# Neck pain is the leading cause of disability burden in China: Findings from the Global Burden of Disease Study 2017

Aimin Wu[1#], Wenlan Dong[2#], Xinying Zeng[2], Xiaohui Xu[2], Tingling Xu[2], Kai Zhang[3], Haijun Tian[3], Jie Zhao[3], Xiangyang Wang[1], Maigeng Zhou[2]

[1]Division of Spine Surgery, Department of Orthopedics, Zhejiang Spine Research Centre, Orthopedic Hospital, The Second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University, Zhejiang Provincial Key Laboratory of Orthopedics, Wenzhou, China; [2]National Centre for Chronic and Noncommunicable Disease Control and Prevention, Chinese Centre for Disease Control and Prevention, Beijing, China; [3]Department of Orthopedics, Ninth People's Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China

*Contributions:* (I) Conception and design: A Wu, W Dong, M Zhou; (II) Administrative support: JZ, X Wang, M Zhou; (III) Provision of study materials or patients: X Zeng, X Xu, T Xu, K Zhang, H Tian; (IV) Collection and assembly of data: A Wu, W Dong, X Zeng, X Xu, T Xu, K Zhang, H Tian; (V) Data analysis and interpretation: A Wu, W Dong, X Zeng, X Xu, T Xu, J Zhao, X Wang, M Zhou; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work as co-first authors.

*Correspondence to:* Maigeng Zhou, PhD. National Centre for Chronic and Noncommunicable Disease Control and Prevention, Chinese Centre for Disease Control and Prevention, 27 Nanwei Rd, Xicheng District, Beijing 100050, China. Email: maigengzhou@126.com.

**Background:** Neck pain (NP) is a common musculoskeletal problem; however, the prevalence and years lived with disability (YLD) of NP in China are still unclear. This study sought to estimate the age-, sex- and province-specific prevalence and YLD of NP in China.

**Methods:** Adopting the methodology framework and analytical strategies used in the Global Burden of Disease (GBD), Injuries, and Risk Factors Study (2017), the prevalence and YLD of NP in China were estimated by age, sex, year, and provinces/regions.

**Results:** In China, the age-standardized point prevalence rate of NP was 4,532.6 per 100,000 persons in 1990 and increased slightly to 4,634.4 per 100,000 persons in 2017. The prevalence of NP was 48.0 million in 1990 and rose dramatically to 87.3 million in 2017 (an increase of 82.0%). The age-standardized YLD rate of NP was 454.0 per 100,000 persons in 1990, and there was a slight increase to 465.6 per 100,000 persons in 2017. The all-age YLD of NP was 4.8 million in 1990 and rose to 8.8 million in 2017 (which represents an increase of 81.1%). In 1990, NP was the third leading cause of YLD in China, and in 2017, NP was the leading cause of disability burden.

**Conclusions:** This study estimated the prevalence and disability burden of NP in China. NP is currently the leading cause of disability burden in China; however, it is currently inadequately recognized and should receive further attention and be subject to further research.

**Keywords:** Neck pain (NP); years lived with disability (YLD); disability burden; China

## Introduction

Neck pain (NP) is a very common clinical condition (1-3). In 2010, the Global Burden of Disease (GBD) Study found that of 291 conditions, NP was the fourth leading condition in terms of disability burden (4). A recent study estimated that at $87.6 billion [uncertainty interval (UI): $67.5–94.1 billion] (USD), the annual cost of low back pain and NP represented the third-highest amount of health-care spending, after diabetes and heart disease (5). Further,

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it has been reported that the risk of back pain and NP will surpass that of diabetes and heart disease (6). Thus, low back pain and NP are truly major public health problems and represent a considerable socioeconomic burden (7-10). Unlike fatal diseases, such as cancer, diabetes, and cardiovascular conditions, NP is non-fatal, and while it does not affect years of life lost (11,12), it significantly affects years lived with disability (YLD).

It is estimated that China's population is 1.407 billion (13), approximately one-fifth of the world population. Previous epidemiological studies on NP had small sample sizes and limited localities (14-16). The database of the GBD Study 2017 provides an updated and comprehensive assessment of the epidemiological characteristics of 354 diseases and injuries (17). The prevalence and YLD of NP in China are still unclear.

It was hypothesized that the prevalence and YLD for NP in China are diverse and would vary according to sex, age, and provinces/regions. Policy decision-makers also require age-, sex-, and province-specific information on the current status of and trend in prevalence and YLD for NP to allocate scarce health-care resources efficiently and precisely. Thus, we used the database of the GBD Study 2017 to estimate the age-, sex-, and province-specific point prevalence and YLD characteristics of NP in China. We present the following article in accordance with the MDAR reporting checklist (available at http://dx.doi.org/10.21037/atm-20-6868).

## Methods

The data examined in this study comprised Chinese data from the GBD Injuries and Risk Factors Study (2017). The GBD Study uses standardized metrics to critically appraise available information to update estimates and report diseases' burden (18). Briefly, the GBD Study (2017) provides comprehensive estimates of age, sex, location, and year for all major diseases and injuries for 195 countries and territories from 1990 to 2017 (17). Our present study focused on the prevalence and YLD of NP in 33 provinces/regions in China, including 31 mainland provinces, municipalities, and autonomous regions and the Hong Kong and Macao Special Administrative Regions (no data from Taiwan were included).

NP was defined as NP with or without pain spreading into the upper limb(s) that lasts for at least one day (4,19). The survey data, systematic reviews of published data, and gray literature sources were gathered, and Bayesian meta-

regression by DisMod-MR 2.1 was used to synthesize the data to estimate the point prevalence and YLD outcomes of NP. Detailed descriptions of the modeling strategy of the estimation and validation have been published previously (17). The step-by-step estimation of the point prevalence and YLD of NP is summarized in Figure S1.

Disability weights (DWs) from the GBD Study (2017) (17) were used to represent the magnitude of health loss associated with NP. DWs were measured on a scale from 0 to 1 (in which "0" represents a state of full health and "1" represents a state equivalent to death) (20). The following four sequelae were developed to describe the different levels of NP severity and its associated functional loss (17,20):

(I) Mild NP (DW: 0.052; 95% CI: 0.036–0.074): NP and difficulty turning the head and lifting things;

(II) Moderate NP (DW: 0.112; 95% CI: 0.079–0.162): Constant NP and difficulty turning the head, holding arms up, and lifting things;

(III) Severe NP (DW: 0.226, 95% CI: 0.147–0.323): Severe NP and difficulty turning the head and lifting things, headaches and arm pain, poor sleep, and feelings of tiredness and worry;

(IV) Most severe NP (DW: 0.300, 95% CI: 0.199–0.434): Constant NP and arm pain, difficulty turning the head, holding arms up, and lifting things, headaches, poor sleep, and feelings of tiredness and worry. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

### Statistical analysis

As NP does not cause mortality, the YLD and disability-adjusted life years values were essentially the same. The unadjusted YLD of each sequela was calculated using the following formulas (17,21):

1) $YLD_{total} = YLD_{sequela1} + YLD_{sequela2} \ldots + YLD_{sequela4}$; and

2) $YLD_{sequela} = Prevalence_{sequela} * DW_{health\ state}$

UIs were calculated using a propagating technique that has previously been described elsewhere (17,22). Briefly, the UIs were calculated from all steps of data manipulations and stored in 1,000 draws; the final estimate was the mean estimate across all 1,000 draws, and the 95% UIs were the 25th and 75th ranked values across all 1,000 draws. Finally, to correct for comorbidity, a microsimulation was performed for each age, sex, location, and year and was used to calculate the comorbidity-adjusted YLD.

**Table 1** The changes of the age-standardized prevalence rate (per 100,000 persons) and all-age prevalent numbers (*1000s) of NP between 1990 and 2017 in China and Global

| | 1990 | | | 2017 | | | Changes % |
|---|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | Mean | LUI | UUI | |
| Age-standardized prevalence rate (95% UI), per 100,000 persons | | | | | | | |
| China | 4,532.6 | 3,977.0 | 5,113.9 | 4,634.4 | 4,078.6 | 5,223.8 | 2.2 |
| Global | 3,582.7 | 3,162.1 | 4,032.6 | 3,551.1 | 3,139.5 | 3,977.9 | –0.9 |
| All-age prevalent numbers (95% UI), *1000s | | | | | | | |
| China | 48,001 | 42,196 | 54,544 | 87,346 | 76,052 | 98,717 | 82.0 |
| Global | 164,338 | 144,875 | 185,856 | 288,719 | 254,715 | 323,483 | 75.7 |

NP, neck pain; LUI, lower uncertainty interval; UUI, upper uncertainty interval.

## Results

### Prevalence

We estimated that the NP's age-standardized point prevalence rate was 4,532.6 per 100,000 persons in 1990 and increased slightly to 4,634.4 per 100,000 persons in 2017 (*Table 1*). The estimated prevalence of NP was 48.0 million in 1990, dramatically increasing to 87.3 million in 2017 (an increase of 82.0%) (*Table 1* and Table S1).

A sex-specific analysis showed that females' age-standardized point prevalence rate was higher than that in males from 1990 to 2017. In 1990, the point prevalence was 5,267.5 per 100,000 persons for females and 3,830.1 per 100,000 persons for males. In 2017, the point prevalence was 5,377.3 per 100,000 persons for females and 3,898.8 per 100,000 persons for males.

For the age categories of 0–4 years to 85–89 years, the point prevalence of NP first increased and then decreased after approximately 70 to 74 years (*Figure 1*). We also found that the point prevalence in females increased faster than that in males. A comparison of the point prevalence rate of different age categories between 1990 and 2017 showed that the 15–19-year category had the highest increase (10.2%), followed by the 10–14-year category (6.3%) (Table S2).

In all 33 provinces/regions, Shanghai had the highest point prevalence rate of NP with 6,065.4 per 100,000 persons in 1990 and 5,740.3 per 100,000 persons in 2017. Hong Kong had the lowest point prevalence rate with 3631.1 per 100,000 persons in 1990 and 3,874.6 per 100,000 persons in 2017 (*Figure 2* and Table S3). Sichuan had the highest NP prevalence in 1990 (4.7 million) but was replaced by Guangdong in 2017 (6.5 million). Due to the limited total population, Macao had the lowest

NP prevalence in 1990 and 2017 of 15,000 and 43,000, respectively (*Figure 2* and Table S4).

