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# Trend of Global Neck Pain Disease Burden from 1990 to 2021

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**Abstract:** *Objective*: This study aims to provide an accurate quantitative analysis of the global burden of neck pain, offering a scientific basis for the formulation of effective prevention and control strategies. *Methods*: Data related to the global burden of neck pain from 1990 to 2021 were collected from the Global Burden of Disease Study (GBD 2021) database. Descriptive analyses were conducted using indicators such as incidence, incidence rate, prevalence, prevalence rate, years lived with disability (YLDs), and YLDs rate. *Results*: From 1990 to 2021, the total number of cases of neck pain worldwide increased from 24.9 million to 43.26 million, an overall increase of 73.82%; the total number of prevalent cases rose from approximately 114 million to about 206 million, representing an overall increase of 79.78%. However, the age-standardized incidence rate and prevalence rate showed relatively small increases of 1.18% and 0.26%, respectively. The total YLDs increased from about 114 million in 1990 to approximately 204 million in 2021, marking an overall increase of 78.42%. The YLD rate per 100,000 population rose from 214.53 in 1990 to 258.71 in 2021, an increase of about 20.59%. The age-standardized YLD rate only saw a slight increase of 0.14%. The incidence rate, prevalence rate, and YLDs rate of neck pain were all higher in females than in males, with a more significant increase observed in females. In 2021, the incidence rate for females approached 620 per 100,000, the prevalence rate was close to 3,200 per 100,000, and the YLDs rate was nearly 290 per 100,000; whereas for males, the incidence rate was about 480 per 100,000, the prevalence rate was around 2,600 per 100,000, and the YLDs rate was nearly 230 per 100,000. *Conclusion*: This study reveals a significant increase in the global burden of neck pain from 1990 to 2021, particularly in the total number of cases. Although the age-standardized incidence and prevalence rates increased relatively modestly, the notable rise in total numbers indicates that neck pain continues to have an escalating impact on global health. The higher incidence, prevalence, and YLDs rates in females compared to males suggest a need for more targeted health interventions and management strategies addressing gender differences. Future research should further explore the specific risk factors for neck pain and their relative contributions, providing a scientific basis for developing effective prevention and control strategies.

**Keywords:** Neck pain; Disease burden; Attributable risk factors; Global

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# 1. Introduction

Neck pain (NP) is a prevalent health issue worldwide, profoundly impacting individuals' quality of life, work efficiency, and socio-economics [1]. As a common musculoskeletal disorder, neck pain can lead to symptoms such as neck discomfort, stiffness, and restricted movement, and may also trigger a range of complications including headaches, shoulder pain, and arm numbness, severely affecting daily activities and occupational functions [2]. With the rapid development of global socio-economics and significant lifestyle changes, the incidence and burden of neck pain have exhibited complex trends over the past few decades. Modern lifestyles, such as prolonged sitting, lack of physical activity, poor posture, and extensive use of electronic devices, are considered significant factors contributing to the rising incidence of neck pain. Additionally, occupational factors, including maintaining fixed postures for long periods, repetitive neck movements, and work-related stress, may exacerbate the occurrence and progression of neck pain [3–4]. Psychological factors, such as stress, anxiety, and depression, are also closely associated with the onset of neck pain. Despite significant differences in the incidence and burden of neck pain across various regions and populations, neck pain has overall become a global public health issue that necessitates in-depth research and effective interventions [5]. This study aims to systematically analyze the trends in the global burden of neck pain from 1990 to 2021 using the Global Burden of Disease (GBD) database and explore its main attributable risk factors, providing a scientific basis for developing effective prevention and control strategies.

# 2. Materials and methods

## 2.1. Data

The data for this study comes from the latest release of the Global Burden of Diseases (GBD2021) database. This database comprehensively records the epidemiological data on global neck pain from 1990 to 2021, covering disease burden indicators such as incidence and prevalence by age, sex, and regional distribution. GBD2021 employs a standardized and comparable methodology to analyze and estimate the disease burden of 369 diseases or injuries across 204 countries (regions) globally, and systematically reviews the attributable disease burden of 88 risk factors, making it the most comprehensive database available worldwide [1]. This study filtered the GBD2021 data, selecting the region as "Global", the disease as "Neck pain", the years covering all years from 1990 to 2021, age set to "Select all", and sex including "Male", "Female", and "Both." The definition of neck pain is based on the International Classification of Diseases, 10th edition (ICD-10) standards.

