





# Global Burden and Trends of UTI in Premenopausal and Postmenopausal Women from 1990 to 2021 and Projections to 2044

Ke Tang\*, Jiayao Feng , Hongshen Lai, Zhongxiang Zhao, Yeson Zou , Qian Lv, Fazhong Dai, Xiaofu Qiu , Wenjie Lai 

Department of Urology, The Affiliated Guangdong Second Provincial General Hospital of Jinan University, Guangzhou, Guangdong, 510317, People's Republic of China

\*These authors contributed equally to this work

Correspondence: Wenjie Lai; Xiaofu Qiu, Department of Urology, The Affiliated Guangdong Second Provincial General Hospital of Jinan University, Guangzhou, Guangdong, 510317, People's Republic of China, Tel +86-020-89168269, Email laiwj@gd2h.org.cn; qiuxf@gd2h.org.cn

**Objective:** Urinary tract infection (UTI) are an important health issue for women, and this study aimed to assess the different disease burdens in premenopausal and postmenopausal women.

**Methods:** In this cross-sectional study, secondary analysis was conducted using Global Burden of Disease (GBD) 2021 data to assess the burden of urinary tract infections in women. Our study applied a joinpoint regression model to assess temporal trends and factors, an age-period-cohort (APC) analysis to evaluate age, period, and cohort effects, and a health inequality analysis to examine regional disparities based on the socio-demographic index (SDI), along with a predictive model for future trend forecasting.

**Results:** From 1990 to 2021, UTI incidence grew faster in premenopausal women (average annual percentage change [AAPC] 0.17 [95% CI 0.15–0.18]) than in postmenopausal women (AAPC 0.04 [95% CI 0.02–0.07]), while mortality increased more for postmenopausal women (AAPC 1.08 [95% CI 0.81–1.36]) than premenopausal women (AAPC 0.45 [95% CI 0.33–0.56]). The COVID-19 pandemic saw a surge in premenopausal UTI incidence (AAPC 0.64 [95% CI 0.62–0.66]). Age, period, and cohort analyses revealed an age-related risk increase in premenopausal women, especially in early birth cohorts. Global health inequalities escalated, with a heavier UTI burden in lower SDI countries. By 2044, projections predict 253.33 million cases in premenopausal and 164.72 million in postmenopausal women, with the biggest increases in the 30–34 and 50–54 age brackets.

**Conclusion:** The study underscores global UTI burden disparities between pre- and postmenopausal women, worsened by COVID-19, urging future policies to enhance healthcare access, antibiotic stewardship, and high-risk group targeting.

**Keywords:** urinary tract infection (UTI), premenopausal women, postmenopausal women, disease burden, global trends

## Introduction

Urinary tract infection (UTI) is a major global health problem, affecting 150 million people each year worldwide. Due to the unique anatomical and physiological characteristics of women, the incidence is significantly higher than that of men.<sup>1</sup> Based on hormone levels, women are classified as pre- (15–49 years) and postmenopausal (50–89 years), the epidemiology of UTI in women at these two stages is markedly different.<sup>2</sup> However, comprehensive epidemiologic analyses focusing on the burden of UTI in pre- and postmenopausal women are limited. Given their high-risk status, the issue warrants more in-depth investigation.

UTI is one of the most common infections in premenopausal women.<sup>3</sup> Sexual activity, hormonal fluctuations, and reproductive health are important factors.<sup>1</sup> During pregnancy, physiological changes increase the risk of infection. Uterine enlargement and urinary tract obstruction are the main causes.<sup>4</sup> In older women, declining estrogen levels weaken the defenses of the urinary tract and vagina, potentially altering the composition of the microbiome and

facilitating the colonization of pathogenic bacteria.<sup>5</sup> Many women at this stage will appear frequent urination, urgent urination, urine pain and other symptoms, serious cases can appear kidney damage and urogenic shock.

Specifically, COVID-19 was spread during the 2021 Global Burden of Disease (GBD) database update. COVID-19 was first identified in December 2019 and was declared a global pandemic within months. This pandemic caused significant changes to healthcare systems worldwide,<sup>6</sup> including the burden of UTI in women. Analyzing the impact of COVID-19 on UTI is crucial. Our study aims to investigate the differential impact of the COVID-19 pandemic on the UTI disease burden in pre- and postmenopausal women, with a focus on understanding the changes in disease burden across these populations.

Overall, our study analyzed the global burden of UTI in pre- and post-menopausal women, quantifying incidence, mortality, and disability-adjusted life years (DALYs) in 204 countries and regions from 1990 to 2021, with projections to 2044. It aims to elucidate the epidemiological characteristics of UTI in this specific population and provide a scientific basis for effective prevention and control strategies.

## Materials and Methods

### Data Sources and Data Collection

The data on UTI analyzed in this study were sourced from the Global Burden of Disease Study 2021 (GBD 2021), developed and maintained by the Institute for Health Metrics and Evaluation (IHME). The GBD 2021 database provides comprehensive and up-to-date epidemiological estimates on the burden of 371 diseases and injuries across 21 GBD regions and 204 countries and territories from 1990 to 2021. All data are freely accessible via the Global Health Data Exchange platform (GHDx, <https://ghdx.healthdata.org/gbd-2021/sources>). The relevant data were anonymous and publicly available, and it has passed the review and exemption of the Ethics Committee of the Affiliated Guangdong Second Provincial General Hospital of Jinan University, Ethics Approval No. 2025-KY-KZ-116-01.

GBD 2021 utilized three primary standardized modeling tools: the Cause of Death Ensemble Model (CODEm), Spatiotemporal Gaussian Process Regression (ST-GPR), and the DisMod-MR 2.1 disease modeling tool. These tools played a pivotal role in integrating and estimating disease burden metrics across diverse datasets.

In GBD 2021, UTI was defined as infections affecting any part of the urinary system (including nephritis, cystitis, and urethritis) that may lead to systemic symptoms such as fever, weakness, discomfort, and functional limitations in daily activities. Asymptomatic bacteriuria was explicitly excluded from this case definition. UTI was identified using International Classification of Diseases and Injuries, 10th Revision (ICD-10) diagnostic codes, specifically: N10, N10.0, N10.9, N11, N11.0-N11.9, N12, N12.0, N12.9, N13.6, N15, N15.1, N15.8, N15.9, N16, N16.0-N16.5, N16.8, N30, N30.0-N30.3, N30.8-N30.9, N34, N34.0-N34.3, and N39.0.<sup>7</sup>

### Socio Demographic Index (SDI)

The SDI, introduced by IHME in 2015, evaluates a country's development using per capita income, education, and fertility rates. In the GBD 2021 study, 204 countries and territories were classified into five SDI categories: low, low-middle, middle, high-middle, and high SDI regions.<sup>7</sup>

### Study Population

We extracted data on the incidence and DALYs of UTI among individuals aged 15 to 89 years from the GBD 2021 database (<https://vizhub.healthdata.org/gbd-results>) for the period 1992 to 2021. This study focuses on women before and after menopause, defining the premenopausal age group as 15 to 49 years and the postmenopausal group as 50 to 89 years. To facilitate meaningful comparisons of disease burden across global populations, we applied direct age standardization using the 2021 GBD global standard population.<sup>7</sup> Age standardization was performed with the `ageadjust.direct` function from the `Epitools` package, ensuring consistent and comparable metrics across different demographic groups.<sup>6</sup>

## Joinpoint Regression Analysis

Trend analysis was conducted using Joinpoint Regression Software (version 5.1.0, available at <https://surveillance.cancer.gov/joinpoint/>). The Joinpoint regression model employs a log-linear approach ( $\ln y = \beta * x$ ) to perform segmented regression. The grid search method (GSM) is used to identify all potential joinpoint by calculating the mean squared error (MSE) for each possible configuration, with the joinpoint corresponding to the smallest MSE selected as the optimal fit. This method was applied to evaluate trends in the burden of disease attributable to UTI over time.

## Trend Analysis

Joinpoint analysis quantifies the trend of rate changes from 1990 to 2021 by calculating the AAPC and its 95% confidence interval (CI). The calculation of the annual percent change (APC) is given by the formula:  $APC = (e^{\beta} - 1) \times 100\%$ , where  $\beta$  represents the regression coefficient from the logarithmic linear model  $\ln y = \beta * x$ . The AAPC is derived by weighting the individual APC across segmented intervals based on the interval width ( $w$ ), then calculating their weighted average, which reflects the overall trend of the epidemic from 1990 to 2021.

## Age-Period-Cohort (APC) Analysis

We applied the age-period-cohort (APC) model to evaluate the impact of age, period, and cohort on health outcomes using the APC Web Tool by the National Cancer Institute. The analysis included key parameters like net drift (overall annual change), local drift (age-specific trends), period relative risk (RR), and cohort RR, all assessed for significance with the Wald chi-square test.

## Cross-Country Inequality Analysis

To evaluate the disparities between the burden of UTI among premenopausal and postmenopausal women across countries and their association with the SDI, we employed the Slope Index of Inequality (SII) and the Concentration Index (CI), as recommended by the World Health Organization (<https://www.who.int/publications/i/item/9789241548632>). The SII quantifies absolute inequality by measuring the difference in health outcomes between the most advantaged and least advantaged subpopulations, considering the entire socioeconomic distribution (eg, education or wealth) using a weighted regression model. In contrast, the CI captures relative inequality by quantifying the extent to which health outcomes are concentrated among disadvantaged or advantaged groups.

To account for heterogeneity, we applied a robust linear regression model, which uses iteratively reweighted least squares to assign lower weights to observations with larger residuals. This approach minimizes the influence of outliers, ensuring more reliable and stable trend estimations. The CI was calculated via numerical integration of the Lorenz curve, providing a comprehensive measure of the concentration of health outcomes within the population.

## Predictive Analysis

Bayesian Age-Period-Cohort (BAPC) models, combined with the Integrated Nested Laplace Approximation (INLA), were used to predict the trends in the incidence of UTI among premenopausal and postmenopausal women from 2022 to 2030. All data analyses were conducted using the R software (version 4.3.3) and Stata V.16, including the R packages BAPC (version 0.0.36), INLA (version 24.05.011), and ggplot2 (version 3.4.2). Statistical significance was set at  $p < 0.05$  (two-tailed), with values below this threshold considered statistically significant.

## Results

### Global Trends in Women UTI

From 1990 to 2021, global UTI cases in women rose from 185 million to 320 million (73%), mortality increased from 40,000 to 120,000 (200%), and DALYs grew from 1.32 million to 3.15 million (138%). In 2021, the age-standardized incidence rate (ASIR) of premenopausal UTI was 11,099.89 (95% CI: 8,381.58–14,144.64) per 100,000, and postmenopausal UTI was 10,279.12 (95% CI: 8,221.59–12,750.40). The age-standardized mortality rate (ASMR) of premenopausal UTI was 0.72 (95% CI: 0.58–0.84), compared to 11.55 (95% CI: 9.70–12.93) for postmenopausal UTI (Table 1 and 2, Figure S1).

