

## Preplanned Studies

## Trends and Distribution of Life Expectancy and Health-Adjusted Life Expectancy — Asia-Pacific Region, 1990–2021

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### Summary

#### What is already known about this topic?

The Asia-Pacific region is the most populous and diverse globally, encompassing nations with both the longest and shortest life expectancies (LE). However, less is known about the health-adjusted life expectancy (HALE) situation in this region.

#### What is added by this report?

This study found diversity in the levels and trends of HALE among countries in the Asia-Pacific region, with HALE in 2021 ranging from 49.87 years in Afghanistan to 74.96 years in Singapore. The largest HALE increase from 1990 to 2021 was observed in the Lao People's Democratic Republic and the smallest in Fiji. HALE continually increased as SDI increased, but different patterns of HALE across countries varied by SDI level.

#### What are the implications for public health practice?

The diversity among these countries provides a prerequisite and scientific basis for promoting the achievement of health goals in the Asia-Pacific region through multilateral and bilateral cooperation.

In recent decades, global total life expectancy (LE) has increased rapidly, from 65.49 years in 1990 to 71.74 in 2021, but the corresponding health-adjusted life expectancy (HALE) has grown relatively slowly, or even stagnated, from 57.05 years in 1990 to 62.20 years in 2021 (1). Although significant progress has been made in understanding and eliminating fatal diseases, research on the impact of mild and non-fatal diseases on lifespan has lagged. In the context of rapid population aging and health transitions, delaying the onset of functional impairment and shortening the period of dependency are critical to improving quality of life. Enhancing HALE, focusing more on quality of life, and narrowing the gap between LE and HALE are the common goal in the global health field.

The Asia-Pacific region is the most populous and diverse region in the world. It includes populous

countries such as China, India, and Bangladesh, and also nations with the longest LE, such as Japan, Singapore, and the Republic of Korea. The region also includes areas like Afghanistan, which faces severe political and cultural conflicts and health threats, as well as regions like Fiji, which is threatened by metabolic and chronic diseases, and Papua New Guinea, with threats from communicable diseases, such as malaria. Analyzing the geographic distribution and trends in HALE in the Asia-Pacific region can reveal health disparities between different countries and regions, helping to understand the impact of various social, economic, cultural, and environmental factors on health. This study analyzed the distribution of HALE in different countries within the Asia-Pacific region, as well as trends in HALE changes from 1990 to 2021. Additionally, it examines the distribution of HALE and its changing trends across different SDI regions. The research results can provide references for contributing to the realization of the Putrajaya Vision of the Asia-Pacific region, including through the Aotearoa Plan of Action of “fostering quality growth that brings palpable benefits and greater health and wellbeing to all” and “preventing, detecting, responding to, and recovering from, pandemics.”

Data on LE and HALE were obtained from the Global Burden of Disease Study (GBD) 2021 (<https://vizhub.healthdata.org/gbd-results/>). GBD 2021 provided a standardized and comprehensive assessment of the global burden of 371 diseases and injuries in 204 countries and territories, using data sources identified from vital registration, verbal autopsy, registry, survey, police, and surveillance data across all countries and territories (2). This study focused on LE and HALE across the Asia-Pacific region and selected 29 major countries for analysis [data for China did not include Hong Kong Special Administrative Region (SAR), Macau SAR, or Taiwan, China] (3). LE was calculated using life tables, and HALE was estimated using Sullivan's method (4), one of the most widely used methods to compute HALE. Although criticized for excluding the possibility of

recovering from disability to health, Sullivan's method can produce reliable estimations of health expectancy if no sudden or significant health events occur (5).

The estimated annual percentage change (EAPC) was determined using linear regression, formulated as  $y = \alpha + \beta x + \varepsilon$ , where  $x = \text{year}$  and  $y = \ln(\text{rate})$ . The EAPC was calculated using the formula  $100 \times (e^{\beta} - 1)$ . LE and HALE were considered to increase if the EAPC value and the lower limit of the 95% confidence interval (CI) were above 0. Conversely, LE and HALE were considered to decrease if the EAPC value and the upper limit of the 95% CI were below 0. Otherwise, LE and HALE were considered stable over time. A joinpoint regression model with natural log-transformed rates was used to analyze the LE and HALE of the 29 countries between 1990 and 2021. A grid search method (GSM) and Monte Carlo permutation test were used to distinguish periods. This analysis was performed using the Joinpoint Regression Program (v4.9.10, Statistical Research and Applications Branch, National Cancer Institute, Washington, USA) (6–7). The sociodemographic index (SDI) is a socioeconomic indicator scored from 0 (worst) to 1 (best), measured by the total fertility rate of the population aged under 25 (TFU25), the average educational attainment of the population aged 15 and over (EDU15+), and the lag distribution of per capita income. Loess regression was employed to examine the association between LE or HALE and SDI. Data analysis and visualization were carried out using R version 4.3.3 (R Core Team, Vienna, Austria, 2024).