## 2.2. Indicator selection

This study employs the number of new cases, number of deaths, years lost to ill health, incidence rate, prevalence rate, years lost to ill health rate, and age-standardized rates (ASR) of incidence, prevalence, and years lost to ill health to assess the global trends and disease burden of neck pain. All of the above data can be directly obtained from the GBD official website (https://www.healthdata.org/gbd).

## 2.3. Statistical methods

All statistical analyses were performed using R software (version 4.2.1) and SAS software (version 9.4) to ensure the accuracy and reliability of the analyses. The significance level was set at $P<0.05$ to evaluate the statistical significance of the results.

# 3. Results

## 3.1. Incidence of neck pain in the global population from 1990–2021

**Table 1** shows that the total incidence and incidence rate of neck pain globally experienced significant growth from 1990 to 2021. The total number of cases increased from 24.9 million in 1990 to 43.26 million in 2021, an overall increase of 73.82%. Correspondingly, the standardized incidence rate (per 100,000 population) slightly increased from 513.21 in 1990 to 519.28 in 2021, a growth of only 1.18%. Specifically, the incidence rate per 100,000 population rose from 466.91 in 1990 to 545.89 in 2021, an increase of approximately 17.48%. The age-standardized incidence rate fluctuated slightly during this period, indicating that although the total number of neck pain cases increased, the growth was not significant when considering changes in population structure. This suggests that despite the rapid growth and aging of the global population over the past 30 years, the incidence of neck pain per 100,000 population has not changed significantly. However, after 2000, the incidence rate and number of cases of neck pain increased significantly, possibly related to changes in modern lifestyles, office environments, and occupational habits. This trend indicates that neck pain remains an important public health issue, necessitating strengthened prevention and management strategies.

**Table 1.** Incidence of neck pain in the global population from 1990 to 2021

| Years | Incidence number | Incidence rate (Per 100,000) | Age-standardized incidence rate (Per 100,000) |
|---|---|---|---|
| 1990 | 24903378.60(19628380.36,30674274.35) | 466.91(368.01,575.11) | 513.21(404.32,630.08) |
| 1991 | 25635861.91(20212707.43,31625825.87) | 473.29(373.17,583.88) | 517.75(407.60,636.30) |
| 1992 | 26315246.94(20754009.71,32521410.59) | 478.70(377.54,591.60) | 521.10(409.98,640.86) |
| 1993 | 26944333.47(21257457.66,33361210.57) | 483.27(381.27,598.36) | 523.36(411.55,643.30) |
| 1994 | 27522098.67(21718438.82,34119537.43) | 487.08(384.37,603.84) | 524.67(412.41,644.51) |
| 1995 | 28060577.86(22145010.49,34834397.38) | 490.22(386.88,608.56) | 525.08(412.61,644.60) |
| 1996 | 28487498.23(22498874.88,35382737.36) | 491.30(388.02,610.22) | 523.42(411.39,641.60) |
| 1997 | 28772776.44(22721199.74,35720646.66) | 489.91(386.87,608.21) | 519.24(408.15,636.11) |
| 1998 | 28990944.65(22880039.10,36014127.93) | 487.42(384.68,605.49) | 513.87(403.92,629.20) |
| 1999 | 29217865.29(23030277.96,36244631.91) | 485.11(382.38,601.78) | 508.68(399.41,622.49) |
| 2000 | 29539466.77(23261370.25,36564511.91) | 484.35(381.41,599.54) | 504.95(396.08,617.51) |
| 2001 | 29923791.79(23573709.62,37007945.17) | 484.50(381.69,599.20) | 502.16(393.84,614.16) |
| 2002 | 30299439.42(23871680.44,37443369.21) | 484.37(381.62,598.58) | 499.09(391.37,610.42) |
| 2003 | 30696020.34(24171548.75,37894616.51) | 484.46(381.49,598.07) | 496.26(389.08,606.95) |
| 2004 | 31145567.89(24501367.05,38420044.91) | 485.26(381.74,598.59) | 494.18(387.37,604.40) |
| 2005 | 31678989.04(24889147.08,39057091.00) | 487.19(382.77,600.66) | 493.30(386.56,603.36) |
| 2006 | 32388142.44(25416170.49,39878636.60) | 491.57(385.75,605.26) | 495.03(388.51,605.64) |
| 2007 | 33274425.15(26139347.55,40924228.11) | 498.32(391.46,612.88) | 499.32(392.21,610.84) |
| 2008 | 34243200.76(26935524.39,42144776.32) | 505.92(397.95,622.66) | 504.57(396.27,616.71) |
| 2009 | 35177129.56(27702165.95,43310498.33) | 512.71(403.76,631.25) | 509.12(399.79,621.75) |