### YLD

The age-standardized YLD rate of NP was 454.0 per 100,000 persons in 1990. This rate increased slightly to 465.6 per 100,000 persons in 2017. The total age YLD of NP was 4.8 million in 1990, rising to 8.8 million in 2017 (an increase of 81.1%) (*Table 2* and Table S5). The sex-specific analysis also showed that the age-standardized YLD rate and all-age YLD for NP were higher in females than in males. The YLD first increased with age and then decreased (*Figure 3*). In 1990, the age category of peak YLD was approximately 35–54 years, while in 2017, the age category of peak YLD was approximately 45–54 years, and reached 1.3 million for each age category of 45–49 and 50–54 years (*Figure 3* and Tables S6,S7).

In all 33 provinces/regions, Shanghai had the highest age-standardized YLD rate of NP; that is, 606.6 per 100,000 persons in 1990 and 576.3 per 100,000 persons in 2017. Hong Kong had the lowest age-standardized YLD rate; that is, 366.6 per 100,000 persons in 1990 and 390.7 per 100,000 persons in 2017 (*Figure 4* and Table S8). In 1990, 471000, Sichuan had the highest all-age YLD of NP. In 2017, at 649000, Guangdong had the highest all-age YLD of NP (*Figure 4* and Table S9).

In 1990, NP was the third leading cause of YLD in China. In 2017, NP was the leading cause of YLD in China. For different provinces/regions, NP was ranked as the leading cause of YLD in 23/33 provinces/regions, the second leading cause in 8/33, the third leading cause in 1/33, and the fifth leading cause in 1/33 (*Table 3*).

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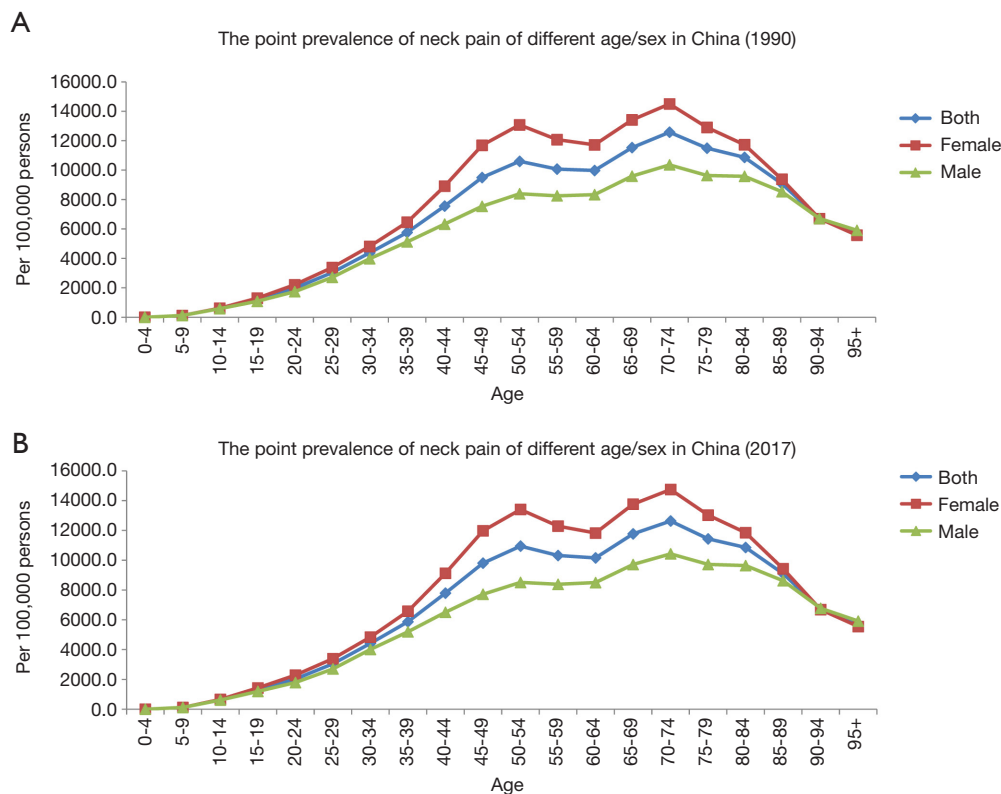


**Figure 1** Age-specific analysis indicates that the point prevalence of NP increased with age in 1990 (A) and 2017 (B). The rise was faster in females than males, and decreased after adults reached 70–74 years of age.

## Discussion

This study was the first to undertake a systematic analysis of NP in China using GBD data. The major finding of the present study is that the prevalent numbers and YLD for NP have increased dramatically in China, and NP became the leading cause of YLD in China in 2017. Globally, NP was only ranked as the ninth cause of YLD in 2017 (17). In China, the age-standardized prevalence rate was 4,532.6 per 100,000 persons (in 1990) and 4,634.4 per 100,000 persons (in 2017). Notably, China's rates are higher than the global rates of 3,282.7 per 100,000 persons (in 1990) and 3,551.1 per 100,000 persons (in 2017). The age-standardized YLD rate in China was 454.0 per 100,000 persons (in 1990) and 465.6 per 100,000 persons (in 2017), which were higher than the global rates of 354.4 per 100,000 persons (in 1990) and 352.0 per 100,000 persons (in 2017). Thus, NP represents a serious problem in China and should receive more attention and be the subject of further research.

In the present study, we also found that Shanghai had the highest NP prevalence in both 1900 and 2017. Despite a 5.4% decrease in NP's point prevalence from 1990 to 2017, NP remained the leading cause of YLD in Shanghai. In most provinces/regions (27/33), the rank increased from 1990 to 2017 in China. The rank of NP causing YLD increased the most in Zhejiang and Gansu, and NP was ranked as the fifth leading cause of YLD in 1990 and as the leading cause in 2017 in the above two provinces.

Many risk factors predispose patients to the development of NP (23,24). In the present study, we found that females were more likely to develop NP than males, which is consistent with previous studies' findings (25,26). Other risk factors of NP include obesity, sleep problems, lifestyle, mood, distress, working in awkward/sustained postures, and poor general health (25-28); these risk factors are common in China currently (29,30) and might be the reason for the increased NP in China. However, the major reason for the increased prevalent numbers and YLD can be attributed to the increase in China's population from 1990 to 2017. Fortunately, most of the risk factors are modifiable. Recently, various interventions have been shown to prevent
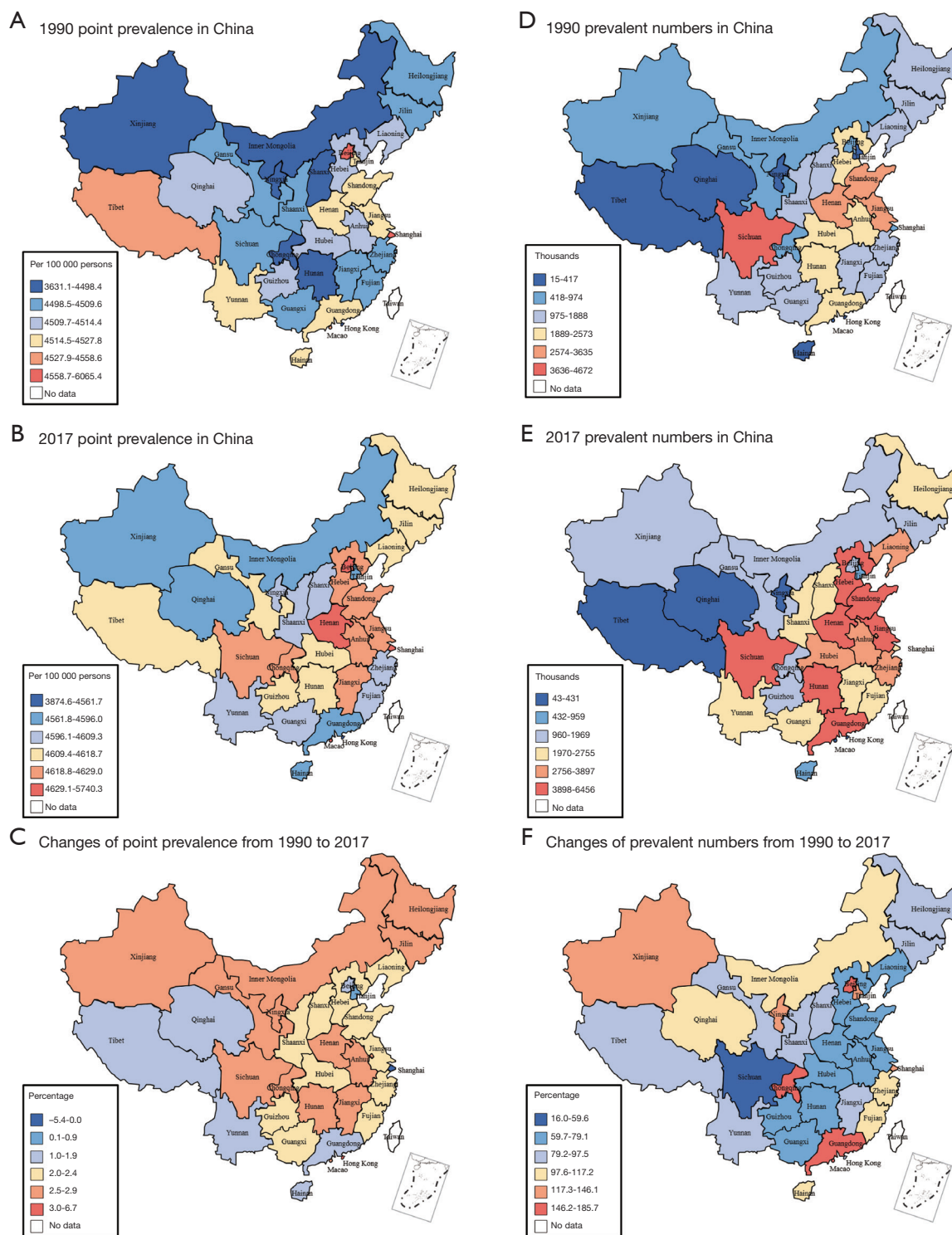
**Figure 2** Map of age-standardized point prevalence and prevalent numbers of NP in China (No data of Taiwan) between 1990 and 2017. (A) The age-standardized point prevalence of neck pain in China at 1990; (B) the age-standardized point prevalence of neck pain in China at 2017; (C) the changes of age-standardized point prevalence of neck pain in China between 1990 and 2017; (D) the prevalent number of neck pain in China at 1990; (E) the prevalent number of neck pain in China at 2017; (F) the changes of prevalent number of neck pain in China between 1990 and 2017.