Across the Asia-Pacific region, LE at birth in 2021 ranged from 58.23 years [95% uncertainty interval (UI): 56.25, 60.27] in Afghanistan to 85.70 years (95% UI: 85.50, 85.90) in Singapore. HALE at birth in 2021 ranged from 49.87 years (95% UI: 46.94, 52.24) in Afghanistan to 74.96 years (95% UI: 71.74, 77.63) in Singapore. Afghanistan was the only country with LE at birth less than 60 years and HALE at birth less than 50 years in 2021. Five countries, including Singapore, Japan, the Republic of Korea, Australia, and New Zealand, had LEs above 80 years and HALEs above 70 years in 2021. Afghanistan, Papua New Guinea, Pakistan, and Fiji had the lowest LE and HALE in 2021. According to EAPC, LE and HALE at birth increased significantly from 1990 to 2021 in all the studied countries. The largest LE increase was observed in the Lao People's Democratic Republic (EAPC=0.93, 95% CI: 0.89, 0.97), and the smallest in the Philippines (EAPC=0.08, 95% CI: 0.04, 0.11). The largest HALE increase was observed

in the Lao People's Democratic Republic (EAPC=0.93, 95% CI: 0.89, 0.97), and the smallest in Fiji (EAPC=0.09, 95% CI: 0.07, 0.12). In addition, the EAPCs of HALE in the countries with the lowest LE and HALE were 0.58 (95% CI: 0.50, 0.66) for Afghanistan, 0.22 (95% CI: 0.19–0.25) for Papua New Guinea, and 0.25 (95% CI: 0.21, 0.29) for Pakistan (Table 1).

The Joinpoint regression analysis revealed that nearly all countries experienced increases in LE and HALE at birth from 1990 to 2021, with the average annual percentage change (AAPC) above zero. Exceptions included the Philippines, Fiji, and the Democratic People's Republic of Korea (DPRK) for LE, and Fiji and the DPRK for HALE (Figure 1). The patterns of change in LE and HALE in Asia-Pacific countries between 1990 and 2021 can be broadly categorized as: 1) continuous increases, such as in China, Bhutan, and Australia; 2) declines in the first few years followed by upward trends and subsequent declines in the last few years, such as in Fiji, Mongolia, and Pakistan; and 3) upward trends for most of the period followed by downward trends in the last few years, such as in Cambodia, Bangladesh, and Viet Nam (Table 2).

Figure 2 shows the association between LE and HALE at birth and SDI across Asia-Pacific countries in 2021. In the Asia-Pacific region, LE and HALE at birth continually increased as SDI increased, although the rate of increase slowed around an SDI of 0.6. Based solely on SDI, LE and HALE at birth were much higher than expected in Maldives and lower in Fiji (Figure 2A and C). Regarding HALE, among the four Asia-Pacific countries with the lowest SDI, three (Afghanistan, Nepal, and Papua New Guinea) showed an inverted-U-curve pattern, while one country (Timor-Leste) experienced increasing HALE at birth. There were three different patterns in low-middle SDI and middle SDI quintile countries: an inverted-U-curve in four countries (India, Pakistan, Philippines, and Indonesia), a U-curve pattern in four countries (DPRK, Fiji, Mongolia, and Thailand), and an increasing growth pattern in seven countries (Bangladesh, Bhutan, Cambodia, Lao People's Democratic Republic, Myanmar, Maldives, and Viet Nam). Of the countries with high-middle SDI, three (China, Malaysia, and Sri Lanka) exhibited an increasing pattern, while one country (Iran) showed an inverted-U-curve pattern. Of the six countries with the highest SDI, all (Australia, New Zealand, Japan, Republic of Korea, Singapore, and Brunei Darussalam)

TABLE 1. LE and HALE at birth in 2021 and EAPC of LE and HALE between 1990 and 2021 in Asia-Pacific countries.