**Table 1 (Continued)**

| Years | Incidence number | Incidence rate (Per 100,000) | Age-standardized incidence rate (Per 100,000) |
|---|---|---|---|
| 2010 | 35945137.87(28340591.34,44238018.08) | 517.14(407.73,636.45) | 511.24(401.45,623.95) |
| 2011 | 36606377.13(28862575.65,44988468.91) | 520.14(410.11,639.24) | 512.00(402.15,624.83) |
| 2012 | 37309535.73(29366425.00,45813842.20) | 523.54(412.08,642.88) | 513.29(403.26,626.34) |
| 2013 | 38025674.76(29875671.14,46656784.74) | 526.95(414.01,646.55) | 514.74(404.49,628.02) |
| 2014 | 38728606.73(30376610.99,47476920.22) | 530.08(415.77,649.82) | 515.99(405.55,629.41) |
| 2015 | 39386652.42(30854091.57,48257675.06) | 532.51(417.15,652.45) | 516.63(406.09,630.12) |
| 2016 | 40038531.38(31378804.31,49020554.92) | 534.80(419.13,654.78) | 517.15(406.47,630.70) |
| 2017 | 40723636.67(31932737.13,49827019.39) | 537.57(421.52,657.73) | 518.01(407.07,631.73) |
| 2018 | 41414971.47(32498736.42,50654233.51) | 540.52(424.15,661.11) | 518.83(407.63,632.73) |
| 2019 | 42085880.25(33018902.57,51434948.19) | 543.37(426.31,664.08) | 519.26(407.90,633.22) |
| 2020 | 42701340.09(33484968.66,52132968.55) | 545.89(428.07,666.46) | 519.24(407.93,633.21) |
| 2021 | 43286060.82(33941593.57,52883959.03) | 548.53(430.11,670.15) | 519.28(407.85,633.38) |
| Percentage change (%) | 73.82(64.11,82.75) | 17.48(10.92,23.52) | 1.18(0.07,2.39) |

## 3.2. Prevalence of neck pain globally (1990–2021)

**Table 2** shows that the total number of people and the prevalence rate of neck pain worldwide increased significantly from 1990 to 2021. The total number of cases rose from approximately 114 million in 1990 to about 206 million in 2021, an overall increase of 79.78%. Correspondingly, the standardized prevalence rate (per 100,000) slightly increased from 2436.71 in 1990 to 2443.02 in 2021, a growth of just 0.26%. Specifically, the prevalence rate per 100,000 people increased from 2148.66 in 1990 to 2610.83 in 2021, an increase of roughly 21.51%. The age-standardized prevalence rate fluctuated slightly during this period, indicating that despite population aging and growth, the adjusted prevalence rate did not rise significantly. This means that the actual prevalence of neck pain globally has not increased markedly due to population changes. Overall, despite a significant increase in the total population base, considering population structure and age factors, the actual prevalence rate of neck pain has only slightly increased. This indicates that neck pain remains a long-term health issue globally, but its expansion rate is limited.