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Table 2 The changes of the age-standardized YLDs rate (per 100,000 persons) and all-age YLDs (*1000s) of NP between 1990 and 2017 in China

| | 1990 | | | 2017 | | | Changes % |
|---|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | Mean | LUI | UUI | |
| Age-standardized YLDs rate (95% UI), per 100,000 persons | | | | | | | |
| China | 454.0 | 315.7 | 636.9 | 465.6 | 323.4 | 650.4 | 2.6 |
| Global | 354.4 | 246.9 | 497.1 | 352.0 | 245.6 | 493.3 | −0.7 |
| All-age YLDs (95% UI), *1000s | | | | | | | |
| China | 4,837 | 3,370 | 6,750 | 8,758 | 6,067 | 12,292 | 81.1 |
| Global | 16,331 | 11,350 | 22,899 | 28,631 | 19,952 | 40,202 | 75.3 |

YLDs, years lived with disability; NP, neck pain; LUI, lower uncertainty interval; UUI, upper uncertainty interval.
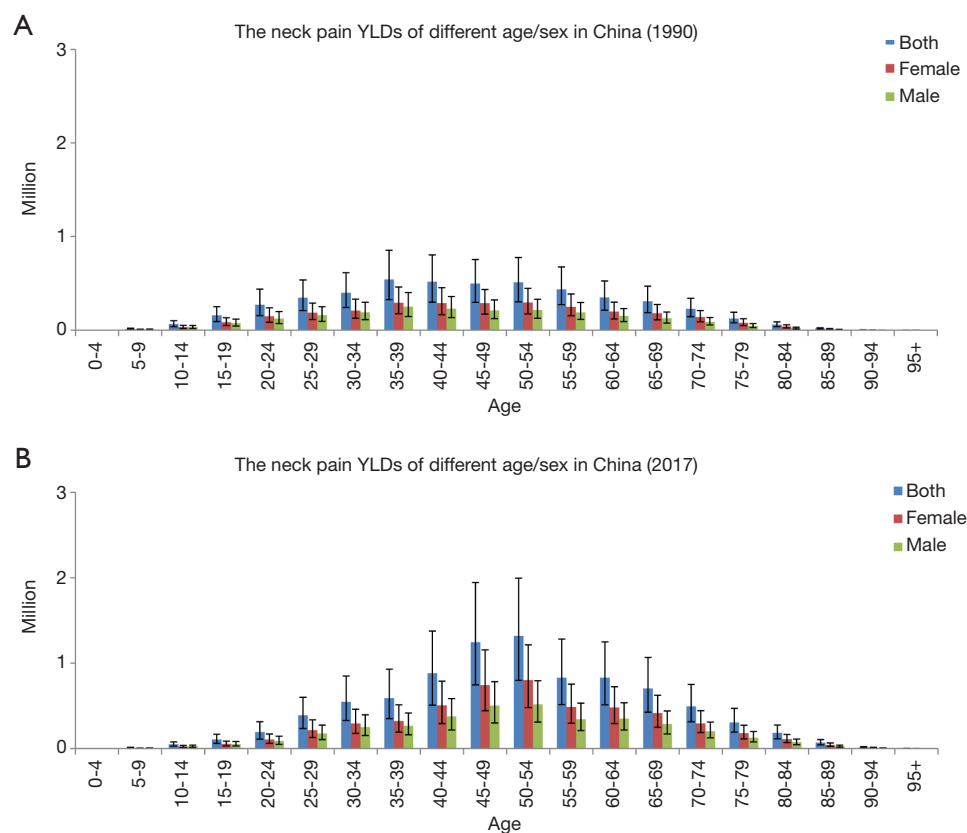


Figure 3 In both 1990 (A) and 2017 (B), the age-specific analysis shows that as age increased, the YLDs first increased and then decreased.

NP. A systematic review conducted by Linton and Van Tulder showed that exercise was an effective preventive intervention for NP (31). However, it has been shown that exercise therapy is not more cost-effective than other interventions for NP (32-34).

NP significantly affects sick leave and the workability of

workers (35). Our study found that NP's point prevalence increased obviously after the age category of 20–24 (Figure 1). For YLD, those in the middle-aged population are the most greatly affected by NP, which is especially common among those aged 45–55 (Figure 3). Previous evidence has shown that workplace-based interventions for
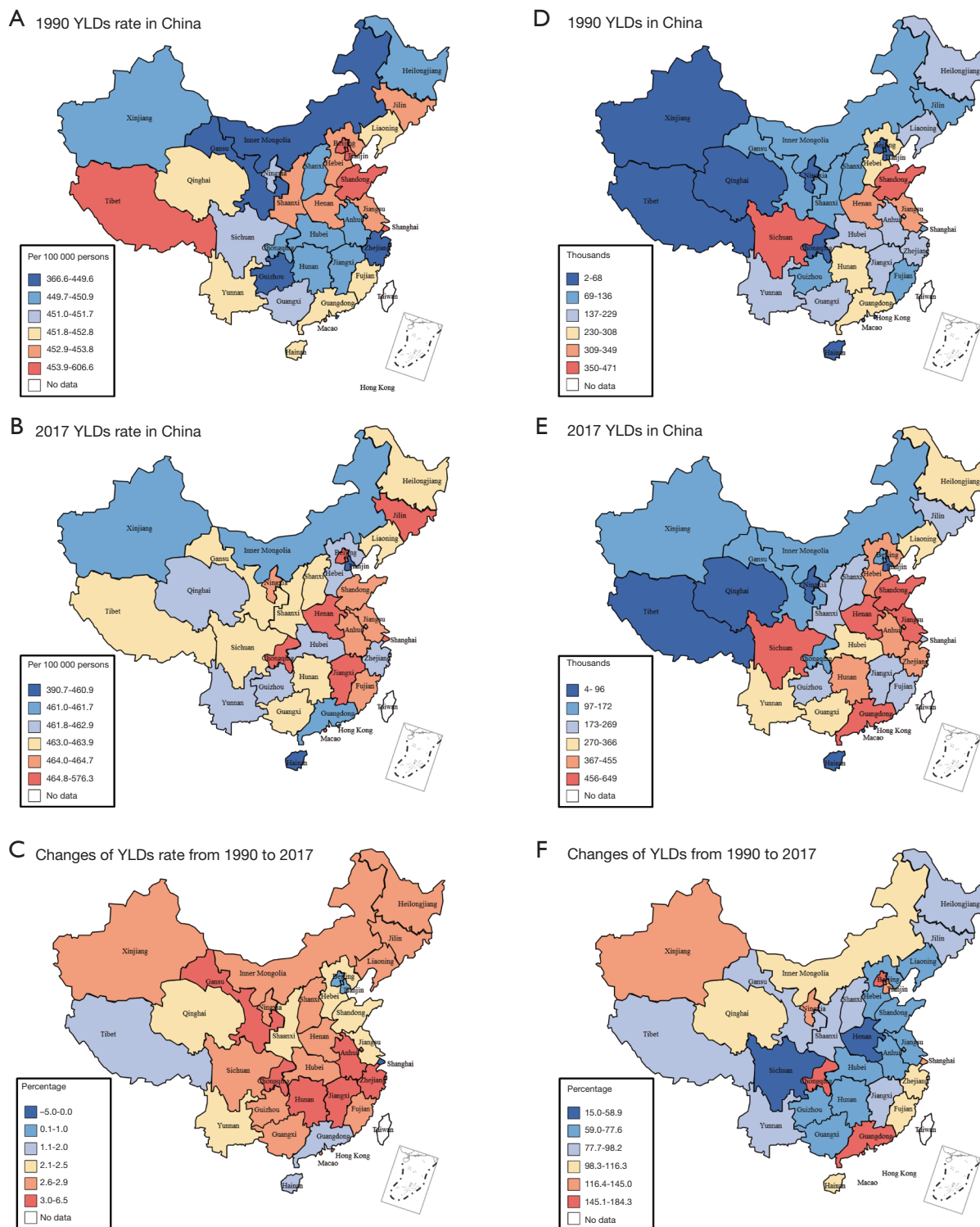
**Figure 4** Map of age-standardized YLDs rate and all-age YLDs of NP in China (no data from Taiwan were included in the analyses between 1990 and 2017. (A) The age-standardized YLDs rate of neck pain in China at 1990; (B) the age-standardized YLDs rate of neck pain in China at 2017; (C) the changes of age-standardized YLDs rate of neck pain in China between 1990 and 2017; (D) the all-age YLDs of neck pain in China at 1990; (E) the all-age YLDs of neck pain in China at 2017; (F) the changes of all-age YLDs of neck pain in China between 1990 and 2017.

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**Table 3** The percent of YLDs caused by NP in all diseases by provinces/regions (in 1990 and 2017)