Country	LE in 2021	HALE in 2021	EAPC of LE, 1990–2021 (95% CI)	EAPC of HALE, 1990–2021 (95% CI)
Afghanistan	58.23	49.87	0.58 (0.50, 0.66)	0.58 (0.50, 0.66)
Australia	83.41	70.79	0.27 (0.26, 0.29)	0.23 (0.22, 0.24)
Bangladesh	72.26	62.45	0.73 (0.67, 0.79)	0.72 (0.66, 0.78)
Bhutan	73.74	63.93	0.70 (0.65, 0.76)	0.69 (0.64, 0.75)
Brunei Darussalam	76.60	66.90	0.22 (0.19, 0.25)	0.19 (0.16, 0.22)
Cambodia	68.19	60.02	0.70 (0.65, 0.74)	0.73 (0.68, 0.78)
China	77.58	68.56	0.48 (0.46, 0.49)	0.45 (0.44, 0.47)
DPRK	73.27	65.25	0.40 (0.21, 0.58)	0.40 (0.21, 0.58)
Fiji	66.10	58.21	0.11 (0.08, 0.13)	0.09 (0.07, 0.12)
India	68.75	59.14	0.49 (0.46, 0.52)	0.51 (0.48, 0.54)
Indonesia	69.51	61.57	0.31 (0.28, 0.34)	0.33 (0.30, 0.36)
The Islamic Republic of Iran	74.37	63.82	0.38 (0.33, 0.43)	0.35 (0.30, 0.40)
Japan	85.15	73.84	0.23 (0.22, 0.24)	0.21 (0.20, 0.21)
Lao People's Democratic Republic	67.78	60.09	0.93 (0.89, 0.97)	0.93 (0.89, 0.97)
Malaysia	72.87	64.01	0.12 (0.09, 0.15)	0.12 (0.09, 0.14)
Maldives	79.41	69.33	0.68 (0.62, 0.74)	0.66 (0.60, 0.72)
Mongolia	70.05	61.28	0.50 (0.47, 0.53)	0.48 (0.45, 0.51)
Myanmar	67.63	59.59	0.80 (0.73, 0.88)	0.80 (0.73, 0.87)
Nepal	68.38	58.98	0.62 (0.53, 0.71)	0.64 (0.55, 0.72)
New Zealand	82.44	70.14	0.29 (0.27, 0.31)	0.27 (0.25, 0.29)
Pakistan	64.96	56.22	0.26 (0.22, 0.30)	0.25 (0.21, 0.29)
Papua New Guinea	63.49	55.91	0.21 (0.18, 0.24)	0.22 (0.19, 0.25)
Philippines	68.27	60.17	0.08 (0.04, 0.11)	0.11 (0.07, 0.14)
Republic of Korea	83.23	72.05	0.51 (0.48, 0.53)	0.45 (0.43, 0.47)
Singapore	85.70	74.96	0.43 (0.42, 0.44)	0.39 (0.38, 0.40)
Sri Lanka	76.60	66.27	0.35 (0.30, 0.41)	0.32 (0.27, 0.37)
Thailand	76.28	66.54	0.38 (0.33, 0.42)	0.36 (0.32, 0.40)
Timor-Leste	68.58	60.14	0.58 (0.48, 0.68)	0.62 (0.52, 0.72)
Viet Nam	74.00	65.61	0.20 (0.19, 0.22)	0.22 (0.20, 0.24)

Abbreviation: LE=life expectancy; HALE=health-adjusted life expectancy; EAPC=estimated annual percentage change; DPRK=Democratic People's Republic of Korea.

experienced a growth pattern (Figure 2D). Similarly, LE also exhibited a comparable association with SDI across these countries in the Asia-Pacific region.

## DISCUSSION

We found that LE and HALE ranges varied significantly across countries in the Asia-Pacific region, with regional HALE in 2021 ranging from 49.87 to 74.96 years. HALEs in Pakistan and Afghanistan were below 60 years, with conflicts leading to substantial declines in LE and HALE or causing severe economic setbacks. Studies suggest that these countries may

require several years or even decades to return to pre-conflict development levels (8). Papua New Guinea, Nepal, and other regional areas currently have relatively low HALEs associated with threats such as local infectious and non-communicable diseases. Moreover, HALE trends in the Asia-Pacific region show regional disparities. Regions experiencing rapid HALE increases include Myanmar and Laos, where progress in combating diseases like diarrhea, tuberculosis, lower respiratory infections, HIV/AIDS, and measles is likely the most significant factor contributing to rising HALE in these areas (2). Some countries, like Fiji and Mongolia, experienced

