

Supplementary materials to: Zhu L, Zhang X, Yang Y, et al. Temporal trends of migraine and tension-type headache in adolescents across China, Germany and the US. *Ann Acad Med Singap* 2026;55:Online First. DOI: <https://doi.org/10.47102/annals-acadmedsg.2026253>

Table S1. Comparison of average annual percent change values between primary analysis and 2 sensitivity analyses for migraine and tension-type headache among adolescents aged 10–19 years in China, the US, and Germany from 1990 to 2021.

Disease	Location	Burden metric	Primary analysis 1990-2021 AAPC (95% CI)	Sensitivity analysis 1 excluding 2020-2021 AAPC (95% CI)	Sensitivity analysis 2 Max 3 joinpoints 1990-2021 AAPC (95% CI)
Migraine	China	Incidence	0.27 (0.24,0.3)	0.29 (0.26,0.33)	0.3 (0.21,0.4)
		Prevalence	0.08 (0.01,0.15)	0.08 (0.004,0.15)	0.06 (0.01,0.12)
		YLDs	0.07 (0.002,0.14)	0.07 (-0.003,0.15)	0.06 (-0.0001,0.13)
	USA	Incidence	0.05 (0.03,0.08)	0.005 (-0.02,0.03)	-0.009 (-0.07,0.05)
		Prevalence	-0.09 (-0.15,-0.02)	-0.1 (-0.17,-0.02)	-0.1 (-0.18,-0.01)
		YLDs	-0.12 (-0.18,-0.05)	-0.12 (-0.19,-0.05)	-0.14 (-0.24,-0.04)
	Germany	Incidence	0.003 (-0.02,0.03)	0.04 (0.004,0.07)	0.04 (-0.07,0.15)
		Prevalence	0.03 (-0.04,0.11)	0.04 (-0.03,0.11)	0.02 (-0.12,0.17)
		YLDs	0.03 (-0.06,0.13)	0.04 (-0.04,0.13)	0.03 (-0.11,0.18)
TTH	China	Incidence	0.31 (0.25,0.33)	0.26 (0.23,0.29)	0.30 (0.20,0.39)
		Prevalence	0.21 (0.19,0.24)	0.17 (0.15,0.19)	0.20 (0.16,0.25)
		YLDs	0.05 (-0.01,0.11)	-0.02 (-0.07,0.04)	0.04 (-0.03,0.10)
	USA	Incidence	-0.04 (-0.05,-0.04)	-0.05 (-0.05,-0.04)	-0.04 (-0.05,-0.04)
		Prevalence	-0.05 (-0.06,-0.03)	-0.05 (-0.06,-0.04)	-0.05 (-0.08,-0.02)
		YLDs	-0.03 (-0.05,0)	-0.03 (-0.05,-0.01)	-0.02 (-0.07,0.04)
	Germany	Incidence	0.02 (0,0.04)	0.02 (0.01,0.04)	0.02 (-0.01,0.05)
		Prevalence	-0.002 (-0.04,0.04)	0.007 (-0.02,0.03)	0.03 (-0.06,0.12)
		YLDs	-0.01(-0.09,0.07)	0.02 (-0.07,0.10)	0.003 (-0.13,0.14)

Note: Sensitivity analysis 1 was calculated for the period 1990-2019 by excluding data from 2020 to 2021. Sensitivity analysis 2 was calculated by restricting the maximum number of joinpoints to 3. **Abbreviations:** AAPC, average annual percent change; CI, confidence interval; TTH, tension-type headache; YLDs, years lived with disability.

Table S2. Segment-specific annual percent change with 95% confidence intervals from joinpoint regression analysis for migraine among adolescents aged 10–19 years in China, the US, and Germany from 1990 to 2021.

Category	Metric	Country	Start Year	End Year	APC	Lower CI	Upper CI
Absolute cases	Incidence	China	1990	1994	-2.4019*	-2.805	-1.997
			1994	2002	1.6386*	1.4599	1.8175
			2002	2005	-0.8614	-2.244	0.5407
			2005	2012	-4.7321*	-4.957	-4.5066
			2012	2015	-2.1766*	-3.4948	-0.8404
			2015	2021	2.3562*	2.1285	2.5843
		USA	1990	1992	-0.0292	-0.6386	0.584
			1992	2004	0.8342*	0.7925	0.876
			2004	2011	0.4068*	0.3003	0.5135
			2011	2014	1.5742*	0.9559	2.1964
			2014	2018	0.5591*	0.2502	0.869
			2018	2021	-0.3096*	-0.6158	-0.0024
		Germany	1990	1998	1.7414*	1.6339	1.849
			1998	2001	0.481	-0.449	1.4198
			2001	2011	-1.6036*	-1.6877	-1.5195
			2011	2015	-0.1186	-0.5915	0.3566
			2015	2019	-1.1867*	-1.6656	-0.7055
	Prevalence	China	2019	2021	-0.0898	-1.0934	0.9239
			1990	1995	-2.9029*	-3.2635	-2.541
			1995	2004	2.0015*	1.8146	2.1887
			2004	2007	-2.4781*	-4.123	-0.805
			2007	2013	-5.1028*	-5.4623	-4.7419
		USA	2013	2016	-1.6141	-3.2774	0.0779
			2016	2021	1.8214*	1.423	2.2214
			1990	1992	-1.1928*	-2.0138	-0.3649
			1992	1996	0.6892*	0.2629	1.1172
			1996	1999	-0.2345	-1.0749	0.6131
		Germany	1999	2012	0.8430*	0.7909	0.895
			2012	2015	1.5703*	0.6501	2.4989
			2015	2021	0.1323	-0.0227	0.2875
			1990	1992	-0.3241	-1.3703	0.7332
			1992	1999	1.5326*	1.3646	1.7008
YLDs		China	1999	2005	-0.4653*	-0.6738	-0.2564
			2005	2011	-2.0519*	-2.2571	-1.8463
			2011	2015	1.0786*	0.5997	1.5598
			2015	2021	-1.1877*	-1.3554	-1.0197
			1990	1995	-2.9611*	-3.3444	-2.5764
			1995	2004	2.0486*	1.8531	2.2445
			2004	2007	-2.2379*	-3.9213	-0.5251
			2007	2012	-5.4373*	-5.9639	-4.9078
			2012	2016	-2.3777*	-3.2395	-1.5082

USA	2000	2005	2.0692*	1.842	2.2969
	2005	2009	0.7859*	0.4301	1.1429
	2009	2015	-0.6425*	-0.8019	-0.4828
	2015	2021	0.0673	-0.0541	0.1889
	1990	1996	-1.1200*	-1.1929	-1.047
	1996	1999	-2.0887*	-2.5182	-1.6574
	1999	2003	-0.3773*	-0.5973	-0.1568
	2003	2011	0.6873*	0.6288	0.7458
	2011	2014	1.8426*	1.4036	2.2836
	2014	2021	0.0063	-0.0514	0.064
Germany	1990	2001	0.0615*	0.0093	0.1138
	2001	2006	0.4302*	0.1858	0.6752
	2006	2010	-0.4144*	-0.7963	-0.0311
	2010	2015	0.8980*	0.653	1.1436
	2015	2019	-0.9816*	-1.3627	-0.5991
	2019	2021	-0.347	-1.1085	0.4204

Note: *P < 0.05 indicates the APC of this segment is statistically significant. **Abbreviations:** YLDs = years lived with disability; ASIR = age-standardised incidence rate; ASPR = age-standardised prevalence rate; ASYR = age-standardised YLD rate.

Table S3. Annual percent change and average annual percent change of migraine incidence rates among adolescents aged 10–19 years, globally and in China, Germany, and the US, stratified by age and sex.

