Fixed Effect, Random Effect, and Common Effect models. The determination of the most appropriate model to be used in the study is conducted using the Chow test, Hausman test, and Lagrange Multiplier test. After the best model is obtained, the next step is to perform statistical tests including the coefficient of determination test, F-test, and t-test.

RESULTS AND DISCUSSION

There are three stages in panel data processing, namely the Chow test, the Hausman test, and the lagrange multiplier (LM) test. The first step in panel data regression analysis is to perform a Chow test, which is used to select whether the common effect model or the fixed effect model is more suitable for the research.

Table 2. Chow Test Estimation Results

GDP	Coefficient	Std.err	t	P > t
AGE	-0.5310707	0.03938	-13.48	0.00
GHE	0.6536331	0.09014	7.25	0.00
TO	0.0561827	0.00428	13.12	0.00
INV	0.1030054	0.01278	8.05	0.00
INST	2.68832	0.31098	8.64	0.00
_cons	-2.656008	0.73526	-3.61	0.00
R-squared				
within	0.5536			
Between	0.8914			
Overall	0.8558			
Prob > F	0.0000			

Source: Data processed, 2025

The significance level used in this study is 5%. In the Chow test approach, a model is said to be more suitable for using a common effect model than a fixed effect model if the probability value is greater than the alpha value. Meanwhile, a model is said to be more suitable for using a fixed effect model in a Chow test if the probability value is smaller than the alpha value. So, the research model is more suitable for using a common effect model if the probability value is > 0.05, and a model is more suitable for using a fixed effect model if the probability value is < 0.05.

Table 3. Hausman Test Estimation Results

GDP	Coefficience (b) Fe	(B) re	(b-B) Difference
AGE	-0.53107	-0.52900	-0.002066
GHE	0.653633	0.694422	-0.040789
TO	0.056182	0.058914	-0.0027317
INV	0.103005	0.109156	-0.0061513
INST	2.68832	2.62681	0.0615035
Chi2(5)	5.71		
Prob > chi2	0.3352		

Source: Data processed, 2025

Based on the results of the Chow test estimation in Table 2, it can be seen that the Chow test estimation obtained a probability value of 0.0000, which is smaller than the significance value (0.0000 < 0.05), so it can be concluded that the best model chosen is the fixed effect model.

The next step to be taken after conducting the Chow test is to conduct a further Hausman test. The Langrange multiple (LM) test is not performed because when conducting the Chow test, the estimation results indicate that the fixed effect model is the best, so the follow-up test that must be performed is the Hausman test. The Hausman test is used to select the best model by comparing the fixed effect model and the random effect model.

In the Hausman test, a model is said to be more suitable or the best choice if the chi-square probability value is less than alpha, which is 0.05. Then, if the chi-square probability in the Hausman test finds a value greater than alpha 0.05, the best model to choose is the random effect model. Based on the Hausman test in Table 3, the Hausman test estimation results obtained a chi-square probability value of 0.3325, meaning that the chi-square probability value is greater than alpha 5% (0.3325 > 0.05). From these findings, it can be concluded that in this Hausman test, the best model that can be selected and used in the study is the random effect model when compared to the fixed effect model.

Table 4. Random Effect Model Estimation Results

GDP	Coefficienct	Std.err.	z	P > z
AGE	-0.5290042	0.0343512	-15.40	0.000
GHE	0.6944226	0.0748002	9.28	0.000
TO	0.0589144	0.0037082	15.89	0.000
INV	0.1091566	0.0121267	10.08	0.000
INST	2.626817	0.260689	9.00	0.000
_cons	-3.218682	0.7017467	-4.59	0.000
F-Statistic Probability	0.0000			
R-squared	0.8597			

Source: Data processed, 2025

Next, it is necessary to test the coefficient of determination. The purpose of the coefficient of determination test itself is to determine how comprehensive the independent variables are to the dependent variables. In the random effect model estimation results in Table 4, it is known that the R-square estimate is 0.8597, which means that the independent variables, which include population ageing and public health expenditure, as well as control variables, which include open trade, investment, and institutions, affect economic growth by 85.97%, while the remaining 14.03% is influenced by other factors outside the model.

Then, an F-test was conducted to determine the overall effect of the independent variables on the dependent variable. In Table 4, the F-statistic probability produced a value of 0.0000, which is smaller than alpha 5% (0.0000 < 0.05), meaning that the independent variables in the study, namely population ageing and public health expenditure, as well as the control variables, which include open trade, investment, and institutions, influence economic growth simultaneously.

Table 4 also presents the estimates from the t-test, which determines the individual effect of each independent variable on the dependent variable. The significance level chosen for this study is 5%. Based on the Random Effect Model (REM) estimation results in Table 4, the findings indicate that population aging has a significant negative impact on economic growth.

Specifically, a 1% increase in the elderly population leads to a 0.5290% decrease in economic growth, assuming ceteris paribus. Conversely, if the elderly population decreases by 1%, economic growth will increase by

0.5290%, assuming ceteris paribus. These findings suggest that population aging can lead to a decline in the proportion of the working-age population and the labor force growth rate. Simultaneously, an aging population implies changes in overall societal productivity levels. This can indirectly hinder economic growth by increasing labor costs.

Furthermore, a higher proportion of elderly individuals relative to the productive-age population can lower national savings rates, as elderly citizens generally have a lower motivation to save. A decline in savings reduces the level of physical capital investment, which in turn diminishes economic growth. This creates a double pressure: declining government revenue and increasing social security expenditures for the elderly—such as medical care and old-age pensions—which can burden and limit the government's capacity to manage investments.