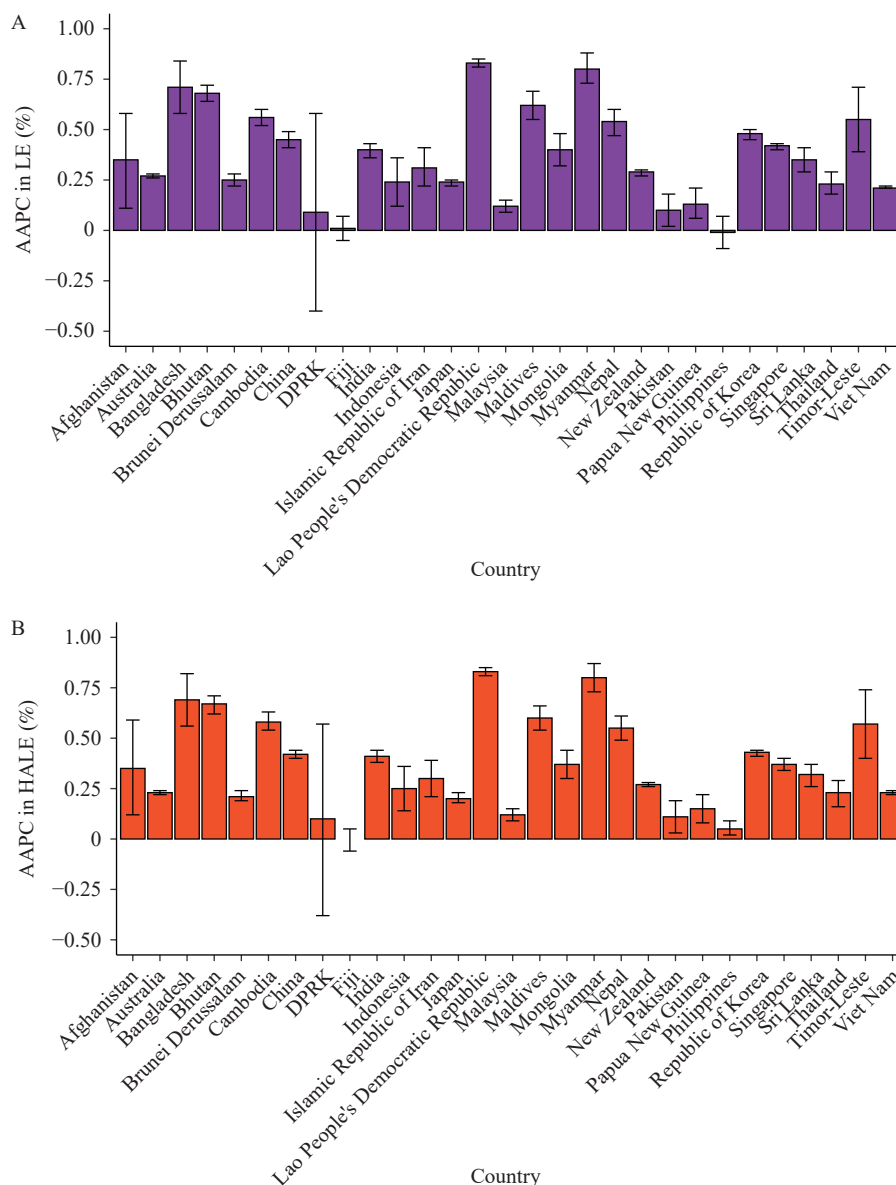


FIGURE 1. Joinpoint analysis of LE (A) and HALE (B) in individuals at birth across Asia-Pacific countries, 1990 to 2021. Abbreviation: AAPC=average annual percent change; LE=life expectancy; HALE=health-adjusted life expectancy; DPRK=Democratic People's Republic of Korea.

declining LE and HALE in the early 1990s, followed by gradual increases by the mid-to-late 1990s, possibly related to local economic development, public health standards, and infectious disease control. This suggests that, with socioeconomic development, countries with currently lower LE, HALE, or SDI can also gradually increase their LE and HALE. Furthermore, this study found that most countries experienced LE and HALE declines starting in 2019 or 2020, likely due to the impact of the COVID-19 pandemic. Against this backdrop, China managed to maintain increasing LE and HALE, indicating that the Chinese government's experience in dealing with pandemics is worth learning

from (9).

We observed that HALE rises with increasing socio-demographic index (SDI) levels. However, the rate of HALE increase differs between regions with higher and lower SDI levels. In regions with higher SDI levels, HALE tends to increase more rapidly with rising SDI, while in lower SDI regions, although HALE is increasing, the rate of increase is slowing. This discrepancy may be attributed to factors such as better healthcare coverage, improved sanitation and hygiene practices, higher levels of education, and increased awareness of preventive health measures in regions with higher SDI levels (10). Conversely, regions with lower

TABLE 2. Joinpoint analysis of LE and HALE at birth across Asia-Pacific countries, 1990 to 2021.