Incidence											
Location	Sex	Age	year	APC	AAPC	Sex	Age	year	APC	AAPC	
Global	Female	10-14 years	1990-1994	-0.04 (-0.1,0.02)	-0.01 (-0.03,0.01)	Male	10-14 years	1990-1993	0.16 (0.03,0.29)	0.11 (0.08,0.13)	
			1994-2000	-0.37 (-0.41,-0.32)				1993-2000	-0.19 (-0.23,-0.15)		
			2000-2007	0.39 (0.36,0.42)				2000-2009	0.47 (0.44,0.49)		
			2007-2010	0.16 (-0.02,0.35)				2009-2015	-0.05 (-0.11,0.01)		
			2010-2021	-0.11 (-0.13,-0.1)				2015-2021	0.04 (0,0.08)		
		15-19 years	1990-1996	0.01 (-0.01,0.03)	1990-1996	0.17 (0.16,0.19)	0.13 (0.12,0.13)				
			1996-2000	-0.56 (-0.62,-0.51)	1996-2000	-0.42 (-0.46,-0.38)					
			2000-2003	-0.12 (-0.23,0)	2000-2006	0.04 (0.02,0.06)					
			2003-2015	0.06 (0.05,0.07)	2006-2015	0.26 (0.25,0.27)					
			2015-2018	0.29 (0.17,0.4)	2015-2019	0.5 (0.46,0.54)					
	2018-2021	0.01 (-0.05,0.07)	2019-2021	-0.01 (-0.09,0.07)							
China	Female	10-14 years	1990-1996	-0.04 (-0.06,-0.02)	0.2 (0.19,0.22)	Male	10-14 years	1990-1995	-0.02 (-0.09,0.05)	0.34 (0.3,0.37)	
			1996-2000	-0.67 (-0.74,-0.6)				1995-2001	-0.24 (-0.31,-0.17)		
			2000-2009	0.77 (0.75,0.78)				2001-2010	0.92 (0.88,0.95)		
			2009-2015	0.03 (-0.01,0.06)				2010-2015	-0.1 (-0.2,0)		
			2015-2019	0.57 (0.5,0.64)				2015-2019	1.13 (0.97,1.29)		
		15-19 years	2019-2021	-0.05 (-0.19,0.08)	2019-2021	-0.12 (-0.45,0.22)	0.24 (0.21,0.27)				
			1990-1996	-0.05 (-0.06,-0.03)	1990-1995	0.04 (-0.03,0.1)					
			1996-2000	-0.77 (-0.81,-0.73)	1995-2000	-0.77 (-0.86,-0.67)					
			2000-2005	0.95 (0.93,0.98)	2000-2005	0.97 (0.87,1.06)					
			2005-2015	-0.01 (-0.02,0)	2005-2015	-0.11 (-0.14,-0.08)					
	2015-2019	1.24 (1.19,1.28)	2015-2019	1.95 (1.8,2.11)							
	2019-2021	-0.1 (-0.18,-0.01)	2019-2021	-0.18 (-0.47,0.11)							
Germany	Female	10-14 years	1990-1994	0.46 (0.4,0.52)	0.05 (0.03,0.07)	Male	10-14 years	1990-2000	-0.12 (-0.14,-0.1)	0.02 (0,0.05)	
			1994-2010	-0.02 (-0.03,-0.01)				2000-2010	-0.02 (-0.04,0)		
			2010-2015	0.75 (0.69,0.8)				2010-2015	1.15 (1.07,1.22)		
			2015-2019	-0.97 (-1.06,-0.89)				2015-2019	-0.95 (-1.07,-0.84)		
			2019-2021	0.08 (-0.1,0.25)				2019-2021	0.09 (-0.16,0.34)		
		15-19 years	1990-1993	2.62 (2.49,2.74)	1990-1994	1.31 (1.26,1.36)	0.09 (0.07,0.11)				
			1993-1996	0.94 (0.7,1.18)	1994-1998	0.26 (0.18,0.34)					
			1996-2000	0.22 (0.1,0.35)	1998-2011	0.01 (0,0.02)					
			2000-2011	-0.03 (-0.05,-0.01)	2011-2015	0.19 (0.11,0.27)					
			2011-2018	-1.15 (-1.19,-1.1)	2015-2019	-1.09 (-1.17,-1.01)					
	2018-2021	-0.09 (-0.21,0.04)	2019-2021	0.08 (-0.08,0.25)							
USA	Female	10-14 years	1990-1995	-1.27 (-1.3,-1.23)	-0.02 (-0.05,0)	Male	10-14 years	1990-1995	-0.48 (-0.53,-0.43)	-0.13 (-0.16,-0.11)	
			1995-1999	-1.95 (-2.03,-1.86)				1995-2000	-1.53 (-1.6,-1.46)		
			1999-2002	-0.14 (-0.31,0.03)				2000-2005	-0.35 (-0.42,-0.28)		
			2002-2010	0.5 (0.48,0.52)				2005-2010	0.42 (0.35,0.5)		
			2010-2014	2.36 (2.27,2.44)				2010-2014	1.34 (1.22,1.45)		
		15-19 years	2014-2021	0.09 (0.07,0.11)	2014-2021	0.05 (0.02,0.08)	0.16 (0.14,0.18)				
			1990-1995	-0.12 (-0.13,-0.1)	1990-1995	-0.35 (-0.4,-0.31)					
			1995-2000	-0.22 (-0.24,-0.2)	1995-2000	0.23 (0.17,0.29)					
			2000-2004	0.2 (0.17,0.23)	2000-2005	-0.94 (-1,-0.89)					

2004-2010	-0.14 (-0.15,-0.12)	2005-2010	0.4 (0.34,0.45)
2010-2015	0.56 (0.54,0.58)	2010-2014	1.99 (1.9,2.09)
2015-2021	-0.02 (-0.03,-0.01)	2014-2021	0.08 (0.06,0.11)

Table S4. Annual percent change and average annual percent change of migraine prevalence rates among adolescents aged 10–19 years, globally and in China, Germany, and the US, stratified by age and sex.

Location	Sex	Age	Year	Prevalence		Sex	Age	year	APC	AAPC
				APC	AAPC					
Global	Female	10-14 years	1990-1992	0.09 (-0.14,0.33)	0 (-0.03,0.03)	Male	10-14 years	1990-1992	0.22 (-0.13,0.57)	0.11 (0.09,0.14)
			1992-2000	-0.16 (-0.19,-0.13)				1992-2000	-0.09 (-0.14,-0.04)	
			2000-2006	0.51 (0.46,0.57)				2000-2009	0.54 (0.5,0.57)	
			2006-2010	0.28 (0.17,0.4)				2009-2021	-0.09 (-0.11,-0.06)	
			2010-2015	-0.34 (-0.41,-0.26)				1990-1996	0.42 (0.38,0.46)	
			2015-2021	-0.23 (-0.26,-0.19)				1996-2005	-0.07 (-0.1,-0.05)	
		15-19 years	1990-1996	0.23 (0.21,0.24)	0.05 (0.04,0.07)	Male	15-19 years	2005-2010	0.43 (0.36,0.51)	0.19 (0.17,0.21)
			1996-2003	-0.23 (-0.24,-0.21)				2010-2019	0.24 (0.22,0.27)	
			2003-2006	0.09 (-0.01,0.2)				2019-2021	-0.13 (-0.37,0.1)	
			2006-2011	0.34 (0.31,0.38)						
			2011-2019	0.05 (0.04,0.07)						
			2019-2021	-0.26 (-0.37,-0.15)						
China	Female	10-14 years	1990-1995	-0.02 (-0.1,0.06)	0.2 (0.16,0.24)	Male	10-14 years	1990-2001	-0.03 (-0.04,-0.02)	0.36 (0.35,0.38)
			1995-2001	-0.22 (-0.3,-0.14)				2001-2005	0.68 (0.63,0.74)	
			2001-2010	0.69 (0.66,0.73)				2005-2009	1.42 (1.37,1.48)	
			2010-2015	-0.05 (-0.17,0.06)				2009-2015	0.03 (0.01,0.05)	
			2015-2019	0.42 (0.25,0.6)				2015-2019	0.78 (0.72,0.83)	
			2019-2021	-0.05 (-0.4,0.31)				2019-2021	-0.06 (-0.16,0.05)	
		15-19 years	1990-1995	0.02 (-0.04,0.08)	0.21 (0.18,0.24)	Male	15-19 years	1990-1996	-0.02 (-0.04,0)	0.32 (0.31,0.34)
			1995-2000	-0.55 (-0.63,-0.46)				1996-2000	-0.5 (-0.57,-0.43)	
			2000-2009	0.71 (0.68,0.74)				2000-2009	0.82 (0.8,0.84)	
			2009-2015	-0.02 (-0.08,0.04)				2009-2015	0 (-0.04,0.03)	
			2015-2019	0.72 (0.58,0.85)				2015-2019	1.25 (1.18,1.32)	
			2019-2021	0 (-0.27,0.27)				2019-2021	-0.07 (-0.22,0.08)	
Germany	Female	10-14 years	1990-1995	-0.36 (-0.4,-0.31)	0.03 (0.01,0.05)	Male	10-14 years	1990-1996	-0.41 (-0.45,-0.37)	0.03 (0.01,0.06)
			1995-2010	-0.02 (-0.03,-0.02)				1996-2010	-0.02 (-0.04,-0.01)	
			2010-2015	1.15 (1.09,1.21)				2010-2015	1.32 (1.24,1.4)	
			2015-2019	-0.72 (-0.82,-0.62)				2015-2019	-0.73 (-0.85,-0.61)	
			2019-2021	0.08 (-0.13,0.28)				2019-2021	0.08 (-0.17,0.33)	
		15-19 years	1990-1993	0.93 (0.9,0.96)	0.06 (0.05,0.07)	Male	15-19 years	1990-2000	0.06 (0.05,0.07)	0.05 (0.04,0.06)
			1993-1996	0.32 (0.26,0.38)				2000-2010	-0.02 (-0.03,-0.01)	
			1996-2010	0 (-0.01,0)				2010-2015	1.05 (1.02,1.08)	
			2010-2015	0.46 (0.44,0.48)				2015-2019	-1.05 (-1.09,-1)	
			2015-2019	-1.07 (-1.1,-1.04)				2019-2021	0.09 (0,0.19)	
			2019-2021	0.08 (0.02,0.14)						
USA	Female	10-14 years	1990-1996	-1.55 (-1.58,-1.52)	-0.13 (-0.15,-0.11)	Male	10-14 years	1990-1995	-0.62 (-0.7,-0.55)	-0.24 (-0.28,-0.2)
			1996-1999	-2.38 (-2.53,-2.22)				1995-1999	-2.14 (-2.3,-1.98)	
			1999-2005	-0.23 (-0.27,-0.19)				1999-2003	-0.46 (-0.63,-0.29)	
			2005-2010	0.77 (0.71,0.82)				2003-2010	0.29 (0.24,0.35)	
			2010-2014	2.44 (2.36,2.52)				2010-2014	0.97 (0.8,1.14)	