| Province/region | 1990 | | | | 2017 | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | YLD ranking | Mean | LUI | UUI | YLD ranking |
| Anhui | 4.4 | 3.6 | 5.2 | 4 | 5.7 | 4.8 | 6.8 | 1 |
| Beijing | 5.1 | 4.3 | 6.1 | 2 | 5.6 | 4.7 | 6.7 | 2 |
| Chongqing | 4.6 | 3.9 | 5.5 | 3 | 5.7 | 4.8 | 6.8 | 3 |
| Fujian | 4.4 | 3.7 | 5.2 | 4 | 5.9 | 5.0 | 7.1 | 1 |
| Gansu | 4.2 | 3.5 | 5.0 | 5 | 5.7 | 4.8 | 6.8 | 1 |
| Guangdong | 4.4 | 3.7 | 5.2 | 2 | 5.4 | 4.5 | 6.5 | 1 |
| Guangxi | 4.3 | 3.6 | 5.1 | 3 | 5.6 | 4.7 | 6.6 | 1 |
| Guizhou | 4.0 | 3.3 | 4.8 | 5 | 5.4 | 4.5 | 6.4 | 1 |
| Hainan | 4.2 | 3.5 | 5.0 | 4 | 5.7 | 4.8 | 6.8 | 2 |
| Hebei | 4.6 | 3.8 | 5.5 | 2 | 5.3 | 4.5 | 6.3 | 2 |
| Heilongjiang | 4.4 | 3.7 | 5.3 | 4 | 5.9 | 5.0 | 7.1 | 1 |
| Henan | 4.6 | 3.9 | 5.4 | 4 | 5.7 | 4.7 | 6.7 | 1 |
| Hong Kong | 4.4 | 3.6 | 5.4 | 5 | 5.0 | 4.1 | 6.1 | 5 |
| Hubei | 4.3 | 3.6 | 5.2 | 5 | 5.6 | 4.7 | 6.8 | 2 |
| Hunan | 4.5 | 3.8 | 5.4 | 3 | 5.8 | 4.9 | 6.9 | 1 |
| Inner Mongolia | 4.5 | 3.7 | 5.4 | 3 | 6.0 | 5.0 | 7.2 | 1 |
| Jiangsu | 4.7 | 4.0 | 5.7 | 4 | 5.7 | 4.8 | 6.9 | 1 |
| Jiangxi | 4.2 | 3.5 | 5.0 | 4 | 5.8 | 4.8 | 6.9 | 1 |
| Jilin | 4.8 | 4.0 | 5.7 | 1 | 6.3 | 5.3 | 7.5 | 1 |
| Liaoning | 4.8 | 4.0 | 5.7 | 3 | 5.9 | 5.0 | 7.1 | 1 |
| Macao | 5.1 | 4.2 | 6.0 | 3 | 6.1 | 5.1 | 7.2 | 1 |
| Ningxia | 4.3 | 3.6 | 5.2 | 3 | 5.7 | 4.8 | 6.9 | 1 |
| Qinghai | 4.4 | 3.6 | 5.2 | 4 | 5.9 | 4.9 | 7.1 | 1 |
| Shaanxi | 4.6 | 3.9 | 5.5 | 4 | 5.7 | 4.8 | 6.9 | 2 |
| Shandong | 4.8 | 4.0 | 5.7 | 3 | 5.8 | 4.9 | 7.0 | 1 |
| Shanghai | 6.7 | 5.6 | 8.0 | 1 | 7.1 | 5.9 | 8.5 | 1 |
| Shanxi | 4.5 | 3.7 | 5.4 | 2 | 5.8 | 4.8 | 6.9 | 1 |
| Sichuan | 4.5 | 3.8 | 5.4 | 3 | 5.6 | 4.7 | 6.7 | 2 |
| Tianjin | 5.1 | 4.3 | 6.1 | 2 | 5.8 | 4.9 | 7.0 | 2 |
| Tibet | 4.0 | 3.3 | 4.8 | 4 | 5.3 | 4.5 | 6.4 | 1 |
| Xinjiang | 4.4 | 3.7 | 5.3 | 3 | 5.8 | 4.8 | 6.9 | 2 |
| Yunnan | 4.1 | 3.5 | 4.9 | 4 | 5.6 | 4.7 | 6.7 | 1 |
| Zhejiang | 4.5 | 3.7 | 5.3 | 5 | 5.8 | 4.9 | 7.0 | 1 |
| China | 4.5 | 3.8 | 5.4 | 3 | 5.7 | 4.8 | 6.8 | 1 |
| Global | 3.2 | 2.8 | 3.6 | 9 | 3.9 | 3.5 | 4.4 | 9 |

The LUI and UUI are the 2.5 to 97.5 centile values of the 95% UIs. The rank of all-age YLDs caused by NP in all diseases included by GBD study 2017. YLDs, years lived with disability; NP, neck pain; LUI, lower uncertainty interval; UUI, upper uncertainty interval.

office workers can reduce NP (36) and might be effective for workers.

### Policy implications

In recent years, governments and funders have paid considerable attention to fatal chronic diseases, such as cardiovascular diseases, cancer, respiratory diseases, and diabetes (37-39). However, despite being a serious public burden, non-fatal chronic diseases (such as NP and back pain) that induce disabilities and are associated with sick leave among workers (35,40) are inadequately recognized.

In the past 28 years, the increasing NP problem, which has become the leading cause of YLD in China, has created significant health-care challenges. We recommend that governments, policymakers, and society generally pay more attention to NP, and the NP should be better recognized and resourced.

### Strengths and limitations

The present study provides the most comprehensive prevalence and YLD estimates of NP in China at both the national and provincial/regional level. The GBD Study (2017) uses the updated DisMod-MR tool 2.1, constructions of the sociodemographic index adjusted by comorbidity, to improve the results' accuracy. However, this study also had some limitations. First, some health information reported by the national authorities is time-lagged. Second, all of the results were estimated and reliant on models rather than original data. Third, the DWs were based on data from selected countries (i.e., Bangladesh, Indonesia, Peru, Tanzania, the USA, Hungary, Italy, the Netherlands, and Sweden) before 2013, and a global web-based survey (20). Further surveys in more countries would improve the generalizability of the DWs. Fourth, the present study did not include urban- or rural-stratified results.

### Conclusions

Overall, the age-standardized point prevalence rate and YLD of NP slightly increased from 1990 to 2017, while the prevalence rate and total YLD of NP increased dramatically in China. NP was the leading cause of disability burden in China in 2017; however, it is currently inadequately recognized and should receive more attention from governments and policymakers.

### Footnote

*Reporting Checklist:* The authors have completed the MDAR reporting checklist. Available at http://dx.doi.org/10.21037/atm-20-6868

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/atm-20-6868). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

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Study –level covariates:
1. Episide ≥3 months
2. Recall 1 week to 1 month
3. Recall 1 month to 1 year
4. School sample
5. Activity limiting low back pain
6. Clainm data

Survey data

Tabulated data

Claims data

Age-sex splitting

Nonfatal database

Dismod-MR 2.1

Prevalence by location/year/age/sex

MEPS

Regression to estimate DW by cause in survey respondents controlling for comorbidity

Severity splits

Prevalence of mild NP

Comorbidity correction

Opportunistic surveys by IHME to fill SF-12 for 60 lay descriptions

Map SF-12 to GBD DW

Prevalence of moderate NP

Unadjusted YLD by sequela

Comorbidity adjusted YLDs

Prevalence of severe NP

DWs for each sequela

Prevalence of most severe NP

**Figure S1** Steps taken in estimating the global burden of neck pain, GBD study 2017.

**Table S1** The detailed information of prevalence age-standardized prevalence rate and all-age prevalence number of neck pain in China from 1990 to 2017

| | All-Age prevalence number (95% UI), *1000s | | | Age-Standardized prevalence rate (95% UI), per 100,000 persons | | |
|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | Mean | LUI | UUI |
| **1990** | | | | | | |
| Female | 27168 | 23759 | 30827 | 5267.5 | 4609.6 | 5961.9 |
| Male | 20833 | 18232 | 23747 | 3830.1 | 3362.1 | 4333.6 |
| Both | 48001 | 42196 | 54544 | 4532.6 | 3977.0 | 5113.9 |
| **1995** | | | | | | |
| Female | 30834 | 26954 | 34934 | 5267.4 | 4609.7 | 5961.5 |
| Male | 23573 | 20668 | 26808 | 3830.4 | 3362.1 | 4333.7 |
| Both | 54407 | 47718 | 61627 | 4532.8 | 3977.1 | 5113.9 |
| **2000** | | | | | | |
| Female | 35802 | 31319 | 40655 | 5386.8 | 4705.3 | 6093.3 |
| Male | 26888 | 23606 | 30932 | 3885.6 | 3430.3 | 4416.6 |
| Both | 62690 | 55410 | 71177 | 4622.7 | 4072.0 | 5223.8 |
| **2005** | | | | | | |
| Female | 42192 | 36675 | 48335 | 5614.7 | 4901.2 | 6392.8 |
| Male | 29836 | 26219 | 34204 | 3887.3 | 3431.6 | 4417.9 |
| Both | 72028 | 63027 | 81910 | 4738.1 | 4165.1 | 5358.5 |
| **2010** | | | | | | |
| Female | 46148 | 40024 | 52940 | 5517.3 | 4817.9 | 6269.9 |
| Male | 32717 | 28587 | 37474 | 3896.4 | 3429.8 | 4403.3 |
| Both | 78866 | 68853 | 90239 | 4696.8 | 4133.7 | 5298.5 |
| **2015** | | | | | | |
| Female | 49718 | 43235 | 56536 | 5420.2 | 4750.9 | 6139.0 |
| Male | 35427 | 30980 | 40237 | 3898.2 | 3430.8 | 4405.1 |
| Both | 85145 | 74079 | 96608 | 4653.4 | 4100.7 | 5242.1 |
| **2017** | | | | | | |
| Female | 50940 | 44146 | 58032 | 5377.3 | 4688.5 | 6097.4 |
| Male | 36407 | 31847 | 41352 | 3898.8 | 3431.4 | 4405.9 |
| Both | 87346 | 76052 | 98717 | 4634.4 | 4078.6 | 5223.8 |

LUI, lower uncertainty interval; UUI, upper uncertainty interval.

