



Received: 2025.10.24

Accepted: 2026.03.25

Available online: 2026.04.20

Published: 2026.XX.XX

Population Dynamic Projections of Near Vision Loss and Refractive Disorders in China and the G20 From 1990 to 2038

Authors' Contribution:

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Statistical Analysis C

Data Interpretation D

Manuscript Preparation E

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Corresponding Author: Ang Ji, e-mail: jiang4815@139.com**Financial support:** None declared**Conflict of interest:** None declared**Background:** Near vision loss (NVL) and refractive disorders (RD) are vision impairments that impact quality of life and economic factors globally. Public health planning requires understanding their burdens and predicting trends.**Material/Methods:** Using Global Burden of Disease (GBD) 2021 data, we analyzed age-standardized prevalence rates (ASPR) and disability-adjusted life year rates (ASDR) for China and the G20 from 1990 to 2021. Trends were described using actual and estimated annual percentage changes. Bayesian age-period-cohort modeling predicted disease burden from 2022 to 2038. Decomposition analysis quantified contributions from population growth, aging, and epidemiological changes.**Results:** NVL ASPR in China was 40 341.49 per 100 000, higher than in the G20. RD ASPR in China was 3044.90 per 100 000, lower than in the G20. Both conditions were more prevalent among women. NVL burden was highest in the 55 to 64 age group; RD burden peaked in the 80 to 84 age group. Overall, NVL showed an increasing trend (China: +1.95%; G20: +1.92%); RD showed a decreasing trend (China: -0.46%; G20: -0.36%). NVL burden is projected to continue rising, whereas RD burden will decline by 2038; both are mainly influenced by population growth.**Conclusions:** We identified divergent trends for NVL and RD in China and the G20 among adults. NVL burden has increased since the mid-1990s and is projected to continue rising through 2038; RD rates have declined. Burdens remain higher in women, particularly in middle-aged (NVL) and older (RD) populations. These findings support sustained, demographically responsive eye health planning.**Keywords:** Aged • Vision Disorders**Full-text PDF:** <https://www.medscimonit.com/abstract/index/idArt/951896>

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Introduction

Near vision loss (NVL) is mainly characterized by blurred or impaired vision at close distances [1]. Refractive disorders (RD), also known as refractive errors, refer to conditions in which – when the eyes are in a relaxed state of accommodation – parallel light rays from the external environment fail to accurately focus on the macula after passing through the ocular refractive system [2]. NVL and RD substantially affect quality of life, disrupt economic and educational opportunities, and impose a considerable economic burden [3,4]. According to a previous report, 36.0 million individuals were blind in 2015, 217 million experienced moderate to severe vision impairment, 188 million had mild vision impairment, and an additional 667 million individuals aged 50 years or older were affected by vision impairment due to uncorrected presbyopia [5]. Understanding long-term trends (1990–2021) and generating reliable projections (through 2038) are critical for public health planning; they enable policymakers to proactively allocate resources and prepare for future healthcare demands associated with an aging global population [6].

It is essential to clarify the distinction between NVL and RD within the Global Burden of Disease (GBD) framework used in the present study. Although NVL is classified as a form of uncorrected refractive error (specifically presbyopia) by the World Health Organization (WHO), the GBD Study categorizes “near vision loss” (GBD cause code: B.2.2) and “refractive disorders” (GBD cause code: B.2.3, including uncorrected myopia, hyperopia, and astigmatism) as non-overlapping entities for analysis and burden estimation. This classification enables more granular assessment of the distinct epidemiological profiles of presbyopia and non-presbyopic refractive conditions.

Multiple studies have examined the global burden of vision impairment [5,6], but important knowledge gaps remain. First, although cross-sectional burden estimates are available, comprehensive analyses that integrate long-term trend assessment (eg, using joinpoint regression to identify significant turning points) with forward-looking age-period-cohort projections are limited. Second, few studies have decomposed the drivers of burden trends for these conditions within major economies. Finally, evidence to inform targeted public health planning – such as the WHO’s SPECS 2030 initiative, which aims to increase refractive error coverage – requires granular, predictive data that incorporate demographic shifts [7]. The selection of 2038 as the projection horizon aligns with the long-term planning scope of such global initiatives and facilitates mid-term policy evaluation.

China and the G20 provide a strategically relevant comparison for several reasons. China is undergoing rapid demographic

aging; the G20 collectively comprises both developed and emerging economies with diverse aging trajectories and eye care systems. Comparison of China with the G20 aggregate contextualizes China’s burden within a major economic bloc and enables the derivation of policy insights relevant to both national and international health planning.

This study aimed to (1) quantify the disease burden and long-term trends of NVL and RD among adults aged 40 years and older in China and the G20 from 1990 to 2021, (2) forecast the future burden through 2038, and (3) decompose the contributions of demographic and epidemiological factors to changes in burden.

Material and Methods

Data Extraction

Data were extracted from the GBD 2021 Results Tool in January 2025. We analyzed “near vision loss” (B.2.2) and “refractive disorders” (B.2.3) using prevalence, years lived with disability (YLDs), and disability-adjusted life years (DALYs). To ensure methodological consistency and clarity, all reported metrics for disease burden trends, comparisons, and projections refer to age-standardized rates (age-standardized prevalence rate [ASPR] and age-standardized disability-adjusted life year rate [ASDR] per 100 000 population), unless otherwise specified in the decomposition analysis, which uses absolute counts. Accordingly, terms such as “prevalence,” “YLDs,” and “DALYs” in the Results section denote their respective age-standardized rates. G20 locations included all member countries (eg, Argentina, Australia, Brazil, Canada, China, etc). Age standardization followed the GBD standard population method. Analyses focused on individuals aged 40 years and older, stratified in 5-year intervals, to capture the onset of presbyopia and age-related refractive changes.

Statistical Analysis

This descriptive analysis examined burdens of NVL and RD globally and across population subgroups from 1990 to 2021. Prevalence rates and DALY rates were age-standardized. The following formula was used:

$$ASR = \frac{\sum_{i=1}^A a_i w_i}{\sum_{i=1}^A w_i} \times 100,000$$

Let i denote the i -th age group, a_i represent the age-specific rate, and w_i be the population size (or weight) of the corresponding age group in the selected reference standard population [8]. In the present study, age-standardized rates (ASRs) are expressed as cases per 100 000 population. Uncertainty intervals (UIs) were defined by the 2.5th and 97.5th percentiles

derived from 1000 draws for each metric. This 1000-draw approach was consistently applied to adjust for and propagate statistical uncertainty in both joinpoint regression and Bayesian age-period-cohort (BAPC) modeling [9].

The estimated annual percentage change (EAPC) was used to describe overall temporal trends in disease burden, as follows:

$$y = \alpha + \beta x + \varepsilon$$
$$APC = (e^{\beta} - 1) \times 100\%$$

Here, y denotes $\ln(\text{ASR})$, x represents calendar year, β is the slope obtained from the regression analysis, and ε is the error term [10]. The 95% confidence interval (CI) was used to assess statistical significance. If both the EAPC estimate and the lower bound of the 95% CI are greater than 0, the age-standardized rate is considered to be increasing. If both the EAPC estimate and the upper bound of the 95% CI are less than 0, the rate is considered to be decreasing. If the 95% CI includes 0, the trend is considered stable [11].

The annual percentage change (APC) represents the rate of change within each segment when distinct trends or turning points occur across different time periods. Joinpoint regression divides the data into segments at these turning points, and the APC is calculated separately for each segment [12]. Joinpoint regression analysis was performed using the Joinpoint Regression Program (version 4.9.0.0; National Cancer Institute) based on historical ASPR and ASDR data from 1990 to 2021. A maximum of 3 joinpoints was allowed, and the optimal number of joinpoints was determined using permutation tests.

The predictive analysis mainly utilized the BAPC model to forecast disease burden from 2022 to 2038, using ASPR and ASDR data from 1990 to 2021 as inputs. The BAPC model was selected over simpler time-series models because it explicitly addresses the separate effects of age, period, and birth cohort, which is essential for long-term projections in populations undergoing substantial demographic transitions. The BAPC model is particularly suitable for predicting future trends in settings with broad population changes [13]. The model was implemented using the R package “BAPC” (version 3.1.2) in R (version 4.2.0). It applies a Bayesian framework with penalized splines to smooth age, period, and cohort effects, thereby generating robust long-term projections [14]. Specifically, penalized complexity priors were used for second-order random walk effects, and vague Gaussian priors () were specified for fixed effects. Model convergence was assessed using integrated nested Laplace approximation based on the effective number of parameters (p_D). Model fit was evaluated using the deviance information criterion and the Watanabe-Akaike information criterion; robustness was confirmed via back-casting (training period: 1990-2010; validation period: 2011-2021), and more than 90% of observed values fell within the 95% credible

intervals. Increasing uncertainty toward 2038 reflects stochastic variation in period extrapolation, demographic forecast uncertainty, and the propagation of historical errors; all population inputs were aligned with GBD 2021 reference scenarios.

Decomposition analysis was performed on the absolute number of cases to quantify the contributions of various factors to changes in disease burden over time. The method was based on the work of Das Gupta [15]. An additive decomposition approach was implemented to partition the change in total cases into contributions from 3 components: population growth (P), age structure change (A), and changes in age-specific rates (E; epidemiological factors). For interpretation, these components were categorized as population, aging, and epidemiological factors.

Ethics Statement

This study used publicly available data from the GBD 2021 database. The data were de-identified and aggregated; therefore, they did not involve human participants. The requirement for ethical approval was waived.

Results

Descriptive Analysis of Disease Burden

Disease Burdens in the G20 and China

Concerning NVL, the disease burden was higher in China than in the G20. Between 1990 and 2021, NVL ASPR in China increased by approximately 60%, rising from 25 176.52 to 40 341.49 per 100 000. Similarly, the G20 showed an increase from 23 675.04 to 35 934.92 per 100 000. In contrast, RD burden was lower in China than in the G20; a decreasing trend was detected in China. RD ASPR in China declined from 3452.55 in 1990 to 3044.90 in 2021 (Tables 1, 2).

Sex-Stratified Burden

In both China and the G20, the burdens of NVL and RD were higher among women than among men. In 2021, NVL ASPR for women in China was 42 918.29, compared with 37 711.62 for men. A similar pattern was observed in the G20 (38 311.63 for women vs 33 394.29 for men). Regarding RD, the ASPR for women in the G20 (3846.06) also exceeded the rate for men (3535.74) (Tables 1, 2; Figures 1, 2).

Age-Stratified Burden

Concerning NVL, the highest burden occurred in the 60 to 64 age group in China; in the G20, it peaked in the 55 to 59 age

Table 1. Overall and sex-specific burdens and trends of near vision loss among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Sex	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
China								
	DALYs	Both	734 155.51 (244 222.86-1 657 407.94)	3 001 675.51 (1 060 286.57-6 602 557.87)	308.86 (334.15-298.37)	251.97 (84.47-566.43)	408.09 (143.71-898.98)	2.00 (1.77-2.23)
	DALYs	Female	396 291.88 (132 954.49-889 544.79)	1 606 306.49 (575 783.38-3 497 856.84)	305.33 (333.07-293.22)	271.16 (91.45-607.11)	432.93 (154.64-944.73)	1.93 (1.72-2.14)
	DALYs	Male	337 863.63 (110 780.78-768 953.52)	1 395 369.03 (484 000.48-3 100 792.25)	313.00 (336.90-303.25)	232.65 (76.98-527.10)	382.89 (132.33-852.03)	2.07 (1.82-2.32)
	Prevalence	Both	72 849 159.55 (34 448 026.68-128 858 722.58)	296 505 506.88 (150 284 302.70-484 072 819.07)	307.01 (336.26-275.66)	25 176.52 (11 889.07-44 399.09)	40 341.49 (20 280.59-66 174.11)	1.95 (1.72-2.17)
	Prevalence	Female	39 545 736.31 (18 833 002.25-69 208 687.05)	159 286 155.05 (81 982 501.78-255 526 198.71)	302.79 (335.31-269.21)	27 187.07 (12 924.84-47 478.25)	42 918.29 (21 928.16-69 160.71)	1.88 (1.67-2.08)
	Prevalence	Male	33 303 423.25 (15 637 956.19-60 387 067.55)	137 219 351.82 (68 337 045.82-230 569 015.68)	312.03 (336.99-281.82)	23 130.45 (10 836.23-41 886.77)	37 711.62 (18 627.46-63 685.41)	2.02 (1.78-2.27)
	YLDs	Both	734 155.51 (244 222.86-1 657 407.94)	3 001 675.51 (1 060 286.57-6 602 557.87)	308.86 (334.15-298.37)	251.97 (84.47-566.43)	408.09 (143.71-898.98)	2.00 (1.77-2.23)
	YLDs	Female	396 291.88 (132 954.49-889 544.79)	1 606 306.49 (575 783.38-3 497 856.84)	305.33 (333.07-293.22)	271.16 (91.45-607.11)	432.93 (154.64-944.73)	1.93 (1.72-2.14)
	YLDs	Male	337 863.63 (110 780.78-768 953.52)	1 395 369.03 (484 000.48-3 100 792.25)	313.00 (336.90-303.25)	232.65 (76.98-527.10)	382.89 (132.33-852.03)	2.07 (1.82-2.32)
G20								
	DALYs	Both	2 477 502.81 (836 027.69-5 598 162.39)	7 725 267.88 (2 765 870.89-16 535 607.98)	211.82 (230.83-195.38)	236.02 (79.80-533.24)	360.98 (129.13-772.04)	1.96 (1.74-2.17)
	DALYs	Female	1 399 099.52 (476 012.85-3 133 322.21)	4 214 709.06 (1 532 627.30-8 976 980.72)	201.24 (221.97-186.50)	255.12 (86.78-572.04)	383.17 (139.28-815.60)	1.89 (1.69-2.10)
	DALYs	Male	1 078 403.30 (361 449.57-2 455 009.45)	3 510 558.81 (1 228 729.91-7 621 825.64)	225.53 (239.95-210.46)	214.98 (72.34-488.42)	337.33 (118.00-732.08)	2.05 (1.82-2.28)
	Prevalence	Both	247 834 450.63 (119 538 834.75-433 648 266.26)	769 627 604.45 (394 697 681.21-1 214 896 822.50)	210.54 (230.18-180.16)	23 675.04 (11 402.57-41 440.79)	35 934.92 (18 419.40-56 708.54)	1.92 (1.71-2.13)

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Table 1 continued. Overall and sex-specific burdens and trends of near vision loss among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Sex	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
	Prevalence	Female	140 728 443.77 (68 225 233.28-242 492 542.44)	422 339 664.32 (218 979 843.65-656 287 888.60)	200.11 (220.97-170.64)	25 668.85 (12 429.05-44 312.53)	38 311.63 (19 874.96-59 492.72)	1.86 (1.66-2.06)
	Prevalence	Male	107 106 006.85 (51 259 280.02-190 443 235.11)	347 287 940.14 (175 255 078.44-559 520 483.41)	224.25 (241.90-193.80)	21 471.19 (10 257.66-38 147.61)	33 394.29 (16 825.36-53 805.87)	2.01 (1.78-2.23)
	YLDs	Both	2 477 502.81 (836 027.69-5 598 162.39)	7 725 267.88 (2 765 870.89-16 535 607.98)	211.82 (230.83-195.38)	236.02 (79.80-533.24)	360.98 (129.13-772.04)	1.96 (1.74-2.17)
	YLDs	Female	1 399 099.52 (476 012.85-3 133 322.21)	4 214 709.06 (1 532 627.30-8 976 980.72)	201.24 (221.97-186.50)	255.12 (86.78-572.04)	383.17 (139.28-815.60)	1.89 (1.69-2.10)
	YLDs	Male	1 078 403.30 (361 449.57-2 455 009.45)	3 510 558.81 (1 228 729.91-7 621 825.64)	225.53 (239.95-210.46)	214.98 (72.34-488.42)	337.33 (118.00-732.08)	2.05 (1.82-2.28)

ASR – age-standardized rate; DALYs – disability-adjusted life-years; EAPC – estimated annual percentage change; UI – uncertainty interval; YLDs – years lived with disability.