15-19 years	2014-2021	0.08 (0.06,0.1)	-0.04 (-0.06,-0.03)	15-19 years	2014-2021	0.03 (-0.02,0.08)	-0.1 (-0.12,-0.08)
	1990-1995	-1.07 (-1.1,-1.04)			1990-1995	-0.46 (-0.5,-0.41)	
	1995-1999	-1.69 (-1.75,-1.63)			1995-1999	-1.44 (-1.53,-1.34)	
	1999-2003	-0.12 (-0.18,-0.06)			1999-2005	-0.52 (-0.56,-0.47)	
	2003-2010	0.44 (0.41,0.46)			2005-2010	0.44 (0.37,0.5)	
	2010-2014	1.97 (1.9,2.04)			2010-2014	1.39 (1.29,1.48)	
	2014-2021	0.08 (0.06,0.09)			2014-2021	0.05 (0.03,0.08)	

Table S5. Annual percent change and average annual percent change of migraine years lived with disability rates among adolescents aged 10–19 years, globally and in China, Germany, and the US, stratified by age and sex.

YLDs											
Location	Sex	Age	year	APC	AAPC	Sex	Age	year	APC	AAPC	
Global	Female	10-14 years	1990-1993	0.05 (-0.14,0.24)	0 (-0.05,0.05)	Male	10-14 years	1990-1992	0.24 (-0.12,0.61)	0.13 (0.1,0.16)	
			1993-1998	-0.22 (-0.34,-0.1)				1992-2000	-0.07 (-0.12,-0.02)		
			1998-2001	0.12 (-0.26,0.49)				2000-2009	0.55 (0.51,0.59)		
			2001-2006	0.54 (0.42,0.66)				2009-2021	-0.08 (-0.1,-0.05)		
			2006-2010	0.24 (0.06,0.43)				1990-1996	0.43 (0.38,0.47)		
			2010-2021	-0.27 (-0.3,-0.25)				1996-2005	-0.05 (-0.08,-0.02)		
		15-19 years	1990-1996	0.25 (0.23,0.27)	0.06 (0.04,0.07)	15-19 years	2005-2010	0.42 (0.34,0.51)	0.19 (0.17,0.22)		
			1996-2002	-0.21 (-0.23,-0.18)			2010-2019	0.25 (0.22,0.28)			
			2002-2005	-0.04 (-0.15,0.07)			2019-2021	-0.24 (-0.51,0.04)			
			2005-2011	0.32 (0.3,0.35)							
			2011-2019	0.06 (0.05,0.08)							
			2019-2021	-0.39 (-0.5,-0.28)							
China	Female	10-14 years	1990-1995	-0.01 (-0.08,0.06)	0.21 (0.17,0.25)	Male	10-14 years	1990-2001	-0.02 (-0.04,0)	0.37 (0.32,0.41)	
			1995-2001	-0.19 (-0.25,-0.12)				2001-2006	0.79 (0.69,0.89)		
			2001-2009	0.75 (0.71,0.79)				2006-2009	1.58 (1.25,1.9)		
			2009-2016	0.05 (0.0,0.1)				2009-2015	0 (-0.08,0.07)		
			2016-2019	0.44 (0.15,0.74)				2015-2019	0.76 (0.6,0.93)		
			2019-2021	0 (-0.29,0.29)				2019-2021	0 (-0.33,0.33)		
		15-19 years	1990-1995	0.05 (-0.02,0.11)	0.22 (0.18,0.25)	15-19 years	1990-1996	0.03 (-0.02,0.07)	0.32 (0.29,0.35)		
			1995-2000	-0.54 (-0.64,-0.45)			1996-2000	-0.45 (-0.57,-0.32)			
			2000-2009	0.74 (0.71,0.77)			2000-2009	0.79 (0.76,0.81)			
			2009-2015	-0.02 (-0.09,0.05)			2009-2015	0.02 (-0.04,0.07)			
			2015-2019	0.64 (0.49,0.79)			2015-2019	1.11 (0.98,1.23)			
			2019-2021	0.11 (-0.19,0.42)			2019-2021	-0.05 (-0.3,0.2)			
Germany	Female	10-14 years	1990-1996	-0.32 (-0.42,-0.22)	0 (-0.04,0.04)	Male	10-14 years	1990-1994	-0.6 (-0.79,-0.41)	0.02 (-0.03,0.06)	
			1996-2010	-0.01 (-0.04,0.02)				1994-2010	-0.04 (-0.06,-0.01)		
			2010-2015	1.12 (0.93,1.3)				2010-2014	1.4 (1.1,1.7)		
			2015-2021	-0.58 (-0.68,-0.48)				2014-2021	-0.29 (-0.37,-0.21)		
		15-19 years	1990-1995	0.69 (0.57,0.8)	0.05 (0,0.1)	15-19 years	1990-1998	0.1 (0.03,0.17)	0.06 (-0.01,0.14)		
			1995-2010	0.02 (0,0.05)			1998-2010	-0.04 (-0.09,0.01)			
			2010-2015	0.38 (0.22,0.54)			2010-2015	1.01 (0.8,1.22)			
			2015-2019	-0.92 (-1.17,-0.66)			2015-2018	-1 (-1.65,-0.35)			
			2019-2021	-0.22 (-0.73,0.3)			2018-2021	-0.1 (-0.44,0.23)			
USA	Female	10-14 years	1990-1995	-1.4 (-1.46,-1.35)	-0.15 (-0.18,-0.13)	Male	10-14 years	1990-1995	-0.63 (-0.74,-0.52)	-0.25 (-0.29,-0.21)	
			1995-1999	-2.5 (-2.62,-2.38)				1995-2000	-2.03 (-2.19,-1.87)		
			1999-2005	-0.23 (-0.28,-0.17)				2000-2008	0.11 (0.04,0.18)		
			2005-2010	0.78 (0.7,0.85)				2008-2014	0.79 (0.67,0.91)		
			2010-2014	2.5 (2.37,2.63)				2014-2021	0.01 (-0.06,0.08)		
			2014-2021	0.01 (-0.03,0.04)				15-19 years	1990-1995		
		15-19 years	1990-1995	-1.02 (-1.09,-0.96)	-0.09 (-0.13,-0.05)	15-19 years	1995-2000	-1.36 (-1.46,-1.26)			

1995-1999	-1.98 (-2.13,-1.83)	2000-2005	-0.33 (-0.43,-0.23)
1999-2002	-0.21 (-0.51,0.09)	2005-2010	0.43 (0.32,0.53)
2002-2010	0.43 (0.39,0.47)	2010-2014	1.31 (1.15,1.47)
2010-2014	1.93 (1.78,2.09)	2014-2021	-0.02 (-0.06,0.02)
2014-2021	-0.02 (-0.06,0.02)		

Table S6. Segment-specific annual percent change with 95% confidence intervals from joinpoint regression analysis for tension-type headache among adolescents aged 10–19 years in China, the US, and Germany from 1990 to 2021.