**Table S2** The detailed information of the point prevalence rate of different age categories between 1990 and 2017

| Age category | 1990 prevalence rate (95% UI), per 100,000 persons. | | | 2017 prevalence rate (95% UI), per 100,000 persons. | | | Changes, % |
|---|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | Mean | LUI | UUI | |
| 0–4 | | | | | | | |
| Female | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| Male | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| Both | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| 5–9 | | | | | | | |
| Female | 115.2 | 68.4 | 172.8 | 116.9 | 69.9 | 189.5 | 1.48 |
| Male | 118.2 | 69.3 | 184.0 | 118.4 | 68.3 | 187.7 | 0.17 |
| Both | 116.8 | 69.3 | 178.2 | 117.7 | 69.5 | 188.5 | 0.77 |
| 10–14 | | | | | | | |
| Female | 613.3 | 429.7 | 841.9 | 657.4 | 469.3 | 910.4 | 7.19 |
| Male | 581.8 | 405.4 | 802.3 | 615.9 | 433.6 | 848.8 | 5.86 |
| Both | 597.1 | 418.9 | 820.2 | 634.9 | 455.4 | 876.6 | 6.33 |
| 15–19 | | | | | | | |
| Female | 1293.9 | 866.7 | 1832.3 | 1429.9 | 970.2 | 2052.5 | 10.51 |
| Male | 1081.7 | 722.2 | 1548.7 | 1196.2 | 806.3 | 1682.8 | 10.59 |
| Both | 1184.9 | 785.0 | 1690.5 | 1305.6 | 889.4 | 1851.2 | 10.19 |
| 20–24 | | | | | | | |
| Female | 2208.7 | 1486.4 | 3128.3 | 2284.7 | 1524.6 | 3245.4 | 3.44 |
| Male | 1739.3 | 1179.0 | 2491.2 | 1791.4 | 1202.8 | 2564.0 | 3.00 |
| Both | 1968.7 | 1337.8 | 2786.0 | 2029.4 | 1368.2 | 2859.4 | 3.08 |
| 25–29 | | | | | | | |
| Female | 3376.6 | 2422.4 | 4719.3 | 3391.9 | 2416.9 | 4791.7 | 0.45 |
| Male | 2713.7 | 1931.0 | 3826.0 | 2705.6 | 1928.0 | 3677.7 | −0.30 |
| Both | 3036.1 | 2170.3 | 4182.3 | 3045.8 | 2184.6 | 4250.8 | 0.32 |
| 30–34 | | | | | | | |
| Female | 4812.9 | 3522.6 | 6636.4 | 4841.1 | 3495.7 | 6681.7 | 0.59 |
| Male | 3978.2 | 2881.1 | 5533.6 | 4011.8 | 2948.3 | 5569.7 | 0.84 |
| Both | 4377.3 | 3206.7 | 6005.9 | 4420.9 | 3215.1 | 6119.2 | 1.00 |
| 35–39 | | | | | | | |
| Female | 6456.7 | 4673.8 | 8907.3 | 6576.6 | 4682.2 | 9238.4 | 1.86 |
| Male | 5121.5 | 3668.7 | 7117.7 | 5196.7 | 3740.9 | 7334.7 | 1.47 |
| Both | 5766.1 | 4203.9 | 7911.0 | 5874.1 | 4161.7 | 8263.9 | 1.87 |
| 40–44 | | | | | | | |
| Female | 8908.8 | 5788.8 | 12398.4 | 9127.4 | 6012.2 | 12872.4 | 2.45 |
| Male | 6329.4 | 4193.9 | 8804.0 | 6507.1 | 4211.4 | 8970.6 | 2.81 |
| Both | 7556.1 | 5003.1 | 10427.5 | 7793.3 | 5080.0 | 10775.2 | 3.14 |
| 45–49 | | | | | | | |
| Female | 11688.3 | 8248.8 | 15723.1 | 11973.1 | 8513.8 | 16463.2 | 2.44 |
| Male | 7542.6 | 5305.9 | 10386.1 | 7716.3 | 5524.3 | 10659.0 | 2.30 |
| Both | 9500.6 | 6775.0 | 12828.6 | 9805.8 | 7013.4 | 13437.0 | 3.21 |
| 50–54 | | | | | | | |
| Female | 13077.7 | 9292.2 | 17531.7 | 13404.7 | 9476.1 | 17904.9 | 2.50 |
| Male | 8395.6 | 5836.5 | 11464.1 | 8510.3 | 5965.8 | 11427.0 | 1.37 |
| Both | 10599.1 | 7525.1 | 14111.9 | 10947.4 | 7750.3 | 14577.7 | 3.29 |
| 55–59 | | | | | | | |
| Female | 12073.8 | 8339.1 | 16931.5 | 12289.2 | 8502.7 | 17304.3 | 1.78 |
| Male | 8255.7 | 5555.0 | 11795.9 | 8383.5 | 5782.7 | 12140.3 | 1.55 |
| Both | 10072.6 | 6937.4 | 14077.6 | 10315.8 | 7170.5 | 14455.6 | 2.41 |
| 60–64 | | | | | | | |
| Female | 11719.6 | 8191.6 | 15826.2 | 11827.1 | 8399.0 | 15887.7 | 0.92 |
| Male | 8334.5 | 5832.4 | 11173.1 | 8498.1 | 6026.4 | 11480.2 | 1.96 |
| Both | 9975.9 | 7031.4 | 13308.3 | 10157.0 | 7198.1 | 13547.2 | 1.82 |
| 65–69 | | | | | | | |
| Female | 13416.7 | 9465.0 | 18058.9 | 13761.7 | 9753.9 | 18331.7 | 2.57 |
| Male | 9589.9 | 6550.5 | 13015.7 | 9713.0 | 6904.9 | 13390.5 | 1.28 |
| Both | 11534.2 | 8136.0 | 15456.9 | 11768.0 | 8362.8 | 15862.1 | 2.03 |
| 70–74 | | | | | | | |
| Female | 14499.3 | 10399.5 | 19729.0 | 14749.5 | 10533.2 | 20009.0 | 1.73 |
| Male | 10358.7 | 7099.3 | 14426.4 | 10430.4 | 7204.5 | 14461.4 | 0.69 |
| Both | 12578.8 | 9198.4 | 17108.3 | 12635.9 | 9015.2 | 17129.8 | 0.45 |
| 75–79 | | | | | | | |
| Female | 12903.0 | 9175.0 | 17657.3 | 13026.5 | 9200.2 | 17948.6 | 0.96 |
| Male | 9636.2 | 6741.5 | 13699.5 | 9718.6 | 6818.3 | 13876.9 | 0.86 |
| Both | 11494.9 | 8211.0 | 15945.8 | 11432.5 | 8123.3 | 15822.7 | −0.54 |
| 80–84 | | | | | | | |
| Female | 11728.4 | 8260.8 | 16198.8 | 11848.9 | 8273.5 | 16494.5 | 1.03 |
| Male | 9580.9 | 6606.5 | 13355.5 | 9640.1 | 6629.1 | 13528.4 | 0.62 |
| Both | 10868.3 | 7618.1 | 14997.5 | 10857.5 | 7617.3 | 15023.3 | −0.10 |
| 85–89 | | | | | | | |
| Female | 9380.1 | 6643.2 | 13020.3 | 9424.7 | 6715.6 | 13061.5 | 0.48 |
| Male | 8536.0 | 6009.7 | 11901.9 | 8622.5 | 6100.7 | 11800.5 | 1.01 |
| Both | 9077.0 | 6500.6 | 12612.2 | 9101.0 | 6474.1 | 12497.7 | 0.26 |
| 90–94 | | | | | | | |
| Female | 6704.2 | 4852.2 | 9120.1 | 6685.5 | 4826.8 | 9016.1 | −0.28 |
| Male | 6708.8 | 4874.5 | 9115.1 | 6773.4 | 4898.3 | 9309.2 | 0.96 |
| Both | 6705.7 | 4897.9 | 9084.9 | 6715.1 | 4910.0 | 9103.8 | 0.14 |
| 95+ | | | | | | | |
| Female | 5575.8 | 3897.9 | 7588.6 | 5553.6 | 3858.3 | 7511.0 | −0.40 |
| Male | 5909.1 | 4177.4 | 7927.5 | 5916.3 | 4190.3 | 8032.2 | 0.12 |
| Both | 5673.7 | 3986.3 | 7692.5 | 5650.3 | 3954.1 | 7627.8 | −0.41 |

LUI, lower uncertainty interval; UUI, upper uncertainty interval.

**Table S3** The detailed information of the age-standardized prevalence rate in different provinces/regions between 1990 and 2017

| Province/region | 1990, Age-Standardized prevalence rate (95% UI), per 100,000 persons | | | 2017, Age-Standardized prevalence rate (95% UI), per 100,000 persons | | | Changes, % |
|---|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | Mean | LUI | UUI | |
| Anhui | 4510.2 | 3958.3 | 5088.8 | 4621.9 | 4070.0 | 5212.3 | 2.5 |
| Beijing | 4610.8 | 4073.8 | 5208.1 | 4655.7 | 4081.2 | 5242.0 | 1.0 |
| Chongqing | 4497.3 | 3944.4 | 5073.5 | 4629.0 | 4075.8 | 5223.4 | 2.9 |
| Fujian | 4508.6 | 3955.8 | 5086.8 | 4608.2 | 4057.6 | 5194.7 | 2.2 |
| Gansu | 4502.0 | 3949.2 | 5078.1 | 4618.0 | 4065.9 | 5207.3 | 2.6 |
| Guangdong | 4522.0 | 3968.1 | 5105.5 | 4596.0 | 4046.1 | 5181.8 | 1.6 |
| Guangxi | 4508.7 | 3956.6 | 5088.1 | 4606.9 | 4055.8 | 5191.6 | 2.2 |
| Guizhou | 4510.6 | 3957.6 | 5089.3 | 4616.3 | 4063.5 | 5201.9 | 2.3 |
| Hainan | 4520.8 | 3967.5 | 5101.4 | 4581.4 | 4033.1 | 5163.3 | 1.3 |
| Hebei | 4514.4 | 3960.6 | 5095.1 | 4620.0 | 4067.7 | 5208.5 | 2.3 |
| Heilongjiang | 4503.8 | 3951.7 | 5081.8 | 4617.5 | 4064.4 | 5203.8 | 2.5 |
| Henan | 4522.6 | 3968.7 | 5105.5 | 4644.3 | 4087.9 | 5236.6 | 2.7 |
| Hong Kong | 3631.1 | 3125.9 | 4232.3 | 3874.6 | 3307.1 | 4550.7 | 6.7 |
| Hubei | 4511.5 | 3958.4 | 5090.4 | 4616.3 | 4066.2 | 5206.3 | 2.3 |
| Hunan | 4494.4 | 3942.9 | 5070.9 | 4610.5 | 4059.2 | 5197.1 | 2.6 |
| Inner Mongolia | 4480.4 | 3931.8 | 5058.0 | 4593.4 | 4041.4 | 5177.3 | 2.5 |
| Jiangsu | 4527.8 | 3973.4 | 5112.2 | 4623.9 | 4071.9 | 5215.7 | 2.1 |
| Jiangxi | 4509.6 | 3956.5 | 5087.8 | 4621.4 | 4069.2 | 5211.4 | 2.5 |
| Jilin | 4507.8 | 3953.9 | 5087.1 | 4618.7 | 4066.3 | 5206.4 | 2.5 |
| Liaoning | 4513.9 | 3959.3 | 5092.7 | 4617.3 | 4064.9 | 5204.5 | 2.3 |
| Macao | 4538.0 | 3980.3 | 5122.5 | 4658.7 | 4096.7 | 5259.4 | 2.7 |
| Ningxia | 4497.8 | 3946.3 | 5074.3 | 4609.3 | 4057.1 | 5195.3 | 2.5 |
| Qinghai | 4512.0 | 3960.7 | 5088.9 | 4595.4 | 4044.3 | 5177.9 | 1.8 |
| Shaanxi | 4502.9 | 3949.3 | 5080.5 | 4605.4 | 4054.9 | 5191.0 | 2.3 |
| Shandong | 4527.0 | 3972.8 | 5111.5 | 4620.9 | 4068.4 | 5209.4 | 2.1 |
| Shanghai | 6065.4 | 5345.6 | 6819.1 | 5740.3 | 5042.1 | 6501.0 | −5.4 |
| Shanxi | 4498.4 | 3946.3 | 5074.8 | 4605.1 | 4053.4 | 5190.9 | 2.4 |
| Sichuan | 4504.4 | 3951.4 | 5080.8 | 4620.2 | 4067.9 | 5211.1 | 2.6 |
| Tianjin | 4526.9 | 3971.5 | 5110.5 | 4561.8 | 4015.9 | 5136.2 | 0.8 |
| Tibet | 4558.6 | 3998.9 | 5149.5 | 4613.5 | 4062.2 | 5197.7 | 1.2 |
| Xinjiang | 4481.0 | 3936.4 | 5057.6 | 4590.9 | 4039.0 | 5174.7 | 2.5 |
| Yunnan | 4520.6 | 3967.2 | 5102.1 | 4606.7 | 4054.8 | 5191.9 | 1.9 |
| Zhejiang | 4500.4 | 3950.1 | 5075.5 | 4602.9 | 4051.4 | 5189.1 | 2.3 |
| China | 4532.6 | 3977.0 | 5113.9 | 4634.4 | 4078.6 | 5223.8 | 2.2 |