**Table 2.** Prevalence of neck pain globally (1990–2021)

| Years | Prevalence number | Prevalence rate (Per 100,000) | Age-standardized prevalence rate (Per 100,000) |
|---|---|---|---|
| 1990 | 114601451.02(88840737.56,141520154.71) | 2148.66(1665.67,2653.36) | 2436.71(1912.98,2992.64) |
| 1991 | 118054621.98(91492834.61,145987445.71) | 2179.53(1689.15,2695.23) | 2458.99(1930.68,3020.59) |
| 1992 | 121288442.97(94045524.00,150095385.63) | 2206.36(1710.79,2730.39) | 2475.34(1943.74,3040.28) |
| 1993 | 124280383.81(96515571.07,153879956.45) | 2229.06(1731.08,2759.95) | 2486.22(1952.52,3053.72) |
| 1994 | 127044169.22(98721900.64,157440067.84) | 2248.39(1747.15,2786.32) | 2492.12(1957.33,3060.91) |

**Table 2 (Continued)**

| Years | Prevalence number | Prevalence rate (Per 100,000) | Age-standardized prevalence rate (Per 100,000) |
|---|---|---|---|
| 1995 | 129588747.41(100720997.80,160741356.10) | 2263.93(1759.61,2808.17) | 2493.54(1958.51,3063.83) |
| 1996 | 131635555.64(102599121.00,162990901.38) | 2270.21(1769.44,2810.97) | 2484.49(1951.55,3049.04) |
| 1997 | 133020364.22(103732025.46,164290911.70) | 2264.92(1766.23,2797.36) | 2462.97(1932.32,3019.06) |
| 1998 | 134087134.11(104490100.05,165180830.06) | 2254.37(1756.76,2777.14) | 2435.66(1909.83,2981.91) |
| 1999 | 135208008.88(105113511.31,166307499.80) | 2244.90(1745.24,2761.26) | 2409.23(1887.75,2949.73) |
| 2000 | 136773983.87(106180334.05,168238985.32) | 2242.65(1741.01,2758.57) | 2389.93(1870.90,2926.45) |
| 2001 | 138635564.47(107846885.62,170531786.59) | 2244.67(1746.17,2761.11) | 2374.97(1861.11,2910.14) |
| 2002 | 140433499.08(109374634.27,172802733.05) | 2245.00(1748.49,2762.47) | 2358.36(1850.15,2891.56) |
| 2003 | 142322634.66(110942255.59,175187826.93) | 2246.21(1750.95,2764.91) | 2342.81(1839.70,2874.18) |
| 2004 | 144479899.66(112701303.22,177887264.50) | 2251.04(1755.92,2771.53) | 2331.08(1831.90,2861.12) |
| 2005 | 147064380.42(114794324.35,181096789.10) | 2261.71(1765.43,2785.10) | 2325.44(1828.70,2854.01) |
| 2006 | 150491564.14(117389664.06,185335558.42) | 2284.08(1781.68,2812.92) | 2332.11(1835.49,2858.07) |
| 2007 | 154759222.16(120910881.36,190627225.01) | 2317.66(1810.75,2854.82) | 2350.44(1851.40,2876.18) |
| 2008 | 159441312.98(124776816.47,196355257.32) | 2355.62(1843.48,2901.00) | 2373.21(1868.31,2903.19) |
| 2009 | 164016159.61(128552701.10,201906387.58) | 2390.54(1873.66,2942.79) | 2392.98(1882.78,2933.64) |
| 2010 | 167871040.92(131709376.74,206523575.27) | 2415.15(1894.89,2971.24) | 2401.80(1889.83,2949.63) |
| 2011 | 171291363.82(134395805.86,210472494.30) | 2433.86(1909.62,2990.58) | 2404.96(1892.85,2953.25) |
| 2012 | 174935366.65(137265393.75,214678265.08) | 2454.77(1926.17,3012.47) | 2411.07(1898.23,2960.39) |
| 2013 | 178675444.48(140181148.95,219026015.80) | 2476.03(1942.58,3035.19) | 2418.15(1904.23,2968.70) |
| 2014 | 182350927.59(143061421.79,223349000.94) | 2495.86(1958.10,3057.01) | 2424.36(1909.40,2975.93) |
| 2015 | 185822944.52(145959568.74,227522797.57) | 2512.34(1973.38,3076.12) | 2427.56(1912.04,2979.83) |
| 2016 | 189264465.01(148779510.09,231733149.34) | 2528.04(1987.27,3095.30) | 2430.51(1914.25,2984.45) |
| 2017 | 192876155.40(151502319.90,236160265.45) | 2546.03(1999.88,3117.40) | 2435.40(1917.83,2991.57) |
| 2018 | 196489260.45(154515966.62,240729684.99) | 2564.46(2016.65,3141.85) | 2440.09(1921.33,2998.32) |
| 2019 | 199938828.23(157213591.51,245022499.96) | 2581.41(2029.79,3163.49) | 2442.50(1923.36,3002.24) |
| 2020 | 203045202.61(159494966.19,248947822.74) | 2595.70(2038.96,3182.51) | 2442.22(1923.24,3000.91) |
| 2021 | 206029628.55(161756682.55,252863254.40) | 2610.83(2049.80,3204.31) | 2443.02(1923.04,3002.33) |
| Percentage change (%) | 79.78(71.45,88.55) | 21.51(15.88,27.44) | 0.26(-1.35,1.87) |