Category	Metric	Country	Start Year	End Year	APC	Lower CI	Upper CI
Absolute cases	Incidence	China	1990	1994	-2.7682*	-3.1879	-2.3467
			1994	2004	1.9906*	1.8637	2.1176
			2004	2007	-3.5836*	-4.9299	-2.2183
			2007	2012	-5.2558*	-5.6757	-4.8339
			2012	2016	-1.7410*	-2.4196	-1.0577
			2016	2021	2.1552*	1.8408	2.4705
		USA	1990	1992	0.233	-0.1508	0.6184
			1992	2000	1.7240*	1.6718	1.7762
			2000	2007	0.5162*	0.4524	0.58
			2007	2014	-0.2095*	-0.2726	-0.1463
			2014	2018	0.4526*	0.2648	0.6408
			2018	2021	-0.2393*	-0.4261	-0.0522
		Germany	1990	1992	-0.4201	-0.9168	0.079
			1992	1999	1.1794*	1.0965	1.2624
			1999	2004	-0.5152*	-0.6668	-0.3635
			2004	2011	-1.8538*	-1.9351	-1.7723
			2011	2016	0.4541*	0.3001	0.6083
			2016	2021	-0.2924*	-0.4044	-0.1802
	Prevalence	China	1990	1995	-2.1892*	-2.5311	-1.8461
			1995	2004	2.2363*	2.0683	2.4046
			2004	2007	-3.4611*	-4.9504	-1.9485
			2007	2012	-5.3913*	-5.8532	-4.9271
			2012	2016	-1.9945*	-2.7288	-1.2546
			2016	2021	1.9329*	1.5903	2.2766
		USA	1990	1992	0.0437	-0.3258	0.4145
			1992	2000	1.7406*	1.6906	1.7906
			2000	2007	0.5499*	0.489	0.6109
			2007	2014	-0.2257*	-0.2862	-0.1652
			2014	2018	0.4230*	0.2434	0.6029
			2018	2021	-0.1892*	-0.3676	-0.0104
		Germany	1990	1992	-1.5587*	-2.2592	-0.8532
			1992	1999	0.7229*	0.6125	0.8333
			1999	2005	-0.5559*	-0.689	-0.4226
			2005	2010	-2.2666*	-2.4536	-2.0792
			2010	2017	0.8860*	0.7764	0.9957
			2017	2021	-0.4306*	-0.6502	-0.2105
	YLDs	China	1990	1995	-2.8444*	-3.3248	-2.3617
			1995	2005	2.0741*	1.8661	2.2825
			2005	2012	-5.2847*	-5.6124	-4.9558
			2012	2016	-2.5762*	-3.5959	-1.5458
			2016	2021	1.8190*	1.3381	2.3022

ASRs	ASIR	USA	1990	1992	-0.178	-0.5781	0.2238
			1992	1999	1.8482*	1.7794	1.917
			1999	2007	0.7568*	0.7027	0.8108
			2007	2014	-0.2514*	-0.3191	-0.1836
			2014	2018	0.4016*	0.1991	0.6046
			2018	2021	-0.1678	-0.369	0.0337
		Germany	1990	1992	-1.4780*	-2.3297	-0.6189
			1992	1999	0.9855*	0.8397	1.1314
			1999	2005	-0.2443*	-0.4323	-0.056
			2005	2010	-2.3580*	-2.6177	-2.0975
			2010	2016	0.6222*	0.4318	0.8129
			2016	2021	-0.5274*	-0.7203	-0.3342
	ASPR	China	1990	1996	0.1301*	0.038	0.2224
			1996	2000	-0.3930*	-0.6654	-0.12
			2000	2004	1.8602*	1.5854	2.1357
			2004	2018	0.0519*	0.0228	0.081
			2018	2021	0.7328*	0.4577	1.0087
		USA	1990	1992	-0.0805*	-0.1529	-0.008
			1992	2000	0.0213*	0.0116	0.031
			2000	2004	-0.3127*	-0.3481	-0.2773
			2004	2021	-0.0034*	-0.0059	-0.001
			1990	2000	-0.2463*	-0.2583	-0.2343
Germany		2000	2005	0.1424*	0.0938	0.191	
		2005	2011	-0.0487*	-0.0835	-0.014	
		2011	2014	0.5828*	0.4296	0.7361	
		2014	2018	0.2374*	0.1585	0.3163	
		2018	2021	-0.0013	-0.081	0.0784	
ASYR	China	1990	1995	-0.0960*	-0.1482	-0.0437	
		1995	2000	-0.3553*	-0.4261	-0.2845	
		2000	2005	1.8386*	1.7667	1.9105	
		2005	2019	-0.1379*	-0.1497	-0.126	
		2019	2021	0.8446*	0.6152	1.0745	
	USA	1990	1992	-0.3310*	-0.4559	-0.2058	
		1992	1999	0.0844*	0.0633	0.1054	
		1999	2004	-0.2899*	-0.3284	-0.2515	
		2004	2009	0.0769*	0.0385	0.1154	
		2009	2014	-0.0822*	-0.1206	-0.0437	
Germany	2014	2021	0.0152	-0.001	0.0315		
	1990	1993	-1.2397*	-1.4456	-1.0333		
	1993	2000	-0.6284*	-0.6919	-0.5649		
	2000	2006	0.2429*	0.1634	0.3224		
	2006	2010	-0.2593*	-0.4374	-0.0809		
	2010	2016	1.2301*	1.1453	1.315		
	2016	2021	0.067	-0.0252	0.1592		
	1990	2000	-0.6859*	-0.735	-0.6368		
	China	2000	2005	2.3086*	2.1101	2.5075	
		2005	2009	-0.0095	-0.2962	0.278	
2009		2019	-0.5001*	-0.5535	-0.4468		

		2019	2021	1.0631*	0.4659	1.6637
		1990	1992	-0.4897*	-0.7285	-0.2504
		1992	1998	0.1437*	0.0903	0.1972
	USA	1998	2004	-0.2133*	-0.2666	-0.1599
		2004	2008	0.2559*	0.1357	0.3763
		2008	2017	-0.0779*	-0.1042	-0.0517
		2017	2021	0.0673	-0.0089	0.1435
		1990	1993	-1.1068*	-1.4854	-0.7267
		1993	2000	-0.3569*	-0.4834	-0.2303
	Germany	2000	2006	0.5295*	0.3628	0.6966
		2006	2010	-0.3952*	-0.7669	-0.0221
		2010	2016	0.8822*	0.7133	1.0513
		2016	2021	-0.2637*	-0.4349	-0.0923

Note: *P < 0.05 indicates the APC of this segment is statistically significant. **Abbreviations:** YLDs = years lived with disability; ASIR = age-standardised incidence rate; ASPR = age-standardised prevalence rate; ASYR = age-standardised YLD rate.

Table S7. Annual percent change and average annual percent change of tension-type headache incidence rates among adolescents aged 10–19 years, globally and in China, Germany, and the US, stratified by age and sex.