LUI, lower uncertainty interval; UUI, upper uncertainty interval.

**Table S4** The detailed information of the all age prevalent numbers in different provinces/regions between 1990 and 2017

| Province/region | 1990, All-Age prevalence number (95% UI), *1000s. | | | 2017, All-Age prevalence number (95% UI), *1000s. | | | Changes, % |
|---|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | Mean | LUI | UUI | |
| Anhui | 2276 | 1996 | 2584 | 3871 | 3358 | 4400 | 70.1 |
| Beijing | 535 | 470 | 606 | 1530 | 1338 | 1731 | 185.7 |
| Chongqing | 677 | 593 | 768 | 1722 | 1498 | 1947 | 154.5 |
| Fujian | 1147 | 1009 | 1302 | 2353 | 2047 | 2675 | 105.1 |
| Gansu | 874 | 764 | 999 | 1590 | 1383 | 1808 | 81.9 |
| Guangdong | 2523 | 2219 | 2864 | 6456 | 5634 | 7353 | 155.9 |
| Guangxi | 1608 | 1414 | 1824 | 2720 | 2372 | 3078 | 69.2 |
| Guizhou | 1214 | 1066 | 1383 | 1969 | 1714 | 2231 | 62.2 |
| Hainan | 249 | 220 | 283 | 536 | 467 | 606 | 114.8 |
| Hebei | 2573 | 2261 | 2919 | 4546 | 3970 | 5131 | 76.7 |
| Heilongjiang | 1389 | 1215 | 1587 | 2743 | 2371 | 3120 | 97.5 |
| Henan | 3456 | 3039 | 3920 | 5518 | 4817 | 6238 | 59.7 |
| Hong Kong | 225 | 193 | 262 | 431 | 363 | 508 | 91.9 |
| Hubei | 2201 | 1929 | 2500 | 3662 | 3174 | 4153 | 66.4 |
| Hunan | 2485 | 2182 | 2819 | 4135 | 3597 | 4681 | 66.4 |
| Inner Mongolia | 829 | 729 | 946 | 1679 | 1455 | 1912 | 102.5 |
| Jiangsu | 3078 | 2708 | 3491 | 5412 | 4713 | 6132 | 75.9 |
| Jiangxi | 1415 | 1245 | 1603 | 2677 | 2331 | 3036 | 89.2 |
| Jilin | 1006 | 881 | 1146 | 1921 | 1662 | 2184 | 91.0 |
| Liaoning | 1762 | 1544 | 2005 | 3155 | 2730 | 3594 | 79.1 |
| Macao | 15 | 13 | 17 | 43 | 37 | 48 | 184.5 |
| Ningxia | 163 | 143 | 186 | 388 | 337 | 441 | 138.4 |
| Qinghai | 161 | 141 | 185 | 350 | 304 | 401 | 117.2 |
| Shaanxi | 1342 | 1177 | 1524 | 2438 | 2122 | 2759 | 81.7 |
| Shandong | 3635 | 3197 | 4121 | 6380 | 5550 | 7221 | 75.5 |
| Shanghai | 974 | 861 | 1098 | 2271 | 1981 | 2576 | 133.2 |
| Shanxi | 1175 | 1031 | 1337 | 2312 | 2008 | 2619 | 96.8 |
| Sichuan | 4672 | 4093 | 5309 | 5419 | 4722 | 6144 | 16.0 |
| Tianjin | 417 | 366 | 473 | 959 | 837 | 1086 | 130.0 |
| Tibet | 82 | 72 | 93 | 162 | 141 | 185 | 97.0 |
| Xinjiang | 547 | 479 | 624 | 1346 | 1167 | 1541 | 146.1 |
| Yunnan | 1411 | 1240 | 1603 | 2755 | 2399 | 3135 | 95.3 |
| Zhejiang | 1888 | 1661 | 2136 | 3897 | 3384 | 4414 | 106.4 |
| China | 48001 | 42196 | 54544 | 87346 | 76052 | 98717 | 82.0 |

LUI, lower uncertainty interval; UUI, upper uncertainty interval.

**Table S5** The detailed information of age-standardized YLDs rate and all-age YLDs of neck pain in China from 1990 to 2017

| | All-Age YLDs (95% UI), *1000s | | | Age-Standardized YLDs rate (95% UI), per 100,000 persons | | |
|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | Mean | LUI | UUI |
| 1990 | | | | | | |
| Female | 2721 | 1886 | 3779 | 525.1 | 363.8 | 733.8 |
| Male | 2116 | 1462 | 3007 | 386.2 | 267.6 | 544.7 |
| Both | 4837 | 3370 | 6750 | 454.0 | 315.7 | 636.9 |
| 1995 | | | | | | |
| Female | 3094 | 2144 | 4301 | 526.2 | 365.8 | 734.8 |
| Male | 2395 | 1647 | 3405 | 386.7 | 267.3 | 546.9 |
| Both | 5489 | 3816 | 7704 | 454.8 | 314.9 | 639.1 |
| 2000 | | | | | | |
| Female | 3596 | 2484 | 5060 | 539.2 | 372.2 | 755.8 |
| Male | 2732 | 1900 | 3848 | 392.6 | 272.8 | 548.3 |
| Both | 6328 | 4380 | 8864 | 464.5 | 321.3 | 646.4 |
| 2005 | | | | | | |
| Female | 4233 | 2918 | 5971 | 562.1 | 389.0 | 789.1 |
| Male | 3025 | 2110 | 4240 | 392.5 | 272.5 | 549.4 |
| Both | 7258 | 5025 | 10182 | 475.9 | 331.0 | 662.9 |
| 2010 | | | | | | |
| Female | 4621 | 3204 | 6548 | 552.2 | 383.6 | 779.9 |
| Male | 3310 | 2301 | 4640 | 393.3 | 272.9 | 549.3 |
| Both | 7931 | 5480 | 11175 | 471.7 | 327.0 | 662.1 |
| 2015 | | | | | | |
| Female | 4968 | 3432 | 7020 | 542.5 | 376.3 | 761.1 |
| Male | 3575 | 2480 | 5018 | 393.4 | 272.5 | 548.4 |
| Both | 8543 | 5912 | 12042 | 467.3 | 324.9 | 653.8 |
| 2017 | | | | | | |
| Female | 5086 | 3515 | 7166 | 538.3 | 374.6 | 752.5 |
| Male | 3672 | 2550 | 5163 | 393.7 | 272.6 | 549.0 |
| Both | 8758 | 6067 | 12292 | 465.6 | 323.4 | 650.4 |