**Table I** Incidence to Deaths and DALYs for Urinary Tract Infections in Premenopausal Women 1990–2021

	1990						2021							AAPC (95% CI)	
		Number (95% CI)		ASR per 100000(95% CI)				Number (95% CI)		ASR per 100000(95% CI)					
Incidence	Incidence ×100,000	Mortality	DALYs	Incidence	Mortality	DALYs	Incidence ×100,000	Mortality	DALYs	Incidence	Mortality	DALYs	Incidence	Mortality	DALYs
Global	1,380.00 (1,060.00 to 1,740.00)	7,931.17 (5,999.04 to 9,185.93)	532,766.40 (422,621.70 to 622,512.10)	10,532.94 (8,058.00 to 13,293.00)	0.63 (0.48 to 0.73)	41.12 (32.76 to 48)	2,180.00 (1,650.00 to 2,770.00)	14,254.42 (11,440.29 to 16,565.41)	917,618.20 (752,560.50 to 1,062,314.00)	11,099.89 (8,381.58 to 14,144.64)	0.72 (0.58 to 0.84)	46.69 (38.26 to 54.08)	0.17 (0.15 to 0.18)	0.45 (0.33 to 0.56)	0.43 (0.32 to 0.53)
High SDI	342.54 (264.34 to 431.35)	403.81 (385.89 to 425.89)	42,778.14 (33,895.75 to 54,430.42)	14,980.04 (11,567.95 to 18,876.83)	0.17 (0.17 to 0.18)	18.57 (14.69 to 23.67)	332.08 (256.65 to 413.74)	668.02 (606.41 to 738.07)	54,718.96 (45,533.74 to 66,497.94)	13,636.43 (10,551.08 to 17,007.58)	0.24 (0.22 to 0.27)	21.07 (17.36 to 25.85)	−0.3 (−0.32 to −0.28)	1.13 (0.59 to 1.67)	0.41 (0.18 to 0.64)
High-middle SDI	230.39 (176.68 to 289.84)	1,083.06 (961.96 to 1,221.74)	72,317.74 (62,946.84 to 83,177.07)	8,339.95 (6,392.34 to 10,486.41)	0.42 (0.37 to 0.47)	27.08 (23.64 to 31.04)	245.82 (186.93 to 310.57)	1,058.48 (942.68 to 1,203.54)	69,895.29 (60,949.73 to 80,765.99)	7,927.32 (6,033.49 to 10,046.33)	0.3 (0.27 to 0.35)	21.23 (18.44 to 24.6)	−0.15 (−0.21 to −0.09)	−0.88 (−1.3 to −0.46)	−0.72 (−1.05 to −0.38)
Middle SDI	369.92 (280.95 to 470.10)	2,151.35 (1,633.79 to 2,555.99)	144,586.90 (114,246.00 to 170,069.60)	8,676.60 (6,595.34 to 10,997.93)	0.53 (0.41 to 0.63)	34.3 (27.18 to 40.36)	664.05 (503.89 to 839.08)	3,949.45 (3,344.58 to 4,504.91)	251,713.00 (215,297.60 to 289,804.30)	10,540.27 (7,993.31 to 13,343.93)	0.61 (0.52 to 0.69)	39.55 (33.81 to 45.54)	0.63 (0.6 to 0.65)	0.47 (0.28 to 0.67)	0.48 (0.31 to 0.65)
Low-middle SDI	335.58 (253.81 to 432.71)	2,849.51 (1,956.69 to 3,543.56)	185,209.30 (132,553.80 to 227,617.60)	12,807.57 (9,691.48 to 16,451.31)	1.12 (0.78 to 1.39)	70.1950.48 (to 86.17)	682.26 (505.00 to 890.65)	5,706.24 (4,181.08 to 7,194.66)	362,301.70 (273,733.50 to 445,677.00)	13,649.47 (10,101.55 to 17,785.36)	1.16 (0.85 to 1.46)	72.57 (54.86 to 89.19)	0.18 (0.14 to 0.23)	0.1 (−0.2 to 0.4)	0.17 (−0.02 to 0.36)
Low SDI	100.57 (75.44 to 130.59)	1,438.09 (1,043.50 to 1,802.24)	87,511.23 (64,660.27 to 108,124.40)	9,495.00 (7,114.21 to 12,273.01)	1.46 (1.07 to 1.83)	84.35 (62.68 to 104.64)	252.76 (187.23 to 329.74)	2,864.16 (2,154.97 to 3,577.62)	178,469.20 (137,879.70 to 220,842.00)	9,737.46 (7,212.32 to 12,662.19)	1.16 (0.87 to 1.45)	68.89 (53.25 to 85.28)	0.08 (0.07 to 0.08)	−0.76 (−0.88 to −0.65)	−0.66 (−0.77 to −0.55)
Andean Latin America	23.03 (17.29 to 29.82)	33.91 (24.02 to 47.84)	3,350.08 (2,485.35 to 4,487.60)	25,224.22 (19,009.02 to 32,478.13)	0.4 (0.28 to 0.57)	37.49 (27.75 to 50.21)	49.67 (36.57 to 64.17)	82.79 (53.44 to 117.94)	7,538.71 (5,366.16 to 10,150.66)	28,319.13 (20,845.82 to 36,601.23)	0.48 (0.31 to 0.68)	43.19 (30.73 to 58.16)	0.3 (0.24 to 0.36)	0.77 (−0.78 to 2.34)	0.54 (−0.35 to 1.43)
Australasia	12.24 (9.13 to 15.90)	5.00 (4.22 to 5.87)	1,024.97 (674.52 to 1,480.66)	22,654.55 (16,907.63 to 29,440.67)	0.09 (0.08 to 0.11)	18.94 (12.47 to 27.39)	16.80 (12.48 to 22.06)	9.81 (8.30 to 11.45)	1,549.80 (1,065.00 to 2,229.50)	23,127.67 (17,181.83 to 30,393.68)	0.12 (0.1 to 0.14)	20.7 (14.05 to 30.05)	0.08 (0.04 to 0.11)	1.02 (−0.2 to 2.26)	0.33 (0.04 to 0.63)
Caribbean	15.63 (11.92 to 20.11)	20.99 (16.43 to 28.83)	2,136.87 (1,606.76 to 2,837.33)	17,163.54 (13,074.04 to 22,043.82)	0.25 (0.19 to 0.34)	24.06 (18.17 to 31.81)	20.45 (15.26 to 26.37)	62.04 (46.08 to 89.53)	4,580.94 (3,525.68 to 6,210.45)	16,910.19 (12,610.50 to 21,827.27)	0.51 (0.38 to 0.73)	37.71 (29 to 51.19)	−0.06 (−0.1 to −0.02)	2.4 (1.85 to 2.95)	1.49 (1.16 to 1.83)
Central Asia	18.88 (14.30 to 24.32)	190.65 (173.49 to 211.04)	12,016.79 (10,879.06 to 13,408.19)	11,342.42 (8,572.26 to 14,581.52)	1.26 (1.15 to 1.39)	75.82 (68.77 to 84.45)	29.93 (21.71 to 39.16)	323.14 (268.22 to 384.11)	19,615.89 (16,427.03 to 23,199.13)	12,262.41 (8,916.57 to 16,064.45)	1.3 (1.08 to 1.55)	79.8 (66.91 to 94.32)	0.25 (0.19 to 0.31)	−0.02 (−0.9 to 0.86)	0.04 (−0.75 to 0.84)
Central Europe	18.81 (14.42 to 23.85)	142.05 (133.68 to 151.30)	8,496.90 (7,814.66 to 9,339.67)	6,159.64 (4,734.36 to 7,812.93)	0.45 (0.42 to 0.48)	27.1 (24.89 to 29.83)	14.23 (10.91 to 17.97)	108.94 (88.45 to 140.37)	6,363.37 (5,174.79 to 8,145.61)	5,601.61 (4,316.46 to 7,090.48)	0.35 (0.29 to 0.45)	21.99 (17.89 to 28.07)	−0.29 (−0.36 to −0.22)	−0.44 (−1.15 to 0.28)	−0.68 (−1.4 to 0.05)
Central Latin America	38.68 (29.07 to 49.03)	187.52 (177.53 to 198.94)	12,819.59 (11,617.16 to 14,290.05)	10,031.03 (7,570.44 to 12,669.40)	0.52 (0.49 to 0.55)	33.89 (30.75 to 37.68)	73.75 (56.18 to 93.30)	790.94 (635.26 to 1,016.96)	45,272.31 (37,012.05 to 57,454.49)	10,728.49 (8,170.78 to 13,578.80)	1.14 (0.91 to 1.46)	65.42 (53.52 to 82.96)	0.22 (0.19 to 0.25)	2.79 (2.43 to 3.15)	2.35 (2.05 to 2.64)
Central Sub-Saharan Africa	8.13 (5.90 to 10.92)	42.57 (24.88 to 77.91)	2,884.64 (1,853.83 to 4,830.21)	6,875.06 (4,993.99 to 9,220.32)	0.4 (0.23 to 0.74)	25.64 (16.34 to 43.63)	21.99 (15.90 to 30.08)	107.30 (60.03 to 209.35)	7,346.83 (4,546.33 to 13,081.33)	7,056.08 (5,104.02 to 9,594.67)	0.37 (0.21 to 0.73)	24.32 (15.02 to 43.7)	0.08 (0.07 to 0.1)	−0.24 (−0.41 to −0.07)	−0.17 (−0.35 to 0)
East Asia	89.89 (67.30 to 115.83)	850.62 (495.46 to 1,168.58)	52,573.92 (32,124.55 to 70,627.42)	2,885.71 (2,167.61 to 3,709.15)	0.28 (0.17 to 0.39)	16.88 (10.37 to 22.61)	98.80 (74.13 to 126.24)	427.65 (310.77 to 654.39)	28,143.90 (21,474.76 to 40,296.44)	2,669.66 (1,993.23 to 3,422.63)	0.11 (0.08 to 0.17)	7.7 (5.89 to 10.94)	−0.23 (−0.26 to −0.21)	−2.95 (−3.37 to −2.52)	−2.5 (−2.86 to −2.15)



Eastern Europe	64.30 (48.38 to 82.49)	547.98 (525.62 to 571.17)	32,631.61 (30,505.29 to 35,229.40)	11,704.56 (8,817.76 to 15,027.79)	0.99 (0.95 to 1.03)	58.82 (54.96 to 63.57)	59.35 (44.50 to 75.80)	496.29 (431.37 to 568.63)	28,719.34 (24,935.70 to 33,073.20)	12,259.44 (9,228.33 to 15,735.93)	0.86 (0.74 to 0.99)	52.62 (45.46 to 60.96)	0.15 (0.11 to 0.18)	-0.32 (-1.17 to 0.53)	-0.28 (-0.92 to 0.37)
Eastern Sub-Saharan Africa	25.88 (19.17 to 33.92)	809.45 (595.12 to 1,069.26)	46,598.79 (34,574.45 to 60,830.96)	6,399.03 (4,729.40 to 8,351.13)	2.3 (1.7 to 3.05)	124.03 (92.42 to 162.56)	65.44 (47.64 to 86.33)	1,635.95 (1,240.94 to 2,110.03)	95,442.56 (73,036.87 to 122,142.10)	6,491.24 (4,726.47 to 8,522.63)	1.78 (1.36 to 2.3)	98.27 (75.41 to 125.7)	0.05 (0.03 to 0.07)	-0.82 (-0.97 to -0.67)	-0.75 (-0.88 to -0.61)
High-income Asia Pacific	49.49 (38.00 to 62.59)	33.39 (28.49 to 40.80)	4,907.22 (3,532.45 to 6,705.67)	10,826.44 (8,319.59 to 13,702.05)	0.07 (0.06 to 0.09)	10.63 (7.63 to 14.57)	40.37 (31.64 to 50.81)	38.15 (32.57 to 43.55)	4,496.36 (3,372.05 to 5,996.11)	10,781.91 (8,468.95 to 13,626.02)	0.08 (0.07 to 0.1)	11.32 (8.36 to 15.33)	0 (-0.03 to 0.03)	0.51 (-0.52 to 1.55)	0.22 (-0.1 to 0.53)
High-income North America	102.68 (78.21 to 130.41)	165.48 (159.27 to 172.39)	15,107.68 (12,436.11 to 18,646.54)	13,616.18 (10,385.36 to 17,316.67)	0.22 (0.21 to 0.23)	19.91 (16.38 to 24.6)	98.94 (76.74 to 123.41)	265.77 (249.23 to 284.08)	19,580.66 (16,970.82 to 23,134.23)	11,693.37 (9,073.89 to 14,601.64)	0.29 (0.27 to 0.31)	22.09 (19.02 to 26.27)	-0.49 (-0.51 to -0.47)	0.92 (0.33 to 1.52)	0.33 (0.03 to 0.63)
North Africa and Middle East	63.19 (47.75 to 81.11)	158.99 (115.62 to 218.12)	13,002.70 (10,036.61 to 16,989.27)	8,041.42 (6,072.59 to 10,281.17)	0.23 (0.17 to 0.32)	17.5 (13.48 to 22.95)	132.90 (99.49 to 172.74)	380.34 (262.44 to 489.80)	28,793.62 (21,595.82 to 36,616.00)	8,339.65 (6,246.63 to 10,842.42)	0.24 (0.16 to 0.31)	18.04 (13.54 to 22.95)	0.11 (0.1 to 0.12)	0.14 (0.04 to 0.23)	0.11 (0.03 to 0.19)
Oceania	0.59 (0.43 to 0.78)	6.38 (2.91 to 11.45)	369.25 (185.47 to 636.17)	4,213.60 (3,079.13 to 5,545.11)	0.5 (0.23 to 0.91)	28.15 (14.25 to 48.62)	1.43 (0.99 to 1.97)	14.37 (7.31 to 26.47)	832.98 (451.73 to 1,458.04)	4,295.78 (2,978.05 to 5,896.48)	0.45 (0.23 to 0.82)	25.48 (13.89 to 44.65)	0.05 (0.02 to 0.08)	-0.37 (-0.51 to -0.2)	-0.32 (-0.44 to -0.2)
South Asia	375.22 (282.46 to 488.55)	3,265.68 (2,324.21 to 4,037.07)	212,260.20 (155,400.70 to 259,964.60)	15,257.52 (11,489.59 to 19,777.72)	1.35 (0.97 to 1.67)	85.19 (62.67 to 104.29)	825.80 (609.64 to 1,070.00)	6,420.01 (4,638.26 to 8,216.30)	413,568.70 (310,525.90 to 516,979.70)	16,872.77 (12,455.08 to 21,899.59)	1.32 (0.96 to 1.69)	84.36 (63.34 to 105.4)	0.3 (0.25 to 0.36)	0 (-0.16 to 0.17)	-0.09 (-0.35 to 0.16)
Southeast Asia	62.30 (47.16 to 79.18)	840.26 (512.10 to 1,073.47)	51,650.24 (32,370.37 to 65,170.78)	5,634.15 (4,283.50 to 7,141.14)	0.77 (0.47 to 0.98)	45.47 (28.89 to 57.42)	105.12 (78.70 to 134.58)	1,294.22 (824.07 to 1,607.65)	76,126.46 (50,476.82 to 93,614.84)	5,596.32 (4,186.33 to 7,173.68)	0.69 (0.44 to 0.85)	40.79 (26.96 to 50.19)	-0.01 (-0.03 to 0)	-0.36 (-0.55 to -0.16)	-0.34 (-0.53 to -0.14)
Southern Latin America	20.43 (15.37 to 26.72)	21.15 (18.77 to 23.92)	2,415.25 (1,808.88 to 3,222.71)	16,537.21 (12,435.80 to 21,613.00)	0.18 (0.16 to 0.2)	19.72 (14.8 to 26.26)	29.93 (22.23 to 39.17)	104,349.26 (118.13 to 118.13)	7,351.78 (6,233.67 to 8,714.23)	17,031.47 (12,644.56 to 22,296.28)	0.57 (0.51 to 0.65)	41.05 (34.74 to 48.73)	0.09 (0.06 to 0.12)	3.65 (2.55 to 4.76)	2.29 (1.77 to 2.81)
Southern Sub-Saharan Africa	12.40 (9.08 to 16.30)	62.75 (29.73 to 87.79)	4,347.64 (2,416.19 to 5,857.35)	9,640.74 (7,073.92 to 12,604.12)	0.52 (0.25 to 0.73)	34.89 (19.3 to 47.01)	20.90 (15.02 to 27.99)	107.08 (69.49 to 162.24)	7,018.81 (4,897.72 to 10,139.34)	9,614.04 (6,911.64 to 12,873.55)	0.5 (0.32 to 0.76)	32.34 (22.55 to 46.77)	-0.01 (-0.02 to 0.01)	-0.09 (-1.17 to 1.01)	-0.2 (-1.1 to 0.72)
Tropical Latin America	117.66 (90.38 to 149.29)	219.57 (204.70 to 235.98)	19,308.92 (16,121.99 to 23,430.27)	29,800.05 (22,883.07 to 37,742.57)	0.61 (0.57 to 0.66)	51.04 (42.85 to 61.48)	180.50 (139.60 to 228.91)	831.78 (766.03 to 895.58)	54,647.18 (48,660.78 to 61,573.03)	29,601.29 (22,879.19 to 37,607.62)	1.29 (1.19 to 1.39)	86.83 (77.16 to 98.09)	-0.03 (-0.05 to -0.01)	2.44 (1.68 to 3.2)	1.79 (1.25 to 2.34)
Western Europe	227.90 (176.77 to 287.64)	79.89 (75.32 to 85.00)	18,491.03 (12,591.45 to 26,232.48)	23,634.39 (18,330.46 to 29,844.90)	0.08 (0.08 to 0.09)	19.07 (12.96 to 27.11)	198.49 (152.13 to 249.50)	150.08 (138.16 to 168.85)	20,067.89 (14,763.13 to 26,770.14)	21,468.31 (16,454.36 to 26,987.19)	0.14 (0.13 to 0.15)	20.65 (14.99 to 27.85)	-0.28 (-0.4 to -0.17)	0.01 (1.2 to 2.82)	0.25 (-0.1 to 0.61)
Western Sub-Saharan Africa	32.89 (24.54 to 42.80)	246.88 (162.54 to 364.84)	16,372.10 (11,381.43 to 23,307.52)	8,058.73 (6,016.69 to 10,429.12)	0.64 (0.43 to 0.95)	40.24 (28.16 to 57.22)	0.64 (68.84 to 123.78)	603.40 (434.79 to 869.21)	40,560.18 (30,255.04 to 56,476.71)	8,302.25 (6,104.01 to 10,909.54)	0.56 (0.4 to 0.79)	35.71 (26.68 to 49.23)	0.09 (0.09 to 0.1)	-0.48 (-0.59 to -0.36)	-0.4 (-0.49 to -0.3)