## 3.3. Years lived with disability due to neck pain in the global population from 1990 to 2021

**Table 3** shows the trend of YLDs (Years Lived with Disability) due to neck pain globally from 1990 to 2021 based on the GBD database analysis. The chart indicates that both the total number of YLDs and the prevalence

of neck pain have increased significantly over this period. The total YLDs rose from approximately 114 million in 1990 to about 204 million in 2021, an overall increase of 78.42%. Correspondingly, the adjusted YLD rate (per 100,000 people) slightly increased from 214.53 in 1990 to 258.71 in 2021, a growth of about 20.59%. Specifically, the YLD rate per 100,000 population rose from 214.53 in 1990 to 258.71 in 2021, indicating a significant increase in YLDs caused by neck pain globally. This suggests that the burden of neck pain on global health has been intensifying year by year. After 2000, the global YLDs due to neck pain increased significantly. Factors such as globalization and industrialization may have led to lifestyle changes like prolonged sitting and high work pressure, further exacerbating these conditions. The age-standardized YLD rate (per 100,000 people) slightly increased from 241.96 in 1990 to 242.10 in 2021, with a growth of only 0.14%, indicating that the actual burden of neck pain has not changed much when considering population structure changes.

**Table 3**. Health loss years due to neck pain in the global population from 1990 to 2021

| Years | YLDs number | YLDs rate (Per 100,000) | Age-standardized YLDs rate (Per 100,000) |
|---|---|---|---|
| 1990 | 11442356.21(7608943.12,16334312.96) | 214.53(142.66,306.25) | 241.96(162.05,343.53) |
| 1991 | 11786408.05(7837530.85,16843804.90) | 217.60(144.70,310.97) | 244.19(163.58,347.06) |
| 1992 | 12108253.11(8046828.93,17338392.27) | 220.26(146.38,315.40) | 245.83(164.69,349.69) |
| 1993 | 12407690.44(8256388.98,17801984.30) | 222.54(148.08,319.29) | 246.95(165.54,351.36) |
| 1994 | 12683073.86(8446181.55,18242001.56) | 224.46(149.48,322.84) | 247.56(166.07,353.20) |
| 1995 | 12936394.91(8612985.41,18631810.98) | 226.00(150.47,325.50) | 247.71(166.33,353.59) |
| 1996 | 13139483.44(8760679.33,18906460.16) | 226.61(151.09,326.06) | 246.82(165.35,351.61) |
| 1997 | 13276019.35(8856502.28,19079237.49) | 226.05(150.80,324.86) | 244.68(163.88,348.26) |
| 1998 | 13381949.05(8932151.22,19198017.98) | 224.99(150.17,322.77) | 241.98(162.34,344.42) |