Categories	location	Total study period						Period 1		Period 2		Period 3		Period 4		Period 5		Period 6		
		Years		AAPC (%)		95% CI		Years		APC (%)		Years		APC (%)		Years		APC (%)		
		1990	2021	1990	2021	1990	2006	1990	2006	1995	1998	1995	1998	1998	2012	1998	2012	2012	2019	2012
	Afghanistan	52.47	58.23	0.35*	(0.11, 0.58)	1990-1995	0.64*	1995-1998	-0.76	1998-2012	1.01*	2012-2019	0.13	2019-2021	-2.53*	-	-	-	-	-
	Australia	76.84	83.41	0.27*	(0.26, 0.28)	1990-2006	0.36*	2006-2021	0.18*	-	-	-	-	-	-	-	-	-	-	-
	Bangladesh	58.91	72.26	0.71*	(0.58, 0.84)	1990-1994	1.67*	1994-2017	0.74*	2017-2021	-0.43	-	-	-	-	-	-	-	-	-
	Bhutan	60.16	73.74	0.68*	(0.64, 0.72)	1990-2004	0.98*	2004-2012	0.65*	2012-2021	0.25*	-	-	-	-	-	-	-	-	-
	Brunei Darussalam	71.20	76.60	0.25*	(0.22, 0.28)	1990-1996	0.48*	1996-2009	0.30*	2009-2016	-0.10*	2016-2021	0.34*	-	-	-	-	-	-	-
	Cambodia	57.45	68.19	0.56*	(0.52, 0.60)	1990-1999	0.40*	1999-2010	1.03*	2010-2019	0.43*	2019-2021	-0.70*	-	-	-	-	-	-	-
	China	67.67	77.58	0.45*	(0.41, 0.49)	1990-1999	0.49*	1999-2004	0.38*	2004-2007	0.85*	2007-2010	0.37*	2010-2015	0.53*	2015-2021	0.22*	-	-	-
	DPRK	69.88	73.27	0.09	(-0.40, 0.58)	1990-2000	-1.64	2000-2004	3.86*	2004-2021	0.24	-	-	-	-	-	-	-	-	-
	Fiji	66.26	66.10	0.01	(-0.05, 0.07)	1990-1997	-0.11*	1997-2019	0.17*	2019-2021	-1.32*	-	-	-	-	-	-	-	-	-
	India	60.80	68.75	0.40*	(0.36, 0.43)	1990-1998	0.46*	1998-2002	0.81*	2002-2019	0.46*	2019-2021	-1.25*	-	-	-	-	-	-	-
	Indonesia	64.01	69.51	0.24*	(0.12, 0.36)	1990-2019	0.34*	2019-2021	-1.15	-	-	-	-	-	-	-	-	-	-	-
	The Islamic Republic of Iran	67.51	74.37	0.31*	(0.22, 0.41)	1990-1992	1.91*	1992-2019	0.40*	2019-2021	-2.39*	-	-	-	-	-	-	-	-	-
	Japan	79.35	85.15	0.24*	(0.22, 0.25)	1990-2002	0.30*	2002-2021	0.20*	-	-	-	-	-	-	-	-	-	-	-
	Lao People's Democratic Republic	52.52	67.78	0.83*	(0.81, 0.85)	1990-1999	0.98*	1999-2012	1.08*	2012-2019	0.58*	2019-2021	-0.54*	-	-	-	-	-	-	-
	Malaysia	72.12	72.87	0.12*	(0.09, 0.15)	1990-2021	0.12*	-	-	-	-	-	-	-	-	-	-	-	-	-
	Maldives	65.67	79.41	0.62*	(0.55, 0.69)	1990-2007	0.94*	2007-2019	0.38*	2019-2021	-0.64	-	-	-	-	-	-	-	-	-
	Mongolia	62.51	70.05	0.40*	(0.32, 0.48)	1990-1995	-0.21	1995-2019	0.57*	2019-2021	-0.20	-	-	-	-	-	-	-	-	-
	Myanmar	55.06	67.63	0.80*	(0.73, 0.88)	1990-2021	0.80*	-	-	-	-	-	-	-	-	-	-	-	-	-
	Nepal	57.98	68.38	0.54*	(0.47, 0.60)	1990-2001	1.19*	2001-2006	0.67*	2006-2019	0.33*	2019-2021	-2.01*	-	-	-	-	-	-	-
	New Zealand	75.50	82.44	0.29*	(0.27, 0.30)	1990-2007	0.37*	2007-2021	0.19*	-	-	-	-	-	-	-	-	-	-	-
	Pakistan	62.50	64.96	0.10*	(0.02, 0.18)	1990-1997	-0.18*	1997-2019	0.38*	2019-2021	-1.90*	-	-	-	-	-	-	-	-	-
	Papua New Guinea	61.42	63.49	0.13*	(0.06, 0.21)	1990-1996	0.46*	1996-2006	0.10*	2006-2019	0.33*	2019-2021	-1.92*	-	-	-	-	-	-	-
	Philippines	68.45	68.27	-0.01	(-0.09, 0.07)	1990-2019	0.11*	2019-2021	-1.75*	-	-	-	-	-	-	-	-	-	-	-
	Republic of Korea	71.97	83.23	0.48*	(0.45, 0.50)	1990-1992	0.74*	1992-2003	0.56*	2003-2007	0.67*	2007-2015	0.44*	2015-2019	0.29*	2019-2021	-0.07	-	-	-
	Singapore	75.59	85.70	0.42*	(0.40, 0.43)	1990-2015	0.44*	2015-2021	0.30*	-	-	-	-	-	-	-	-	-	-	-
	Sri Lanka	69.62	76.60	0.35*	(0.29, 0.41)	1990-2021	0.35*	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thailand	71.02	76.28	0.23*	(0.18, 0.29)	1990-1996	-0.12*	1996-2004	0.34*	2004-2012	0.74*	2012-2019	0.15*	2019-2021	-0.85*	-	-	-	-	-
	Timor-Leste	59.30	68.58	0.55*	(0.39, 0.71)	1990-2008	0.89*	2008-2021	0.08	-	-	-	-	-	-	-	-	-	-	-
	Viet Nam	69.36	74.00	0.21*	(0.21, 0.22)	1990-2000	0.40*	2000-2010	0.09*	2010-2019	0.23*	2019-2021	-0.18*	-	-	-	-	-	-	-