**Table S6** The detailed information of the all-age YLDs of different age categories between 1990 and 2017

| Age category | 1990, All-Age YLDs (95% UI) | | | 2017, All-Age YLDs (95% UI) | | | Changes, % |
|---|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | Mean | LUI | UUI | |
| 0–4 | | | | | | | |
| Female | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Male | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Both | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 5–9 | | | | | | | |
| Female | 6150 | 3072 | 10352 | 4075 | 2147 | 6984 | -33.7 |
| Male | 6823 | 3447 | 11663 | 4929 | 2523 | 8461 | -27.8 |
| Both | 12973 | 6680 | 21857 | 9004 | 4665 | 15467 | -30.6 |
| 10–14 | | | | | | | |
| Female | 32016 | 18464 | 51032 | 23353 | 13691 | 36842 | -27.1 |
| Male | 32429 | 18375 | 50917 | 25898 | 15155 | 40641 | -20.1 |
| Both | 64445 | 37476 | 101026 | 49251 | 28941 | 77810 | -23.6 |
| 15–19 | | | | | | | |
| Female | 83340 | 49525 | 133180 | 53887 | 31896 | 86415 | -35.3 |
| Male | 73948 | 43057 | 118260 | 51433 | 29647 | 81514 | -30.4 |
| Both | 157288 | 92394 | 250672 | 105320 | 61570 | 168247 | -33.0 |
| 20–24 | | | | | | | |
| Female | 147587 | 84616 | 238678 | 105184 | 61272 | 170663 | -28.7 |
| Male | 122703 | 69922 | 198437 | 88916 | 49823 | 144931 | -27.5 |
| Both | 270290 | 154759 | 438323 | 194100 | 110823 | 313597 | -28.2 |
| 25–29 | | | | | | | |
| Female | 186349 | 114278 | 288886 | 214473 | 128588 | 337018 | 15.1 |
| Male | 159586 | 94176 | 249931 | 174746 | 105104 | 274625 | 9.5 |
| Both | 345934 | 209397 | 536374 | 389219 | 234165 | 600283 | 12.5 |
| 30–34 | | | | | | | |
| Female | 208648 | 126624 | 331921 | 294264 | 178034 | 460534 | 41.0 |
| Male | 189867 | 112423 | 297818 | 251634 | 153312 | 395276 | 32.5 |
| Both | 398515 | 242186 | 614575 | 545898 | 329118 | 849873 | 37.0 |
| 35–39 | | | | | | | |
| Female | 291124 | 175498 | 461075 | 322648 | 192741 | 512753 | 10.8 |
| Male | 250046 | 146361 | 401220 | 266077 | 161058 | 416695 | 6.4 |
| Both | 541170 | 326258 | 853677 | 588726 | 349892 | 929514 | 8.8 |
| 40–44 | | | | | | | |
| Female | 288323 | 164942 | 452681 | 505630 | 292071 | 789052 | 75.4 |
| Male | 228612 | 133962 | 359731 | 376804 | 216718 | 584960 | 64.8 |
| Both | 516935 | 299108 | 803869 | 882434 | 508783 | 1376330 | 70.7 |
| 45–49 | | | | | | | |
| Female | 287546 | 171918 | 433859 | 742983 | 444046 | 1155726 | 158.4 |
| Male | 210108 | 122841 | 322667 | 501510 | 300242 | 783327 | 138.7 |
| Both | 497654 | 297400 | 754825 | 1244493 | 745552 | 1944361 | 150.1 |
| 50–54 | | | | | | | |
| Female | 294632 | 173664 | 446870 | 800998 | 480863 | 1214961 | 171.9 |
| Male | 215165 | 126554 | 329837 | 517561 | 309589 | 794103 | 140.5 |
| Both | 509797 | 302091 | 776045 | 1318559 | 798593 | 1995561 | 158.6 |
| 55–59 | | | | | | | |
| Female | 247657 | 153610 | 386465 | 487076 | 297856 | 754294 | 96.7 |
| Male | 188347 | 115262 | 295557 | 342392 | 210473 | 531359 | 81.8 |
| Both | 436005 | 272771 | 675924 | 829468 | 515097 | 1282854 | 90.2 |
| 60–64 | | | | | | | |
| Female | 197900 | 118570 | 299084 | 479913 | 293297 | 723038 | 142.5 |
| Male | 151093 | 91744 | 230602 | 350351 | 217507 | 535983 | 131.9 |
| Both | 348994 | 213222 | 525716 | 830264 | 512767 | 1248330 | 137.9 |
| 65–69 | | | | | | | |
| Female | 180775 | 109802 | 273846 | 415141 | 250123 | 624627 | 129.6 |
| Male | 126721 | 75536 | 193324 | 287378 | 171589 | 439960 | 126.8 |
| Both | 307496 | 187086 | 469613 | 702519 | 426110 | 1067738 | 128.5 |
| 70–74 | | | | | | | |
| Female | 139625 | 89253 | 209216 | 293363 | 186241 | 443289 | 110.1 |
| Male | 87468 | 55033 | 135221 | 201043 | 125245 | 311197 | 129.8 |
| Both | 227093 | 143553 | 340997 | 494406 | 313734 | 750753 | 117.7 |
| 75–79 | | | | | | | |
| Female | 78702 | 49622 | 121964 | 179337 | 112947 | 273782 | 127.9 |
| Male | 45134 | 27982 | 70806 | 125803 | 77528 | 199184 | 178.7 |
| Both | 123836 | 78372 | 192003 | 305140 | 192810 | 470792 | 146.4 |
| 80–84 | | | | | | | |
| Female | 37869 | 23926 | 57054 | 109695 | 68998 | 164358 | 189.7 |
| Male | 20929 | 12910 | 31941 | 73484 | 45485 | 110938 | 251.1 |
| Both | 58798 | 37168 | 88621 | 183179 | 115165 | 275971 | 211.5 |
| 85–89 | | | | | | | |
| Female | 11184 | 6948 | 16989 | 42435 | 26172 | 65455 | 279.4 |
| Male | 5773 | 3532 | 8783 | 26552 | 16175 | 40592 | 359.9 |
| Both | 16957 | 10330 | 25792 | 68988 | 42259 | 105315 | 306.8 |
| 90–94 | | | | | | | |
| Female | 1697 | 1064 | 2556 | 9757 | 6271 | 15012 | 474.9 |
| Male | 825 | 525 | 1255 | 5076 | 3233 | 7558 | 515.2 |
| Both | 2522 | 1604 | 3770 | 14833 | 9500 | 22544 | 488.1 |
| 95+ | | | | | | | |
| Female | 198 | 123 | 302 | 1590 | 993 | 2405 | 703.1 |
| Male | 88 | 56 | 131 | 623 | 395 | 936 | 604.8 |
| Both | 286 | 180 | 435 | 2212 | 1378 | 3343 | 672.7 |

YLDs, years lived with disability; LUI, lower uncertainty interval; UUI, upper uncertainty interval.

**Table S7** The detailed information of the YLDs rate of different age categories between 1990 and 2017

| Age category | 1990, YLDs rate (95% UI), per 100,000 persons | | | 2017, YLDs rate (95% UI), per 100,000 persons | | | Changes, % |
|---|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | Mean | LUI | UUI | |
| 0–4 | | | | | | | |
| Female | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Male | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Both | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5–9 | | | | | | | |
| Female | 12.2 | 6.1 | 20.5 | 12.4 | 6.5 | 21.2 | 1.4 |
| Male | 12.5 | 6.3 | 21.4 | 12.6 | 6.4 | 21.6 | 0.6 |
| Both | 12.4 | 6.4 | 20.8 | 12.5 | 6.5 | 21.4 | 1.0 |
| 10–14 | | | | | | | |
| Female | 64.6 | 37.3 | 103.0 | 69.4 | 40.7 | 109.5 | 7.4 |
| Male | 61.3 | 34.8 | 96.3 | 65.1 | 38.1 | 102.1 | 6.1 |
| Both | 62.9 | 36.6 | 98.6 | 67.0 | 39.4 | 105.9 | 6.6 |
| 15–19 | | | | | | | |
| Female | 134.9 | 80.1 | 215.5 | 149.5 | 88.5 | 239.8 | 10.9 |
| Male | 113.4 | 66.0 | 181.3 | 125.7 | 72.5 | 199.2 | 10.9 |
| Both | 123.8 | 72.7 | 197.3 | 136.9 | 80.0 | 218.6 | 10.5 |
| 20–24 | | | | | | | |
| Female | 228.4 | 131.0 | 369.4 | 237.9 | 138.6 | 386.0 | 4.1 |
| Male | 181.6 | 103.5 | 293.6 | 187.5 | 105.1 | 305.6 | 3.3 |
| Both | 204.5 | 117.1 | 331.6 | 211.8 | 120.9 | 342.2 | 3.6 |
| 25–29 | | | | | | | |
| Female | 347.7 | 213.2 | 539.1 | 351.8 | 210.9 | 552.8 | 1.2 |
| Male | 282.0 | 166.4 | 441.7 | 281.7 | 169.5 | 442.8 | −0.1 |
| Both | 314.0 | 190.1 | 486.8 | 316.4 | 190.4 | 488.1 | 0.8 |
| 30–34 | | | | | | | |
| Female | 493.8 | 299.7 | 785.6 | 499.8 | 302.4 | 782.2 | 1.2 |
| Male | 411.8 | 243.8 | 645.9 | 416.1 | 253.5 | 653.7 | 1.1 |
| Both | 451.0 | 274.1 | 695.5 | 457.4 | 275.8 | 712.1 | 1.4 |
| 35–39 | | | | | | | |
| Female | 658.8 | 397.1 | 1043.4 | 675.1 | 403.3 | 1072.9 | 2.5 |
| Male | 528.2 | 309.1 | 847.5 | 536.8 | 324.9 | 840.7 | 1.6 |
| Both | 591.2 | 356.4 | 932.6 | 604.7 | 359.4 | 954.8 | 2.3 |
| 40–44 | | | | | | | |
| Female | 901.6 | 515.8 | 1415.5 | 929.6 | 536.9 | 1450.6 | 3.1 |
| Male | 648.3 | 379.9 | 1020.2 | 667.9 | 384.1 | 1036.8 | 3.0 |
| Both | 768.8 | 444.8 | 1195.5 | 796.3 | 459.1 | 1242.0 | 3.6 |
| 45–49 | | | | | | | |
| Female | 1177.5 | 704.0 | 1776.6 | 1212.3 | 724.6 | 1885.8 | 3.0 |
| Male | 770.1 | 450.2 | 1182.6 | 789.0 | 472.3 | 1232.3 | 2.5 |
| Both | 962.5 | 575.2 | 1459.9 | 996.8 | 597.2 | 1557.3 | 3.6 |
| 50–54 | | | | | | | |
| Female | 1309.8 | 772.0 | 1986.6 | 1346.3 | 808.2 | 2042.1 | 2.8 |
| Male | 850.4 | 500.2 | 1303.6 | 862.7 | 516.1 | 1323.7 | 1.5 |
| Both | 1066.6 | 632.0 | 1623.6 | 1103.5 | 668.4 | 1670.1 | 3.5 |
| 55–59 | | | | | | | |
| Female | 1197.6 | 742.8 | 1868.8 | 1222.3 | 747.4 | 1892.8 | 2.1 |
| Male | 826.9 | 506.0 | 1297.6 | 841.2 | 517.1 | 1305.5 | 1.7 |
| Both | 1003.3 | 627.7 | 1555.4 | 1029.7 | 639.5 | 1592.6 | 2.6 |
| 60–64 | | | | | | | |
| Female | 1151.4 | 689.9 | 1740.1 | 1163.3 | 710.9 | 1752.6 | 1.0 |
| Male | 827.5 | 502.5 | 1263.0 | 843.6 | 523.7 | 1290.6 | 1.9 |
| Both | 984.6 | 601.5 | 1483.1 | 1002.9 | 619.4 | 1507.9 | 1.9 |
| 65–69 | | | | | | | |
| Female | 1300.0 | 789.6 | 1969.3 | 1336.2 | 805.1 | 2010.5 | 2.8 |
| Male | 941.2 | 561.1 | 1436.0 | 953.4 | 569.3 | 1459.6 | 1.3 |
| Both | 1123.5 | 683.6 | 1715.9 | 1147.7 | 696.1 | 1744.4 | 2.2 |
| 70–74 | | | | | | | |
| Female | 1380.6 | 882.5 | 2068.8 | 1409.6 | 894.9 | 2130.0 | 2.1 |
| Male | 999.8 | 629.0 | 1545.6 | 1008.0 | 628.0 | 1560.3 | 0.8 |
| Both | 1204.0 | 761.1 | 1807.9 | 1213.1 | 769.8 | 1842.1 | 0.8 |
| 75–79 | | | | | | | |
| Female | 1211.1 | 763.6 | 1876.8 | 1225.5 | 771.8 | 1870.9 | 1.2 |
| Male | 916.8 | 568.4 | 1438.2 | 924.4 | 569.7 | 1463.6 | 0.8 |
| Both | 1084.2 | 686.2 | 1681.0 | 1080.4 | 682.7 | 1666.9 | −0.4 |
| 80–84 | | | | | | | |
| Female | 1080.4 | 682.6 | 1627.8 | 1091.5 | 686.6 | 1635.4 | 1.0 |
| Male | 893.8 | 551.4 | 1364.2 | 897.9 | 555.8 | 1355.6 | 0.5 |
| Both | 1005.7 | 635.7 | 1515.8 | 1004.6 | 631.6 | 1513.5 | −0.1 |
| 85–89 | | | | | | | |
| Female | 849.7 | 527.8 | 1290.7 | 852.6 | 525.8 | 1315.1 | 0.3 |
| Male | 782.8 | 479.0 | 1191.0 | 788.7 | 480.4 | 1205.7 | 0.7 |
| Both | 825.7 | 503.0 | 1255.8 | 826.8 | 506.5 | 1262.2 | 0.1 |
| 90–94 | | | | | | | |
| Female | 596.6 | 374.1 | 898.5 | 594.8 | 382.3 | 915.1 | −0.3 |
| Male | 605.4 | 385.1 | 921.1 | 609.4 | 388.1 | 907.5 | 0.7 |
| Both | 599.4 | 381.2 | 895.9 | 599.7 | 384.1 | 911.5 | 0.0 |
| 95+ | | | | | | | |
| Female | 488.9 | 303.7 | 746.0 | 487.2 | 304.4 | 737.3 | −0.3 |
| Male | 524.8 | 331.0 | 779.8 | 525.3 | 333.4 | 789.6 | 0.1 |
| Both | 499.5 | 313.4 | 758.4 | 497.4 | 309.8 | 751.6 | −0.4 |