| 1999 | 13492490.26(9012695.84,19287357.37) | 224.02(149.64,320.23) | 239.36(160.56,339.97) |
| 2000 | 13647443.75(9125622.24,19482447.96) | 223.77(149.63,319.45) | 237.45(159.59,337.15) |
| 2001 | 13832848.42(9251768.90,19720985.78) | 223.97(149.80,319.31) | 235.99(158.62,335.04) |
| 2002 | 14011608.18(9382829.91,19979325.92) | 223.99(150.00,319.39) | 234.36(157.46,332.71) |
| 2003 | 14200966.25(9515626.15,20253033.13) | 224.13(150.18,319.64) | 232.87(156.17,330.46) |
| 2004 | 14416024.35(9665430.07,20560614.09) | 224.61(150.59,320.34) | 231.74(155.56,328.90) |
| 2005 | 14673762.17(9835301.98,20957418.85) | 225.67(151.26,322.31) | 231.21(155.27,328.47) |
| 2006 | 15012643.81(10059596.94,21440239.89) | 227.85(152.68,325.41) | 231.87(155.63,329.25) |
| 2007 | 15437234.32(10343912.88,22092019.26) | 231.19(154.91,330.85) | 233.73(156.94,331.91) |
| 2008 | 15902915.06(10640886.08,22717146.05) | 234.95(157.21,335.63) | 236.02(158.47,334.27) |
| 2009 | 16355182.10(10935127.05,23337743.18) | 238.38(159.38,340.15) | 237.99(159.71,337.31) |
| 2010 | 16737049.95(11178192.58,23878612.22) | 240.79(160.82,343.54) | 238.89(160.23,338.83) |
| 2011 | 17072344.57(11412593.79,24334193.78) | 242.58(162.16,345.76) | 239.19(160.42,338.90) |
| 2012 | 17430329.44(11659759.97,24818078.36) | 244.59(163.62,348.26) | 239.79(160.74,339.61) |
| 2013 | 17797393.85(11903678.46,25324949.52) | 246.63(164.96,350.94) | 240.49(161.07,340.48) |

**Table 3 (Continued)**

| Years | YLDs number | YLDs rate (Per 100,000) | Age-standardized YLDs rate (Per 100,000) |
|---|---|---|---|
| 2014 | 18157592.47(12121326.70,25822220.50) | 248.53(165.91,353.43) | 241.10(161.54,341.11) |
| 2015 | 18495550.57(12364371.80,26289679.65) | 250.06(167.17,355.44) | 241.39(161.93,341.71) |
| 2016 | 18831781.92(12584522.64,26727571.95) | 251.54(168.09,357.00) | 241.67(162.00,341.91) |
| 2017 | 19183617.16(12812703.92,27259736.74) | 253.23(169.13,359.84) | 242.15(162.37,343.25) |
| 2018 | 19534346.50(13027129.80,27702018.62) | 254.95(170.02,361.55) | 242.59(162.59,343.43) |
| 2019 | 19867146.71(13255260.69,28174781.48) | 256.50(171.14,363.76) | 242.79(162.77,344.03) |
| 2020 | 20145432.68(13446255.74,28503224.97) | 257.54(171.90,364.38) | 242.47(162.71,343.03) |
| 2021 | 20415496.55(13638705.32,28856642.59) | 258.71(172.83,365.67) | 242.30(162.60,342.76) |
| Percentage change (%) | 78.42(69.94,87.21) | 20.59(14.86,26.53) | 0.14(-1.52,1.77) |