Incidence											
Location	Sex	Age	year	APC	AAPC	Sex	Age	year	APC	AAPC	
Global	Female	10-14 years	1990-1994	0 (-0.04,0.05)	-0.01 (-0.03,0)	Male	10-14 years	1990-1994	0.07 (0.02,0.13)	0 (-0.02,0.02)	
			1994-2000	-0.28 (-0.31,-0.24)				1994-2000	-0.38 (-0.41,-0.34)		
			2000-2005	0.27 (0.23,0.32)				2000-2005	0.34 (0.29,0.4)		
			2005-2010	0.06 (0.01,0.11)				2005-2010	0.03 (-0.03,0.08)		
			2010-2017	-0.07 (-0.09,-0.04)				2010-2015	-0.08 (-0.13,-0.02)		
			2017-2021	0.01 (-0.04,0.06)				2015-2021	0.07 (0.04,0.1)		
		15-19 years	1990-1996	0.27 (0.26,0.29)	0.07 (0.06,0.08)		15-19 years	1990-1995	0.45 (0.4,0.5)	0.12 (0.09,0.14)	
			1996-2002	-0.17 (-0.19,-0.16)				1995-2002	-0.22 (-0.26,-0.19)		
			2002-2006	0.06 (0.02,0.1)				2002-2015	0.13 (0.12,0.15)		
			2006-2011	0.17 (0.14,0.19)				2015-2019	0.3 (0.19,0.41)		
			2011-2019	0.08 (0.07,0.1)				2019-2021	-0.01 (-0.23,0.2)		
			2019-2021	-0.14 (-0.22,-0.05)							
China	Female	10-14 years	1990-1995	0 (-0.07,0.06)	0.17 (0.14,0.19)	Male	10-14 years	1990-1995	-0.01 (-0.09,0.07)	0.25 (0.22,0.28)	
			1995-2000	-0.22 (-0.31,-0.13)				1995-2000	-0.34 (-0.45,-0.23)		
			2000-2005	1.06 (0.96,1.15)				2000-2005	1.72 (1.61,1.83)		
			2005-2018	-0.02 (-0.04,0)				2005-2018	-0.03 (-0.05,-0.01)		
			2018-2021	0.44 (0.29,0.59)				2018-2021	0.49 (0.31,0.66)		
		15-19 years	1990-1995	-0.01 (-0.11,0.09)	0.31 (0.25,0.37)		15-19 years	1990-2000	-0.26 (-0.37,-0.16)	0.41 (0.32,0.51)	
			1995-2000	-0.34 (-0.48,-0.2)				2000-2005	2.38 (1.96,2.81)		
			2000-2004	2.35 (2.13,2.58)				2005-2018	-0.06 (-0.13,0.02)		
			2004-2007	0.3 (-0.14,0.75)				2018-2021	1.47 (0.8,2.15)		
			2007-2018	-0.04 (-0.08,-0.01)							
			2018-2021	0.56 (0.34,0.78)							
			Germany	Female				10-14 years	1990-2000		
2000-2010	-0.01 (-0.02,0.01)	1995-2000			-0.67 (-0.7,-0.63)						
2010-2015	1.55 (1.49,1.6)	2000-2011			0.02 (0.01,0.03)						
2015-2021	0.01 (-0.02,0.04)	2011-2018			0.7 (0.68,0.72)						
15-19 years	1990-1993	0.19 (0.18,0.21)			0.03 (0.03,0.04)	15-19 years	2018-2021	0.15 (0.09,0.21)	0.03 (0.02,0.04)		
	1993-1996	0.05 (0.02,0.08)					1990-1996	0.05 (0.04,0.06)			
	1996-1999	0.18 (0.15,0.2)					1996-1999	0.35 (0.29,0.41)			
	1999-2009	0 (0,0.01)					1999-2010	0.01 (0,0.01)			
	2009-2018	-0.03 (-0.03,-0.03)					2010-2015	-0.25 (-0.27,-0.23)			
	2018-2021	-0.01 (-0.02,0.01)					2015-2019	0.22 (0.19,0.25)			
							2019-2021	-0.01 (-0.07,0.05)			
	USA	Female					10-14 years	1990-2000			0 (0,0)
2000-2005			-0.1 (-0.1,-0.09)	2000-2005	-0.34 (-0.36,-0.33)						
2005-2021			0 (0,0)	2005-2021	0 (0,0)						
15-19 years			1990-2000	0.01 (0,0.01)	-0.05 (-0.06,-0.05)	15-19 years	1990-2000	0.01 (0,0.01)	-0.04 (-0.04,-0.04)		
			2000-2005	-0.36 (-0.37,-0.35)			2000-2005	-0.29 (-0.3,-0.28)			
			2005-2021	0 (0,0.01)			2005-2021	0 (0,0)			

Table S8. Annual percent change and average annual percent change of tension-type headache prevalence rates among adolescents aged 10–19 years globally and in China, Germany, and the US, stratified by age and sex.

Prevalence											
Location	Sex	Age	year	APC	AAPC	Sex	Age	year	APC	AAPC	
Global	Female	10-14 years	1990-1994	0.01 (-0.03,0.06)	-0.01 (-0.03,0)	Male	10-14 years	1990-1994	0.04 (0.0,0.07)	15-19 years	-0.02 (-0.03,0)
			1994-2000	-0.26 (-0.3,-0.23)				1994-2000	-0.26 (-0.28,-0.23)		
			2000-2005	0.26 (0.21,0.31)				2000-2005	0.26 (0.22,0.3)		
			2005-2010	0.07 (0.02,0.12)				2005-2010	0.05 (0.01,0.09)		
			2010-2017	-0.08 (-0.11,-0.05)				2010-2016	-0.09 (-0.12,-0.07)		
			2017-2021	0 (-0.05,0.04)				2016-2021	-0.01 (-0.04,0.01)		
		15-19 years	1990-1996	0.22 (0.18,0.26)	1990-1993	0.44 (0.3,0.57)					
			1996-2002	-0.24 (-0.29,-0.19)	1993-1996	0.23 (-0.04,0.51)					
			2002-2021	0.1 (0.1,0.11)	1996-2001	-0.34 (-0.43,-0.25)	0.1 (0.06,0.13)				
					2001-2015	0.11 (0.1,0.12)					
					2015-2021	0.19 (0.15,0.24)					
China	Female	10-14 years	1990-1994	0.01 (-0.04,0.07)	0.1 (0.08,0.12)	Male	10-14 years	1990-1995	0 (-0.05,0.05)	15-19 years	0.14 (0.12,0.16)
			1994-2001	-0.09 (-0.12,-0.06)				1995-2000	-0.23 (-0.3,-0.16)		
			2001-2004	1.05 (0.87,1.23)				2000-2005	0.98 (0.91,1.05)		
			2004-2018	0.01 (0.0,0.02)				2005-2018	-0.02 (-0.03,0)		
			2018-2021	0.17 (0.08,0.26)				2018-2021	0.3 (0.19,0.41)		
			1990-1995	0.02 (-0.1,0.13)				1990-1995	-0.02 (-0.21,0.18)		
		15-19 years	1995-2000	-0.32 (-0.47,-0.16)	1995-2000	-0.48 (-0.75,-0.2)					
			2000-2004	2.16 (1.9,2.41)	2000-2005	2.53 (2.25,2.81)	0.42 (0.34,0.5)				
			2004-2007	0.25 (-0.26,0.77)	2005-2018	-0.06 (-0.12,-0.01)					
			2007-2018	-0.06 (-0.1,-0.02)	2018-2021	1.24 (0.79,1.69)					
			2018-2021	0.68 (0.43,0.93)							
Germany	Female	10-14 years	1990-1994	-1.13 (-1.2,-1.05)	-0.01 (-0.03,0.01)	Male	10-14 years	1990-1994	-0.71 (-0.76,-0.67)	15-19 years	-0.01 (-0.03,0.01)
			1994-2000	-0.59 (-0.64,-0.54)				1994-2000	-0.59 (-0.62,-0.56)		
			2000-2010	0 (-0.02,0.01)				2000-2008	0.01 (-0.01,0.02)		
			2010-2015	1.61 (1.54,1.68)				2008-2011	0.12 (0.0,0.24)		
			2015-2021	-0.03 (-0.07,0.01)				2011-2019	0.74 (0.72,0.75)		
			1990-1994	-1.18 (-1.27,-1.1)				2019-2021	-0.11 (-0.24,0.03)		
		15-19 years	1994-1999	-0.59 (-0.67,-0.5)	1990-1993	-0.93 (-1.01,-0.85)					
			1999-2010	-0.03 (-0.05,-0.01)	1993-1996	-0.69 (-0.84,-0.53)					
			2010-2015	1.58 (1.5,1.66)	1996-1999	-1.02 (-1.17,-0.87)	-0.02 (-0.04,0.01)				
			2015-2021	0.14 (0.09,0.18)	1999-2010	-0.04 (-0.05,-0.02)					
					2010-2019	0.9 (0.89,0.92)					
					2019-2021	-0.14 (-0.29,0.02)					
USA	Female	10-14 years	1990-2000	0.01 (0,0.01)	-0.01 (-0.01,-0.01)	Male	10-14 years	1990-2000	0.01 (0.01,0.02)	15-19 years	-0.06 (-0.06,-0.06)
			2000-2005	-0.08 (-0.09,-0.08)				2000-2005	-0.41 (-0.43,-0.39)		
			2005-2021	0 (0,0)				2005-2021	0 (0,0)		
		15-19 years	1990-2000	0.01 (0,0.01)	-0.03 (-0.04,-0.03)	Male	1990-2000	0.01 (0.01,0.02)			
			2000-2005	-0.23 (-0.24,-0.22)			2000-2005	-0.48 (-0.5,-0.46)	-0.07 (-0.08,-0.07)		
			2005-2021	0 (0,0)			2005-2021	0 (0,0.01)			

Table S9. Annual percent change and average annual percent change of tension-type headache years lived with disability rates among adolescents aged 10–19 years globally and in China, Germany, and the US, stratified by age and sex.