Table 2. Overall and sex-specific burdens and trends of refractive disorders among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Sex	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
China								
	DALYs	Both	475 520.73 (327 550.65-690 377.25)	1044 984.91 (706 993.12-152 7301.15)	119.76 (115.84-121.23)	172.63 (119.37-249.52)	143.93 (97.57-210.04)	-0.50 (-0.73 to -0.27)
	DALYs	Female	263 269.68 (182 330.56-381 832.57)	583 554.89 (395 042.23-851 505.15)	121.66 (116.66-123.00)	186.48 (129.45-269.64)	155.87 (105.61-227.39)	-0.46 (-0.70 to -0.23)
	DALYs	Male	212 251.06 (144 726.08-308 685.55)	461 430.03 (310 441.18-678 224.67)	117.40 (114.5-119.71)	157.20 (107.84-227.47)	131.28 (88.6-192.36)	-0.53 (-0.77 to -0.30)
	Prevalence	Both	953 6689.25 (7 43 6851.27-1 209 4440.44)	2 214 2891.50 (17 063 883.03-28 311 604.23)	132.19 (129.45-134.09)	3 452.55 (2 695.64-4 373.00)	3 044.90 (2 344.96-3 894.20)	-0.46 (-0.62 to -0.31)
	Prevalence	Female	525 6958.67 (4 105 178.3-6 661 331.44)	12 325 125.07 (9 510 367.98-15 768 757.13)	134.45 (131.67-136.72)	3 719.10 (2 906.06-4 709.45)	3 293.90 (2 539.65-4 215.22)	-0.41 (-0.57 to -0.25)

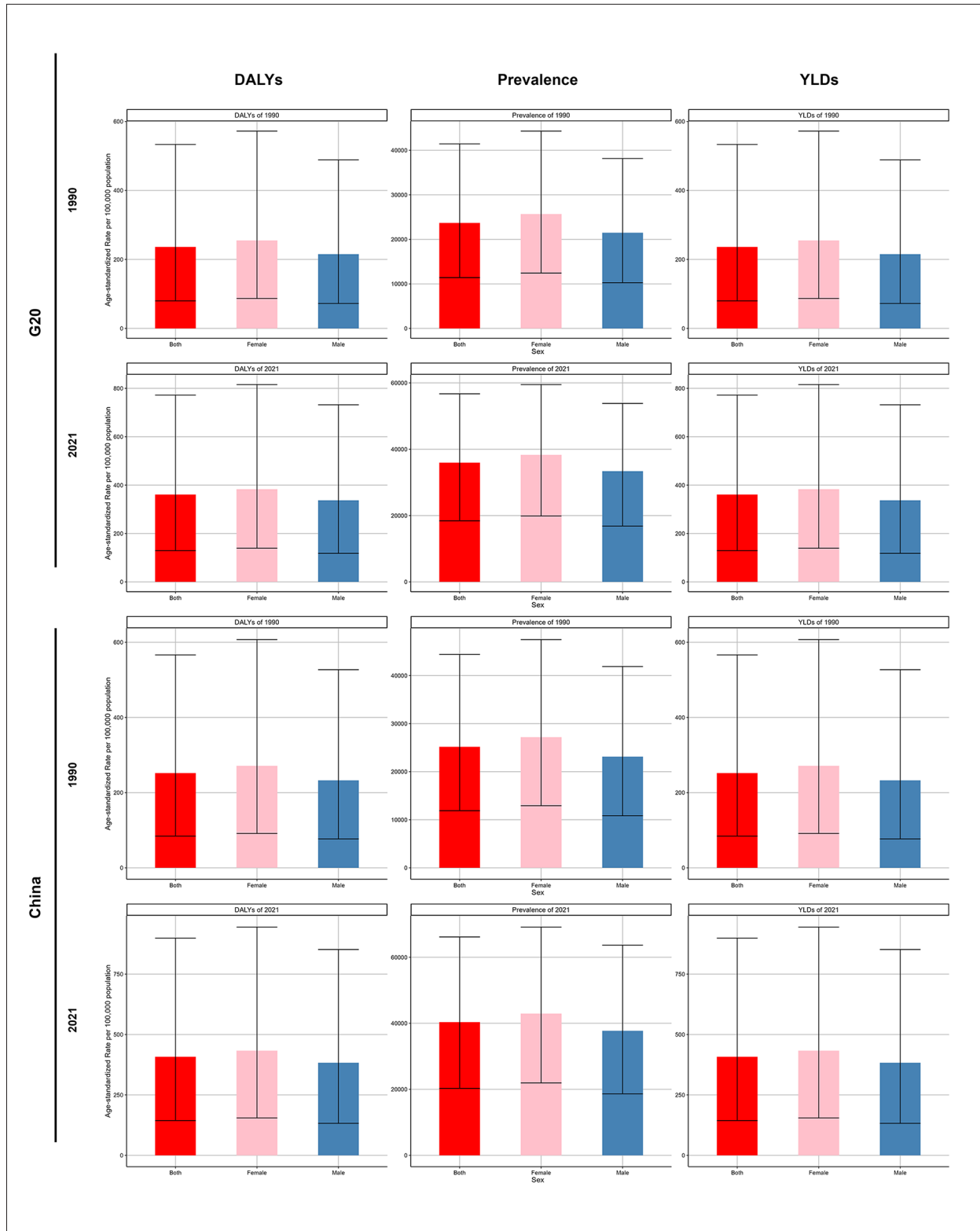
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Table 2 continued. Overall and sex-specific burdens and trends of refractive disorders among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Sex	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
	Prevalence	Male	4 27 9730.58 (3 32 4887.1- 5 437 528.18)	9 817 766.43 (7 553 757.49- 12 577 607.45)	129.40 (127.19- 131.31)	3 157.51 (2 457.06- 4 008.58)	2 781.59 (2 138.68- 3 565.05)	-0.51 (-0.66 to -0.36)
	YLDs	Both	475 520.73 (327 550.65- 690 377.25)	1 044 984.91 (706 993.12- 1 527 301.15)	119.76 (115.84- 121.23)	172.63 (119.37- 249.52)	143.93 (97.57- 210.04)	-0.50 (-0.73 to -0.27)
	YLDs	Female	263 269.68 (182 330.56- 381 832.57)	583 554.89 (395 042.23- 851 505.15)	121.66 (116.66- 123.00)	186.48 (129.45- 269.64)	155.87 (105.61- 227.39)	-0.46 (-0.70 to -0.23)
	YLDs	Male	212 251.06 (144 726.08- 308 685.55)	461 430.03 (310 441.18- 678 224.67)	117.40 (114.5- 119.71)	157.20 (107.84- 227.47)	131.28 (88.6- 192.36)	-0.53 (-0.77 to -0.30)
G20								
	DALYs	Both	1 958 002.80 (1 323 508.09- 2 870 000.27)	3 521 557.52 (2 338 702.23- 5 219 915.82)	79.85 (76.7- 81.88)	188.91 (127.94- 276.34)	161.72 (107.36- 239.79)	-0.50 (-0.57 to -0.44)
	DALYs	Female	1 058 662.03 (716 108.94- 1 546 048.89)	1 919 650.09 (1 277 225.94- 2 837 164.25)	81.33 (78.36- 83.51)	192.41 (130.11- 281.02)	168.14 (111.66- 248.97)	-0.43 (-0.50 to -0.37)
	DALYs	Male	899 340.78 (607 080.89- 1 323 515.14)	1 601 907.44 (1 061 087.51- 2 383 233.14)	78.12 (74.79- 80.07)	185.74 (125.98- 272.10)	154.77 (102.65- 229.94)	-0.60 (-0.66 to -0.54)
	Prevalence	Both	42 680 752.76 (33 278 924.85- 53 803 962.14)	80 314 238.86 (62 032 038.89- 102 437 978.38)	88.17 (86.4- 90.39)	4 103.44 (3 201.35- 5 171.56)	3 695.07 (2 851.42- 4 712.72)	-0.36 (-0.42 to -0.29)
	Prevalence	Female	23 123 615.76 (18 042 614.83- 29 167 840.88)	43 688 588.79 (33 806 578.04- 55 685 719.41)	88.93 (87.37- 90.91)	4 205.94 (3 280.21- 5 308.07)	3 846.06 (2 972.34- 4 902.63)	-0.31 (-0.37 to -0.24)
	Prevalence	Male	19 557 137.00 (15 235 894.13- 24 688 018.16)	36 625 650.07 (28 230 720.06- 46 699 800.89)	87.28 (85.29- 89.16)	4 010.33 (3 130.72- 5 054.59)	3 535.74 (2 724.41- 4 507.80)	-0.43 (-0.49 to -0.36)
	YLDs	Both	1 958 002.80 (1 323 508.09- 2 870 000.27)	3 521 557.52 (2 338 702.23- 5 219 915.82)	79.85 (76.7- 81.88)	188.91 (127.94- 276.34)	161.72 (107.36- 239.79)	-0.50 (-0.57 to -0.44)
	YLDs	Female	1 058 662.03 (716 108.94- 1 546 048.89)	1 919 650.09 (1 277 225.94- 2 837 164.25)	81.33 (78.36- 83.51)	192.41 (130.11- 281.02)	168.14 (111.66- 248.97)	-0.43 (-0.50 to -0.37)
	YLDs	Male	899 340.78 (607 080.89- 1 323 515.14)	1 601 907.44 (1 061 087.51- 2 383 233.14)	78.12 (74.79- 80.07)	185.74 (125.98- 272.10)	154.77 (102.65- 229.94)	-0.60 (-0.66 to -0.54)

ASR – age-standardized rate; DALYs – disability-adjusted life-years; EAPC – estimated annual percentage change; UI – uncertainty interval; YLDs – years lived with disability.

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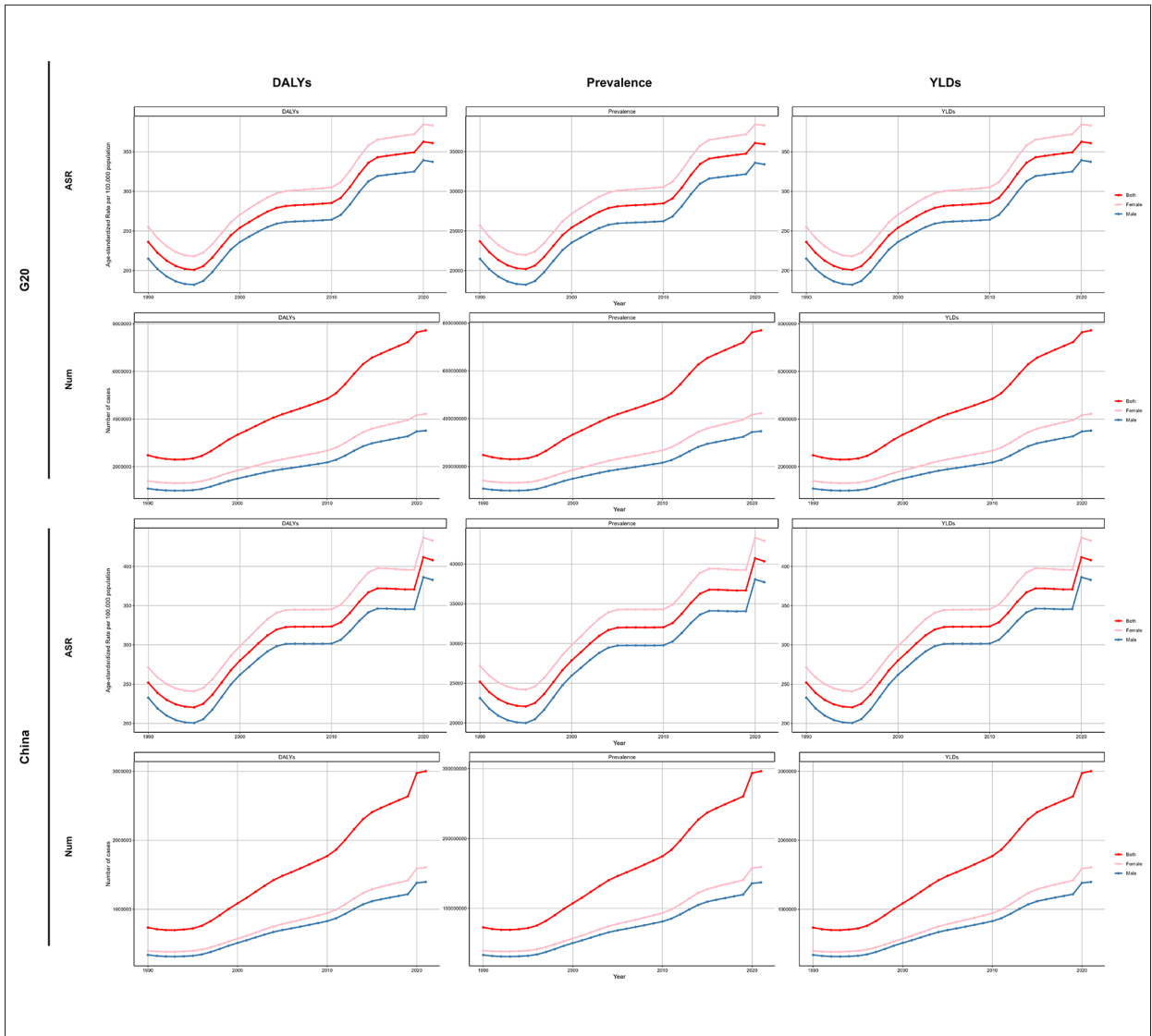
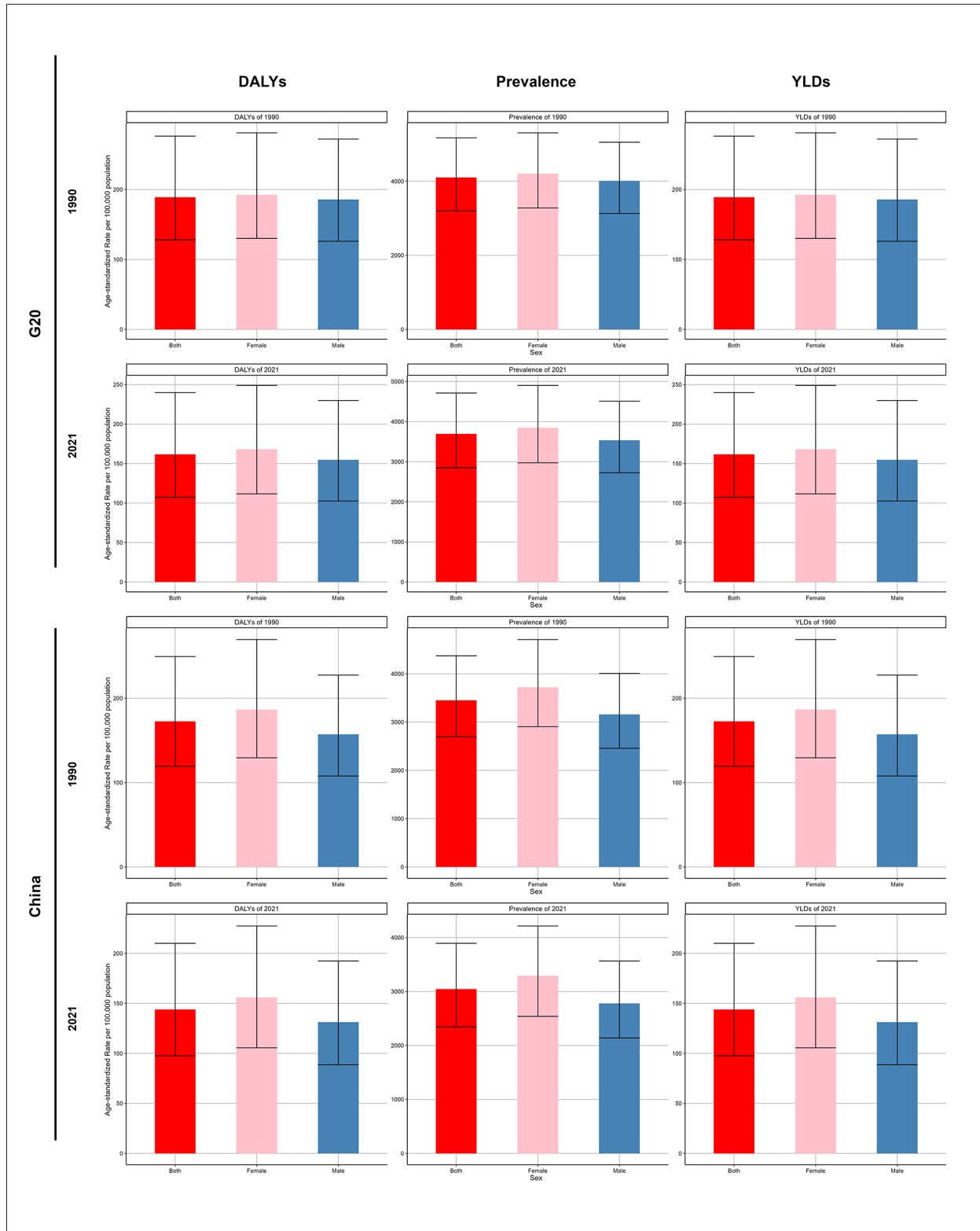


Figure 1. Sex-specific disease burden and temporal trends of near vision loss among individuals aged 40 years and older in China and G20 member countries, 1990 to 2021. DALYs – disability-adjusted life-years; YLDs – years lived with disability.