## 3.4. Changes in global neck pain by gender from 1990 to 2021

**Figure 1** shows that the incidence of neck pain in both genders has increased from 1990 to 2021, with the incidence rate in females consistently higher than in males. Overall, the incidence rate of neck pain in females has been continuously rising since 1990, reaching nearly 620 per 100,000 in 2021. In contrast, the incidence rate in males is relatively lower but also shows an upward trend, approaching 480 per 100,000 in 2021. After age standardization, the incidence rate decreases, but females still show a significantly higher rate than males, and both genders exhibit an increasing trend. The prevalence rate of neck pain in both genders also shows an upward trend within the same period. The prevalence rate in females rose to 3,200 per 100,000 in 2021, while the prevalence rate in males approached 2,600 per 100,000 in 2021. After age standardization, the prevalence rate decreases, but the gender disparity remains. The YLDs rate for both genders also shows that females have a significantly higher rate than males. By 2021, the YLDs rate in females approached 290 per 100,000, while the rate in males was close to 230 per 100,000. After age standardization, the YLDs rate in females remains higher than in males, and both show an increasing trend. Overall, from 1990 to 2021, the global incidence, prevalence, and YLDs rates of neck pain have shown a significant upward trend across genders. Females exhibit higher rates in all three metrics compared to males, with a more notable increase. Particularly in terms of incidence and prevalence, females show a larger disparity compared to males. These trends underscore the significance of neck pain as a public health issue globally and suggest the need for more targeted gender-specific health interventions and management strategies.

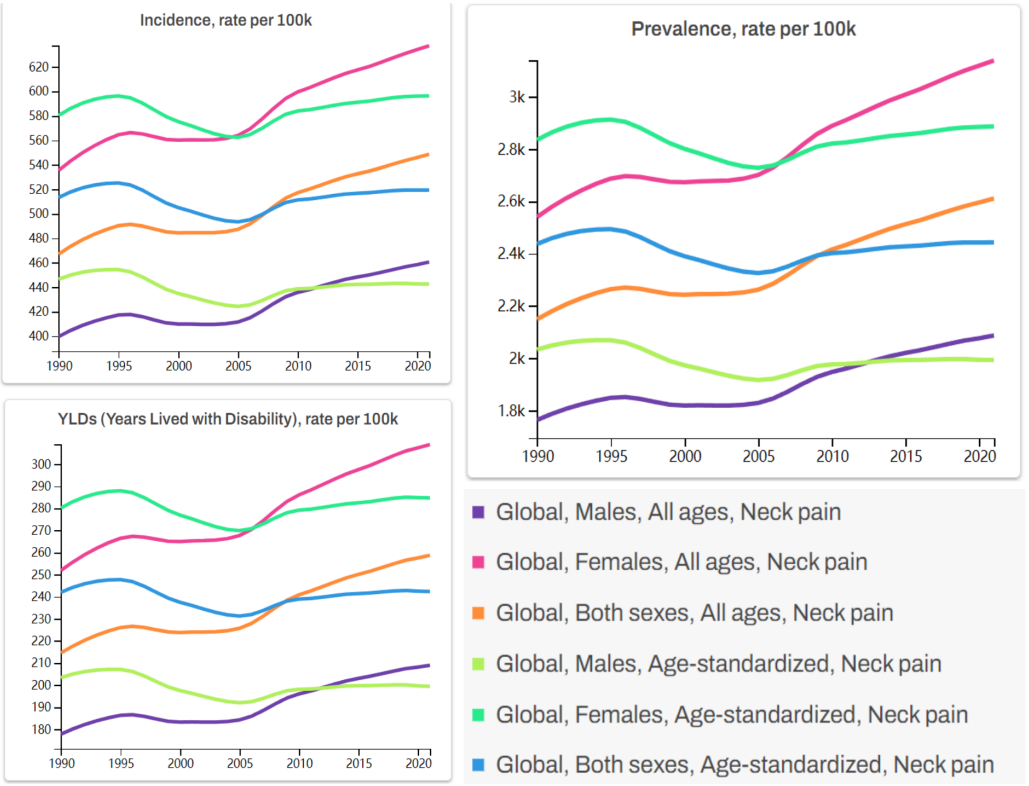


**Figure 1**. Changes in the number of deaths attributable to risk factors for neck pain in the global population from 1990 to 2021

## 4. Discussion

This study reveals the global trends and characteristics of neck pain through a systematic analysis of the global burden of neck pain from 1990 to 2021. The results show that from 1990 to 2021, the incidence, prevalence, and years lived with disability (YLDs) of neck pain globally have significantly increased. This trend reflects the severity and complexity of neck pain as a global health problem. Although the age-standardized incidence and prevalence rates have grown relatively modestly, the significant increase in the total number of cases indicates that the impact of neck pain on global health is still intensifying.