YLDs										
Location	Sex	Age	year	APC	AAPC	Sex	Age	year	APC	AAPC
Global	Female	10-14 years	1990-1994	0.02 (-0.05,0.08)	0.02 (0,0.04)	Male	10-14 years	1990-1994	0.03 (-0.04,0.09)	0.01 (0,0.03)
			1994-2000	-0.2 (-0.24,-0.15)				1994-2000	-0.22 (-0.27,-0.18)	
			2000-2005	0.23 (0.16,0.29)				2000-2006	0.21 (0.16,0.25)	
			2005-2011	0.09 (0.05,0.14)				2006-2021	0.02 (0.02,0.03)	
			2011-2021	0 (-0.02,0.02)				1990-1993	0.31 (0.26,0.36)	
			1990-1996	0.29 (0.26,0.32)				1993-1996	0.17 (0.06,0.27)	
		15-19 years	1996-1999	-0.02 (-0.18,0.15)	0.08 (0.06,0.11)		15-19 years	1996-2001	-0.24 (-0.27,-0.21)	0.07 (0.05,0.08)
			1999-2002	-0.23 (-0.39,-0.07)				2001-2015	0.04 (0.04,0.05)	
			2002-2006	-0.09 (-0.17,-0.01)				2015-2019	0.26 (0.21,0.32)	
			2006-2010	0.18 (0.1,0.26)				2019-2021	0.06 (-0.04,0.17)	
			2010-2021	0.12 (0.1,0.13)						
China	Female	10-14 years	1990-1996	0.02 (-0.08,0.12)	0.15 (0.1,0.21)	Male	10-14 years	1990-1996	0 (-0.07,0.07)	0.15 (0.1,0.2)
			1996-2000	-0.23 (-0.52,0.07)				1996-2000	-0.28 (-0.51,-0.06)	
			2000-2005	0.64 (0.46,0.82)				2000-2005	1.03 (0.89,1.17)	
			2005-2018	0.04 (0.01,0.07)				2005-2011	-0.08 (-0.18,0.01)	
			2018-2021	0.62 (0.35,0.9)				2011-2019	0.05 (0.0,0.11)	
			1990-1995	0.02 (-0.06,0.09)				2019-2021	0.38 (-0.05,0.81)	
		15-19 years	1995-2000	-0.42 (-0.53,-0.32)	0.23 (0.19,0.26)		15-19 years	1990-1995	-0.05 (-0.24,0.14)	0.23 (0.16,0.3)
			2000-2004	1.23 (1.06,1.4)				1995-2000	-0.41 (-0.67,-0.16)	
			2004-2019	0.06 (0.04,0.07)				2000-2005	1.42 (1.16,1.67)	
			2019-2021	1.7 (1.35,2.06)				2005-2018	0 (-0.04,0.05)	
								2018-2021	0.79 (0.39,1.18)	
Germany	Female	10-14 years	1990-1996	-0.83 (-1,-0.67)	0.02 (-0.08,0.12)	Male	10-14 years	1990-1998	-0.58 (-0.73,-0.42)	0.01 (-0.1,0.13)
			1996-2011	0.03 (-0.02,0.07)				1998-2012	0.03 (-0.04,0.11)	
			2011-2014	1.49 (0.55,2.45)				2012-2016	0.9 (0.15,1.65)	
			2014-2021	0.12 (-0.01,0.24)				2016-2021	0.19 (-0.14,0.52)	
			1990-1995	-0.74 (-0.92,-0.56)				1990-2000	-0.69 (-0.76,-0.62)	
		15-19 years	1995-2010	0.01 (-0.03,0.05)	-0.01 (-0.06,0.05)		15-19 years	2000-2009	0.1 (0.01,0.19)	-0.02 (-0.07,0.04)
			2010-2015	0.84 (0.59,1.09)				2009-2017	0.66 (0.55,0.77)	
			2015-2021	-0.14 (-0.28,0)				2017-2021	0.06 (-0.21,0.34)	
USA	Female	10-14 years	1990-1998	0.03 (0.01,0.06)	0.01 (0,0.02)	Male	10-14 years	1990-2000	0.03 (0,0.05)	-0.04 (-0.06,-0.02)
			1998-2007	-0.04 (-0.06,-0.01)				2000-2005	-0.38 (-0.47,-0.29)	
			2007-2021	0.02 (0.01,0.03)				2005-2021	0.03 (0.02,0.04)	
			1990-1997	0.01 (-0.02,0.04)				1990-1994	0.11 (0.06,0.17)	
			1997-2006	-0.11 (-0.14,-0.09)				1994-2001	-0.04 (-0.07,-0.01)	
		15-19 years	2006-2011	0.05 (-0.02,0.13)	-0.04 (-0.05,-0.02)		15-19 years	2001-2004	-0.54 (-0.71,-0.36)	-0.05 (-0.07,-0.02)
			2011-2021	-0.05 (-0.06,-0.03)				2004-2019	0.03 (0.02,0.04)	
								2019-2021	-0.18 (-0.35,-0.01)	

Fig. S1. Temporal trends in migraine cases among adolescents aged 10–19 years in China, the US, and Germany from 1990 to 2021, stratified by sex. (A-C) Estimated incidence, prevalence, and years lived with disability (YLD) cases of migraine. Colours represent female and male subgroups

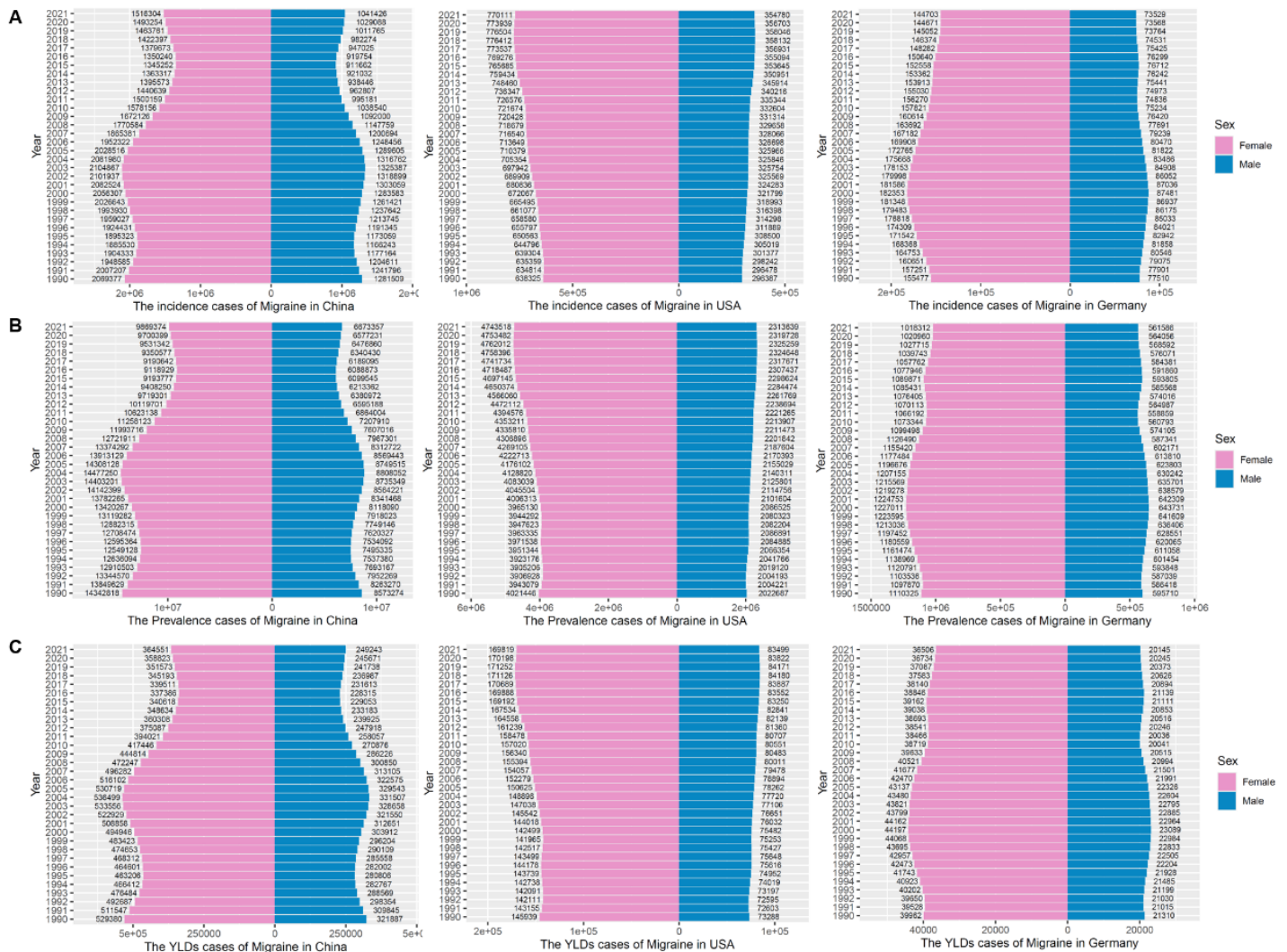


Fig. S2. Temporal trends in age-standardised rates of migraine among adolescents aged 10–19