YLDs, years lived with disability; LUI, lower uncertainty interval; UUI, upper uncertainty interval.

**Table S8** The detailed information of age standardized YLDs rate of different provinces/regions between 1990 and 2017

| Province/region | 1990, age standardized YLDs rate, per 100,000 persons. | | | 2017, age standardized YLDs rate, per 100,000 persons. | | | Changes, % |
|---|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | Mean | LUI | UUI | |
| Anhui | 450.9 | 311.6 | 633.9 | 464.3 | 320.9 | 647.5 | 3.0 |
| Beijing | 462.2 | 320.4 | 651.5 | 466.9 | 323.7 | 651.4 | 1.0 |
| Chongqing | 450.3 | 314.2 | 636.4 | 465.6 | 324.3 | 648.5 | 3.4 |
| Fujian | 452.1 | 312.8 | 629.9 | 464.3 | 322.4 | 644.0 | 2.7 |
| Gansu | 449.6 | 312.5 | 631.6 | 463.9 | 322.4 | 648.8 | 3.2 |
| Guangdong | 452.8 | 314.5 | 634.9 | 461.0 | 320.7 | 641.6 | 1.8 |
| Guangxi | 451.7 | 314.1 | 631.6 | 463.7 | 321.1 | 648.2 | 2.7 |
| Guizhou | 449.5 | 312.0 | 627.9 | 462.6 | 324.3 | 648.1 | 2.9 |
| Hainan | 452.0 | 315.1 | 636.2 | 460.9 | 319.9 | 640.6 | 2.0 |
| Hebei | 453.4 | 315.5 | 636.5 | 462.9 | 323.0 | 646.7 | 2.1 |
| Heilongjiang | 450.4 | 313.6 | 633.4 | 463.3 | 321.8 | 644.8 | 2.9 |
| Henan | 453.8 | 316.3 | 636.9 | 466.9 | 325.0 | 651.5 | 2.9 |
| Hong Kong | 366.6 | 248.2 | 524.0 | 390.7 | 262.9 | 559.1 | 6.5 |
| Hubei | 450.3 | 312.9 | 631.3 | 462.3 | 320.9 | 641.0 | 2.7 |
| Hunan | 450.1 | 313.4 | 631.7 | 463.7 | 321.9 | 647.6 | 3.0 |
| Inner Mongolia | 449.2 | 311.7 | 630.8 | 461.7 | 320.0 | 645.4 | 2.8 |
| Jiangsu | 453.2 | 313.8 | 639.1 | 464.2 | 323.5 | 647.3 | 2.4 |
| Jiangxi | 450.7 | 315.5 | 631.0 | 465.3 | 324.5 | 647.6 | 3.2 |
| Jilin | 453.3 | 313.4 | 635.9 | 465.4 | 322.2 | 647.7 | 2.7 |
| Liaoning | 452.1 | 313.4 | 636.2 | 463.9 | 321.0 | 643.8 | 2.6 |
| Macao | 457.3 | 318.0 | 645.0 | 469.6 | 326.7 | 652.4 | 2.7 |
| Ningxia | 451.5 | 314.4 | 633.1 | 464.1 | 323.7 | 646.9 | 2.8 |
| Qinghai | 452.8 | 313.6 | 634.3 | 462.5 | 322.2 | 645.7 | 2.2 |
| Shaanxi | 453.0 | 314.2 | 637.0 | 463.5 | 322.0 | 649.0 | 2.3 |
| Shandong | 454.0 | 316.0 | 635.7 | 464.7 | 322.7 | 649.7 | 2.4 |
| Shanghai | 606.6 | 422.6 | 850.8 | 576.3 | 398.1 | 804.2 | -5.0 |
| Shanxi | 450.8 | 313.2 | 632.1 | 463.2 | 323.9 | 642.9 | 2.8 |
| Sichuan | 451.2 | 313.7 | 633.7 | 463.6 | 322.7 | 646.8 | 2.8 |
| Tianjin | 454.8 | 316.3 | 638.3 | 458.8 | 319.3 | 641.2 | 0.9 |
| Tibet | 455.3 | 316.3 | 638.8 | 463.6 | 321.3 | 646.9 | 1.8 |
| Xinjiang | 450.1 | 312.3 | 631.7 | 461.7 | 321.4 | 646.4 | 2.6 |
| Yunnan | 452.1 | 313.3 | 636.8 | 462.4 | 322.2 | 644.9 | 2.3 |
| Zhejiang | 449.6 | 312.3 | 629.6 | 462.9 | 321.7 | 648.1 | 3.0 |
| China | 454.0 | 315.7 | 636.9 | 465.6 | 323.4 | 650.4 | 2.6 |

YLDs, years lived with disability; LUI, lower uncertainty interval; UUI, upper uncertainty interval.

**Table S9** The detailed information of the all age YLDs of different provinces/regions between 1990 and 2017

| Province/region | 1990 All-Age YLDs (95% UI), *1000s. | | | 2017 All-Age YLDs (95% UI), *1000s. | | | Changes, % |
|---|---|---|---|---|---|---|---|
| | Mean | LUI | UUI | Mean | LUI | UUI | |
| Anhui | 229 | 159 | 322 | 387 | 267 | 543 | 69.2 |
| Beijing | 54 | 37 | 76 | 153 | 106 | 217 | 184.3 |
| Chongqing | 68 | 47 | 96 | 172 | 119 | 240 | 152.2 |
| Fujian | 116 | 80 | 162 | 237 | 165 | 333 | 104.8 |
| Gansu | 88 | 61 | 124 | 160 | 110 | 225 | 81.1 |
| Guangdong | 254 | 177 | 358 | 649 | 452 | 915 | 155.7 |
| Guangxi | 162 | 112 | 226 | 273 | 189 | 383 | 68.7 |
| Guizhou | 122 | 85 | 170 | 197 | 137 | 276 | 61.6 |
| Hainan | 25 | 17 | 35 | 54 | 37 | 76 | 114.8 |
| Hebei | 260 | 181 | 363 | 455 | 315 | 639 | 75.0 |
| Heilongjiang | 140 | 98 | 197 | 275 | 190 | 390 | 95.7 |
| Henan | 349 | 243 | 488 | 554 | 385 | 782 | 58.9 |
| Hong Kong | 23 | 15 | 33 | 43 | 29 | 62 | 89.8 |
| Hubei | 221 | 154 | 309 | 366 | 253 | 511 | 65.3 |
| Hunan | 250 | 174 | 350 | 415 | 285 | 583 | 65.7 |
| Inner Mongolia | 84 | 58 | 118 | 169 | 117 | 239 | 101.1 |
| Jiangsu | 309 | 214 | 435 | 541 | 375 | 759 | 74.7 |
| Jiangxi | 142 | 99 | 197 | 269 | 188 | 379 | 89.1 |
| Jilin | 102 | 71 | 143 | 193 | 134 | 273 | 89.3 |
| Liaoning | 178 | 123 | 249 | 316 | 218 | 445 | 77.6 |
| Macao | 2 | 1 | 2 | 4 | 3 | 6 | 183.1 |
| Ningxia | 16 | 11 | 23 | 39 | 27 | 55 | 137.3 |
| Qinghai | 16 | 11 | 23 | 35 | 24 | 50 | 116.3 |
| Shaanxi | 136 | 94 | 190 | 245 | 171 | 346 | 80.5 |
| Shandong | 366 | 255 | 512 | 639 | 442 | 901 | 74.5 |
| Shanghai | 97 | 68 | 137 | 227 | 158 | 318 | 133.3 |
| Shanxi | 118 | 83 | 166 | 232 | 162 | 326 | 96.2 |
| Sichuan | 471 | 328 | 661 | 541 | 375 | 754 | 15.0 |
| Tianjin | 42 | 29 | 59 | 96 | 67 | 135 | 129.0 |
| Tibet | 8 | 6 | 12 | 16 | 11 | 23 | 98.2 |
| Xinjiang | 55 | 38 | 78 | 136 | 94 | 193 | 145.0 |
| Yunnan | 142 | 98 | 200 | 277 | 192 | 391 | 94.8 |
| Zhejiang | 189 | 132 | 263 | 391 | 270 | 553 | 106.5 |
| China | 4837 | 3370 | 6750 | 8758 | 6067 | 12292 | 81.1 |

YLDs, years lived with disability; LUI, lower uncertainty interval; UUI, upper uncertainty interval.