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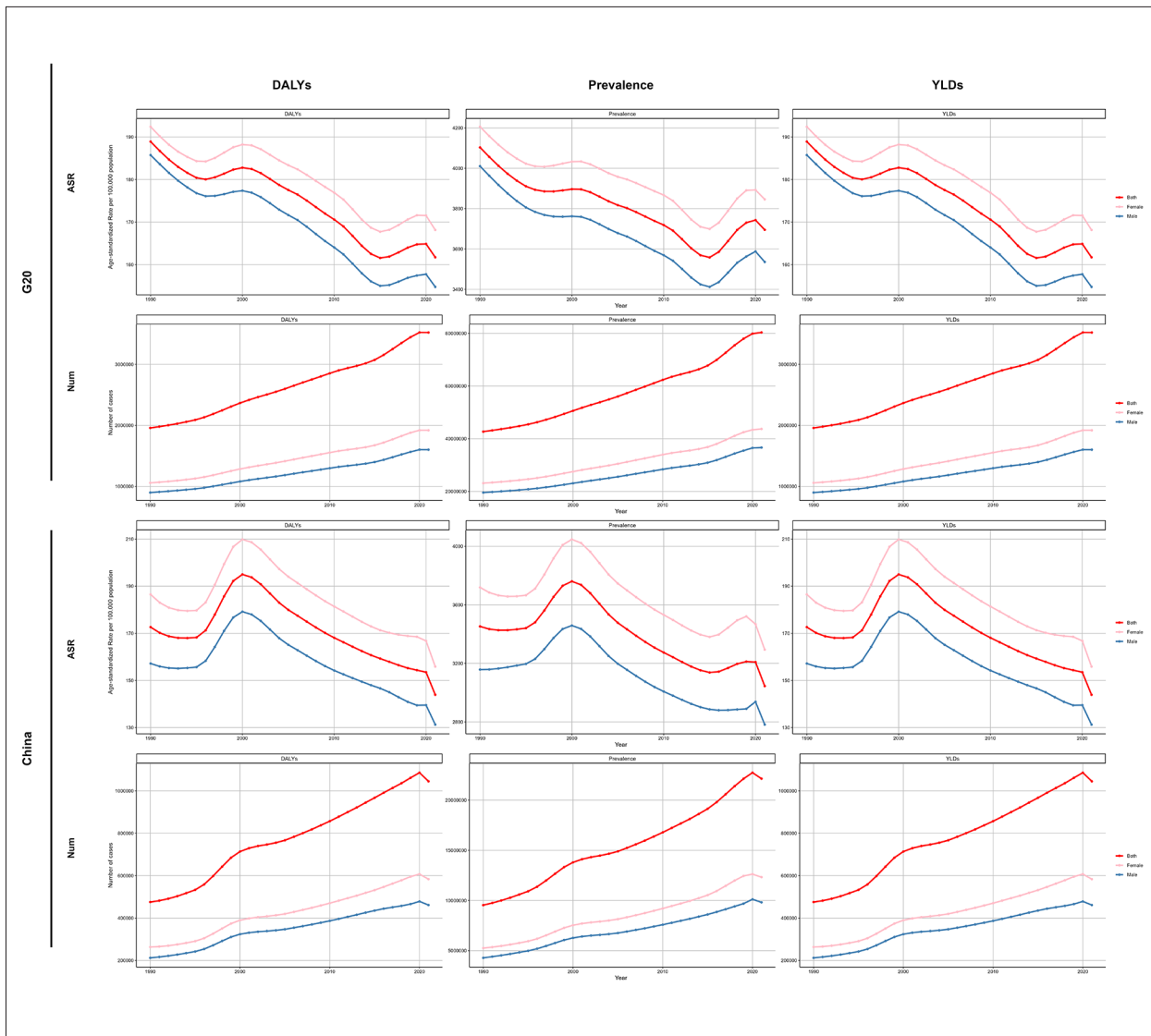


Figure 2. Sex-specific disease burden and temporal trends of refractive disorders among individuals aged 40 years and older in China and G20 member countries, 1990 to 2021. DALYs – disability-adjusted life-years; YLDs – years lived with disability.

group. RD burden was highest in the 80 to 84 age group in both China and the G20 (Tables 3, 4; Figures 3, 4).

Disease Burden Trends in China and the G20 (1990 to 2021)

EAPCs in China and the G20

From 1990 to 2021, age-standardized rates of NVL showed a consistent increasing trend in both China and the G20, with EAPCs ranging from 1.92 to 2.00 (Table 1; Figure 1). In contrast, RD burden declined over the same period, with EAPCs ranging from -0.50 to -0.36 (Table 2; Figure 2).

APCs in China and the G20

Joinpoint analysis indicated that NVL burden in both China and the G20 shifted from a declining to an increasing trend around 1995. The most rapid growth occurred during 2019 to 2021 in China (APC: ASPR 5.25, ASDR 5.31) and during 2011 to 2014 in the G20 (APC: ASPR 5.21, ASDR 5.20) (Table 5; Figure 5).

Concerning RD burden, China experienced the steepest increase during 1995 to 2000, peaking in 2000 (APC: ASPR 2.03, ASDR 3.36). In the G20, the trend shifted from decline to increase around 2015, with the most rapid growth observed during 2015 to 2019 (APC: ASPR 1.37, ASDR 0.65) (Table 6; Figure 5).

Table 3. Age-specific burdens and trends of near vision loss among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Age	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
China								
	DALYs	40-44 years	56 826.85 (18 476.36-133 575.3)	173 386.71 (62 400.03-381 539.31)	205.11 (237.73-185.64)	84.70 (27.54-199.09)	189.42 (68.17-416.83)	3.41 (2.97-3.86)
	DALYs	45-49 years	72 013.44 (19 648.27-185 955.69)	383 928.51 (117 886.85-926 923.99)	433.13 (499.99-398.46)	139.51 (38.06-360.25)	348.01 (106.86-840.2)	4.26 (3.64-4.89)
	DALYs	50-54 years	99 845.14 (37 814.71-222 093.89)	562 128.57 (222 530.86-1 238 135.01)	463.00 (488.48-457.48)	209.27 (79.26-465.5)	465.11 (184.12-1024.45)	3.64 (3.12-4.17)
	DALYs	55-59 years	126 653.06 (39 307.70-281 949.68)	594 650.90 (208 387-1 283 355.52)	369.51 (430.14-355.17)	292.04 (90.64-650.12)	540.88 (189.54-1167.3)	2.62 (2.28-2.97)
	DALYs	60-64 years	121 873.42 (41 872.69-256 728.36)	405 574.97 (144 955.80-848 442.06)	232.78 (246.18-230.48)	344.88 (118.49-726.5)	555.54 (198.56-1162.17)	1.94 (1.70-2.18)
	DALYs	65-69 years	100 387.91 (33 164.51-228 788.93)	391 920.28 (136 303.05-851 023.79)	290.41 (310.99-271.97)	367.97 (121.56-838.61)	510.95 (177.70-1109.5)	1.26 (1.10-1.41)
	DALYs	70-74 years	74 966.73 (25 239.32-174 009.62)	244 804.92 (83 432.07-537 240.56)	226.55 (230.56-208.74)	398.39 (134.13-924.71)	459.33 (156.54-1008.02)	0.44 (0.33-0.55)
	DALYs	75-79 years	49 654.85 (17 047.68-106 621.77)	133 571.26 (45 932.27-285 389.04)	169.00 (169.43-167.66)	436.31 (149.79-936.86)	403.31 (138.69-861.71)	-0.44 (-0.59 to -0.3)
	DALYs	80-84 years	23 372.05 (8 507.53-49 228.67)	70 042.70 (24 124.42-155 355.74)	199.69 (183.57-215.58)	441.22 (160.61-929.35)	353.90 (121.89-784.95)	-0.95 (-1.12 to -0.78)
	DALYs	85-89 years	7 047.67 (2 531.11-15 284.22)	29 765.74 (9 921.55-68 258.63)	322.35 (291.98-346.6)	417.80 (150.05-906.08)	312.48 (104.16-716.57)	-1.21 (-1.39 to -1.02)
	DALYs	90-94 years	1 324.08 (553.75-2757.1)	9 472.53 (3723.84-21248.07)	615.41 (572.47-670.67)	431.55 (180.48-898.6)	323.08 (127.01-724.7)	-1.19 (-1.37 to -1.01)
	DALYs	95+ years	190.32 (59.22-414.7)	2 428.41 (688.83-5 646.12)	1 175.96 (1063.10-1 261.5)	470.02 (146.26-1024.15)	379.97 (107.78-883.45)	-0.86 (-0.98 to -0.74)
	Prevalence	40-44 years	54 828 25.50 (2 591 235.17-9 764 484.96)	16 709 953.73 (8 516 594.09-27 657 174.83)	204.77 (228.67-183.24)	8 171.82 (3 862.08-14 553.37)	18 255.52 (9 304.33-30 215.3)	3.41 (2.96-3.86)
	Prevalence	45-49 years	6 963 502.55 (2 739 901.81-13 967 453.54)	37 148 859.00 (15 846 743.18-70 502 945.35)	433.48 (478.37-404.77)	13490.20 (5307.94-27058.77)	33 673.25 (14 364.14-63 906.77)	4.27 (3.64-4.89)
	Prevalence	50-54 years	9 709 748.06 (5 357 715.75-16 447 642.81)	54 627 986.65 (31 347 409.66-92 054 533.24)	462.61 (485.09-459.68)	20 351.23 (11 229.55-34 473.57)	45 199.75 (25 937.17-76 166.86)	3.64 (3.12-4.16)

APPROVED GALLEY PROOF

Table 3 continued. Age-specific burdens and trends of near vision loss among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Age	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
	Prevalence	55-59 years	12 426 918.26 (5 487 151.77-21 868 075.31)	58 200 380.90 (30 392 846.02-86 247 941.48)	368.34 (453.89-294.4)	28 653.85 (12 652.21-50 423.17)	52 937.17 (27 644.34-78 448.32)	2.61 (2.27-2.96)
	Prevalence	60-64 years	12 056 420.62 (5 825 189.69-19 402 190.5)	40 019 433.93 (19 810 294.57-58 668 913.15)	231.93 (240.08-202.38)	34 117.96 (16 484.46-54 905.44)	54 817.26 (27 135.47-80 362.69)	1.93 (1.70-2.17)
	Prevalence	65-69 years	10 032 400.68 (4 647 369.86-18 749 800.54)	39 067 954.88 (20 274 924.47-62 550 034.36)	289.42 (336.27-233.6)	36 773.22 (17 034.68-68 726.38)	50 933.72 (26 432.85-81 547.81)	1.25 (1.09-1.4)
	Prevalence	70-74 years	7 622 234.94 (3 744 053.23-14 348 712.86)	24 829 795.44 (12 234 343.30-41 008 864.84)	225.75 (226.77-185.8)	40 505.77 (19 896.50-76 251.35)	46 588.09 (22 955.27-76 944.85)	0.43 (0.32-0.55)
	Prevalence	75-79 years	5 157 357.19 (24 84 222.25-8 540 507.85)	13 883 120.05 (6 614 090.48-23 493 222.00)	169.19 (166.24-175.08)	45 316.71 (21 828.38-75 043.8)	41 918.98 (19 970.72-70 935.92)	-0.44 (-0.58 to -0.3)
	Prevalence	80-84 years	2 474 518.85 (1 149 189.83-4 195 841.18)	7 457 821.40 (3 268 149.55-13 324 424.54)	201.38 (184.39-217.56)	46 714.37 (21 694.59-79 209.77)	37 681.26 (16 512.60-67 322.76)	-0.93 (-1.10 to -0.76)
	Prevalence	85-89 years	757 619.69 (342 689.19-1 302 645.63)	3 235 283.42 (1 398 878.11-6 151 225.91)	327.03 (308.21-372.21)	44 913.13 (20 315.27-77 223.31)	33 963.55 (14 685.23-64 574.71)	-1.18 (-1.36 to -0.99)
	Prevalence	90-94 years	144 443.83 (71 579.32-237 975.72)	1 049 347.64 (489 321.93-1 926 313.32)	626.47 (583.61-709.46)	47 077.39 (23 329.26-77 561.47)	35 789.64 (16 689.09-65 699.92)	-1.15 (-1.33 to -0.98)
	Prevalence	95+ years	211 69.38 (7 728.82-33 391.68)	275 569.84 (90 707.35-487 226.04)	1 201.74 (1 073.63-1 359.12)	52 280.30 (19 087.23-82 464.71)	43 118.53 (14 193.02-76 236.46)	-0.81 (-0.94 to -0.69)
	YLDs	40-44 years	56 826.85 (18 476.36-133 575.3)	173 386.71 (62 400.03-381 539.31)	205.11 (237.73-185.64)	84.70 (27.54-199.09)	189.42 (68.17-416.83)	3.41 (2.97-3.86)
	YLDs	45-49 years	72 013.44 (19 648.27-185 955.69)	383 928.51 (117 886.85-926 923.99)	433.13 (499.99-398.46)	139.51 (38.06-360.25)	348.01 (106.86-840.2)	4.26 (3.64-4.89)
	YLDs	50-54 years	99 845.14 (37 814.71-222 093.89)	562 128.57 (222 530.86-1 238 135.01)	463.00 (488.48-457.48)	209.27 (79.26-465.5)	465.11 (184.12-1024.45)	3.64 (3.12-4.17)
	YLDs	55-59 years	126 653.06 (39 307.70-281 949.68)	594 650.90 (20 8387.00-1 283 355.52)	369.51 (430.14-355.17)	292.04 (90.64-650.12)	540.88 (189.54-1167.3)	2.62 (2.28-2.97)
	YLDs	60-64 years	121 873.42 (41 872.69-256 728.36)	405 574.97 (144 955.80-848 442.06)	232.78 (246.18-230.48)	344.88 (118.49-726.5)	555.54 (198.56-1162.17)	1.94 (1.70-2.18)
	YLDs	65-69 years	100 387.91 (33 164.51-228 788.93)	391 920.28 (136 303.05-851 023.79)	290.41 (310.99-271.97)	367.97 (121.56-838.61)	510.95 (177.70-1109.5)	1.26 (1.10-1.41)