**Abbreviations:** ASR, age-standardized rate; AAPC, average annual percentage changes; DALYs, Disability-adjusted life years.

**Table 2** Incidence, Deaths and DALYs for Urinary Tract Infections in Postmenopausal Women 1990–2021

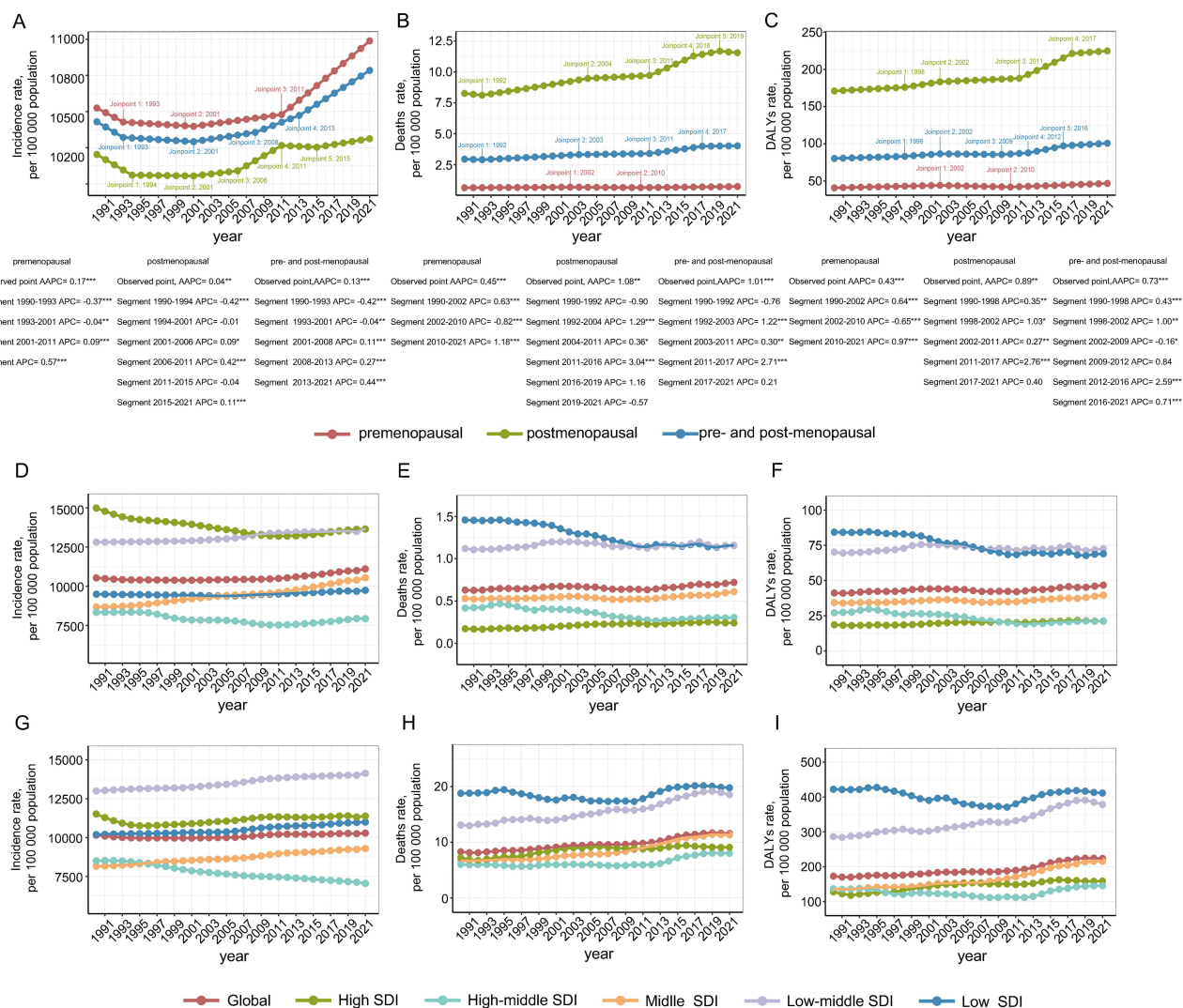
	1990						2021						AAPC(95% CI)		
	Number (95% CI)			ASR per 100,000(95% CI)			Number (95% CI)			ASR per 100,000(95% CI)					
Incidence	Incidence ×100,000	Mortality	DALYs	Incidence	Mortality	DALYs	Incidence ×100,000	Mortality	DALYs	Incidence	Mortality	DALYs	Incidence	Mortality	DALYs
Global	468.56 (375.02 to 581.83)	36,871.34 (31,800.48 to 43,225.85)	787,756.26 (680,702.70 to 920,923.02)	10,156.70 (8,128.83 to 12,610.14)	8.29 (7.14 to 9.71)	173.01 (149.36 to 202.06)	1,018.87 (815.29 to 1,263.31)	115,608.03 (97,069.67 to 129,364.51)	2,232,824.30(10,279.12 (1,886,689.00 to 2,505,718.60)	(8,221.60 to 12,750.40)	11.55 (9.7 to 12.93)	223.61 (188.94 to 250.95)	0.04 (0.02 to 0.07)	1.08 (0.81 to 1.36)	0.89 (0.72 to 1.05)
High SDI	146.07 (117.06 to 180.96)	11,405.90 (10,029.87 to 12,154.52)	190,029.51 (170,568.60 to 202,465.88)	11,518.38 (9,200.18 to 14,307.83)	7.23 (6.39 to 7.69)	127.98 (115.45 to 136.43)	246.19 (196.88 to 305.11)	26,246.24 (21,696.75 to 29,517.68)	416,280.24 (355,321.30 to 463,223.15)	11,379.07 (9,066.86 to 14,159.17)	9.07 (7.62 to 10.15)	158.68 (137.57 to 175.78)	−0.04 (−0.13 to 0.05)	0.71 (0.39 to 1.04)	0.68 (0.37 to 0.99)
High-middle SDI	104.82 (83.56 to 129.75)	7,417.07 (6,817.01 to 8,099.90)	169,770.92 (157,077.80 to 184,114.56)	8,503.26 (6,777.04 to 10,529.79)	6.03 (5.53 to 6.6)	136.91 (126.48 to 148.62)	162.19 (130.92 to 199.24)	19,903.96 (17,176.62 to 22,211.87)	353,310.82 (309,088.80 to 395,923.84)	7,044.58 (5,679.67 to 8,667.33)	7.99 (6.9 to 8.92)	145.3 (127.23 to 163.01)	−0.6 (−0.64 to −0.55)	0.99 (0.51 to 1.47)	0.25 (−0.26 to 0.76)
Middle SDI	99.3 (79.13 to 123.65)	6,567.66 (5,459.00 to 8,531.95)	147,927.58 (123,516.90 to 189,035.97)	8,157.38 (6,509.19 to 10,146.04)	6.68 (5.57 to 8.7)	135.82 (113.54 to 174.2)	303.27 (241.54 to 375.37)	32,774.93 (27,624.12 to 37,939.67)	653,227.38 (558,443.30 to 754,389.36)	9,287.13 (7,404.51 to 11,488.90)	11.31 (9.51 to 13.09)	215.18 (183.62 to 248.44)	0.42 (0.39 to 0.45)	1.73 (1.49 to 1.97)	1.51 (1.3 to 1.72)
Low-middle SDI	91.19 (71.42 to 114.42)	7,446.81 (5,593.86 to 9,833.79)	179,882.67 (135,736.80 to 232,543.87)	12,991.97 (10,194.99 to 16,273.18)	13.09 (9.86 to 17.49)	286.31 (216.44 to 373.8)	240.3 (190.51 to 302.03)	27,138.70 (20,365.66 to 33,398.24)	592,134.13 (442,429.50 to 728,978.52)	14,123.55 (11,211.43 to 17,723.21)	18.53 (13.97 to 22.76)	378.12 (283.44 to 464.96)	0.25 (0.22 to 0.28)	1.19 (0.91 to 1.46)	0.95 (0.74 to 1.17)
Low SDI	26.69 (21.11 to 33.88)	3,988.29 (3,065.01 to 5,380.86)	99,190.44 (76,691.90 to 131,227.33)	10,190.64 (8,076.23 to 12,907.27)	18.8 (14.43 to 25.76)	422.25 (326.12 to 565.28)	66.12 (52.14 to 82.98)	9,450.06 (7,158.45 to 11,741.84)	216,185.68 (165,052.80 to 268,020.07)	10,988.26 (8,683.44 to 13,770.14)	19.77 (14.96 to 24.6)	411.14 (313.38 to 510.14)	0.24 (0.22 to 0.27)	0.19 (−0.01 to 0.4)	−0.07 (−0.22 to 0.08)
Andean Latin America	4.24 (3.25 to 5.36)	199.65 (144.37 to 292.39)	3,822,252,799.50 to 5,482.27)	18,209.61 (13,961.66 to 22,973.65)	9.79 (7.09 to 14.33)	179.64 (131.59 to 258.12)	13.83 (10.74 to 17.31)	1,047.11 (663.84 to 1,491.46)	19,088.22 (12,273.80 to 27,004.22)	20,527.86 (15,945.77 to 25,684.16)	16.28 (10.32 to 23.18)	293.27 (188.54 to 414.82)	0.38 (0.35 to 0.41)	1.65 (0.51 to 2.8)	1.59 (0.32 to 2.87)
Australasia	3.27 (2.45 to 4.24)	192.59 (163.04 to 221.23)	3,307.85 (2,811.45 to 3,803.88)	12,915.28 (9,662.81 to 16,722.77)	6.26 (5.3 to 7.19)	112.11 (95.19 to 129.21)	7.2 (5.29 to 9.61)	504.79 (390.42 to 609.09)	7,527.40 (5,990.35 to 9,021.08)	13,278.43 (9,810.31 to 17,711.60)	7.14 (5.56 to 8.6)	113.92 (91.29 to 136.4)	0.04 (−0.01 to 0.1)	0.6 (−1.09 to 2.32)	0.09 (−1.27 to 1.48)
Caribbean	3.54 (2.75 to 4.5)	100.52 (84.79 to 128.44)	2,101.00 (1,748.41 to 2,696.60)	12,365.78 (9,600.77 to 15,749.88)	3.56 (3.01 to 4.54)	73.61 (61.25 to 94.38)	7.63 (5.95 to 9.58)	546.57 (453.23 to 657.67)	10,231.62 (8,541.81 to 12,421.46)	12,331.18 (9,616.89 to 15,482.13)	8.71 (7.22 to 10.48)	164.32 (137.21 to 199.53)	−0.01 (−0.01 to 0)	2.9 (2.01 to 3.81)	2.62 (1.81 to 3.44)
Central Asia	6.75 (5.3 to 8.53)	380.68 (343.63 to 428.19)	10,153.42 (9,242.36 to 11,302.36)	10,683.36 (8,406.74 to 13,481.95)	6.2 (5.59 to 6.97)	162.59 (147.93 to 181.07)	12.89 (9.93 to 16.31)	862.51 (729.53 to 1,002.13)	21,429.51 (18,217.95 to 24,873.09)	11,712.54 (9,045.10 to 14,788.95)	9.05 (7.65 to 10.5)	209.84 (178.29 to 243.4)	0.29 (0.21 to 0.37)	0.88 (−0.1 to 1.87)	0.53 (−0.43 to 1.5)
Central Europe	16.7 (13.31 to 20.81)	2,007.12 (1,864.31 to 2,144.18)	42,157.48 (39,287.20 to 44,950.21)	8,898.28 (7,086.15 to 11,094.72)	10.39 (9.65 to 11.11)	219.69 (204.66 to 234.32)	21.49 (17.18 to 26.77)	2,966.46 (2,530.37 to 3,487.06)	50,409.17 (42,899.79 to 60,540.34)	8,473.18 (6,752.86 to 10,588.18)	9.42 (7.99 to 11.22)	175.16 (147.78 to 214.08)	−0.15 (−0.19 to −0.12)	−0.05 (−1.05 to 0.96)	−0.64 (−1.41 to 0.14)
Central Latin America	12.82 (10.24 to 16.01)	844.49 (778.42 to 920.70)	17,006.40 (15,764.81 to 18,396.47)	13,215.64 (10,567.74 to 16,480.30)	10.39 (9.54 to 11.38)	195.44 (180.83 to 212.06)	45.55 (36.32 to 56.11)	6,265.81 (5,275.74 to 7,531.30)	132,503.20 (110,345.60 to 163,776.10)	15,102.50 (12,053.88 to 18,598.31)	22.14 (18.68 to 26.5)	455.92 (380.53 to 561.02)	0.45 (0.35 to 0.54)	2.48 (2.11 to 2.85)	2.86 (2.47 to 3.24)
Central Sub- Saharan Africa	1.94 (1.48 to 2.51)	141.54 (76.55 to 309.60)	3,597.00 (2,005.52 to 7,564.68)	6,444.97 (4,930.23 to 8,303.56)	7.18 (3.86 to 16.48)	149.99 (82.94 to 327.38)	4.94 (3.79 to 6.35)	367.19 (191.54 to 784.71)	8,770.34 (4,748.72 to 18,281.60)	6,704.69 (5,163.38 to 8,586.43)	7.18 (3.74 to 15.44)	147.51 (79.11 to 310.5)	0.12 (0.11 to 0.14)	0 to 0.06)	−0.06 (−0.12 to 0.01)
East Asia	33.8 (26.57 to 42.2)	2,470.04 (1,577.56 to 3,362.87)	57,227.71 (36,770.75 to 77,417.76)	3,327.24 (2,616.82 to 4,153.15)	2.91 (1.86 to 3.97)	61.32 (39.43 to 83.01)	86.58 (67.83 to 108.78)	4,418.23 (3,299.53 to 6,673.37)	87,191.16 (65,721.79 to 132,087.20)	3,284.81 (2,571.87 to 4,129.53)	1.8 (1.35 to 2.71)	34.47 (25.99 to 52.06)	−0.03 (−0.06 to −0.01)	−1.55 (−2.06 to −1.04)	−1.83 (−2.22 to −1.44)
Eastern Europe	50.38 (39.45 to 62.66)	3,801.99 (3,605.73 to 3,971.08)	96,150.60 (91,179.24 to 100,385.65)	12,838.75 (10,046.27 to 15,975.55)	9.28 (8.8 to 9.69)	239.57 (227.28 to 250.16)	57.98 (45.79 to 71.18)	7,952.43 (6,840.95 to 9,205.40)	158,396.93 (135,812.70 to 186,013.30)	13,629.69 (10,746.61 to 16,797.42)	15.58 (13.4 to 18.1)	329.23 (281.95 to 388.45)	0.19 (0.16 to 0.22)	1.82 (0.81 to 2.84)	1.11 (0.21 to 2.01)