LE at birth

Continued

Categories	location	Total study period										Period 1		Period 2		Period 3		Period 4		Period 5		Period 6	
		Years		AAPC (%)		95% CI		Years		APC (%)		Years		APC (%)		Years		APC (%)		Years		APC (%)	
		1990	2021	44.86	0.35*	(0.12, 0.59)	1990-1995	0.65*	1995-1998	-0.76	1998-2012	1.01*	2012-2019	0.12	2019-2021	-2.41*	-	-	-	-	-	-	-
	Afghanistan	44.86	0.35*	(0.12, 0.59)	1990-1995	0.65*	1995-1998	-0.76	1998-2012	1.01*	2012-2019	0.12	2019-2021	-2.41*	-	-	-	-	-	-	-	-	
	Australia	65.97	0.23*	(0.22, 0.24)	1990-2005	0.29*	2005-2021	0.17*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Bangladesh	51.02	0.69*	(0.56, 0.82)	1990-1995	1.53*	1995-2018	0.71*	2018-2021	-0.87	-	-	-	-	-	-	-	-	-	-	-	-	
	Bhutan	52.36	0.67*	(0.62, 0.71)	1990-2004	0.95*	2004-2012	0.66*	2012-2021	0.25*	-	-	-	-	-	-	-	-	-	-	-	-	
	Brunei Darussalam	62.88	0.21*	(0.19, 0.24)	1990-1996	0.44*	1996-2009	0.28*	2009-2016	-0.09*	2016-2021	0.21*	-	-	-	-	-	-	-	-	-	-	
	Cambodia	50.20	0.58*	(0.54, 0.63)	1990-1999	0.42*	1999-2008	1.09*	2008-2012	0.77*	2012-2019	0.41*	2019-2021	-0.68*	-	-	-	-	-	-	-	-	
	China	60.32	0.42*	(0.40, 0.44)	1990-1998	0.49*	1998-2004	0.41*	2004-2007	0.77*	2007-2015	0.44*	2015-2021	0.15*	-	-	-	-	-	-	-	-	
	DPRK	62.28	0.10	(-0.38, 0.57)	1990-2000	-1.59	2000-2004	3.86*	2004-2021	0.23	-	-	-	-	-	-	-	-	-	-	-	-	
	Fiji	58.51	0.00	(-0.06, 0.05)	1990-1997	-0.11*	1997-2019	0.16*	2019-2021	-1.36*	-	-	-	-	-	-	-	-	-	-	-	-	
	India	52.08	0.41*	(0.38, 0.44)	1990-1998	0.48*	1998-2002	0.79*	2002-2019	0.49*	2019-2021	-1.23*	-	-	-	-	-	-	-	-	-	-	
	Indonesia	56.46	0.25*	(0.14, 0.36)	1990-2019	0.36*	2019-2021	-1.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	The Islamic Republic of Iran	58.15	0.30*	(0.21, 0.39)	1990-1992	1.96*	1992-2019	0.37*	2019-2021	-2.19*	-	-	-	-	-	-	-	-	-	-	-	-	
	Japan	69.45	0.20*	(0.18, 0.23)	1990-2004	0.25*	2004-2011	0.13*	2011-2018	0.26*	2018-2021	0.03	-	-	-	-	-	-	-	-	-	-	
	Lao People's Democratic Republic	46.55	0.83*	(0.81, 0.85)	1990-1999	0.99*	1999-2012	1.07*	2012-2019	0.57*	2019-2021	-0.56*	-	-	-	-	-	-	-	-	-	-	
	Malaysia	63.22	0.12*	(0.09, 0.15)	1990-2021	0.12*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Maldives	57.65	0.60*	(0.54, 0.66)	1990-2007	0.93*	2007-2019	0.36*	2019-2021	-0.71	-	-	-	-	-	-	-	-	-	-	-	-	
	Mongolia	55.03	0.37*	(0.30, 0.44)	1990-1995	-0.18	1995-2019	0.55*	2019-2021	-0.34	-	-	-	-	-	-	-	-	-	-	-	-	
	Myanmar	48.63	0.80*	(0.73, 0.87)	1990-2021	0.80*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Nepal	49.77	0.55*	(0.49, 0.61)	1990-2000	1.19*	2000-2006	0.74*	2006-2019	0.37*	2019-2021	-2.02*	-	-	-	-	-	-	-	-	-	-	
	New Zealand	64.50	0.27*	(0.26, 0.28)	1990-2006	0.38*	2006-2021	0.15*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Pakistan	54.05	0.11*	(0.03, 0.19)	1990-1997	-0.14	1997-2019	0.35*	2019-2021	-1.72*	-	-	-	-	-	-	-	-	-	-	-	-	
	Papua New Guinea	53.82	0.15*	(0.08, 0.22)	1990-1996	0.46*	1996-2006	0.13*	2006-2019	0.32*	2019-2021	-1.74*	-	-	-	-	-	-	-	-	-	-	
	Philippines	59.67	0.05*	(0.02, 0.09)	1990-1995	0.46*	1995-2019	0.11*	2019-2021	-1.61*	-	-	-	-	-	-	-	-	-	-	-	-	
	Republic of Korea	63.23	0.43*	(0.41, 0.44)	1990-1992	0.71*	1992-2008	0.53*	2008-2019	0.34*	2019-2021	-0.23*	-	-	-	-	-	-	-	-	-	-	
	Singapore	66.86	0.37*	(0.34, 0.40)	1990-2011	0.42*	2011-2019	0.34*	2019-2021	0.02	-	-	-	-	-	-	-	-	-	-	-	-	
	Sri Lanka	61.00	0.32*	(0.26, 0.37)	1990-2021	0.32*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Thailand	62.03	0.23*	(0.16, 0.29)	1990-1996	-0.09	1996-2004	0.34*	2004-2009	0.80*	2009-2014	0.41*	2014-2019	0.07	2019-2021	-0.72*	-	-	-	-	-	-	
	Timor-Leste	51.65	0.57*	(0.40, 0.74)	1990-2010	0.86*	2010-2021	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Viet Nam	61.28	0.23*	(0.22, 0.24)	1990-2000	0.44*	2000-2011	0.12*	2011-2019	0.22*	2019-2021	-0.21*	-	-	-	-	-	-	-	-	-	-	