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Table 3 continued. Age-specific burdens and trends of near vision loss among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Age	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
	YLDs	70-74 years	749 66.73 (25 239.32-174 009.62)	244 804.92 (83 432.07-537 240.56)	226.55 (230.56-208.74)	398.39 (134.13-924.71)	459.33 (156.54-1008.02)	0.44 (0.33-0.55)
	YLDs	75-79 years	49 654.85 (17 047.68-106 621.77)	133 571.26 (45 932.27-285 389.04)	169.00 (169.43-167.66)	436.31 (149.79-936.86)	403.31 (138.69-861.71)	-0.44 (-0.59 to -0.3)
	YLDs	80-84 years	23 372.05 (8 507.53-49 228.67)	70 042.70 (24 124.42-155 355.74)	199.69 (183.57-215.58)	441.22 (160.61-929.35)	353.90 (121.89-784.95)	-0.95 (-1.12 to -0.78)
	YLDs	85-89 years	7 047.67 (2 531.11-15 284.22)	29 765.74 (9 921.55-68 258.63)	322.35 (291.98-346.6)	417.80 (150.05-906.08)	312.48 (104.16-716.57)	-1.21 (-1.39 to -1.02)
	YLDs	90-94 years	1 324.08 (553.75-2 757.1)	9 472.53 (3 723.84-21 248.07)	615.41 (572.47-670.67)	431.55 (180.48-898.6)	323.08 (127.01-724.7)	-1.19 (-1.37 to -1.01)
	YLDs	95+ years	190.32 (59.22-414.7)	2428.41 (688.83-5646.12)	1175.96 (1063.10-1261.5)	470.02 (146.26-1024.15)	379.97 (107.78-883.45)	-0.86 (-0.98 to -0.74)
G20								
	DALYs	40-44 years	239 237.60 (831 77.05-5 401 68.18)	774 970.96 (277 381.51-1 594 945.52)	223.93 (233.48-195.27)	111.03 (38.60-250.69)	234.92 (84.08-483.48)	3.46 (3.09-3.83)
	DALYs	45-49 years	310 541.46 (89 371.88-782 681.01)	1 129 561.49 (363 520.38-2 497 169.05)	263.74 (306.75-219.05)	179.70 (51.72-452.92)	343.72 (110.62-759.87)	3.13 (2.75-3.51)
	DALYs	50-54 years	369 732.06 (138 346.93-833 493.35)	1 320 418.48 (527 178.85-2 768 207.35)	257.13 (281.06-232.12)	232.40 (86.96-523.9)	411.42 (164.26-862.52)	2.73 (2.40-3.06)
	DALYs	55-59 years	386 203.04 (123 955.04-852 764.88)	1 269 022.95 (445 561.84-2 728 826.46)	228.59 (259.45-220.00)	273.85 (87.89-604.67)	435.69 (152.97-936.88)	2.17 (1.91-2.43)
	DALYs	60-64 years	368 523.62 (124 085.70-786 102.62)	993 177.58 (356 450.68-2 080 479.93)	169.50 (187.26-164.66)	299.53 (100.85-638.93)	422.87 (151.77-885.82)	1.66 (1.46-1.86)
	DALYs	65-69 years	291 261.75 (97 445.75-663 695.9)	855 312.28 (300 265.49-1 885 728.02)	193.66 (208.14-184.13)	303.29 (101.47-691.1)	403.79 (141.76-890.26)	1.19 (1.04-1.33)
	DALYs	70-74 years	210 230.89 (71 897.20-487 870.51)	603 854.36 (211 381.54-1 316 256.34)	187.23 (194.01-169.8)	320.40 (109.57-743.53)	372.71 (130.47-812.41)	0.69 (0.59-0.79)
	DALYs	75-79 years	162 238.69 (5 5957.45-351 477.48)	372 096.91 (132 379.76-796 433.3)	129.35 (136.57-126.6)	332.47 (114.67-720.27)	358.18 (127.43-766.66)	0.30 (0.22-0.38)
	DALYs	80-84 years	91 967.01 (34 118.61-195 420.29)	236 654.56 (87 680.92-497 311.41)	157.33 (156.99-154.48)	325.98 (120.93-692.67)	338.51 (125.42-711.35)	0.11 (0.01-0.21)

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Table 3 continued. Age-specific burdens and trends of near vision loss among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Age	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
	DALYs	85-89 years	35 527.17 (12 990.06-78 162.14)	112 389.59 (41 695.01-243 963.37)	216.35 (220.98-212.12)	296.92 (108.57-653.24)	301.73 (111.94-654.96)	-0.04 (-0.15 to 0.06)
	DALYs	90-94 years	9 707.37 (3 975.06-20 927.55)	43 830.71 (18 086.18-93 584.92)	351.52 (354.99-347.19)	285.25 (116.81-614.96)	296.65 (122.41-633.38)	-0.04 (-0.12 to 0.04)
	DALYs	95+ years	2332.15 (706.96-5 398.48)	13 978.01 (4 288.73-32 702.3)	499.36 (506.64-505.77)	294.62 (89.31-682.00)	313.48 (96.18-733.41)	0.17 (0.13-0.21)
	Prevalence	40-44 years	23 277 560.63 (11 482 458.02-40 172 833.27)	75 390 028.53 (40 625 885.51-115 648 811.38)	223.87 (253.81-187.88)	10 802.92 (5 328.91-18 643.87)	22 853.10 (12 314.99-35 056.8)	3.45 (3.08-3.83)
	Prevalence	45-49 years	30 307 171.80 (12 775 733.88-58 467 775.23)	110 115 874.72 (51 068 003.43-183 459 777.77)	263.33 (299.73-213.78)	1 7538.23 (7 393.09-33 834.27)	33 507.66 (15 539.72-55 825.81)	3.12 (2.74-3.5)
	Prevalence	50-54 years	36 281 614.92 (19 745 905.01-62 502 506.6)	129 258 864.96 (73 347 694.66-203 580 481.91)	256.27 (271.46-225.72)	22 805.31 (12 411.56-39 286.81)	40 274.55 (22 853.71-63 431.72)	2.72 (2.39-3.05)
	Prevalence	55-59 years	38 221 146.14 (17 700 632.52-66 224 973.66)	125 122 907.63 (65 893 649.33-187 590 066.89)	227.37 (272.27-183.26)	27 101.52 (12 551.01-46 958.24)	42 958.17 (22 623.12-64 404.88)	2.16 (1.90-2.41)
	Prevalence	60-64 years	36 779 291.73 (17 995 708.15-60 235 162.84)	98 853 125.85 (48 609 566.23-147 396 910.81)	168.77 (170.12-144.7)	29 893.57 (14 626.60-48 958.1)	42 089.25 (20 696.77-62 758.01)	1.65 (1.45-1.85)
	Prevalence	65-69 years	29 367 798.88 (13 915 265.94-53 446 227.61)	85 993 814.58 (43 260 316.77-139 421 131.65)	192.82 (210.88-160.86)	30 580.27 (14 489.77-55 652.8)	40 597.88 (20 423.29-65 821.04)	1.17 (1.03-1.32)
	Prevalence	70-74 years	21 560 713.00 (106 25 027.66-40 294 358.36)	618 25 721.26 (31 596 373.62-103 699 085.18)	186.75 (197.38-157.35)	32 859.01 (16 192.78-61 409.5)	38 159.63 (19 501.69-64 004.41)	0.68 (0.58-0.78)
	Prevalence	75-79 years	17 008 576.79 (8 253 603.48-27 110 053.73)	39 045 564.27 (19 541 879.64-61 054 847.52)	129.56 (136.77-125.21)	34 855.28 (16 913.92-55 556.01)	37 585.70 (18 811.23-58 772.08)	0.30 (0.23-0.38)
	Prevalence	80-84 years	9 829 531.55 (4 623 754.88-16 237 377.4)	25 336 136.95 (12 032 284.09-40 918 136.53)	157.76 (160.23-152.00)	34 841.14 (16 389.07-57 553.98)	36 240.61 (17 210.88-58 528.98)	0.11 (0.01-0.21)
	Prevalence	85-89 years	3 863 818.15 (1 785 486.89-6 648 892.58)	12 255 175.20 (5 715 302.71-21 167 532.22)	217.18 (220.10-218.36)	32 292.04 (14 922.29-55 568.43)	32 900.85 (15 343.58-56 827.4)	-0.04 (-0.14 to 0.07)
	Prevalence	90-94 years	1 074 373.18 (542 762.06-1 820 110.8)	4 854 485.78 (2 438 344.53-8 113 555.77)	351.84 (349.25-345.77)	31 570.54 (15 949.11-53 484.1)	32 855.12 (16 502.69-54 912.47)	-0.04 (-0.12 to 0.04)
	Prevalence	95+ years	262 853.86 (92 496.25-487 994.18)	1 575 904.73 (568 380.68-2 846 484.88)	499.54 (514.49-483.3)	33 206.57 (11 685.14-61 648.75)	35 342.51 (12 746.96-63 837.56)	0.17 (0.13-0.2)

APPROVED GALLEY PROOF

Table 3 continued. Age-specific burdens and trends of near vision loss among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Age	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
	YLDs	40-44 years	239 237.60 (83 177.05-540 168.18)	774 970.96 (277 381.51-1 594 945.52)	223.93 (233.48-195.27)	111.03 (38.60-250.69)	234.92 (84.08-483.48)	3.46 (3.09-3.83)
	YLDs	45-49 years	310 541.46 (89 371.88-782 681.01)	1 129 561.49 (363 520.38-2 497 169.05)	263.74 (306.75-219.05)	179.70 (51.72-452.92)	343.72 (110.62-759.87)	3.13 (2.75-3.51)
	YLDs	50-54 years	369 732.06 (138 346.93-833 493.35)	1 320 418.48 (527 178.85-2 768 207.35)	257.13 (281.06-232.12)	232.40 (86.96-523.9)	411.42 (164.26-862.52)	2.73 (2.40-3.06)
	YLDs	55-59 years	386 203.04 (123 955.04-852 764.88)	1 269 022.95 (445 561.84-2 728 826.46)	228.59 (259.45-220.00)	273.85 (87.89-604.67)	435.69 (152.97-936.88)	2.17 (1.91-2.43)
	YLDs	60-64 years	368 523.62 (124 085.70-786 102.62)	993 177.58 (356 450.68-2 080 479.93)	169.50 (187.26-164.66)	299.53 (100.85-638.93)	422.87 (151.77-885.82)	1.66 (1.46-1.86)
	YLDs	65-69 years	29 1261.75 (97 445.75-66 3695.9)	855 312.28 (300 265.49-1 885 728.02)	193.66 (208.14-184.13)	303.29 (101.47-691.1)	403.79 (141.76-890.26)	1.19 (1.04-1.33)
	YLDs	70-74 years	210 230.89 (71 897.20-487 870.51)	603 854.36 (211 381.54-1 316 256.34)	187.23 (194.01-169.8)	320.40 (109.57-743.53)	372.71 (130.47-812.41)	0.69 (0.59-0.79)
	YLDs	75-79 years	162 238.69 (55 957.45-351 477.48)	372 096.91 (132 379.76-796 433.3)	129.35 (136.57-126.6)	332.47 (114.67-720.27)	358.18 (127.43-766.66)	0.30 (0.22-0.38)
	YLDs	80-84 years	91 967.01 (34 118.61-195 420.29)	236 654.56 (87 680.92-497 311.41)	157.33 (156.99-154.48)	325.98 (120.93-692.67)	338.51 (125.42-711.35)	0.11 (0.01-0.21)
	YLDs	85-89 years	35 527.17 (12 990.06-78 162.14)	112 389.59 (41 695.01-243 963.37)	216.35 (220.98-212.12)	296.92 (108.57-653.24)	301.73 (111.94-654.96)	-0.04 (-0.15 to 0.06)
	YLDs	90-94 years	9 707.37 (3 975.06-20 927.55)	43 830.71 (18 086.18-93 584.92)	351.52 (354.99-347.19)	285.25 (116.81-614.96)	296.65 (122.41-633.38)	-0.04 (-0.12 to 0.04)
	YLDs	95+ years	2 332.15 (706.96-5 398.48)	13 978.01 (4 288.73-32 702.3)	499.36 (506.64-505.77)	294.62 (89.31-682.00)	313.48 (96.18-733.41)	0.17 (0.13-0.21)

ASR – age-standardized rate; DALYs – disability-adjusted life-years; EAPC – estimated annual percentage change; UI – uncertainty interval; YLDs – years lived with disability.

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Table 4. Age-specific burdens and trends of refractive disorders among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Age	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
China								
	DALYs	40-44 years	27 365.70 (18 713.51-39 903.81)	35 544.27 (23 841.44-52 932.6)	29.89 (27.40-32.65)	40.79 (27.89-59.47)	38.83 (26.05-57.83)	0.01 (-0.10 to 0.13)
	DALYs	45-49 years	33 311.20 (23 196.95-48 138.52)	68 213.60 (46 101.77-101 510.05)	104.78 (98.74-110.87)	64.53 (44.94-93.26)	61.83 (41.79-92.01)	0.12 (-0.07 to 0.31)
	DALYs	50-54 years	47 088.16 (32 033.20-69 747.7)	111 801.40 (74 381.55-165 765.3)	137.43 (132.20-137.66)	98.69 (67.14-146.19)	92.51 (61.54-137.16)	0.07 (-0.21 to 0.35)
	DALYs	55-59 years	64 192.23 (43 172.62-96 462.95)	145 883.03 (94 297.32-222 041.22)	127.26 (118.42-130.18)	148.01 (99.55-222.42)	132.69 (85.77-201.96)	-0.16 (-0.45 to 0.13)
	DALYs	60-64 years	73 713.37 (50 209.89-109 192.77)	130 505.73 (85 938.06-193 442.53)	77.04 (71.16-77.16)	208.60 (142.09-309.00)	178.76 (117.72-264.97)	-0.39 (-0.67 to -0.11)
	DALYs	65-69 years	79 199.09 (53 462.45-114 214.06)	181 854.59 (122 255.88-265 720.21)	129.62 (128.68-132.65)	290.30 (195.96-418.65)	237.09 (159.39-346.43)	-0.55 (-0.82 to -0.29)
	DALYs	70-74 years	68 812.68 (48 269.85-98 150.04)	154 549.71 (106 240.29-221 452.45)	124.59 (120.10-125.63)	365.68 (256.51-521.58)	289.98 (199.34-415.51)	-0.71 (-0.96 to -0.46)
	DALYs	75-79 years	48 828.11 (34 949.07-67 665.63)	108 157.67 (77 172.83-151 313.09)	121.51 (120.82-123.62)	429.04 (307.09-594.56)	326.57 (233.02-456.88)	-0.91 (-1.14 to -0.68)
	DALYs	80-84 years	24 176.91 (17 354.45-34 541.01)	66 805.69 (47 858.95-94 777.51)	176.32 (175.77-174.39)	456.42 (327.62-652.07)	337.54 (241.81-478.87)	-1.05 (-1.24 to -0.85)
	DALYs	85-89 years	7 456.48 (5 252.76-10 418.35)	31 327.00 (22 003.36-43 518.56)	320.13 (318.89-317.71)	442.03 (311.39-617.62)	328.87 (230.99-456.85)	-1.13 (-1.27 to -0.99)
	DALYs	90-94 years	1 227.76 (834.67-1729.72)	8 646.25 (5 750.54-12 367.3)	604.23 (588.96-614.99)	400.15 (272.04-563.75)	294.89 (196.13-421.81)	-1.20 (-1.30 to -1.09)
	DALYs	95+ years	149.04 (101.23-212.69)	1 695.97 (1 151.13-2 460.32)	1 037.93 (1 037.15-1 056.76)	368.07 (250.00-525.27)	265.37 (180.12-384.97)	-1.23 (-1.30 to -1.15)
	Prevalence	40-44 years	553 689.64 (416 869.11-701 239.21)	781 697.78 (580 357.69-994 929.03)	41.18 (39.22-41.88)	825.24 (621.32-1045.15)	854.00 (634.04-1 086.95)	0.30 (0.17-0.43)
	Prevalence	45-49 years	679 039.76 (529 666.00-855 450.58)	1 516 399.20 (1 180 950.78-1 924 875.92)	123.32 (122.96-125.01)	1 315.49 (1 026.11-1 657.24)	1 374.53 (1 070.46-1 744.79)	0.36 (0.18-0.54)
	Prevalence	50-54 years	969 890.69 (75 3785.00-1 237 166.02)	2 494 240.47 (1 917 455.87-3 160 952.44)	157.17 (154.38-155.50)	2 032.85 (1 579.90-2 593.05)	2 063.76 (1 586.52-2 615.40)	0.24 (0.04-0.45)