Eastern Sub-Saharan Africa	6.44 (5.08 to 8.09)	2,359.74 (1,789.80 to 3,283.54)	59,031.66 (44,895.15 to 81,389.50)	7,260.82 (5,747.96 to 9,110.13)	32.47 (24.6 to 45.55)	740.62 (562.85 to 1026.93)	15.67 (12.32 to 19.71)	5,163.72 (4,022.40 to 6,657.18)	120,140.54 (93,940.41 to 154,695.08)	7,549.85 (5,951.12 to 9,477.30)	31.38 (24.39 to 40.45)	666.48 (520.42 to 858.3)	0.12 (0.12 to 0.13)	-0.11 (-0.29 to 0.08)	-0.35 (-0.53 to -0.16)
High-income Asia Pacific	20.32 (15.7 to 25.7)	961.75 (815.78 to 1,131.56)	6,574.96 (14,246.08 to 19,580.01)	8,332.43 (6,439.13 to 10,537.68)	3.85 (3.26 to 4.53)	66.04 (56.62 to 78)	36.83 (28.08 to 47.1)	3,480.60 (2,531.46 to 4,300.94)	48,940.61 (37,054.94 to 59,648.99)	8,661.82 (6,684.46 to 11,017.64)	4.6 (3.44 to 5.62)	75.67 (59.17 to 91.05)	0.11 (0.08 to 0.15)	0.5 (-0.14 to 1.14)	0.37 (-0.26 to 0.99)
High-income North America	68.3 (53.96 to 85.29)	5,463.32 (4,698.94 to 5,893.31)	87,067.44 (76,945.59 to 93,515.62)	16,783.27 (13,199.46 to 21,021.86)	10.67 (9.25 to 11.49)	181.85 (161.84 to 195.24)	126.33 (100.62 to 156.87)	10,289.92 (8,708.34 to 11,363.04)	176,924.35 (154,847.10 to 193,356.39)	17,143.48 (13,626.69 to 21,325.77)	12.37 (10.53 to 13.64)	223.13 (196.49 to 243.49)	0.09 (-0.01 to 0.18)	0.48 (0.01 to 0.95)	0.67 (0.26 to 1.08)
North Africa and Middle East	9.37 (7.28 to 11.87)	952.06 (695.70 to 1,179.82)	18,999.25 (14,065.91 to 34,465.85)	4,773.08 (3,721.92 to 6,035.41)	6.92 (5.05 to 13.24)	122.44 (90.32 to 226.58)	26.87 (20.83 to 34.14)	3,144.93 (2,399.03 to 4,013.23)	58,588.50 (44,926.28 to 74,264.43)	5,035.34 (3,916.22 to 6,381.97)	8.21 (6.25 to 10.47)	138.14 (105.79 to 175.38)	0.18 (0.15 to 0.2)	0.61 (0.46 to 0.76)	0.41 (0.3 to 0.53)
Oceania	0.17 (0.13 to 0.22)	15.25 (8.86 to 25.45)	364.04 (209.45 to 608.70)	4,945.78 (3,764.44 to 6,435.59)	7.26 (4.35 to 11.87)	138.44 (81.58 to 228.64)	0.46 (0.35 to 0.6)	35.98 (22.32 to 62.98)	850.79 (528.98 to 1,497.20)	5,075.28 (3,865.57 to 6,608.79)	6.26 (3.94 to 10.74)	0.18 (76.8 to 212.2)	0.09 (0.07 to 0.1)	-0.5 (-0.9 to -0.09)	-0.43 (-0.68 to -0.18)
South Asia	105.89 (82.93 to 133.3)	8,373.33 (6,212.07 to 10,965.11)	205,977.56 (154,016.50 to 264,631.03)	16,351.20 (12,835.77 to 20,538.07)	16.41 (12.16 to 21.73)	360.95 (269.54 to 468.31)	312.89 (246.77 to 394.97)	30,543.62 (22,562.55 to 38,112.64)	679,686.54 (501,128.10 to 844,246.84)	18,284.53 (14,441.01 to 23,056.07)	20.35 (15.08 to 25.38)	426.38 (315.13 to 529.64)	0.33 (0.29 to 0.38)	0.76 (0.33 to 1.19)	0.59 (0.28 to 0.9)
Southeast Asia	26.11 (20.88 to 32.5)	2,265.62 (1,669.65 to 3,366.63)	51,923.80 (38,766.30 to 75,010.03)	8,207.95 (6,574.38 to 10,201.26)	8.97 (6.6 to 13.48)	185.87 (138.52 to 271.61)	66.06 (52.64 to 82.22)	8,840.11 (6,143.14 to 11,418.75)	179,794.78 (126,704.90 to 228,660.41)	7,900.90 (6,310.93 to 9,819.10)	13.19 (9.14 to 17.11)	246.81 (173.61 to 315.48)	-0.1 (-0.16 to -0.04)	1.24 (1.14 to 1.35)	0.91 (0.83 to 1)
Southern Latin America	6.77 (5.25 to 8.74)	400.14 (346.92 to 454.02)	7,244.04 (6,328.46 to 8,200.81)	12,452.89 (9,663.77 to 16,097.08)	7.14 (6.19 to 8.11)	129.06 (112.66 to 146.18)	13.98 (11.01 to 17.37)	3,511.30 (2,943.21 to 4,048.29)	55,305.86 (47,162.75 to 63,324.53)	14,186.20 (11,165.37 to 17,654.28)	29.6 (24.92 to 34.09)	491.57 (421.15 to 561.96)	0.4 (0.36 to 0.44)	4.64 (3.43 to 5.88)	4.32 (3 to 5.66)
Southern Sub-Saharan Africa	2.26 (1.75 to 2.87)	82.03 (39.68 to 122.88)	1,773.81 (908.36 to 2,532.84)	6,636.24 (5,151.22 to 8,413.98)	2.79 (1.36 to 4.2)	56.54 (28.94 to 81.26)	5.1 (3.91 to 6.47)	251.92 (139.24 to 421.35)	5,562.05 (3,328.67 to 9,013.72)	6,674.60 (5,120.27 to 8,459.10)	3.89 (2.13 to 6.53)	79.6 (47.08 to 129.61)	0.01 (-0.03 to 0.04)	1.1 (0.7 to 1.5)	1.11 (0.73 to 1.49)
Tropical Latin America	20.15 (15.95 to 25.1)	1,060.25 (953.16 to 1,150.91)	22,059.91 (20,009.48 to 23,974.84)	18,535.32 (14,664.72 to 23,101.86)	11.72 (10.46 to 12.74)	225.16 (203.37 to 244.79)	56.15 (44.87 to 68.99)	12,003.12 (10,148.50 to 13,357.05)	209,178.27 (182,256.10 to 230,086.96)	18,327.63 (14,647.28 to 22,514.61)	39.94 (33.74 to 44.47)	690.59 (600.99 to 759.95)	-0.03 (-0.06 to 0.01)	4.13 (3.25 to 5.02)	3.75 (2.98 to 4.53)
Western Europe	61.51 (49.17 to 76.41)	4,247.65 (3,734.69 to 4,580.67)	68,288.33 (60,680.10 to 74,000.05)	10,106.65 (8,053.40 to 12,601.24)	4.75 (4.2 to 5.11)	83.39 (74.29 to 90.68)	78.79 (62.1 to 97.64)	12,182.96 (9,781.47 to 13,952.40)	172,323.11 (142,027.60 to 196,164.66)	9,222.19 (7,255.61 to 11,468.23)	8.4 (6.87 to 9.57)	134.44 (113.08 to 152.38)	-0.29 (-0.38 to -0.2)	1.92 (1.44 to 2.4)	1.62 (1.1 to 2.14)
Western Sub-Saharan Africa	7.83 (6.08 to 9.87)	551.58 (374.09 to 819.12)	12,927.74 (8,863.55 to 18,974.11)	8,209.53 (6,388.18 to 10,357.86)	6.55 (4.45 to 9.72)	143.23 (98.22 to 210.48)	21.66 (16.84 to 27.26)	1,228.76 (887.99 to 1,890.30)	29,981.40 (21,903.66 to 44,415.01)	8,439.07 (6,588.60 to 10,612.10)	6.57 (4.77 to 10.26)	139 (101.66 to 210.09)	0.09 (0.08 to 0.11)	-0.01 (-0.07 to 0.06)	-0.11 (-0.2 to -0.03)

**Abbreviations:** ASR, age-standardized rate; AAPC, average annual percentage changes; DALYs, Disability-adjusted life years.

From 1990 to 2021, UTI incidence increased faster in premenopausal women (average annual percentage change [AAPC]: 0.17 [95% CI: 0.15–0.18]) than in postmenopausal women (AAPC: 0.04 [95% CI: 0.02–0.07]). During this period, mortality growth was higher in postmenopausal women (AAPC: 1.08 [95% CI: 0.81–1.36]) than in premenopausal women (AAPC: 0.45 [95% CI: 0.33–0.56]) (Table 1 and 2).