years in China, the US, and Germany from 1990 to 2021, stratified by sex. (A-C)

standardised incidence, prevalence, and years lived with disability (YLD) rates of migraine. Colours

represent female and male subgroups. ASR: age-standardised rates

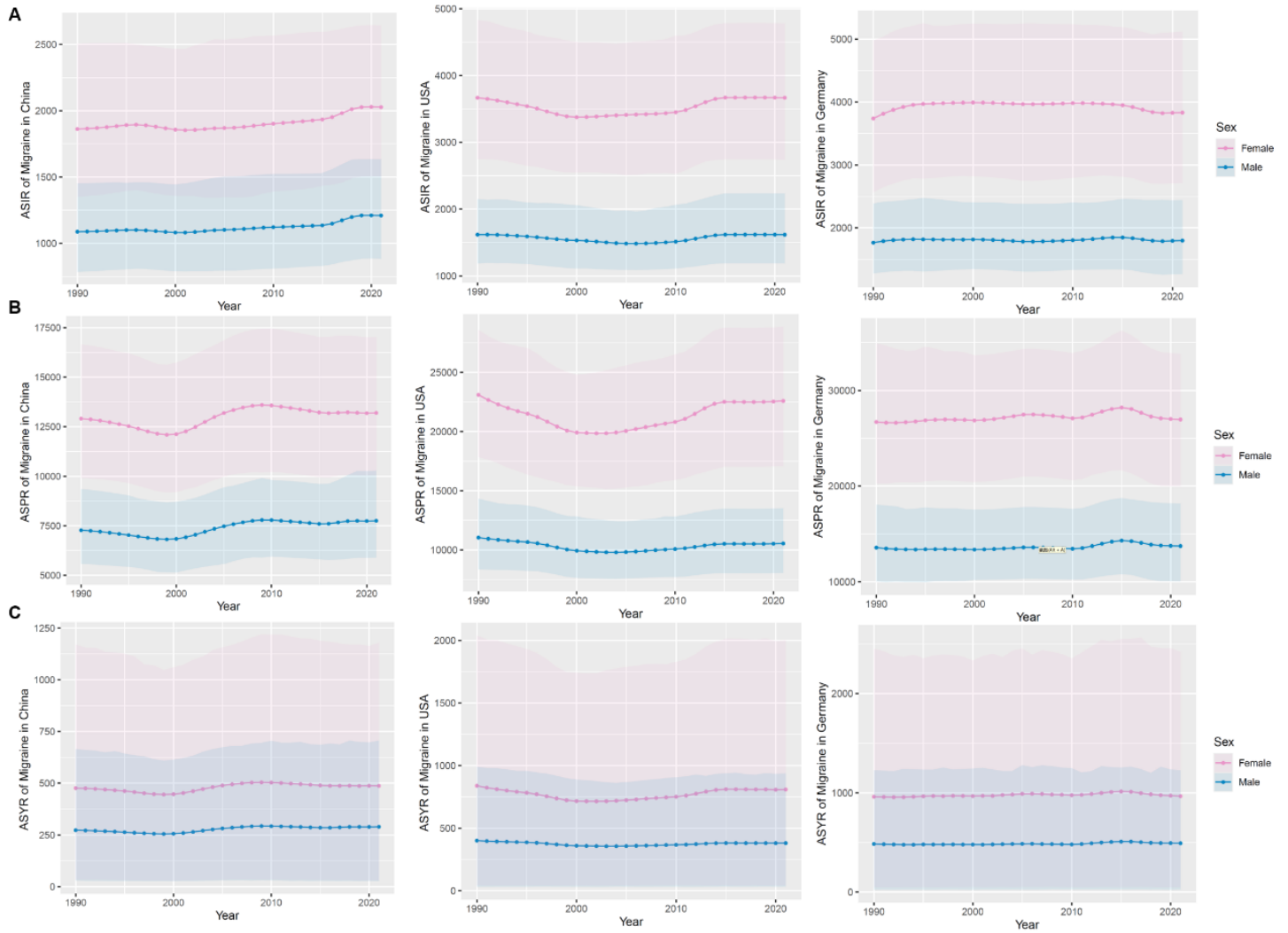


Fig. S3. Temporal trends in tension-type headache cases among adolescents aged 10–19 years in China, the US, and Germany from 1990 to 2021, stratified by sex. (A-C) Estimated incidence, prevalence, and years lived with disability (YLD) cases of migraine. Colours represent female and male subgroups.

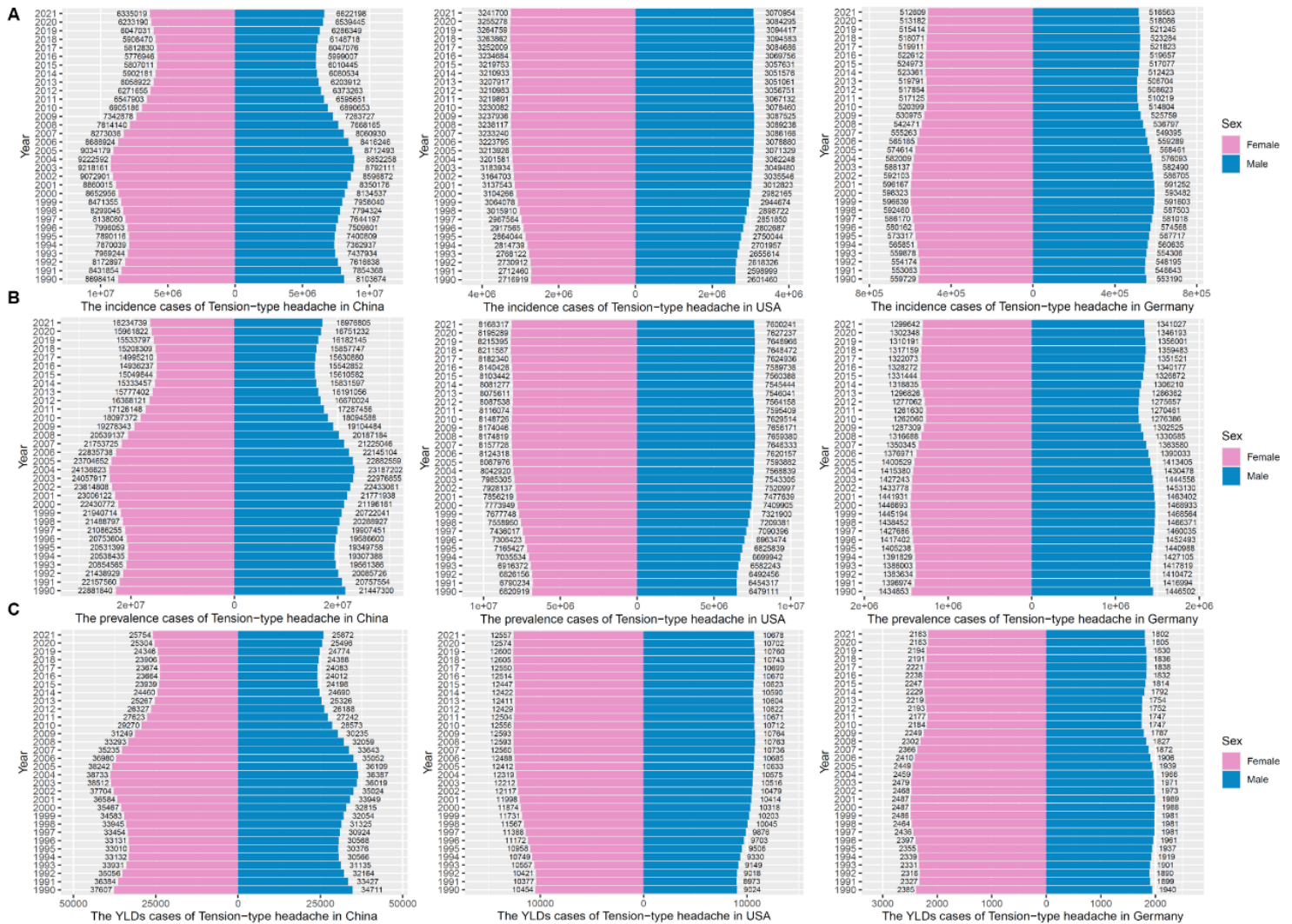


Fig. S4. Temporal trends in age-standardised rates of tension-type headache among adolescents aged 10–19 years in China, the US, and Germany from 1990 to 2021, stratified by sex. (A-C) Age-standardised incidence (ASR), prevalence, and years lived with disability (YLD) rates of migraine. Colours represent female and male subgroups.