APPROVED GALLEY PROOF

Table 4 continued. Age-specific burdens and trends of refractive disorders among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Age	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
	Prevalence	55-59 years	1 331 253.34 (1 032 693.60-1 707 657.82)	3 215 913.38 (2 458 953.73-4 138 309.06)	141.57 (138.11-142.34)	3069.59 (2381.17-3937.50)	2925.09 (2236.58-3764.07)	-0.09 (-0.28 to 0.10)
	Prevalence	60-64 years	1 499 276.71 (1 150 746.63-1 950 642.64)	2 813 862.67 (2 156 171.65-3 667 035.56)	87.68 (87.37-87.99)	4242.74 (3256.45-5520.04)	3854.33 (2953.45-5022.98)	-0.38 (-0.55 to -0.20)
	Prevalence	65-69 years	1 569 381.40 (1 236 412.44-1 968 153.65)	3 820 424.46 (2 968 875.19-4 851 502.57)	143.44 (140.12-146.5)	5 752.48 (4532.00-7 214.16)	4 980.77 (3 870.59-6 325.01)	-0.56 (-0.72 to -0.39)
	Prevalence	70-74 years	1 340 588.27 (1 054 324.58-1 711 391.46)	3 159 318.09 (2 430 978.69-4 105 331.24)	135.67 (130.57-139.88)	7 124.10 (5 602.85-9 094.61)	5 927.82 (4 561.24-7 702.82)	-0.75 (-0.91 to -0.59)
	Prevalence	75-79 years	944 012.77 (750 616.16-1 142 575.43)	2 164 844.82 (1 681 312.11-2 671 290.99)	129.32 (123.99-133.80)	8 294.86 (6 595.52-10 039.59)	6 536.58 (5 076.59-8 065.75)	-0.98 (-1.13 to -0.82)
	Prevalence	80-84 years	472 560.84 (372 168.16-595 308.55)	1 333 282.39 (1 035 671.76-1 708 775.48)	182.14 (178.28-187.04)	8 921.08 (7 025.85-11 238.33)	6 736.52 (5 232.82-8 633.73)	-1.14 (-1.28 to -1)
	Prevalence	85-89 years	148 842.78 (118 586.89-188 646.23)	630 079.87 (495 263.73-810 414.67)	323.32 (317.64-329.59)	8 823.68 (7 030.06-11 183.31)	6 614.49 (5 199.21-8 507.62)	-1.24 (-1.36 to -1.11)
	Prevalence	90-94 years	25 048.53 (18 722.41-32 065.60)	17 7149.21 (13 2105.22-23 0804.60)	607.22 (605.60-619.79)	8 163.86 (6 102.04-10 450.88)	6 041.95 (4 505.65-7 871.95)	-1.29 (-1.41 to -1.18)
	Prevalence	95+ years	3 104.51 (2 260.30-4 143.24)	35 679.16 (25 786.60-47 382.66)	1 049.27 (1 040.85-1 043.61)	7 666.96 (5 582.09-10 232.23)	5 582.73 (4 034.84-7 413.98)	-1.31 (-1.41 to -1.20)
	YLDs	40-44 years	27 365.70 (18 713.51-39 903.81)	35 544.27 (23 841.44-52 932.60)	29.89 (27.40-32.65)	40.79 (27.89-59.47)	38.83 (26.05-57.83)	0.01 (-0.10 to 0.13)
	YLDs	45-49 years	33 311.20 (23 196.95-48 138.52)	68 213.60 (46 101.77-101 510.05)	104.78 (98.74-110.87)	64.53 (44.94-93.26)	61.83 (41.79-92.01)	0.12 (-0.07 to 0.31)
	YLDs	50-54 years	47 088.16 (32 033.20-69 747.70)	11 1801.40 (74 381.55-16 5765.30)	137.43 (132.20-137.66)	98.69 (67.14-146.19)	92.51 (61.54-137.16)	0.07 (-0.21 to 0.35)
	YLDs	55-59 years	64 192.23 (43 172.62-96 462.95)	145 883.03 (94 297.32-22 2041.22)	127.26 (118.42-130.18)	148.01 (99.55-222.42)	132.69 (85.77-201.96)	-0.16 (-0.45 to 0.13)
	YLDs	60-64 years	73 713.37 (50 209.89-109 192.77)	130 505.73 (85 938.06-193 442.53)	77.04 (71.16-77.16)	208.60 (142.09-309.00)	178.76 (117.72-264.97)	-0.39 (-0.67 to -0.11)
	YLDs	65-69 years	79 199.09 (53 462.45-114 214.06)	181 854.59 (122 255.88-265 720.21)	129.62 (128.68-132.65)	290.30 (195.96-418.65)	237.09 (159.39-346.43)	-0.55 (-0.82 to -0.29)

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Table 4 continued. Age-specific burdens and trends of refractive disorders among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Age	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
	YLDs	70-74 years	68 812.68 (48 269.85-98 150.04)	154 549.71 (106 240.29-221 452.45)	124.59 (120.10-125.63)	365.68 (256.51-521.58)	289.98 (199.34-415.51)	-0.71 (-0.96 to -0.46)
	YLDs	75-79 years	48 828.11 (34 949.07-67 665.63)	108 157.67 (77 172.83-151 313.09)	121.51 (120.82-123.62)	429.04 (307.09-594.56)	326.57 (233.02-456.88)	-0.91 (-1.14 to -0.68)
	YLDs	80-84 years	24 176.91 (17 354.45-34 541.01)	66 805.69 (47 858.95-94 777.51)	176.32 (175.77-174.39)	456.42 (327.62-652.07)	337.54 (241.81-478.87)	-1.05 (-1.24 to -0.85)
	YLDs	85-89 years	7 456.48 (5 252.76-10 418.35)	31 327.00 (22 003.36-43 518.56)	320.13 (318.89-317.71)	442.03 (311.39-617.62)	328.87 (230.99-456.85)	-1.13 (-1.27 to -0.99)
	YLDs	90-94 years	1 227.76 (834.67-1 729.72)	8 646.25 (5 750.54-1 2367.3)	604.23 (588.96-614.99)	400.15 (272.04-563.75)	294.89 (196.13-421.81)	-1.20 (-1.30 to -1.09)
	YLDs	95+ years	149.04 (101.23-212.69)	1695.97 (1151.13-2460.32)	1037.93 (1037.15-1056.76)	368.07 (250.00-525.27)	265.37 (180.12-384.97)	-1.23 (-1.30 to -1.15)
G20								
	DALYs	40-44 years	15 5994.38 (101 696.61-237 903.5)	220 427.91 (141 163.19-334 634.79)	41.31 (38.81-40.66)	72.40 (47.20-110.41)	66.82 (42.79-101.44)	-0.35 (-0.46 to -0.25)
	DALYs	45-49 years	187 665.14 (126 633.25-278 287.82)	299 604.68 (197 100.62-451 273.93)	59.65 (55.65-62.16)	108.60 (73.28-161.04)	91.17 (59.98-137.32)	-0.53 (-0.60 to -0.46)
	DALYs	50-54 years	234 606.67 (157 666.60-347 432.16)	389 629.03 (256 253.75-589 974.92)	66.08 (62.53-69.81)	147.47 (99.10-218.38)	121.40 (79.84-183.82)	-0.55 (-0.59 to -0.5)
	DALYs	55-59 years	278 477.67 (181 740.33-417 467.65)	473 497.54 (300 069.26-723 126.2)	70.03 (65.11-73.22)	197.46 (128.87-296.01)	162.56 (103.02-248.27)	-0.58 (-0.63 to -0.52)
	DALYs	60-64 years	296 432.19 (198 545.31-440 111.71)	484 325.34 (316 652.38-724 247.47)	63.38 (59.49-64.56)	240.93 (161.37-357.72)	206.21 (134.82-308.37)	-0.59 (-0.65 to -0.52)
	DALYs	65-69 years	269 703.80 (181 437.32-389 817.22)	518 664.56 (343 756.20-769 800.14)	92.31 (89.46-97.48)	280.84 (188.93-405.91)	244.86 (162.29-363.42)	-0.49 (-0.60 to -0.38)
	DALYs	70-74 years	217 097.84 (149 852.52-311 755.58)	446 185.77 (301 264.33-650 096.18)	105.52 (101.04-108.53)	330.86 (228.38-475.12)	275.39 (185.94-401.25)	-0.49 (-0.60 to -0.39)
	DALYs	75-79 years	168 136.03 (119 268.45-235 745.30)	317 337.24 (221 322.45-449 882.76)	88.74 (85.57-90.83)	344.56 (244.41-483.11)	305.47 (213.05-433.06)	-0.46 (-0.52 to -0.39)
	DALYs	80-84 years	99 434.80 (71 671.35-141 330.65)	215 144.83 (153 525.11-306 900.34)	116.37 (114.21-117.15)	352.45 (254.04-500.95)	307.74 (219.60-438.99)	-0.43 (-0.51 to -0.35)

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Table 4 continued. Age-specific burdens and trends of refractive disorders among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Age	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
	DALYs	85-89 years	38 979.11 (27 296.81-53 729.79)	108 840.65 (75 629.43-150 528.35)	179.23 (177.06-180.16)	325.77 (228.13-449.05)	292.20 (203.04-404.12)	-0.44 (-0.52 to -0.37)
	DALYs	90-94 years	9 533.44 (6 401.88-13 590.25)	37 732.81 (25 201.30-54 680.15)	295.79 (293.65-302.35)	280.14 (188.12-399.35)	255.38 (170.56-370.07)	-0.36 (-0.43 to -0.29)
	DALYs	95+ years	1 941.75 (1 297.67-2 828.61)	10 167.16 (6 764.20-14 770.61)	423.61 (421.26-422.19)	245.30 (163.94-357.34)	228.02 (151.70-331.26)	-0.23 (-0.28 to -0.17)
	Prevalence	40-44 years	3 693 140.85 (2 726 437.27-4 704 424.74)	5 443 658.68 (4 017 189.25-6 955 363.97)	47.40 (47.34-47.85)	1 713.96 (1 265.32-2 183.28)	1 650.14 (1 217.74-2 108.39)	-0.22 (-0.33 to -0.1)
	Prevalence	45-49 years	42 981 74.79 (33 720 004.77-53 812 866.73)	72 251 76.11 (56 143 689.97-90 787 524.43)	68.10 (66.50-68.71)	2 487.28 (1 951.32-3 114.06)	2 198.58 (1 708.42-2 762.62)	-0.36 (-0.45 to -0.28)
	Prevalence	50-54 years	532 330 1.87 (4 100 870.67-6 757 218.35)	9 259 426.38 (7 044 316.02-11 803 604.6)	73.94 (71.78-74.68)	3 346.03 (2 577.66-4 247.34)	2 885.06 (2 194.87-3 677.77)	-0.39 (-0.46 to -0.31)
	Prevalence	55-59 years	6 258 353.68 (4 870 599.69-7 954 449.4)	11 168 154.82 (8 581 365.30-14 404 590.45)	78.45 (76.19-81.09)	4 437.62 (3 453.60-5 640.27)	3 834.34 (2 946.22-4 945.5)	-0.43 (-0.52 to -0.33)
	Prevalence	60-64 years	6 536 988.80 (5 057 830.50-8 434 623.48)	11 291 211.34 (8 646 827.74-14 739 361.03)	72.73 (70.96-74.75)	5 313.15 (4 110.92-6 855.52)	4 807.52 (3 681.61-6 275.66)	-0.44 (-0.54 to -0.35)
	Prevalence	65-69 years	5 715 901.63 (4 552 217.94-7 105 209.47)	11 663 465.51 (9 158 534.68-14 732 037.73)	104.05 (101.19-107.34)	5 951.89 (4 740.16-7 398.55)	5 506.35 (4 323.77-6 955.03)	-0.34 (-0.44 to -0.25)
	Prevalence	70-74 years	4 419 406.72 (3 461 017.13-5 576 808.44)	9 709 752.50 (7 551 851.09-12 518 011.48)	119.71 (118.20-124.47)	6 735.27 (5 274.67-8 499.18)	5 992.98 (4 661.10-7 726.28)	-0.33 (-0.40 to -0.25)
	Prevalence	75-79 years	3 387 328.49 (2 730 808.21-4 057 315.96)	6 683 541.85 (5 293 384.45-8 155 064.18)	97.31 (93.84-101.00)	6 941.57 (5 596.18-8 314.56)	6 433.65 (5 095.47-7 850.16)	-0.30 (-0.35 to -0.26)
	Prevalence	80-84 years	2 001 454.10 (1 594 049.83-2 502 100.11)	4 521 644.89 (3 557 051.21-5 744 142.87)	125.92 (123.15-129.57)	7 094.23 (5 650.17-8 868.79)	6 467.73 (5 087.98-8 216.38)	-0.31 (-0.35 to -0.27)
	Prevalence	85-89 years	804 589.96 (633 377.26-1 017 958.64)	2 311 223.38 (1 804 213.69-2 956 396.73)	187.25 (184.86-190.42)	6 724.40 (5 293.48-8 507.64)	6 204.82 (4 843.68-7 936.89)	-0.36 (-0.40 to -0.31)
	Prevalence	90-94 years	200 797.83 (149 679.81-257 047.47)	815 562.16 (603 395.22-1 053 582.35)	306.16 (303.12-309.88)	5 900.46 (4 398.35-7 553.36)	5 519.72 (4 083.77-7 130.64)	-0.30 (-0.36 to -0.25)
	Prevalence	95+ years	41 314.05 (30 031.75-55 519.36)	221 421.23 (159 541.28-297 070.57)	435.95 (431.24-435.08)	5 219.24 (3 793.94-7 013.81)	4 965.77 (3 578.00-6 662.34)	-0.19 (-0.24 to -0.14)