Joinpoint regression showed that from 2001 to 2011, incidence increased gradually in premenopausal women (APC: 0.09 [95% CI: 0.07–0.11]) and more significantly in postmenopausal women from 2006 to 2011 (APC: 0.42 [95% CI: 0.34–0.49]). After 2011, premenopausal UTI incidence rose sharply (APC: 0.57 [95% CI: 0.55–0.59]), while postmenopausal UTI incidence showed a slight decline (APC: –0.04 [95% CI: –0.10 through 0.02]) (Figure 1A). From 2011 to 2016, mortality associated with postmenopausal UTI increased markedly (APC: 3.04 [95% CI: 2.40–3.68]). Significant changes in postmenopausal UTI mortality rates occurred in 1992, 2004, 2016, and 2019 (Figure 1B), DALYs show the same trend as mortality rates (Figure 1C).



**Figure 1** Joinpoint regression analysis of the global incidence, deaths, and DALYs from UTI in premenopausal, postmenopausal, and overall woman populations from 1990 to 2021, along with a line graph illustrating the global incidence, deaths, and DALYs from UTI stratified by menopause status and SDI from 1990 to 2021. (A–C). Joinpoint regression analysis of the global incidence (A), deaths (B), and DALYs (C) from UTI in premenopausal, postmenopausal, and overall woman populations from 1990 to 2021. (D–F). Line charts of the incidence (D), deaths (E), and DALYs (F) rates of premenopausal UTI from 1990 to 2021 at the global level, stratified by SDI. (G–I). Line charts of the incidence (G), deaths (H), and DALYs (I) rates of postmenopausal UTI from 1990 to 2021 at the global level, stratified by SDI. \* Represents statistical significance. \* P < 0.05, \*\* P < 0.01, \*\*\* P < 0.001.

**Abbreviations:** UTI, urinary tract infection; SDI, Socio demographic index; AAPC, average annual percentage changes; APC, annual percentage change; DALYs, disability-adjusted life years.

## SDI Regions Trends in Pre- and Post-Menopausal UTI

For premenopausal UTI between 1990 and 2021, high SDI regions had the biggest drop in ASIR (AAPC:  $-0.3$ , 95% CI:  $-0.32$  to  $-0.28$ ), while low-middle SDI regions unexpectedly kept rising and overtook high SDI regions by 2021 (Table 1; Figure 1D). Middle SDI regions exhibited the fastest ASIR growth (AAPC:  $0.63$ , 95% CI:  $0.60$ – $0.65$ ). Death rates increased in all areas except low and high-middle SDI regions (Figure 1E), with DALYs following the same pattern as death rates (Figure 1F).

For Postmenopausal UTI, Middle SDI regions again grew fastest (AAPC:  $0.42$ , 95% CI:  $0.39$ – $0.45$ ), while high-middle SDI regions had the sharpest decline (AAPC:  $-0.6$ , 95% CI:  $-0.64$  to  $-0.55$ ) (Table 2; Figure 1G). ASMR rose across all regions, with the largest increase in middle SDI regions (AAPC:  $1.73$ , 95% CI:  $1.49$ – $1.97$ ) (Table 2 and Figure 1H), and DALYs matched death rate trends exactly across all regions (Figure 1I).

Figure 2 shows global trends in UTI cases by age and SDI regions from 1990 to 2021. The largest ASIR increase for premenopausal UTI occurred in the 20–24 age group, while the 30–34 age group showed a decline. For postmenopausal UTI, the largest ASIR increase was in the 75–79 age group, with declines in the 50–54 and 85–89 age groups (Figure 2A–C, Tables S1 and S2).

Among SDI regions, high SDI regions showed declining premenopausal UTI ASIR across all age groups. Middle SDI regions showed the most pronounced increase, driven by the 20–24 age group. For postmenopausal UTI, ASIR declined across most age groups as economic levels rose, but older age groups retained higher ASIR. Premenopausal UTI cases were most prevalent in the 30–34 age group, while postmenopausal cases were concentrated in the 50–54 age group across all regions (Figure 2C and D). The ASMR (Age-Standardized Mortality Rate) of premenopausal UTI is predominantly concentrated in the 25–39 age group, while the postmenopausal elderly age group exhibits higher ASMR (Figure S2). Regarding DALYs (Disability-Adjusted Life Years), premenopausal UTI account for a larger proportion in the 45–49 age interval. Postmenopausal UTI show uneven regional distribution globally, with most regions having a higher burden in the 70–80 age range, while a few areas demonstrate more pronounced impacts in the 85–89 age group (Figure S3, Tables S1 and S2).

## Region Trends in Pre- and Post-Menopausal UTI

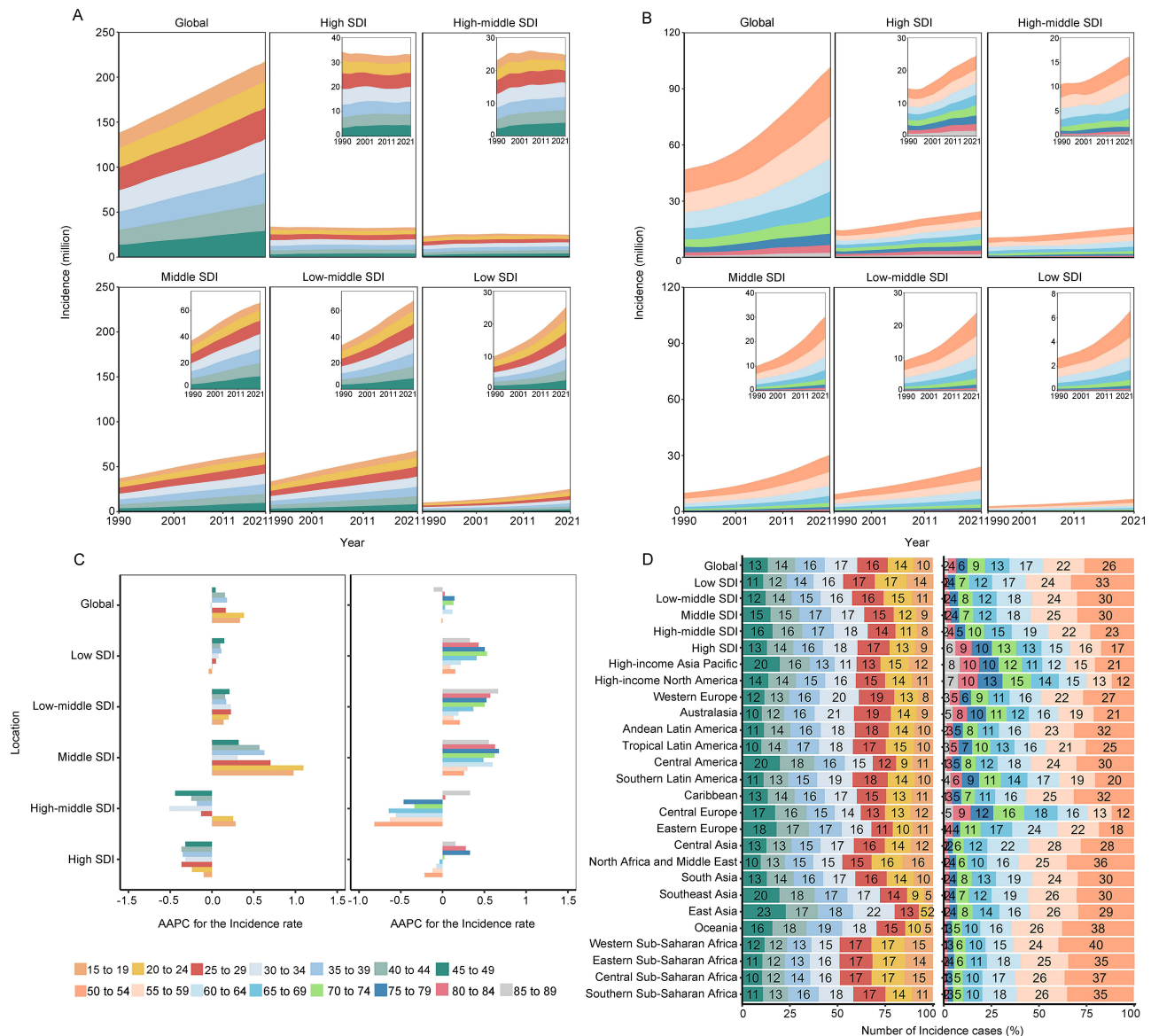
In 2021, the peak ASIR of premenopausal UTI was in Latin America's tropical region (29,601.29 per 100,000, 95% CI: 22,879.19–37,607.62), with South Asia seeing the largest incidence rise (AAPC:  $0.3\%$ , 95% CI:  $0.25$ – $0.36$ ) (Table 1, Figure 3A). Postmenopausal UTI's highest ASIR was in the Andean region (20,527.86 per 100,000, 95% CI: 15,945.77–25,684.16), with Central Latin America having the steepest increase from 1990 to 2021 (AAPC:  $0.45\%$ , 95% CI:  $0.35$ – $0.54$ ) (Table 2, Figure 3B).

For mortality, premenopausal UTI ASMR decreased in over half the regions, while postmenopausal UTI ASMR rose in most. Southern Latin America had the largest ASMR increases for both, with AAPC of  $3.65\%$  (95% CI:  $2.55$ – $4.76$ ) for premenopausal and  $4.64\%$  (95% CI:  $3.43$ – $5.88$ ) for postmenopausal UTI. Notable ASMR increases also occurred in tropical Latin America, the Caribbean, and Central Latin America. Conversely, East Asia saw the largest ASMR declines, with AAPCs of  $-2.95\%$  (95% CI:  $-3.37$  to  $-2.52$ ) for premenopausal and  $-1.55\%$  (95% CI:  $-2.06$  to  $-1.04$ ) for postmenopausal UTI (Table 1 and 2, Figure 3A and B).

For DALYs, the highest age-standardized DALYs rate (ASDR) for premenopausal UTI in 2021 were in sub-Saharan Africa (98.27, 95% CI: 75.41–125.70) and the tropical region of Latin America (86.83, 95% CI: 77.16–98.09). For postmenopausal UTI, the highest ASDR was in the tropical region of Latin America (690.59, 95% CI: 600.99–759.95), followed by sub-Saharan Africa (666.48, 95% CI: 520.42–858.30). Central Latin America had the largest increase in DALYs for premenopausal UTI (AAPC  $2.35\%$  [95% CI:  $2.05$ – $2.64$ ]), while Southern Latin America had the largest increase for postmenopausal UTI (AAPC  $4.64\%$  [95% CI:  $3.43$ – $5.88$ ]) (Table 1 and 2, Figure 3A and B).

Figure 4 shows a positive correlation between premenopausal UTI ASIR and SDI, while postmenopausal UTI ASIR shows no consistent pattern (Figure 4). DALYs for both premenopausal and postmenopausal UTI are negatively correlated with SDI (Figure S4).





**Figure 2** Temporal trend of UTI incidence in pre- and postmenopausal women, stratified by age pattern, across different regions. **(A)** Incident cases of different age groups (15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49) in premenopausal women with UTI from 1990 to 2021, globally and in 5 SDI regions. **(B)** Incident cases of different age groups (50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, 85–89) in postmenopausal women with UTI from 1990 to 2021, globally and in 5 SDI regions. **(C)** The AAPC of incidence for pre- and postmenopausal UTI among various age groups, from 1990 to 2021, globally and across 5 SDI regions. **(D)** The percentage distribution of incident cases of pre- and postmenopausal UTI across different age groups, globally, across five regions, and within 21 GBD regions for 1990 and 2021.