Additionally, population aging may lead to a decrease in interest rates. Capital tends to flow from countries with higher aging rates toward those with relatively lower aging rates (W. F. Liu & Warwick, 2020). Many studies show results consistent with this research, including those conducted by Emerson et al. (2024), Huang et al. (2019), Kotschy & Bloom (2023), Lai & Yip (2022), H.-H. Lee & Shin (2019), Y. Liu et al. (2023), C.-Y. Park et al. (2020), D. Park & Shin (2023), Thanh Trong et al. (2024), and Y. Yang et al. (2021).

The findings of this study also align with the Solow Growth Theory (1956), which posits that economic growth is influenced by the availability of production factors, including labor, population, and capital accumulation. A population with a larger proportion of elderly individuals will naturally lead to a decline in productivity and consumption levels, which ultimately hampers a nation's economic growth.

Meanwhile, public health expenditure shows a significant positive correlation with economic growth, as indicated by a t-statistic probability of 0.0000, which is smaller than the 5% alpha level (0.0000 < 0.05). The coefficient itself stands at 0.6944. From these results, it can be concluded that a 1% increase in public health expenditure will lead to a 0.6944% increase in economic growth, assuming ceteris paribus.

Conversely, a 1% decrease in public health expenditure will result in a 0.6944% decline in economic growth, assuming ceteris paribus. These findings imply that the magnitude of health funding allocated by governments in the Asia-Pacific region significantly influences economic growth. The positive and significant impact of public health expenditure suggests that governments should implement policies that encourage health insurance spending to create a more stable and productive economy, which subsequently impacts national economic growth (Seo et al., 2019).

Gaies (2022) states that in economies characterized by low human capital and productivity, investments in the health sector—whether managed by the public or private sector—yield significant benefits. This is based on the premise that good individual health allows people to work and learn more optimally, ultimately contributing to increased productivity and economic output.

The results of this study are consistent with several previous studies, which found that public health expenditure has a positive and significant influence on economic growth (Esen & Çelik Keçili, 2022; Sosvilla-Rivero et al., 2025; Y. Yang et al., 2021; Zhang et al., 2020). Furthermore, these findings align with the Endogenous Growth Theory proposed by Romer (1986) and Lucas (1988). This theory posits that

investment in both human and physical capital is a fundamental factor determining long-term economic growth. Additionally, the theory emphasizes the importance of active stakeholder engagement in formulating public policies oriented toward economic development, particularly through strengthening investments aimed at improving the quality of human resource capabilities.

Furthermore, several control variables incorporated into the empirical model, including trade openness, investment, and institutions, are proven to exert a positive and significant influence on economic growth in the Asia-Pacific region. Specifically, the estimated coefficient for trade openness indicates a unidirectional relationship with economic growth. A coefficient value of 0.0589 implies that if trade openness increases by 1%, economic growth will rise by 0.0589%, assuming ceteris paribus.

Trade openness allows a country to optimize the potential of various leading sectors through production specialization, thereby reducing production costs and increasing productivity. Moreover, integration with international markets expands marketing opportunities for domestic products, which in turn encourages an increase in production capacity and national output.

Trade openness also serves as a vehicle for technology and knowledge diffusion through the import of advanced capital goods and intermediate inputs, resulting in enhanced economic efficiency and competitiveness. These mechanisms establish trade openness as a crucial factor in supporting economic growth, particularly in the long term. Several studies have similarly revealed a significant positive relationship between trade openness and economic growth (Gold & Tregenna, 2024; Ji et al., 2022; Sunde et al., 2023; Yu & Gu, 2025).

Investment also exerts a significant positive influence on economic growth. The coefficient yields a value of 0.1091, meaning that if investment increases by 1%, economic growth will rise by 0.1091%, assuming ceteris paribus. Khan et al. (2017) reveal that investment is a vital factor linking the dynamics of a country's economic growth across the past, present, and future.

The role of investment is not limited to the reconstruction of production capacity but also serves as a primary driver of economic development. Economies capable of attracting investment from both domestic and foreign actors tend to have a stronger impetus for generating economic growth. Empirical findings demonstrate that investment levels have a positive and significant relationship with the economy, aligning with previous studies conducted by Awodumi & Adewuyi (2020), Erum & Hussain (2019), S. Khan et al. (2019), Pasara & Garidzirai (2020), and Rahman & Velayutham (2020).

Furthermore, institutions also have a significant positive impact on economic growth. The institutional quality within a country is a crucial element, as a nation's prosperity is determined not only by geographical conditions, culture, natural resources, and other factors but also by the quality of its institutions.

The results of this study indicate that if the institutional score increases by 1 point, economic growth will increase by 2.6268, assuming ceteris paribus. The findings of this study are consistent with several previous studies (Acquah et al., 2023; Alexiou et al., 2020; de Almeida et al., 2024; Hussen, 2023; Thanh Trong et al., 2024), which reveal that institutions

have a significant positive effect on economic growth.

CONCLUSION

Population aging has become a global issue in recent years, and the Asia–Pacific region is one of the regions experiencing the fastest population aging compared to other parts of the world. Demographic transition characterized by a large proportion of elderly population inevitably leads to a decline in productivity and consumption, thereby hindering a country's economic growth. In addition, health is a crucial factor in supporting the quality of human resources, as a healthy population promotes higher productivity, which in turn contributes to increased economic growth.

This study focuses on 30 countries in the Asia–Pacific region over the period from 2008 to 2022. The data used in this study are secondary data sourced from the World Bank, with the objective of exploring the relationship between population aging and public health expenditure on economic growth.

Panel data regression analysis is employed as the research method, and the estimation results reveal that population aging has a significant negative effect on economic growth, while public health expenditure has a significant positive effect on economic growth. Meanwhile, the control variables—trade openness, investment, and institutional quality—show significant positive effects on economic growth.

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