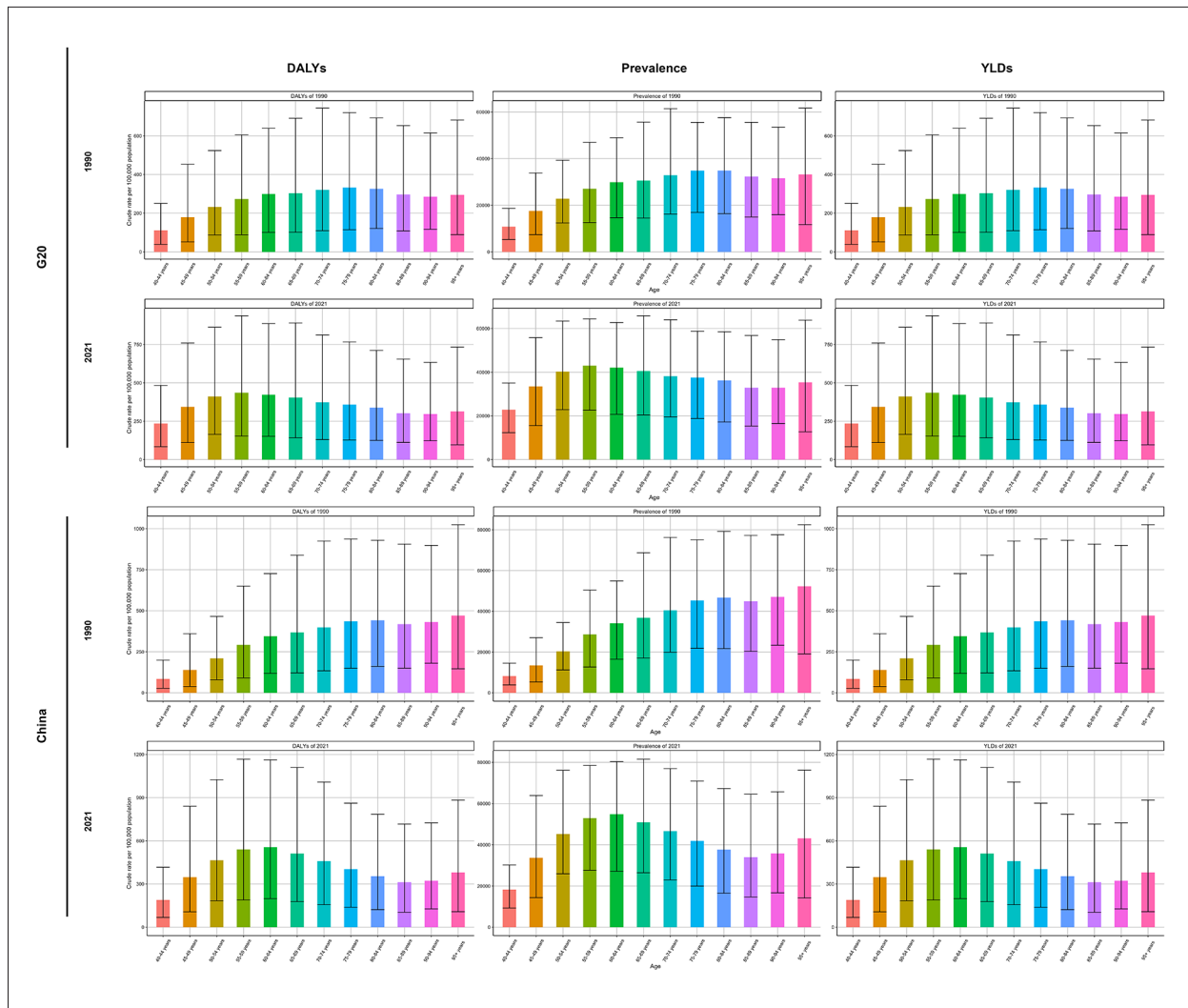
APPROVED GALLEY PROOF

Table 4 continued. Age-specific burdens and trends of refractive disorders among individuals aged 40 years and older in China and the G20, 1990 to 2021.

Country	Measure	Age	Absolute number, 1990 (95% UI)	Absolute number, 2021 (95% UI)	% Change (95% UI)	ASR (per 100 000), 1990 (95% UI)	ASR (per 100 000), 2021 (95% UI)	EAPC (95% CI)
	YLDs	40-44 years	155 994.38 (101 696.61-237 903.5)	220 427.91 (141 163.19-334 634.79)	41.31 (38.81-40.66)	72.40 (47.20-110.41)	66.82 (42.79-101.44)	-0.35 (-0.46 to -0.25)
	YLDs	45-49 years	187 665.14 (126 633.25-278 287.82)	299 604.68 (197 100.62-451 273.93)	59.65 (55.65-62.16)	108.60 (73.28-161.04)	91.17 (59.98-137.32)	-0.53 (-0.60 to -0.46)
	YLDs	50-54 years	234 606.67 (157 666.60-347 432.16)	389 629.03 (256 253.75-589 974.92)	66.08 (62.53-69.81)	147.47 (99.10-218.38)	121.40 (79.84-183.82)	-0.55 (-0.59 to -0.5)
	YLDs	55-59 years	278 477.67 (181 740.33-417 467.65)	473 497.54 (300 069.26-723 126.2)	70.03 (65.11-73.22)	197.46 (128.87-296.01)	162.56 (103.02-248.27)	-0.58 (-0.63 to -0.52)
	YLDs	60-64 years	296 432.19 (198 545.31-440 111.71)	484 325.34 (316 652.38-724 247.47)	63.38 (59.49-64.56)	240.93 (161.37-357.72)	206.21 (134.82-308.37)	-0.59 (-0.65 to -0.52)
	YLDs	65-69 years	269 703.80 (181 437.32-389 817.22)	518 664.56 (343 756.20-769 800.14)	92.31 (89.46-97.48)	280.84 (188.93-405.91)	244.86 (162.29-363.42)	-0.49 (-0.60 to -0.38)
	YLDs	70-74 years	217 097.84 (149 852.52-311 755.58)	446 185.77 (301 264.33-650 096.18)	105.52 (101.04-108.53)	330.86 (228.38-475.12)	275.39 (185.94-401.25)	-0.49 (-0.60 to -0.39)
	YLDs	75-79 years	168 136.03 (119 268.45-235 745.3)	317 337.24 (221 322.45-449 882.76)	88.74 (85.57-90.83)	344.56 (244.41-483.11)	305.47 (213.05-433.06)	-0.46 (-0.52 to -0.39)
	YLDs	80-84 years	99 434.80 (71 671.35-141 330.65)	215 144.83 (153 525.11-306 900.34)	116.37 (114.21-117.15)	352.45 (254.04-500.95)	307.74 (219.60-438.99)	-0.43 (-0.51 to -0.35)
	YLDs	85-89 years	38 979.11 (27 296.81-53 729.79)	108 840.65 (75 629.43-150 528.35)	179.23 (177.06-180.16)	325.77 (228.13-449.05)	292.20 (203.04-404.12)	-0.44 (-0.52 to -0.37)
	YLDs	90-94 years	9 533.44 (6 401.88-13 590.25)	37 732.81 (25 201.30-54 680.15)	295.79 (293.65-302.35)	280.14 (188.12-399.35)	255.38 (170.56-370.07)	-0.36 (-0.43 to -0.29)
	YLDs	95+ years	1 941.75 (1 297.67-2 828.61)	10 167.16 (6 764.20-14 770.61)	423.61 (421.26-422.19)	245.30 (163.94-357.34)	228.02 (151.70-331.26)	-0.23 (-0.28 to -0.17)

ASR – age-standardized rate; DALYs – disability-adjusted life-years; EAPC – estimated annual percentage change; UI – uncertainty interval; YLDs – years lived with disability.

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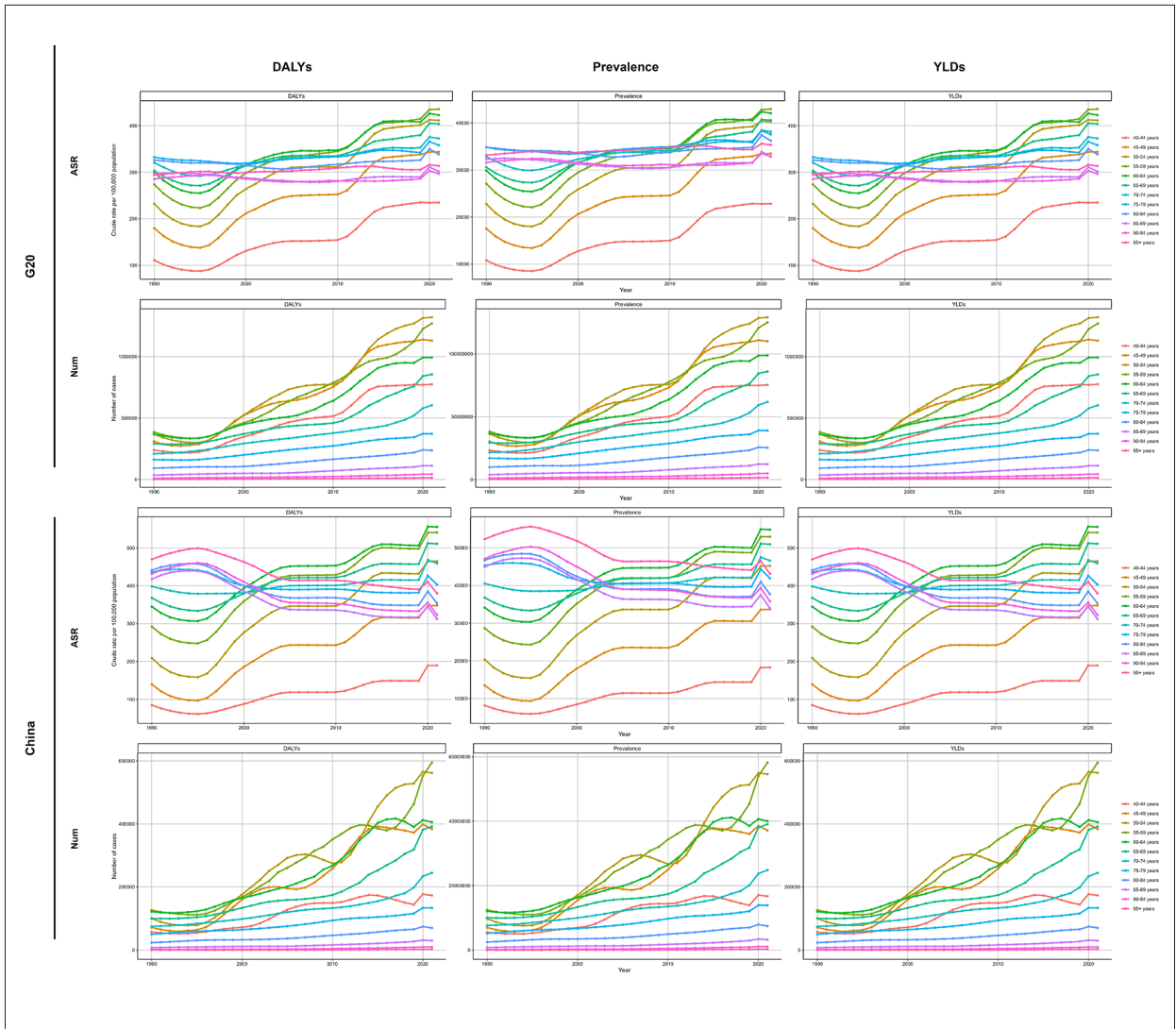
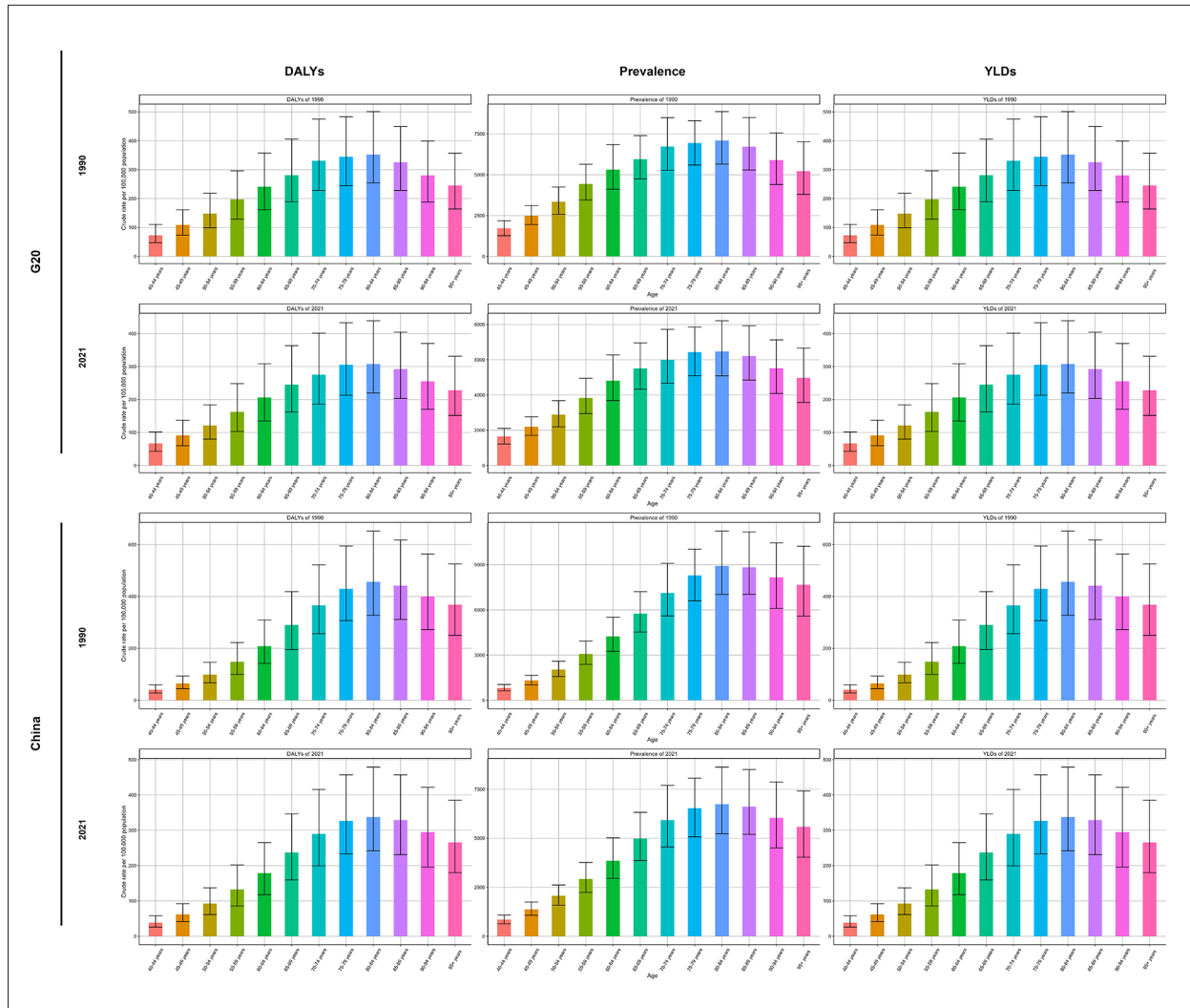


Figure 3. Age-specific disease burden and temporal trends of near vision loss among individuals aged 40 years and older in China and G20 member countries, 1990 to 2021. DALYs – disability-adjusted life-years; YLDs – years lived with disability.