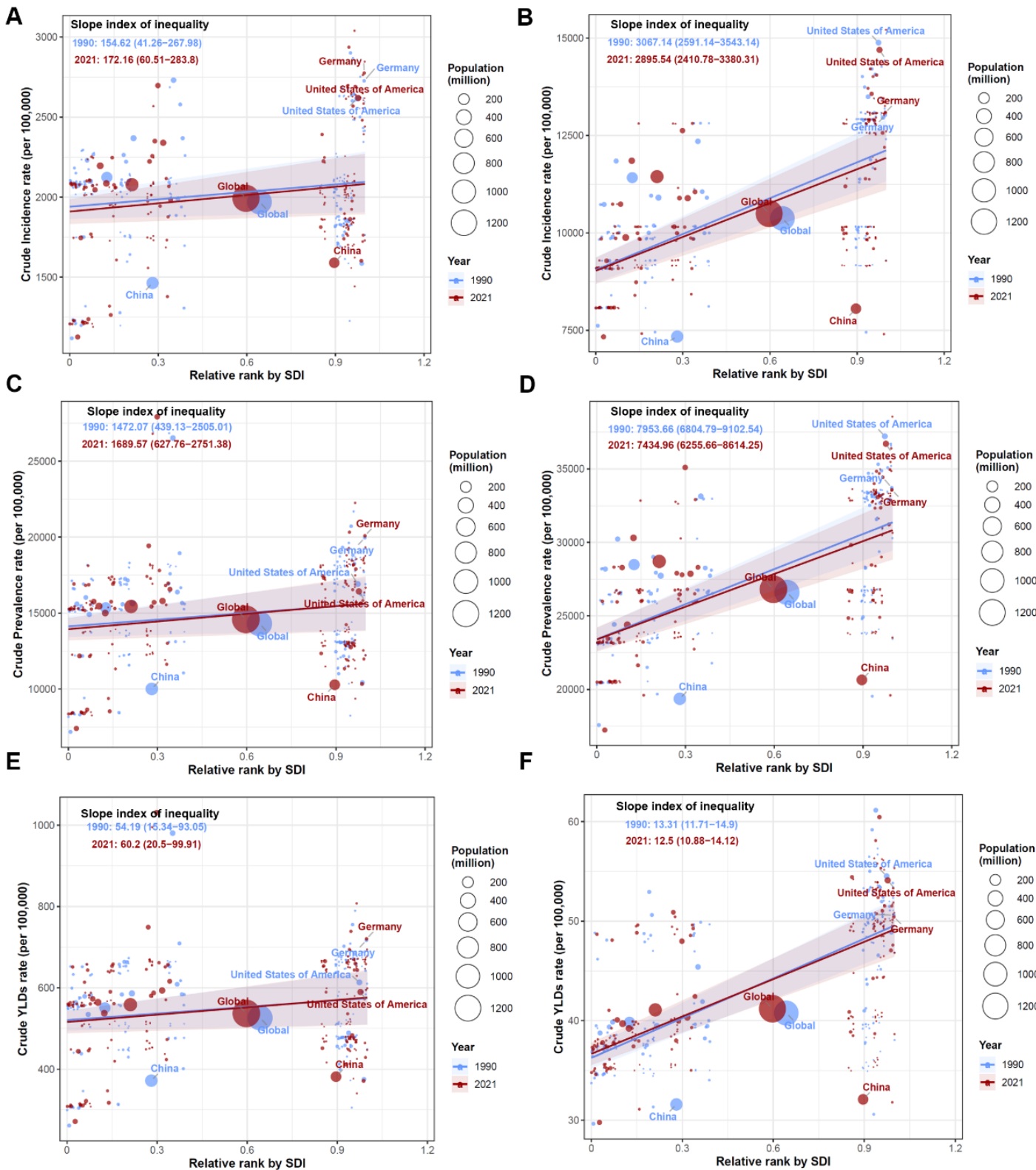


Fig. S5. Sociodemographic inequalities in migraine and tension-type headache burden among adolescents aged 10–19 years at the global level and in 3 countries from 1990 to 2021. (A, C, E)

Slope index of inequality (SII) for crude incidence, prevalence, and years lived with disability (YLD) rates of migraine. (B, D, F) Corresponding SII values for tension-type headache (TTH). Lines indicate global inequality trends in 1990 and 2021.

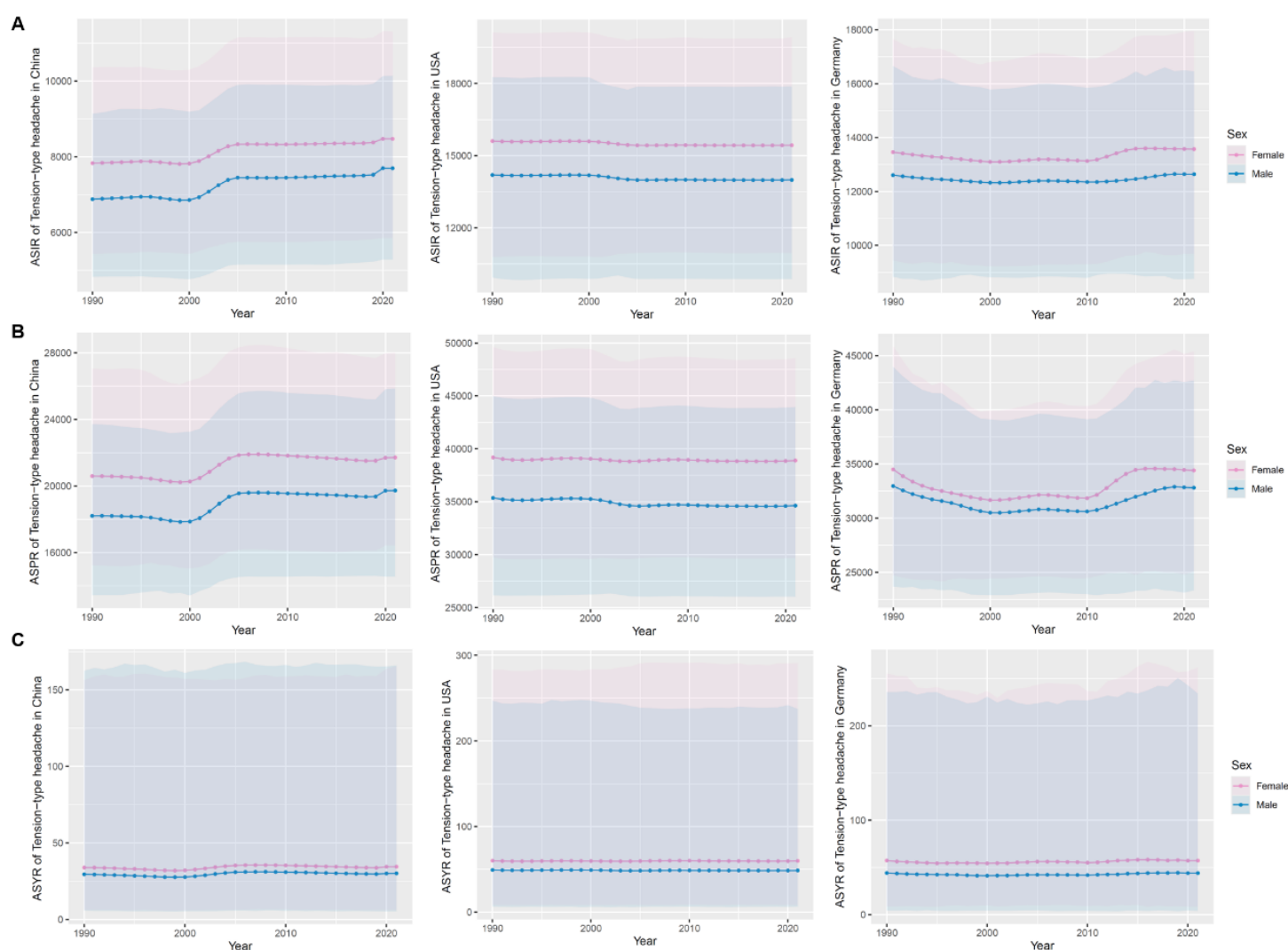


Fig. S6. Concentration curves of migraine and tension-type headache burden by sociodemographic index among adolescents aged 10–19 years globally and in 3 countries in 1990 and 2021. (A, C and E) Concentration curves for incidence, prevalence, and years lived with disability (YLD) rates of migraine. (B, D and F) Corresponding concentration curves for TTH. Concentration index (CI) values are shown for 1990 and 2021. SDI: sociodemographic index; TTH: tension-type headache