Note: "-" means no joinpoints identified.

Abbreviations: AAPC=average annual percent change; APC=annual percent change; LE=life expectancy; HALE=health-adjusted life expectancy; DPRK=Democratic People's Republic of Korea. \* Statistically significant at a two-tailed P&lt;0.05.

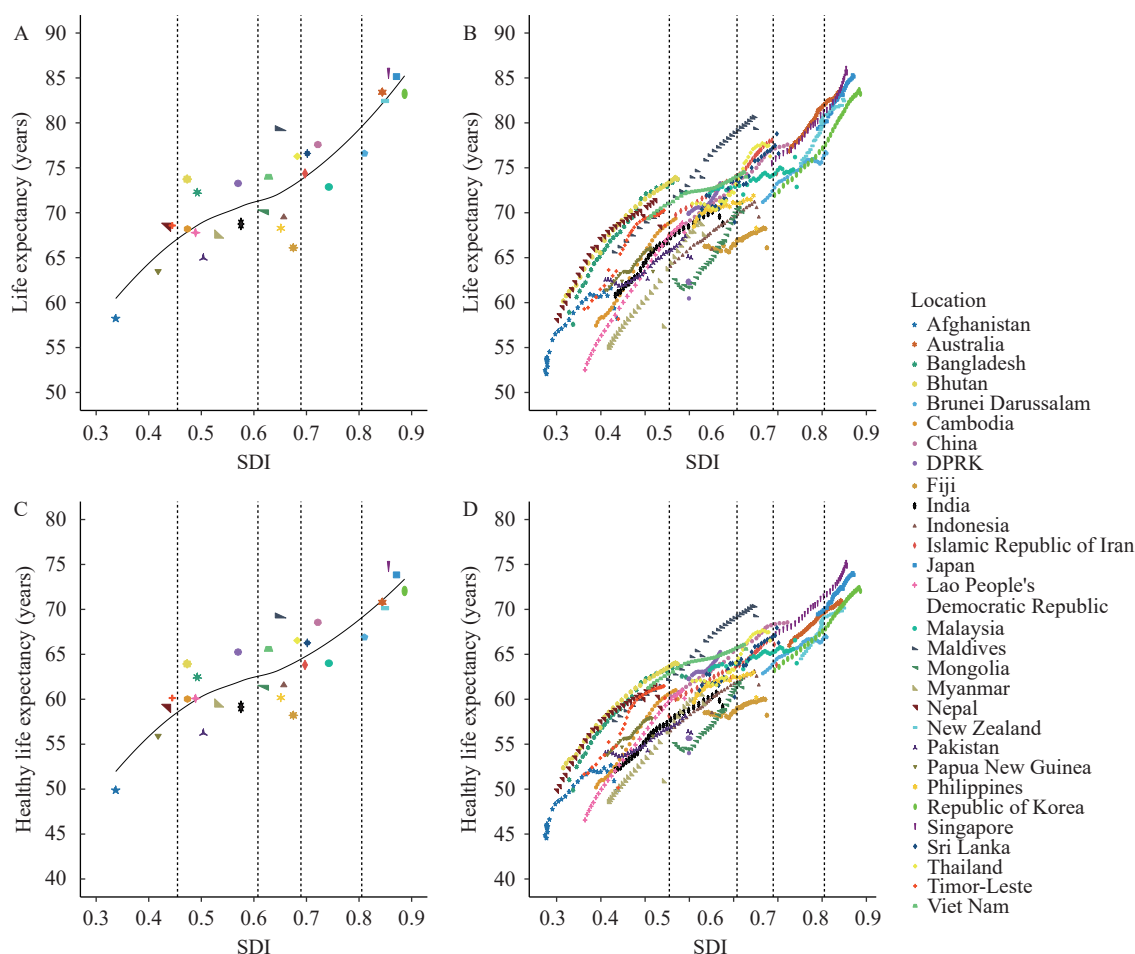


FIGURE 2. Life expectancy (LE) and health-adjusted life expectancy (HALE) at birth across Asia-Pacific countries by SDI, 1990–2021. (A) LE, 2021; (B) LE, 1990–2021; (C) HALE, 2021; (D) HALE, 1990–2021.