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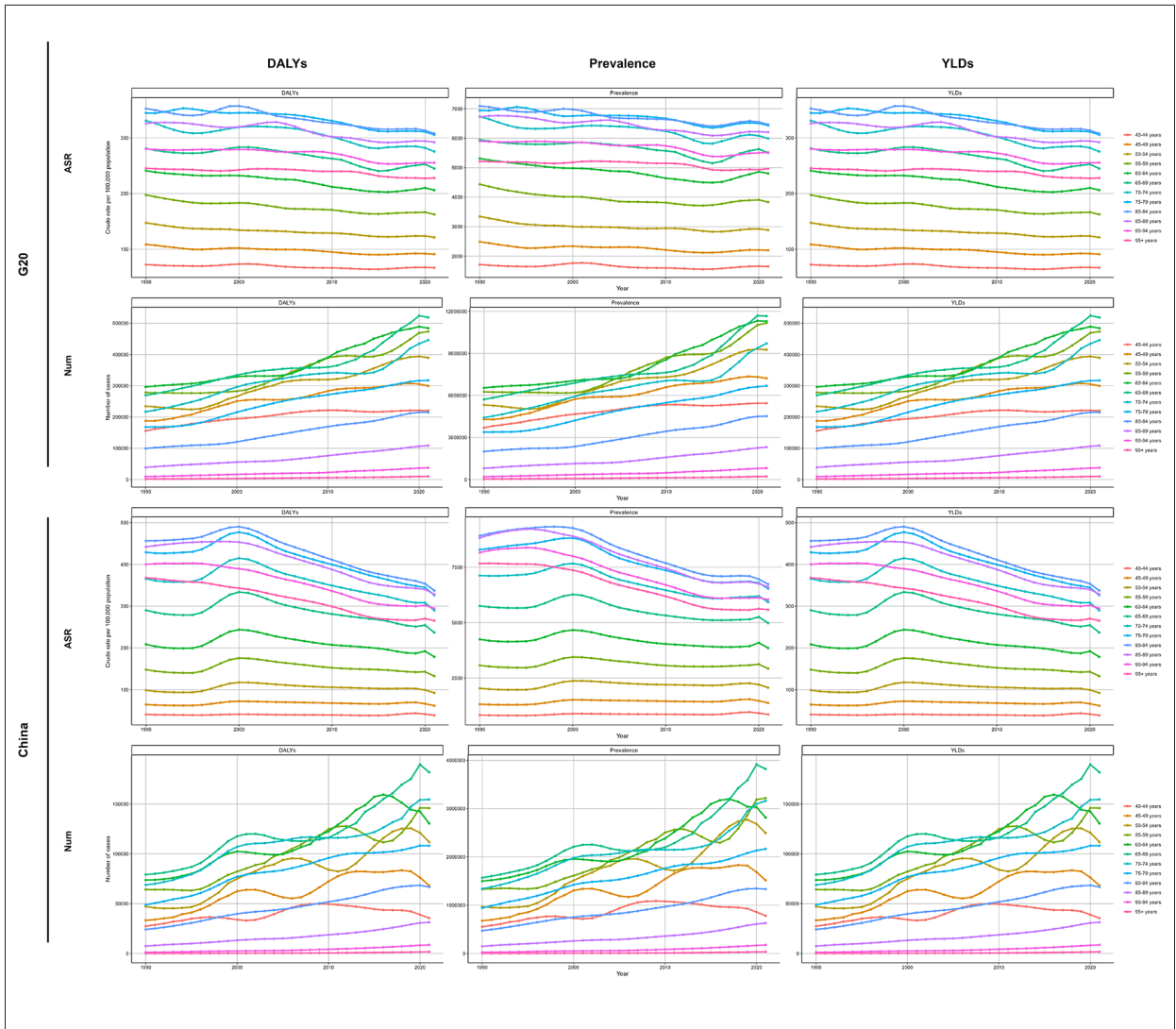


Figure 4. Age-specific disease burden and temporal trends of refractive disorders among individuals aged 40 years and older in China and G20 member countries, 1990 to 2021. DALYs – disability-adjusted life-years; YLDs – years lived with disability.

Table 5. APC in age-standardized rates of near vision loss among individuals aged 40 years and older in China and the G20, 1990 to 2021 (joinpoint analysis).

Country	Measure	Sex	Time period	APC, % (95% CI)	P
China	DALYs	Both	1990-1995	-2.54 (-3.17 to -1.90)	<0.001
			1995-2003	4.94 (4.54-5.35)	<0.001
			2003-2011	0.32 (-0.07 to 0.70)	0.099
			2011-2014	4.08 (1.12-7.12)	0.010
			2014-2019	0.37 (-0.53 to 1.29)	0.394
			2019-2021	5.31 (2.35-8.34)	0.001
		Female	1990-1995	-2.36 (-2.87 to -1.84)	<0.001
			1995-2003	4.60 (4.27-4.92)	<0.001
			2003-2011	0.41 (0.09-0.72)	0.014
			2011-2014	4.06 (1.67-6.50)	0.002
			2014-2019	0.34 (-0.40 to 1.07)	0.344
			2019-2021	4.95 (2.59-7.37)	<0.001
		Male	1990-1995	-2.92 (-3.66 to -2.18)	<0.001
			1995-2003	5.82 (5.22-6.42)	<0.001
			2003-2011	0.59 (0.23-0.96)	0.003
			2011-2014	3.73 (0.34-7.23)	0.033
			2014-2019	0.45 (-0.59 to 1.51)	0.372
			2019-2021	5.68 (2.25-9.22)	0.003
G20	DALYs	Both	1990-1995	-5.41 (-8.27 to -2.47)	0.002
			1995-2003	-1.84 (-4.79 to 1.20)	0.214
			2003-2011	4.66 (4.12-5.19)	<0.001
			2011-2014	0.61 (0.28-0.94)	0.001
			2014-2019	5.20 (2.17-8.33)	0.002
			2019-2021	0.96 (0.57-1.35)	<0.001
		Female	1990-1995	-5.20 (-7.70 to -2.63)	0.001
			1995-2003	-1.92 (-4.51 to 0.73)	0.142
			2003-2011	4.38 (3.91-4.84)	<0.001
			2011-2014	0.68 (0.40-0.97)	<0.001
			2014-2019	5.07 (2.44-7.77)	0.001
			2019-2021	0.91 (0.58-1.25)	<0.001
		Male	1990-1995	-5.56 (-8.58 to -2.44)	0.002
			1995-2003	-2.12 (-5.24 to 1.10)	0.179
			2003-2011	5.63 (4.88-6.39)	<0.001
			2011-2014	0.80 (0.50-1.09)	<0.001
			2014-2019	5.12 (1.88-8.46)	0.004
			2019-2021	1.04 (0.63-1.46)	<0.001

DALYs – disability-adjusted life-years; APC – annual percentage change; CI – confidence interval. $P < 0.05$ indicates APC is significantly different from zero. Results for Prevalence and YLDs follow similar segmentation patterns; data are available upon request.

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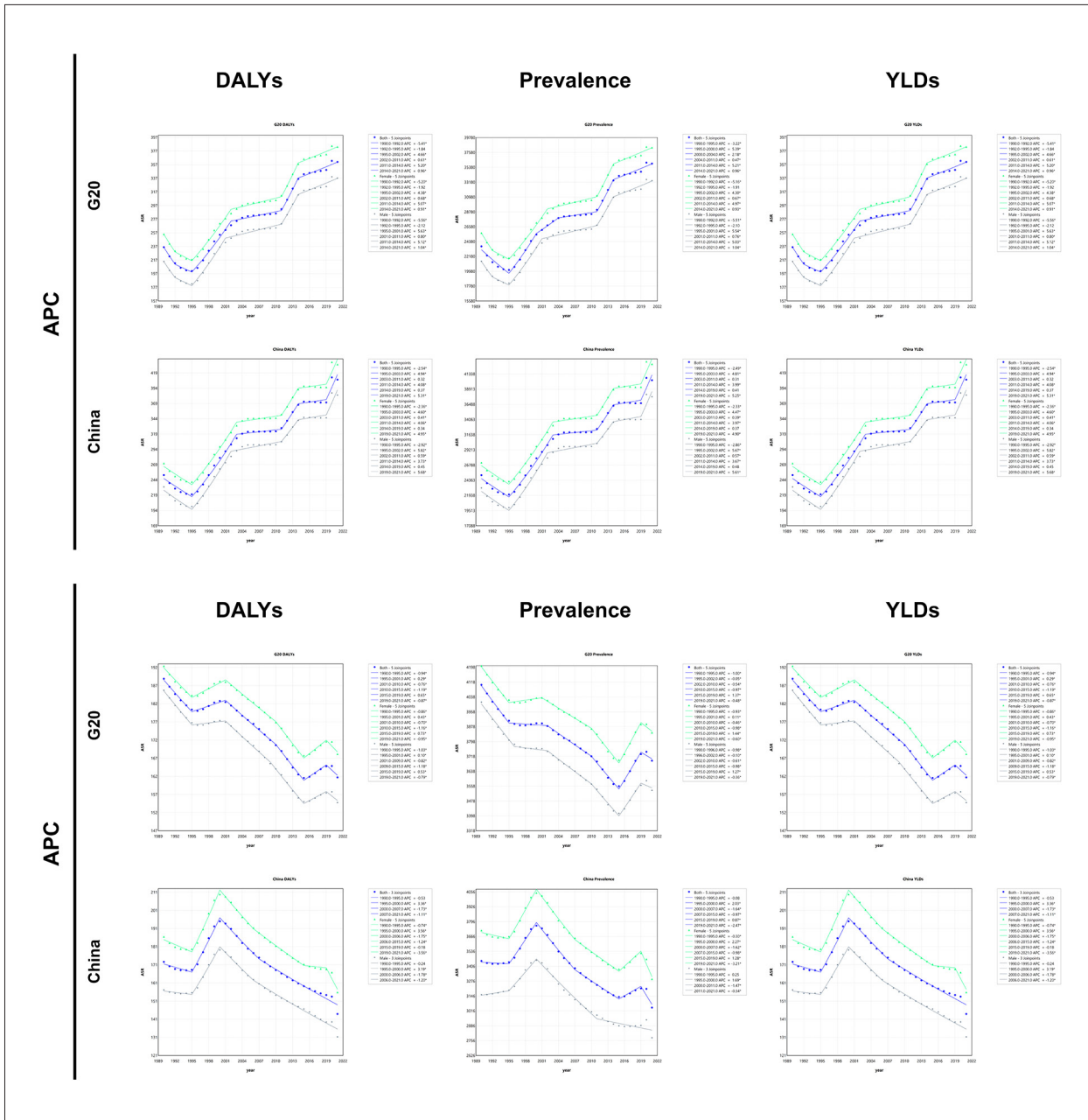


Figure 5. APCs in near vision loss and refractive disorders among individuals aged 40 years and older in China and the G20, 1990 to 2021. APC – annual percentage change; DALYs – disability-adjusted life-years; YLDs – years lived with disability.

Table 6. APC in age-standardized rates of refractive disorders among individuals aged 40 years and older in China and the G20, 1990 to 2021 (joinpoint analysis).

Country	Measure	Sex	Time period	APC, % (95% CI)	P		
China	DALYs	Both	1990-1995	-0.53 (-1.14 to 0.08)	0.087		
			1995-2000	3.36 (2.47-4.25)	<0.001		
			2000-2007	-1.73 (-2.18 to -1.28)	<0.001		
			2007-2021	-1.11 (-1.24 to -0.98)	<0.001		
		Female	1990-1995	-0.74 (-0.95 to -0.53)	<0.001		
			1995-2000	3.56 (3.26-3.87)	<0.001		
			2000-2006	-1.75 (-1.95 to -1.55)	<0.001		
			2006-2015	-1.24 (-1.34 to -1.14)	<0.001		
			2015-2019	-0.18 (-0.65 to 0.29)	0.417		
			2019-2021	-3.56 (-4.49 to -2.62)	<0.001		
		Male	1990-1995	-0.24 (-0.79 to 0.31)	0.378		
			1995-2000	3.19 (2.39-3.98)	<0.001		
			2000-2007	-1.78 (-2.31 to -1.24)	<0.001		
			2007-2021	-1.20 (-1.30 to -1.10)	<0.001		
		G20	DALYs	Both	1990-1995	-0.94 (-1.02 to -0.87)	<0.001
					1995-2000	0.29 (0.22-0.36)	<0.001
2000-2006	-0.76 (-0.80 to -0.73)				<0.001		
2006-2015	-1.19 (-1.29 to -1.08)				<0.001		
2015-2019	0.65 (0.48-0.82)				<0.001		
2019-2021	-0.87 (-1.21 to -0.54)				<0.001		
Female	1990-1995			-0.86 (-0.94 to -0.78)	<0.001		
	1995-2000			0.43 (0.35-0.51)	<0.001		
	2000-2006			-0.70 (-0.74 to -0.66)	<0.001		
	2006-2015			-1.16 (-1.27 to -1.05)	<0.001		
	2015-2019			0.73 (0.54-0.91)	<0.001		
	2019-2021			-0.95 (-1.31 to -0.58)	<0.001		
Male	1990-1995			-1.03 (-1.10 to -0.96)	<0.001		
	1995-2000			0.10 (0.03-0.17)	0.006		
	2000-2006			-0.82 (-0.86 to -0.78)	<0.001		
	2006-2015			-1.18 (-1.25 to -1.12)	<0.001		
			2015-2019	0.53 (0.37-0.69)	<0.001		
			2019-2021	-0.79 (-1.10 to -0.47)	<0.001		

DALYs – disability-adjusted life-years; APC – annual percentage change; CI – confidence interval. $P < 0.05$ indicates APC is significantly different from zero. Results for Prevalence and YLDs follow similar segmentation patterns; data are available upon request.

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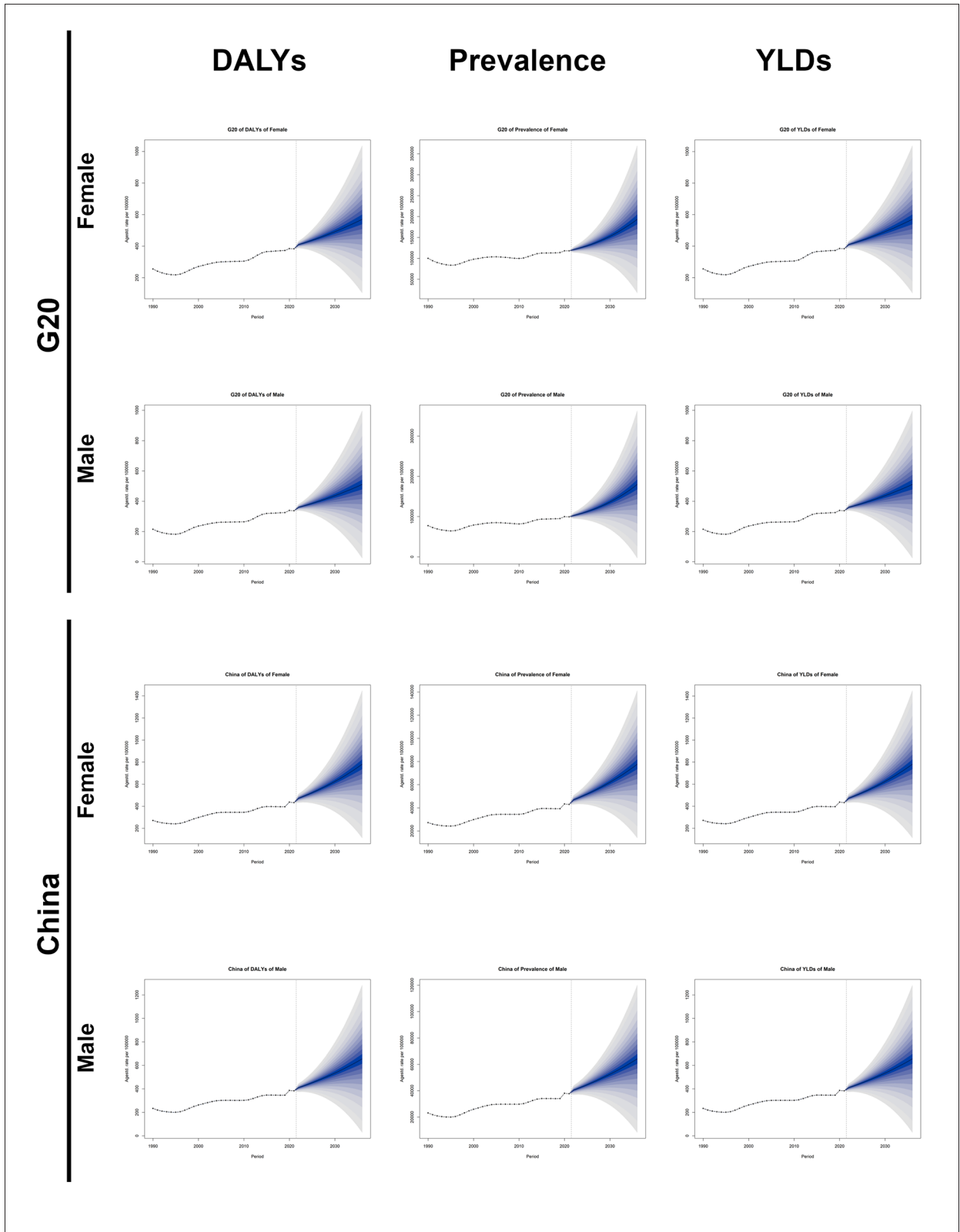


Figure 6. Projected disease burden of near vision loss among individuals aged 40 years and older in China and the G20, 2022 to 2038, based on the BAPC model. BAPC – Bayesian age-period-cohort; DALYs – disability-adjusted life-years; YLDs – years lived with disability.