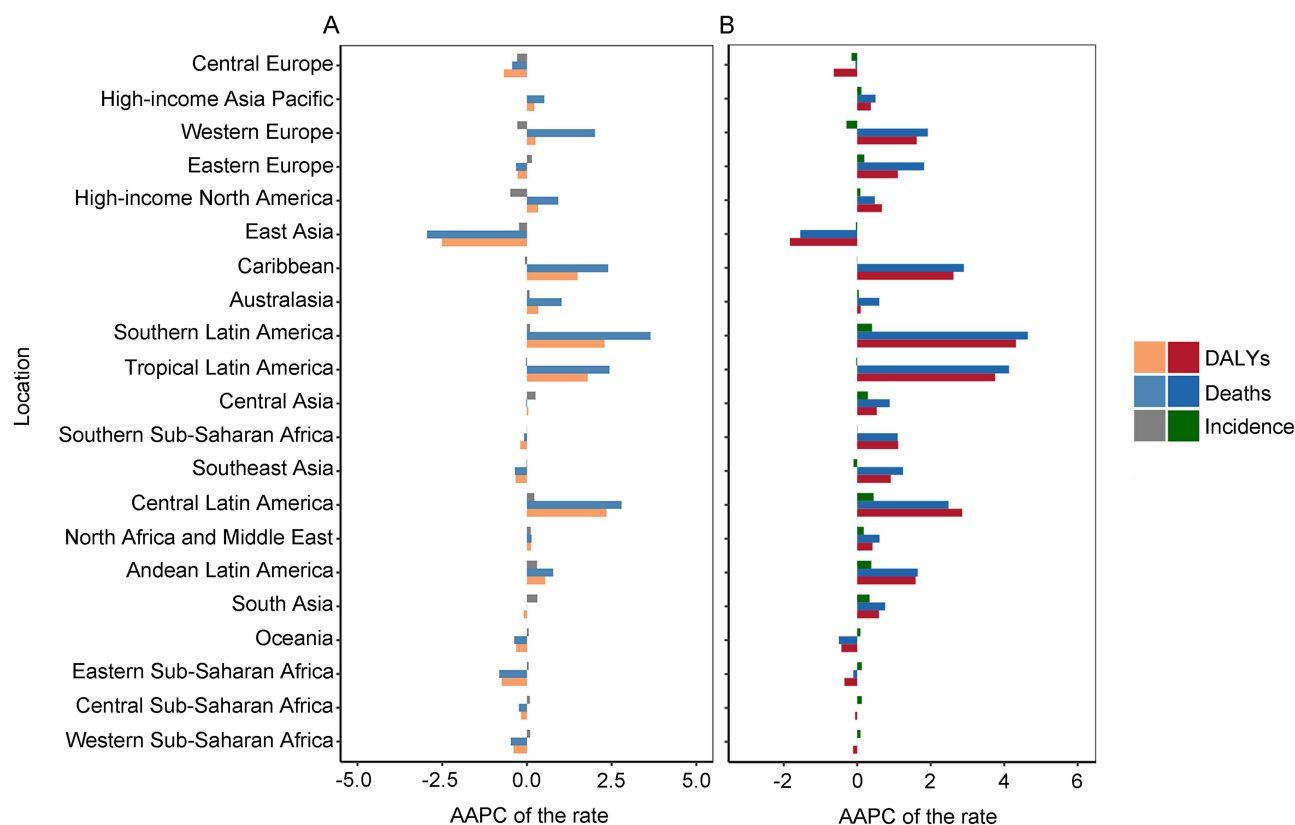
**Abbreviations:** UTI, urinary tract infection; SDI, Socio demographic index; AAPC, average annual percentage changes.

# National Trends in Pre- and Post-Menopausal UTI

In 2021, Ecuador recorded the highest ASIR for both pre- and postmenopausal UTI globally (Figure 5A and B). The ASIR for premenopausal UTI was 35,677.45 per 100,000 (95% CI: 24,646.85–47,133.35) (Figure 5A, Table S3), while for postmenopausal UTI, it was 25,650.64 (95% CI: 17,608.46–34,595.12) (Figure 5B, Table S4). Croatia had the greatest increase in premenopausal ASIR (AAPC 0.67 [95% CI: 0.55–0.79]) (Figure 5C). Similarly, Jordan showed the greatest increase in postmenopausal ASIR (AAPC 0.67 [95% CI: 0.55–0.79]) (Figure 5D).

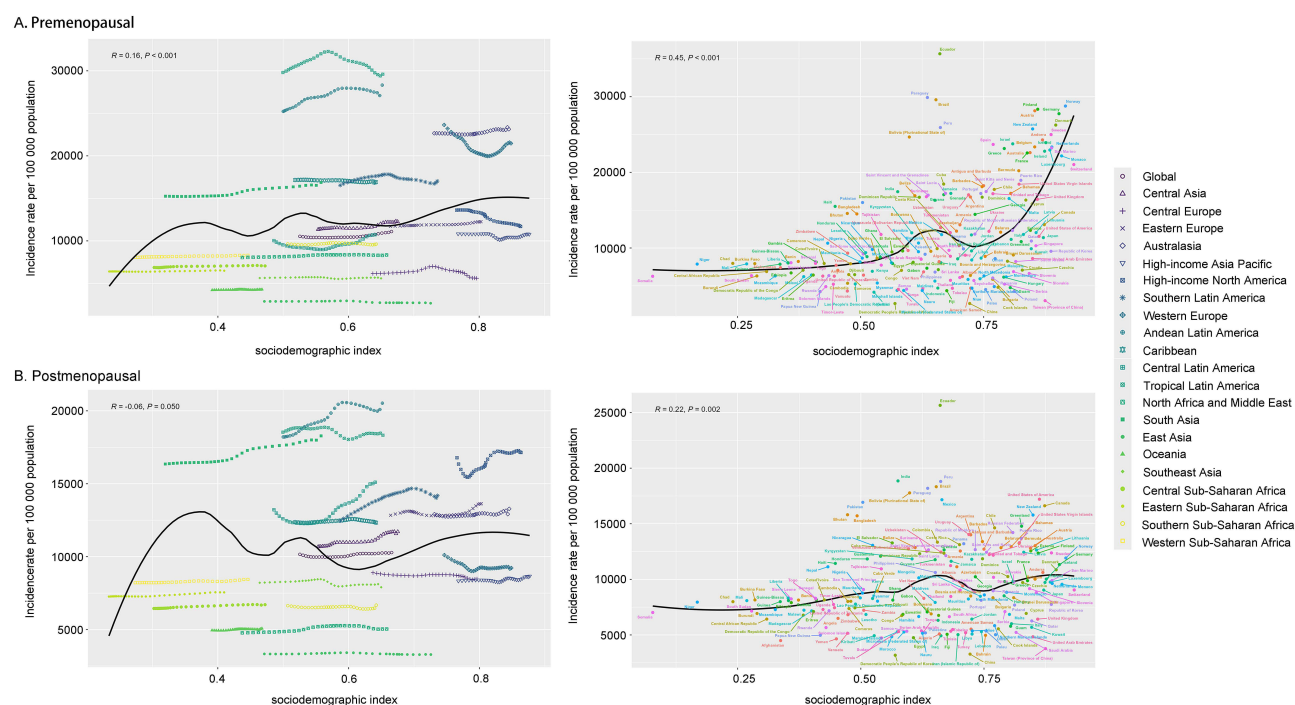
For mortality, Turkmenistan had the highest ASMR for premenopausal UTI in 2021, at 4.54 per 100,000 (95% CI: 3.38–6.12) (Figure 5E, Table S3). Ethiopia recorded the highest postmenopausal ASMR, at 47.07 (95% CI: 32.3–65.2) (Figure 5F, Table S4). Kuwait showed the greatest ASMR increases for both pre- and postmenopausal UTI. The AAPC





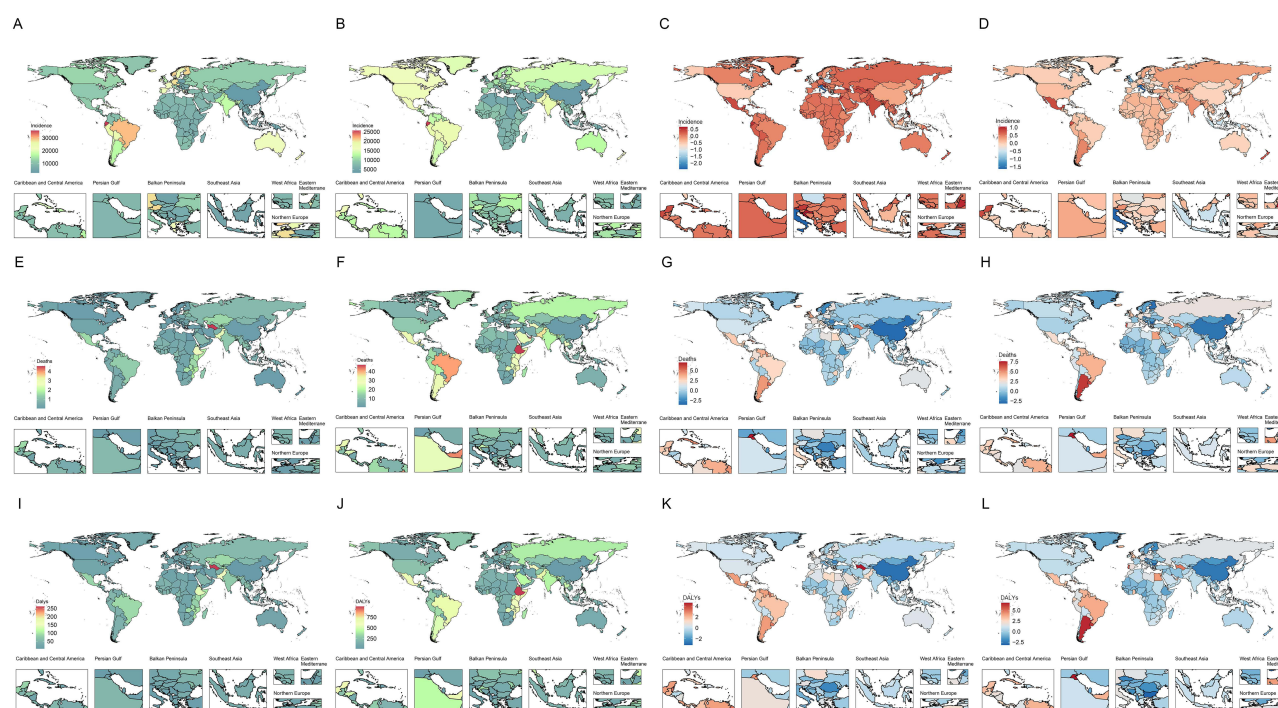
**Figure 3** Temporal trend of the UTI burden in premenopausal and postmenopausal women globally, across 5 SDI regions, and in 21 GBD regions. (A) and (B). AAPC of the incidence, death rates, and DALYs rates for premenopausal (A) / postmenopausal (B) UTI in 21 GBD regions from 1990 to 2021.

**Abbreviations:** UTI, urinary tract infection; SDI, Socio demographic index; AAPC, average annual percentage changes; DALYs, disability-adjusted life years.



**Figure 4** The association between pre- and postmenopausal UTI incidence and sociodemographic indicators at regional and national levels. (A and B) The association between premenopausal (A) / postmenopausal (B) UTI incidence and sociodemographic indicators at the regional and national levels.

**Abbreviation:** UTI, urinary tract infection.



**Figure 5** Global map of incidence, deaths, and DALYs for pre- and postmenopausal UTI in 2021, along with their AAPC from 1990 to 2021. (A and B) Incidence of premenopausal (A)/postmenopausal (B) UTI in 2021. (C and D). AAPC of the incidence of premenopausal (C) / postmenopausal (D) UTI between 1990 and 2021. (E and F). Deaths of premenopausal (E) / postmenopausal (F) UTI in 2021. (G and H). AAPC of the Deaths of premenopausal (G) / postmenopausal (H) UTI between 1990 and 2021. (I and J). DALYs of premenopausal (I) / postmenopausal (J) UTI in 2021. (K and L). AAPC of the DALYs of premenopausal (K) / postmenopausal (L) UTI between 1990 and 2021. **Abbreviations:** DALYs, disability-adjusted life years; UTI, urinary tract infection; AAPC, average annual percentage changes.

for premenopausal UTI mortality in Kuwait was 6.99 (95% CI: 3.61–10.47), while for postmenopausal mortality, it was 7.58 (95% CI: 2.78–12.6) (Figure 5G and H, Tables S3 and S4).

For ASDR, Turkmenistan had the highest premenopausal ASDR in 2021, at 261.74 per 100,000 (95% CI: 196.41–349.32), with the greatest increase over the study period (AAPC 4.6 [95% CI: 3.69–5.53]), rising from 63.75 in 1990 (95% CI: 55.66–73.14). Ethiopia recorded the highest postmenopausal ASDR in 2021, at 999.69 (95% CI: 683.02–1,390.45). Kuwait showed the largest increase in postmenopausal ASDR (AAPC 6.76 [95% CI: 2.36–11.35]), consistent with its ASMR trends (Figure 5I–L, Tables S3 and S4).

Figure 4 shows a positive correlation between ASIR and SDI among 204 countries, with higher incidence in high-middle SDI countries (Figure 4). Conversely, ASMR negatively correlated with SDI, indicating lower mortality in higher SDI regions (Figure S4).

## Impact of COVID-19 on UTI Among Pre- and Post-Menopausal

From 2019 to 2021, the global ASIR for premenopausal UTI continued to rise (AAPC 0.64, [95% CI 0.62–0.66]), exceeding the rate observed from 1990 to 2018 (AAPC 0.22 [95% CI 0.17–0.26]). Similarly, the ASMR for premenopausal UTI showed an upward trend (AAPC 1.31 [95% CI 1.15–1.47]), which was significantly higher than the AAPC from 1990 to 2018 (AAPC 0.63 [95% CI 0.52 to 0.75]). The ASDR also exhibited a rising trend during 2019–2021 (AAPC 0.96 [95% CI 0.84–1.07]) (Table 3).

Notably, during the COVID-19 pandemic period (2019–2021), the incidence, mortality, and DALYs for premenopausal UTI showed accelerated growth across nearly all SDI regions compared to 1990–2018. In contrast, the disease burden of postmenopausal UTI remained largely unchanged during this period. Interestingly, the ASMR for postmenopausal UTI even showed a declining trend (AAPC −0.42 [95% CI −1.88 to 1.05]), while DALYs exhibited a slight decrease (Table 3).