Abbreviation: LE=life expectancy; HALE=health-adjusted life expectancy; SDI=sociodemographic index; DPRK=Democratic People's Republic of Korea.

SDI levels may face challenges such as limited healthcare coverage, a higher prevalence of infectious diseases, and malnutrition, which, despite efforts to enhance healthcare services and public health interventions, result in a slower rate of HALE increase.

This study has some limitations. First, the scarcity of primary data might affect the representativeness of the data. Second, the uncertainty estimates were similarly wide across countries, suggesting a heavy reliance on modeling.

In summary, this study analyzed the geographic distribution of LE and HALE, along with their changing trends over time and in relation to SDI levels in the Asia-Pacific region. This study found diversity in the levels and trends of LE and HALE among countries in the Asia-Pacific region, highlighting significant HALE disparities across areas. In 2021, the maximum HALE difference in the region reached 25.09 years, suggesting that achieving health equity

goals within the Asia-Pacific framework continues to pose substantial challenges. Increased global health cooperation and assistance are urgently needed to address this considerable gap. Utilizing multilateral global health cooperation frameworks in the Asia-Pacific region, such as APEC, ASEAN, and the Lancang-Mekong Cooperation, is essential to facilitate the implementation of health development roadmaps and action plans. These represent critical governance strategies for reducing health inequalities and enhancing health outcomes in the Asia-Pacific region.

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## REFERENCES

- Chatterji S, Byles J, Cutler D, Seeman T, Verdes E. Health, functioning, and disability in older adults—present status and future implications. *Lancet* 2015;385(9967):563 – 75. [https://doi.org/10.1016/s0140-6736\(14\)61462-8](https://doi.org/10.1016/s0140-6736(14)61462-8).
- GBD 2021 Diseases and Injuries Collaborators. Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet* 2024;403(10440):2133 – 61. [https://doi.org/10.1016/s0140-6736\(24\)00757-8](https://doi.org/10.1016/s0140-6736(24)00757-8).
- Li J, Xie DD, Cui HL, Yue C, Wang QY, Luo C, et al. Trends in the burden and determinants of HIV in the Asia-Pacific region (1990-2019): an age-period-cohort analysis of the 2019 Global Burden of Disease Study. *J Med Virol* 2024;96(6):e29724. <https://doi.org/10.1002/jmv.29724>.
- GBD 2021 Demographics Collaborators. Global age-sex-specific mortality, life expectancy, and population estimates in 204 countries and territories and 811 subnational locations, 1950-2021, and the impact of the COVID-19 pandemic: a comprehensive demographic analysis for the Global Burden of Disease Study 2021. *Lancet* 2024;403(10440):1989 – 2056. [https://doi.org/10.1016/s0140-6736\(24\)00476-8](https://doi.org/10.1016/s0140-6736(24)00476-8).
- Jagger C, Robine JM. Healthy life expectancy. In: Rogers R, Crimmins E M, editors. *International handbook of adult mortality*. Dordrecht: Springer. 2011; p. 551-68. [http://dx.doi.org/10.1007/978-90-481-9996-9\\_26](http://dx.doi.org/10.1007/978-90-481-9996-9_26)
- Kim HJ, Fay MP, Feuer EJ, Midthune DN. Permutation tests for joinpoint regression with applications to cancer rates. *Stat Med* 2000;19(3):335 – 51. [https://doi.org/10.1002/\(sici\)1097-0258\(20000215\)19:3<335::aid-sim336>3.0.co;2-z](https://doi.org/10.1002/(sici)1097-0258(20000215)19:3<335::aid-sim336>3.0.co;2-z).
- National Cancer Institute. Joinpoint trend analysis software. 2022. <https://surveillance.cancer.gov/joinpoint/>. [2024-6-10].
- Jawad M, Hone T, Vamos EP, Roderick P, Sullivan R, Millett C. Estimating indirect mortality impacts of armed conflict in civilian populations: panel regression analyses of 193 countries, 1990-2017. *BMC Med* 2020;18(1):266. <https://doi.org/10.1186/s12916-020-01708-5>.
- The Lancet. COVID-19 and China: lessons and the way forward. *Lancet* 2020;396(10246):213. [https://doi.org/10.1016/s0140-6736\(20\)31637-8](https://doi.org/10.1016/s0140-6736(20)31637-8).
- Kanchanachitra C, Lindelow M, Johnston T, Hanvoravongchai P, Lorenzo FM, Huong NL, et al. Human resources for health in southeast Asia: shortages, distributional challenges, and international trade in health services. *Lancet* 2011;377(9767):769 – 81. [https://doi.org/10.1016/s0140-6736\(10\)62035-1](https://doi.org/10.1016/s0140-6736(10)62035-1).