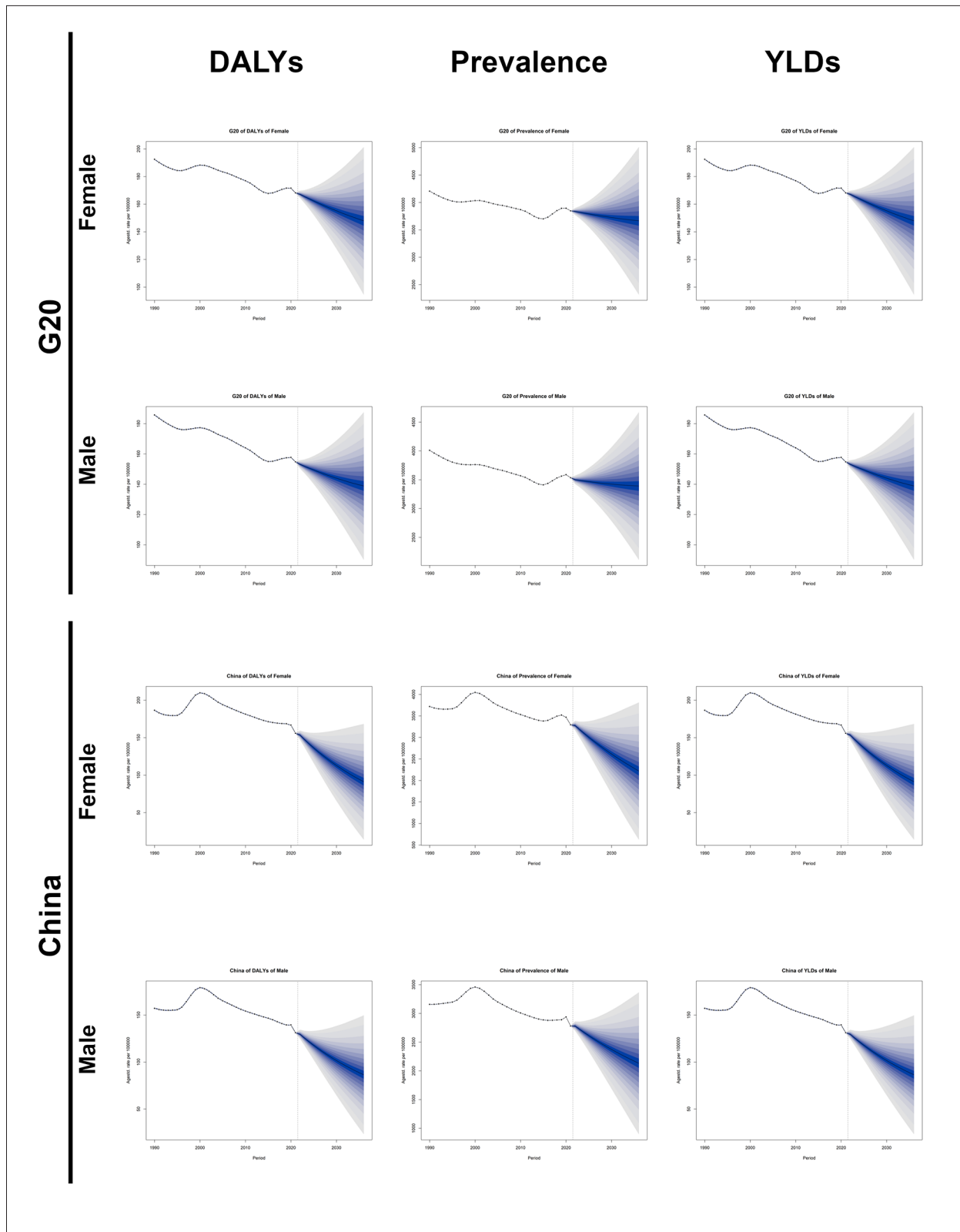


Figure 7. Projected disease burden of refractive disorders among individuals aged 40 years and older in China and the G20, 2022 to 2038, based on the BAPC model. BAPC – Bayesian age-period-cohort; DALYs – disability-adjusted life-years; YLDs – years lived with disability.

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Table 7. Proportional contributions of population growth, epidemiological changes, and aging to changes in prevalence, YLDs, and DALYs of NVL and RD among individuals aged 40 years and older in China and the G20, 1990 vs 2021.

Country	Disease	DALYs (Proportional contribution, %)		
		Population growth effect	Epidemiological change effect	Aging effect
China	NVL	59.1	36.4	4.5
China	RD	105.0	-31.7	26.7
G20	NVL	58.8	39.2	2.0
G20	RD	117.5	-28.0	10.5
		Prevalence (Proportional contribution, %)		
		Population growth effect	Epidemiological change effect	Aging effect
China	NVL	59.1	36.4	4.5
China	RD	97.1	-13.3	16.2
G20	NVL	58.8	39.2	2.0
G20	RD	107.7	-16.9	9.2
		YLDs (Proportional contribution, %)		
		Population growth effect	Epidemiological change effect	Aging effect
China	NVL	59.1	36.4	4.5
China	RD	105.0	-31.7	26.7
G20	NVL	58.8	39.2	2.0
G20	RD	117.5	-28.0	10.5

DALYs – disability-adjusted life-years; NVL – near vision loss; RD – refractive disorders; YLDs – years lived with disability.

The apparent discrepancy between the overall declining trend (negative EAPC) and segments of increase (positive APC) warrants clarification. The EAPC reflects the average trend over the entire study period (1990-2021); joinpoint regression identifies specific inflection points where trend slopes change. Regarding RD burden in the G20, although the long-term trajectory is downward due to substantial declines in earlier decades, the positive APC observed after 2015 reflects a recent, localized reversal or plateau that does not offset the overall historical decline when calculating the EAPC.

Predictive Analysis (2022 to 2038)

According to the BAPC model, NVL burden is projected to continue increasing through 2038 in both China and the G20. The ASPR is expected to rise from 40 341 to approximately 51 500 (95% UI: 25 000-84 000) in China and from 35 935 to approximately 46 000 (95% UI: 23 000-71 000) in the G20 (Figure 6). In contrast, RD burden is projected to decline, with the ASPR decreasing from 3045 to approximately 2500 (95% UI: 1900-3200) in China and from 3695 to approximately 3100 (95% UI: 2400-3900) in the G20 (Figure 7).

Decomposition Analysis

Decomposition analysis was performed on the absolute counts of prevalence, YLDs, and DALYs for NVL and RD among individuals aged 40 years and older, comparing 1990 and 2021. The additive decomposition method proposed by Das Gupta was utilized to quantify the proportional contributions of 3 driving factors: population growth, population aging, and epidemiological changes (ie, changes in age-specific rates). Concerning both NVL and RD in China and the G20, population growth was the primary driver of increases in absolute case numbers. The proportional contributions of each factor to prevalence, YLDs, and DALYs are presented in Table 7. Regarding NVL, epidemiological factors also positively contributed to the increase in disease burden in both China and the G20 (China: 36.4%; G20: 39.2%); aging showed a smaller positive contribution with the lowest proportional impact. With respect to RD, epidemiological factors negatively contributed to the overall burden (China: -31.7%; G20: -28.0%), partially offsetting the increases driven by population growth and aging. Notably, the contributions of population growth to DALYs for RD exceeded 100% in China (105.0%) and the G20 (117.5%). Decomposition results for NVL were highly consistent across the 3 metrics (prevalence,

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Figure 8. Decomposition analysis of the disease burden of near vision loss and refractive disorders among individuals aged 40 years and older in China and the G20. DALYs – disability-adjusted life-years; YLDs – years lived with disability.

YLDs, and DALYs), with identical proportional contributions of population growth (59.1%), epidemiological changes (36.4%), and aging (4.5%) in China, and 58.8%, 39.2%, and 2.0% in the G20, respectively (Table 7; Figure 8).

Discussion

This study used data from the GBD 2021 database to evaluate disease burdens of NVL and RD. NVL burden was higher in China than in the G20, whereas RD burden was lower in China. Both conditions have a substantial impact on affected populations [5,16].

In both China and the G20, NVL and RD burdens were higher among women than among men. Notably, this sex disparity persisted after age standardization, indicating that differences in population age structure do not fully explain the observed gap. Age-stratified analyses (Tables 3, 4) showed that higher rates in women were evident across most age groups within the population aged 40 years and older, rather than being driven by a single demographic cohort. Although the underlying mechanisms remain unclear, several hypotheses have been proposed. Longer life expectancy in women has historically been considered a contributing factor for increased exposure to age-related eye conditions [6,17]; however, the persistence of disparities after age standardization suggests additional

mechanisms. Potential contributors include sex-specific hormonal changes (eg, postmenopausal shifts) and differences in social or behavioral risk profiles [18]. Given the ecological nature of the present study, these factors cannot be definitively established as causal and should be interpreted as plausible explanations. Further individual-level studies are needed to clarify the relative contributions of biological susceptibility and sex-related exposures.

Concerning NVL, the burden was highest among middle-aged individuals. Specifically, the highest burdens were observed in the 60 to 64 age group in China and the 55 to 59 age group in the G20. In contrast, RD burden was greatest among older adults, peaking in the 80 to 84 age group in both China and the G20. Similar age-specific patterns have been reported in the literature [6]. Effective management of aging populations is essential to control age-related eye diseases [5,19].

Overall, NVL burden in China and the G20 has slightly increased over the past few decades, whereas RD burden has modestly declined. Regarding temporal inflection points, NVL burden in both China and the G20 reached its lowest level around 1995 and has since increased. RD burden in China peaked in 2000 and subsequently declined, whereas the G20 exhibited a generally continuous downward trend in RD burden. These patterns may be consistent with lifestyle changes identified in previous studies, including increased near work and digital device use [20,21].

Projected trends for NVL and RD in China and the G20 are broadly similar. Forecasts through 2038 indicate continued divergence, where NVL burden is expected to increase and RD burden will decrease. However, these BAPC projections are scenario-based estimates. Wide uncertainty intervals suggest that future trajectories may be substantially influenced by advances in assistive technologies, changes in healthcare policy, or demographic shifts. Overall, greater attention should be directed toward the rising NVL burden, and appropriate policies should be developed to mitigate its impact.

In both China and the G20, population growth was the main factor contributing to the increased burdens of NVL and RD from 1990 to 2021; proportional contributions to NVL DALYs reached 59.1% in China and 58.8% in the G20, whereas contributions to RD DALYs peaked at 105.0% in China and 117.5% in the G20 (Table 7). These findings highlight the importance of addressing challenges associated with population growth. Epidemiological factors also substantially contributed to the increased contributed burden (China: 36.4%; G20: 39.2%), suggesting increased exposure to risk factors or changes in social behaviors [22]. Aging had the smallest impact on NVL burden, with proportional contributions of 4.5% in China and 2.0% in the G20. Epidemiological changes negatively contributed to RD DALYs (China: -31.7%; G20: -28.0%), representing the main driver of the decline in age-standardized RD burden and partially offsetting increases associated with population growth and aging. Considering the effects of population growth and aging, investments in reducing visual impairment over recent decades have yielded substantial benefits [5,23,24]. Moreover, evidence indicates that most visual impairment conditions in underdeveloped regions are preventable and treatable [25]. These findings underscore the need for continued and increased investment in eye health.

Given that the highest NVL burden occurs among middle-aged individuals (55-64 years), who represent a key working population, policy interventions should prioritize occupational eye health screening and subsidized access to reading glasses for this group. To address the increasing NVL burden, resource allocation should emphasize accessible, low-cost primary eye care models, consistent with the WHO Global Eye Health Strategy (2022-2030), which promotes integrated, people-centered eye care [26]. Countries with rapidly aging populations, such as Japan and Italy (both G20 members), have implemented community-based screening programs to improve early detection of age-related eye diseases, providing valuable models for China and other G20 countries [27,28]. In an international context, cohort studies in East Asia have shown that factors such as intensive educational demands and increased near work contribute to the high prevalence of non-presbyopic RD [29]. The higher burden observed among women highlights the need for sex-specific interventions that address potential eye care access barriers related to socioeconomic or biological factors.

Compared with recent studies concerning NVL and RD burden, which have mainly provided cross-sectional estimates or short-term trend analyses, the present study offers an integrated approach by combining long-term trend assessment, age-period-cohort projections through 2038, and decomposition of contributing factors within a China-G20 comparative framework. This comprehensive approach captures historical dynamics and provides scenario-based projections, offering more robust evidence for policy planning.

This study has some limitations. First, the most recent available data extend only through 2021, which may affect the accuracy of predictive analyses. Second, internal heterogeneity within regions was not examined, which may obscure disparities in development across countries. Further in-depth research is warranted. Finally, in economically underdeveloped regions, limited diagnostic capacity and healthcare infrastructure may result in incomplete data collection, potentially leading to underestimation of disease burden.

Conclusions

Using GBD 2021 data, this study provides an integrated assessment of long-term trends and future projections of NVL and RD among adults aged 40 years and older in China and the G20, incorporating joinpoint analysis, BAPC modeling, and decomposition of demographic drivers. The findings indicate that, although age-standardized rates of RD have modestly declined, NVL burden has increased since the mid-1990s and is projected to continue rising through 2038; population growth was the primary driver of increases in absolute case numbers. Burdens remain higher among women – particularly in middle-aged groups for NVL and older groups for RD – highlighting persistent sex- and age-related disparities. However, the projections are scenario-based and subject to wide uncertainty intervals; analyses relying on aggregated GBD estimates may obscure within-country heterogeneity and data limitations in under-resourced settings. Within these constraints, the findings underscore the need for sustained, demographically responsive eye health planning in China and across the G20.

Data Availability: Datasets generated and/or analyzed during this study are available from the Global Burden of Disease (GBD) 2021 repository, which is publicly accessible online at: <https://vizhub.healthdata.org/gbd-results/>.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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