**Table 3** Trends in Incidence, Deaths, and DALYs for Urinary Tract Infections in Pre- and Postmenopausal Females Before and During COVID-19

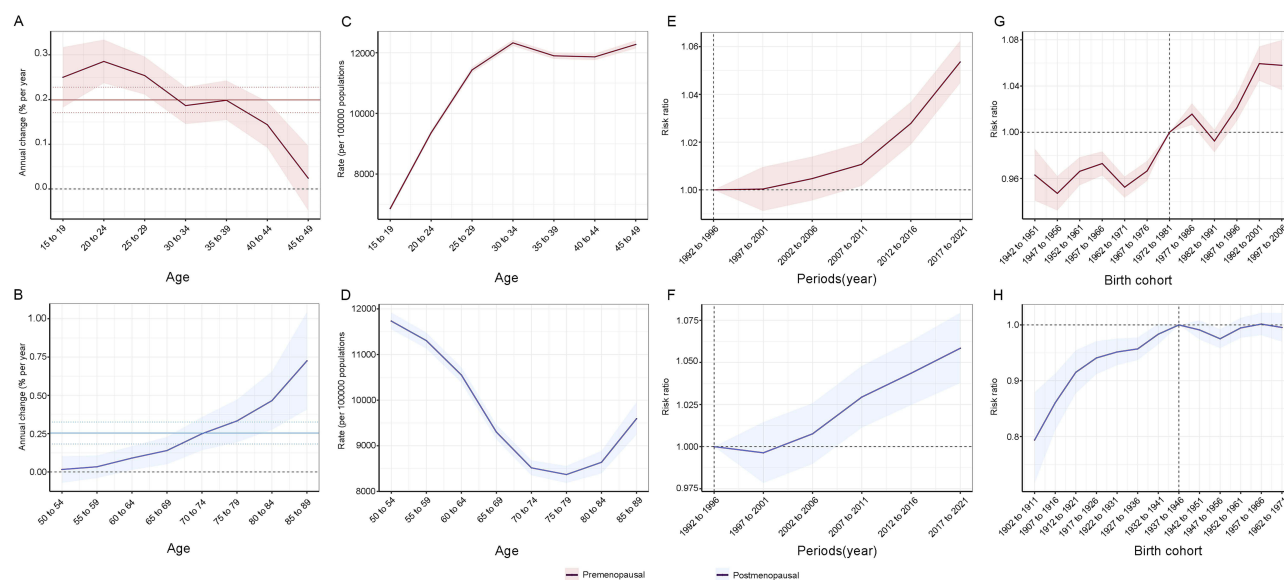
	Incidence AAPC(95% CI)	Mortality AAPC(95% CI)	DALYs AAPC(95% CI)
Premenopausal			
1990–2018	0.22 (0.17 to 0.26)	0.63 (0.52 to 0.75)	0.5 (0.39 to 0.6)
2019–2021	0.64 (0.62 to 0.66)	1.31 (1.15 to 1.47)	0.96 (0.84 to 1.07)
1990–2021	0.26 (0.22 to 0.3)	0.7 (0.59 to 0.81)	0.54 (0.44 to 0.64)
Postmenopausal			
1990–2018	0.03 (0 to 0.05)	1.35 (1.17 to 1.53)	0.99 (0.73 to 1.26)
2019–2021	0.04 (0.03 to 0.06)	−0.42 (−1.88 to 1.05)	−0.06 (−1.88 to 1.79)
1990–2021	0.03 (0.01 to 0.05)	1.23 (1.03 to 1.44)	0.94 (0.65 to 1.22)

## Net Drift and Local Drift in Different Age Groups

Analysis of age-period-cohort models from 1990 to 2021 revealed a net global incidence drift of 0.20% for premenopausal UTI and 0.27% for DALYs. In the 20–24 years age group, the localized drift in incidence was 0.23%, followed by a gradual decline in growth rates with increasing age (Figure 6A, Tables S5 and S6). The incidence of premenopausal UTI increased most rapidly in the middle SDI region (net drift of 0.64%), while the high SDI region exhibited a negative growth rate (net drift of −0.27%) (Figure S5A). Similarly, the DALYs burden for premenopausal UTI decreased progressively with age, with a peak localized drift of 0.298% in the 30–34 years age group and the highest net drift in the middle SDI region (0.52%) (Figure S5B).

## Age, Period, and Cohort Effects

For premenopausal UTI, incidence climbed with age globally, with a peak at 25–29 years in high SDI regions before a decline, while low-middle SDI regions showed a peak at 45–49 years (Figure 6B, Figure S5C). The DALYs burden increased with age universally, with significant fluctuations in low-middle and low SDI regions, particularly peaking at 45–49 years (Figure S5D), for period effects, the risk of premenopausal UTI increased globally but decreased in high and



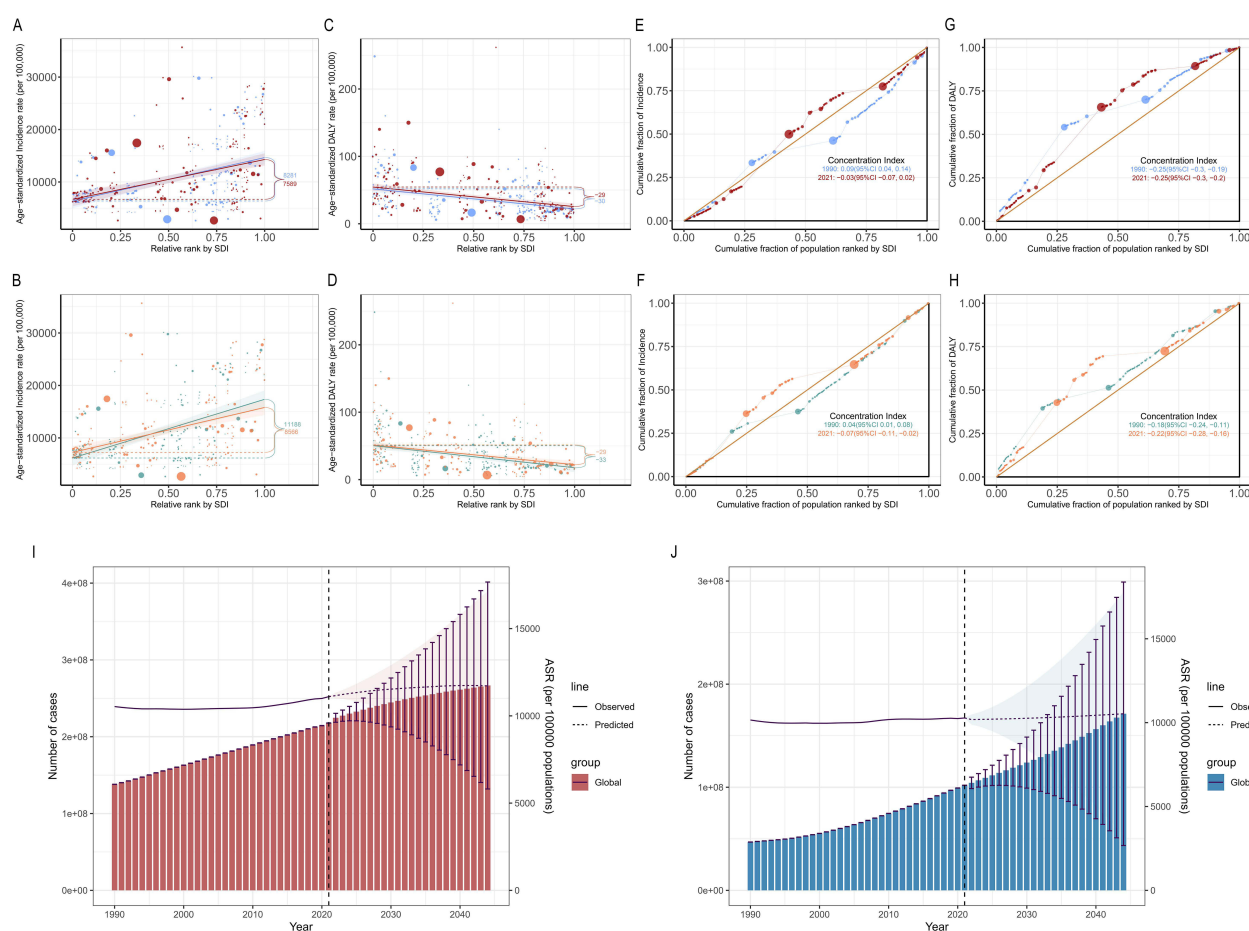
**Figure 6** Local drifts, as well as the effects of age, period, and cohort, on the incidence of pre- and postmenopausal UTI globally from 1990 to 2021. (A) Local drifts in premenopausal UTI incidence (estimated from age-period-cohort models), 1990–2021. The dots and shaded areas represent the annual percentage change in incidence (percent per year) and their corresponding 95% confidence intervals. (B–D) The effects of age (B), period (C) and cohort (D) on premenopausal UTI incidence globally from 1990 to 2021. (E) Local drifts in postmenopausal UTI incidence from 1990 to 2021. (F–H) The effects of age (F), period (G) and cohort (H) on postmenopausal UTI incidence globally from 1990 to 2021.

high-middle SDI regions (Figure 6C, Figure S5E, Table S7), DALYs show subtle differences (Figure S5F), Cohort analysis revealed an increased burden among women born between 1972 and 1981 (Figure 6D, Figure S5G–H, Table S8).

In contrast, postmenopausal UTI exhibited a slightly higher net global incidence drift (0.25%) compared to premenopausal UTI, while the net DALYs drift was significantly higher at 0.99% (Figure 6E, Figure S6A and B). Incidence in high SDI regions decreased until age 65–69, then gradually increased. In other SDI regions, incidence generally declined with age, though globally it rose significantly after 75–79 years (Figure 6F, Figure S6C). The DALYs burden increased with age globally and in most SDI regions (Figure S6D). Period effects showed rising risks in all regions except slight decreases in high-middle SDI regions (Figure 6G, Figure S6E, Table S7), DALYs showed increased risk in all regions (Figure S6F). Cohort effects indicated increased global incidence among women born after 1937–1946 (Figure 6H, Figure S6G, Table S8). Additionally, the DALYs burden rose with birth year for cohorts born after 1952–1961 (Figure S6H, Table S8). The Wald chi-square test was conducted for the results of age-period-cohort model analysis (Table S9).

## Health Inequality and Predictions

In terms of absolute inequality in 1990 and 2021, the SII for premenopausal UTI incidence was 8280.99 (95% CI: 5688.86–10,873.11) in 1990 and 7589 (95% CI: 5183.465–9994.759) in 2021 (Figure 7A). For postmenopausal UTI incidence, the SII in 1990 was 11188.21 (95% CI: 8378.42–13998) and 8565.81 (95% CI: 6036.04–11,095.59) in 2021



**Figure 7** Analysis of health inequalities, and prediction of the number and rate of incidence for urinary tract infections before and after menopause, from 2022 to 2044. (A)–(D). Absolute income-related health inequality in pre- and postmenopausal UTI incidence (A and B) and the burden of DALYs (C and D), comparing 1990 versus 2021. (E–H) Relative income-related health inequality in pre- and postmenopausal UTI incidence (E and F) and the burden of DALYs (G and H), 1990 versus 2021. (I) Predural UTI incidence of premenopausal UTI incidence from 2022 to 2044. (J) Predicting postmenopausal UTI incidence from 2022 to 2044.

**Abbreviations:** UTI, urinary tract infection; DALYs, disability-adjusted life years.



(Figure 7B). The absolute inequality in DALYs for premenopausal and postmenopausal UTI did not show substantial changes from 1990 to 2021 (Figure 7C and D). The relative inequality analysis of the ASIR and ASDR for pre- and postmenopausal UTI showed that in 1990, the relative inequality concentration index (RII) for the premenopausal ASIR was 0.09 (95% CI: 0.04–0.14), and it changed to –0.03 (95% CI: –0.07 to 0.02) by 2021 (Figure 7E). This trend was more pronounced in postmenopausal women, where the RII for postmenopausal UTI ASIR was –0.07 (95% CI: –0.11 to –0.02) in 2021 (Figure 7F). There was no significant difference in the relative inequality concentration index for premenopausal UTI ASDR between 1990 and 2021 (Figure 7G), but the relative inequality concentration index for postmenopausal UTI ASDR increased from –0.18 (95% CI: –0.24 to –0.11) in 2019 to –0.22 (95% CI: –0.28 to –0.16) in 2021 (Figure 7H). However, the statistical significance of this change cannot be conclusively determined due to overlapping confidence intervals.

The predicted results indicate that by 2044, the global number of premenopausal UTI cases is projected to reach 253.33 million, with the ASIR increasing to 11,719.27 per 100,000 population, representing a 5.58% rise compared to 2021 (Figure 7I, Table S10). Postmenopausal UTI cases are estimated to rise to 164.72 million, with an ASIR of 10,527.98 per 100,000 population, marking a 2.42% increase from 2021 (Figure 7J, Table S10). By 2024, the number of cases among individuals aged 30–34 years is expected to increase to 44.29 million, with an incidence of 7,476.75 per 100,000 population. Similarly, for the 50–54-year age group, cases are projected to rise to 39.73 million, with an incidence of 13,688.79 per 100,000 population. These two age groups are anticipated to remain the highest contributors to UTI incidence in their respective pre- and postmenopausal categories by 2044 (Table S11).

## Discussion

Our study found that over the past 32 years, UTI have become an increasing health threat to women worldwide. Notably, significant differences in disease burden have emerged between pre- and postmenopausal women, with distinct patterns observed.