The study found that the global incidence and prevalence of neck pain have shown a significant upward trend over the past 30 years. Specifically, the incidence increased from 24.9 million cases in 1990 to 43.26 million cases in 2021, an overall increase of 73.82%; the number of prevalent cases increased from approximately 114 million cases in 1990 to approximately 206 million cases in 2021, an overall increase of 79.78%. However, the age-standardized incidence and prevalence rates grew relatively modestly, at 1.18% and 0.26%, respectively. This indicates that although global population growth and aging have some impact on the incidence and prevalence of neck pain, the actual growth rate is not significant. This phenomenon may be closely related to changes in modern lifestyles, office environments, and occupational habits, especially factors like prolonged sitting and long-term use of electronic devices leading to neck muscle fatigue and injury.

YLDs are an important indicator for measuring the burden of disease, reflecting the loss of healthy life years due to diseases. The results show that from 1990 to 2021, the total YLDs of global neck pain increased

from approximately 114 million to approximately 204 million, an overall increase of 78.42%. The YLD rate per 100,000 population increased from 214.53 in 1990 to 258.71 in 2021, an increase of about 20.59%. However, the age-standardized YLD rate only slightly increased by 0.14%, indicating that considering changes in population structure, the actual burden of neck pain has not changed significantly. This result suggests that although the impact of neck pain on global health has increased in total, its distribution and impact across different age groups have not changed significantly [6].

The study also explored the changing trends in incidence, prevalence, and YLDs rates of neck pain across different genders. The results indicate that the incidence, prevalence, and YLDs rates of neck pain in females are higher than those in males and have increased more significantly. This phenomenon may be related to physiological, psychological, and social role differences in females [7]. Females are generally more susceptible to musculoskeletal disorders, especially in the neck and shoulder areas. Additionally, exposure factors in occupational choices and work environments may also lead to higher neck pain risk in females [8]. This finding emphasizes the need to pay special attention to the health needs of the female population when formulating prevention and intervention strategies.

Based on existing literature and research background, it can be speculated that some major factors may have an important impact on the prevalence trends of neck pain. These factors include: Lifestyle: Modern lifestyles such as prolonged sitting, lack of exercise, and poor posture are important risk factors for neck pain [9]. Occupational factors: Occupational exposures such as long-term use of electronic devices and repetitive neck movements may lead to neck muscle fatigue and injury [10]. Psychological factors: Psychological factors such as stress and anxiety may exacerbate neck pain symptoms [11]. Socioeconomic factors: Levels of socioeconomic development, accessibility, and quality of healthcare services may also affect the incidence and prevalence of neck pain [12].

This study, based on data from the Global Burden of Disease (GBD2021) database, provides a comprehensive analysis of the global burden of neck pain [13]. However, there are some limitations to the study. First, GBD data may have certain errors and uncertainties, especially in data collection and reporting methods across different countries and regions [14]. Secondly, this study did not explore specific attributable risk factors and their relative contributions in detail, which requires further research to clarify [15]. Moreover, the study mainly focused on overall global trends and did not deeply analyze differences across different regions and populations, which should be supplemented in future research [16].

Future research should further explore the specific risk factors of neck pain and their relative contributions, especially the differences across different regions and populations. Additionally, more intervention studies are needed to evaluate the effectiveness of different prevention and treatment strategies to provide scientific evidence for formulating targeted public health policies. By deeply studying the prevalence trends and influencing factors of neck pain, better prevention and control strategies can be formulated to reduce the burden of neck pain on global health.

## Disclosure statement

The authors declare no conflict of interest.

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