Between 1990 and 2021, the global incidence, mortality, and DALYs of UTI in women have increased significantly by 73%, 200%, and 138%, respectively. Notably, the mortality increase far exceeds the incidence, suggesting UTI severity may be underestimated, particularly in resource-limited regions.<sup>8</sup>

Moreover, the joinpoint regression analysis showed that, between 1990 and 2021, the incidence of UTI increased at a much faster pace in premenopausal women compared to postmenopausal women, particularly after 2011. The difference may be the result of lifestyle changes, such as working long hours, lack of exercise, and increased stress.<sup>9</sup> Antibiotic resistance and higher recurrence rates further contribute to this trend.<sup>1</sup> These combined factors have significantly increased UTI incidence among premenopausal women. In contrast, postmenopausal women continue to bear a substantial burden of UTI incidence in certain regions, particularly in low- and middle-SDI regions. Our findings indicate that, from 1990 to 2021, the ASIR of UTI consistently remained highest in low-middle SDI regions.

Although there has been a rapid increase in incidence among premenopausal women, the increase in mortality among postmenopausal women has been significantly greater. This may be due to immune decline and comorbidities.<sup>10</sup> This discrepancy is concerning, as diagnostic delays, comorbidities, and complications in the elderly may lead to higher mortality.<sup>11</sup> In high SDI regions, ASMR for postmenopausal women remains low, indicating the effectiveness of healthcare and public health interventions. In contrast, low SDI regions have the highest ASMR, highlighting the urgent need for better healthcare, education, and prevention in resource-limited areas.<sup>12</sup>

The ASIR of UTI in premenopausal women has declined in high-SDI regions but has risen significantly in low- and middle-SDI regions. By 2021, the ASIR in low- and middle-SDI regions exceeded that of high-SDI regions. Surprisingly, the ASIR of UTI in postmenopausal women remains high in low- and middle-SDI regions. Moreover, both pre- and postmenopausal women in these regions experienced the largest increases in ASMR. Such disparities warrant the attention of policymakers, who should address healthcare conditions, resource allocation, and the prevalence of chronic diseases affecting postmenopausal women in low- and middle-SDI regions.<sup>13</sup> This phenomenon likely reflects the dual impact of chronic diseases and population aging on the global disease burden.<sup>14</sup>

In 2021, the ASIR of UTI in premenopausal women was highest in tropical Latin America, indicating a significant burden in this region. Additionally, South Asia showed the largest increase in ASIR between 1990 and 2021, with India

as the main contributor. This aligns with previous studies and may be linked to rapid urbanization, increasing antibiotic resistance, and rapid population growth.<sup>12,15</sup> Although more than half of the regions experienced a decline in premenopausal UTI ASMR, Southern Latin America exhibited a significant increase in mortality. Of particular concern, postmenopausal UTI mortality also showed the highest growth trend in Southern Latin America. A prior study identified Southern and Tropical Latin America as the two regions with the highest mortality burden caused by antimicrobial resistance (AMR).<sup>16</sup> This disparity may reflect an “amplification effect” driven by weakened immunity, comorbid chronic diseases, and the lack of targeted disease management strategies for postmenopausal women. These challenges are likely compounded by local poverty, inadequate healthcare services, and weak social and health infrastructure.<sup>14</sup>

In contrast, the ASMR in East Asia significantly declined, reflecting the success of comprehensive public health programs and improved healthcare services. This suggests that the successful experiences of East Asia may provide valuable insights for other high-burden regions. Policymakers should focus on high-burden regions by improving healthcare resource allocation, strengthening antibiotic stewardship, promoting hygiene education, and implementing extensive health education programs for vulnerable populations, particularly postmenopausal women.

It is worth mentioning that the APC model reveals distinct patterns in the burden of UTI among pre- and postmenopausal women. The incidence of UTI among premenopausal women increases rapidly, peaking at ages 20–24, before declining gradually. In contrast, the burden of UTI among postmenopausal women rises significantly with advancing age, accelerating notably after 65–69 years. This sharp increase is reflected in a marked rise in DALYs in the elderly population. These findings highlight elderly women as a critical demographic in the global burden of UTI.<sup>12,17</sup> The observed age-specific trends underscore the need for tailored prevention and intervention strategies for women at different life stages, with particular emphasis on the care needs of older women.<sup>18</sup>

The health inequality analysis of ASIR and ASDR shows a shift in UTI burden from high- to low-income populations since 1990, especially among postmenopausal women. Improved healthcare and sanitation in high-income settings may have reduced their burden, while low-income groups face greater challenges.<sup>19</sup> Postmenopausal women are particularly vulnerable due to age-related changes and higher health risks.<sup>20</sup> Policies should prioritize improving healthcare access in low-income regions, especially for vulnerable groups. Further research should investigate sociocultural, healthcare, and regional factors to develop equitable strategies for reducing the global UTI burden.

In contrast to previous studies, our research creatively analyzed the special period of COVID-19 epidemic. Data from 2019 to 2021 show that the AAPC in ASIR and ASMR for UTI among premenopausal women was significantly higher compared to the trends observed from 1990 to 2018. This indicates not only a substantial increase in incidence but also a worsening severity of UTI. Several factors may contribute to this phenomenon. First, the reallocation of healthcare resources during the COVID-19 pandemic hindered the timely diagnosis and treatment of UTI.<sup>21</sup> Second, lockdown measures during this period led to increased psychological and physical stress for premenopausal women in both household and workplace environments.<sup>22</sup> Third, the inappropriate use of antibiotics heightened the risk of infection and exacerbated the disease burden.<sup>23</sup> Additionally, the increased use of telehealth consultations and electronic medical records (EMRs) during the pandemic may have contributed to a higher number of reported UTI cases, as more consultations were conducted remotely without physical exams or urine culture testing. While this may have increased the number of diagnosed cases, we believe that the substantial increase in DALYs still reflects a true worsening of UTI burden during the pandemic, not solely a reporting artifact. The significant increase in DALYs further confirms the growing global health burden of UTI among premenopausal women during the pandemic.

From 2019 to 2021, the burden of postmenopausal UTI changed slightly, with modest declines in ASMR and DALYs, in contrast to the sharp increase observed in premenopausal UTI. This disparity may be attributed to the pathogenesis of UTI in postmenopausal women, linked to structural and functional changes in the urinary tract, is less affected by short-term external factors.<sup>18</sup> Apparently, the accelerated effect of COVID-19 on premenopausal UTI highlights the vulnerabilities in healthcare systems.<sup>24</sup>

Our forecasts showed that by 2044, the number of UTI cases in premenopausal women worldwide will increase to 253 million, with an ASIR growth of 5.58%. In comparison, the number of cases in postmenopausal women is projected to reach 165 million, with an ASIR growth of 2.42%. Although the growth rate for postmenopausal women is lower, the



total number of cases and related DALYs will continue to pose a significant challenge to global health. This trend underscores the necessity of tailoring prevention and treatment strategies for women of different age groups.

Nonetheless, our study has limitations, including regional disparities in data quality, with potential underrepresentation in low-income areas. UTI classifications and pathogen characteristics were not detailed, and future projections overlooked unforeseen factors. Health inequality analysis remained at the macro level, lacking exploration of individual socioeconomic factors, cultural practices, and healthcare accessibility.

## Conclusion

In conclusion, our study provides new insights into the global burden of UTI among women and underscores the importance of incorporating age-specific perspectives into UTI research and public health policies, particularly in the post- COVID-19 era.

## Data Sharing Statement

All data and materials generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

## Acknowledgments

I thank everyone who participated in this study. I would like to express my gratitude to everyone who assisted in the distribution of the survey.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## Funding

This work was supported by the National Natural Science Foundation of China [grant numbers: 82303906]; the Natural Science Foundation of Guangdong Province, China [grant numbers: 2023A1515010588].

## Disclosure

The authors report no conflicts of interest in this work.

## References

1. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. *Nat Rev Microbiol.* 2015;13(5):269–284. doi:10.1038/nrmicro3432
2. Liang Y, Dai X, Chen J, et al. Global burden and trends in pre- and post-menopausal gynecological cancer from 1990 to 2019, with Projections to 2040: a cross-sectional study. *Int J Surg.* 2024;2024:1. doi:10.1097/js9.0000000000001956
3. Naber KG, Wullt B, Wagenlehner FM. Antibiotic treatment of uncomplicated urinary tract infection in premenopausal women. *Int J Antimicrob Agents.* 2011;38(21–35):21–35. doi:10.1016/j.ijantimicag.2011.09.003
4. Ansaldi Y, Martinez de Tejada Weber B. Urinary tract infections in pregnancy. *Clin Microbiol Infect.* 2023;29(10):1249–1253. doi:10.1016/j.cmi.2022.08.015
5. Wang HD, Abbas KM, Abbasifard M, et al. Global age-sex-specific fertility, mortality, healthy life expectancy (HALE), and population estimates in 204 countries and territories, 1950–2019: a comprehensive demographic analysis for the Global Burden of Disease Study 2019. *Lancet.* 2020;396(10258):1160–1203. doi:10.1016/s0140-6736(20)30977-6
6. Anderson RN, Rosenberg HM. Age standardization of death rates: implementation of the year 2000 standard. *Natl Vital Stat Rep.* 1998;47(3):1–16,20.
7. Ferrari AJ, Santomauro DF, Aali A, et al. 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):2133–2161. doi:10.1016/s0140-6736(24)00757-8
8. Kariuki S, Dougan G. Antibacterial resistance in sub-Saharan Africa: an underestimated emergency. *Ann N Y Acad Sci.* 2014;1323(1):43–55. doi:10.1111/nyas.12380

9. Bannai A, Tamakoshi A. The association between long working hours and health: a systematic review of epidemiological evidence. *Scand J Work Environ Health*. 2014;40(1):5–18. doi:10.5271/sjweh.3388
10. Esme M, Topeli A, Yavuz BB, Akova M. Infections in the Elderly Critically-Ill Patients. *Front Med*. 2019;6:118. doi:10.3389/fmed.2019.00118
11. Bellmann-Weiler R, Weiss G. Pitfalls in the diagnosis and therapy of infections in elderly patients--a mini-review. *Gerontology*. 2009;55(3):241–249. doi:10.1159/000193996
12. Yang X, Chen H, Zheng Y, Qu S, Wang H, Yi F. Disease burden and long-term trends of urinary tract infections: a worldwide report. *Front Public Health*. 2022;10:888205. doi:10.3389/fpubh.2022.888205
13. Carey G, Crammond B, De Leeuw E. Towards health equity: a framework for the application of proportionate universalism. *Int J Equity Health*. 2015;14(1):81. doi:10.1186/s12939-015-0207-6
14. Fulop T, Larbi A, Witkowski JM, et al. Aging, frailty and age-related diseases. *Biogerontology*. 2010;11(5):547–563. doi:10.1007/s10522-010-9287-2
15. Zeng Z, Zhan J, Zhang K, Chen H, Cheng S. Global, regional, and national burden of urinary tract infections from 1990 to 2019: an analysis of the global burden of disease study 2019. *World J Urol*. 2022;40(3):755–763. doi:10.1007/s00345-021-03913-0
16. Li X, Fan H, Zi H, et al. Global and Regional Burden of Bacterial Antimicrobial Resistance in Urinary Tract Infections in 2019. *J Clin Med*. 2022;11(10):2817. doi:10.3390/jcm11102817
17. Medina M, Castillo-Pino E. An introduction to the epidemiology and burden of urinary tract infections. *Ther Adv Urol*. 2019;11:1756287219832172. doi:10.1177/1756287219832172
18. Eriksson I, Gustafson Y, Fagerström L, Olofsson B. Prevalence and factors associated with urinary tract infections (UTIs) in very old women. *Arch Gerontol Geriatr Mar-Apr*. 2010;50(2):132–135. doi:10.1016/j.archger.2009.02.013
19. Bloom DE, Khoury A, Subbaraman R. The promise and peril of universal health care. *Science*. 2018;361(6404):9644. doi:10.1126/science.aat9644
20. Kalhori RP, Faraji A, Yari M, Ganjabi M, Kazeminia M. Global Prevalence of Urinary Tract Infections in the Older Persons: a Systematic Review and Meta-Analysis. *Ageing International*. 2024;49(4):813–835. doi:10.1007/s12126-024-09569-6
21. Laventhal N, Basak R, Dell ML, et al. The Ethics of Creating a Resource Allocation Strategy During the COVID-19 Pandemic. *Pediatrics*. 2020;146(1):1. doi:10.1542/peds.2020-1243
22. Burhamah W, AlKhayyat A, Oroszlányová M, et al. The psychological burden of the COVID-19 pandemic and associated lockdown measures: experience from 4000 participants. *J Affect Disord*. 2020;277:977–985. doi:10.1016/j.jad.2020.09.014
23. Miranda C, Silva V, Capita R, Alonso-Calleja C, Igrejas G, Poeta P. Implications of antibiotics use during the COVID-19 pandemic: present and future. *J Antimicrob Chemother*. 2020;75(12):3413–3416. doi:10.1093/jac/dkaa350
24. Filip R, Gheorghita Puscaselu R, Anchidin-Norocel L, Dimian M, Savage WK. Global Challenges to Public Health Care Systems during the COVID-19 Pandemic: a Review of Pandemic Measures and Problems. *J Pers Med*. 2022;12(8):1295. doi:10.3390/jpm12081295

International Journal of Women's Health

Publish your work in this journal

The International Journal of Women's Health is an international, peer-reviewed open-access journal publishing original research, reports, editorials, reviews and commentaries on all aspects of women's healthcare including gynecology, obstetrics, and breast cancer. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/international-journal-of-womens-health-journal>

**Dovepress**  
Taylor & Francis Group