Lai *et al. BMC Pulmonary Medicine* (2025) 25:234
https://doi.org/10.1186/s12890-025-03661-6

BMC Pulmonary Medicine

RESEARCH Open Access

Prevalence and burden of chronic cough in China: results from a population-based survey

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Abstract

Background Chronic cough is associated with reduced mental and physical health and increased health care resource use. The lack of nationwide data on chronic cough hinders our understanding of the prevalence, demographics, and impacts of chronic cough in China. The aim of this study was to estimate the lifetime and annual prevalence of chronic cough in mainland China and to describe the sociodemographic and health-related characteristics of adults with chronic cough.

Methods This was a cross-sectional study using self-reported information from a nationally representative sample of 20,051 adults. Respondents with chronic cough (daily cough for ≥ 8 weeks) during the prior 12 months were matched to respondents without chronic cough.

Results We estimated a lifetime prevalence of 7.0% and an annual prevalence of 4.1% for chronic cough among adult residents of mainland China. Affected individuals had a mean age of 43.5 years, and there were no significant differences in prevalence between men and women. Compared to matched controls, the chronic cough group had more comorbidities and included a higher proportion of individuals who had been diagnosed with respiratory and sleep-related conditions. Chronic cough was also associated with significantly worse depression and anxiety symptom severity and health-related quality of life, as well as increased impairment of work and other daily activities and higher rates of all-cause health care resource use.

Conclusions Chinese adults with chronic cough show a middle age, equal gender distribution. Chronic cough affects an estimated 46.4 million adults in mainland China during their lifetime and is associated with significant individual and health care system burden.

Take home message Chronic cough affects approximately 4.1% (27.2 million) of adults per year in mainland China and is associated with worse health and health-related quality of life, impairment of work productivity and other daily activities, and increased all-cause health care resource use.

Keywords Chronic cough, Cough, Sickness impact profile, Quality of life, Health surveys, China

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Background

Cough lasting > 8 weeks (chronic cough) is a debilitating condition associated with poor physical and mental health, reduced work productivity and quality of life, and increased health care resource use [1–27]. Many cases resolve via treatment of common underlying causes such as asthma, gastroesophageal reflux disease (GERD), upper airway cough syndrome, and eosinophilic bronchitis, or cessation of prescription drugs that can cause cough as a side-effect [28–30]. However, other cases remain unexplained and/or refractory to treatment. The current evidence-based Chinese clinical practice guidelines for the management of cough recommend treatment of underlying medical comorbidities, consideration of multiple concurrent causes and occupational exposures such as airborne particulates, and empirical treatment (i.e., treatment selection based on the physician's best judgment) of unexplained/refractory cough with Western and/or traditional Chinese medicines [29].

The estimation of the global and country-specific prevalence of chronic cough has been hampered by the use of differing methodologies and definitions [26, 31]. The global prevalence of chronic cough has been estimated as 9.6% [32], but other studies have estimated lower rates (3.8–5.5%) in the US and Western European countries [11, 12, 15, 33, 34]. Studies of the demographics of chronic cough in China have identified interesting potential differences compared to other national populations. A recent meta-analysis assessed 35 studies of the prevalence of chronic cough in China, conducted in different regions using different methodologies and definitions of chronic cough, and estimated an overall prevalence of 8.8% among adults ≥ 18 years of age when only studies defining chronic cough as daily cough for > 8 weeks were considered [35]. Most of the included studies had small sample sizes and a low-to-moderate grade of evidence.

The primary objective of the current study was to use a nationally representative sample of adults in mainland China to estimate the lifetime and annual prevalence of chronic cough. We also aimed to compare the sociodemographic characteristics and the health-related characteristics and outcomes of adults with and without chronic cough, providing comprehensive nationwide data on the demographics and burden of this condition in China.

Methods

Study design

This was a cross-sectional study using self-reported information from a national online survey.

Study population

The study population comprised residents of China ≥ 18 years of age who had completed the 2020 National Health and Wellness Survey (NHWS), a self-administered online questionnaire that is conducted annually in China and other countries. Studies using similar methods have described the prevalence and characteristics of chronic cough in nine other countries and regions that participate in the NHWS (Table 1) [11, 12, 15, 34, 36–39]. The NHWS uses a targeted quota sampling framework to select panelists who mirror the urban adult population of mainland China by age, binary sex, and region of residence using a demographic distribution based on data from the National Bureau of Statistics of China [40]. The annual sample size for the NHWS in China is approximately 20,000.

All NHWS respondents were asked whether they had experienced chronic cough (defined as daily cough for ≥ 8 weeks) at any time during their life, and also specifically during the prior 12 months. To compare individuals with and without chronic cough during the prior 12 months, respondents who had experienced chronic cough were matched (nearest neighbor without replacement) at a 1:3 ratio to respondents with no chronic cough who had similar (≤ 0.2 SD) chronic cough propensity scores. Propensity scores were calculated based on age, sex, interaction of marital status and household income, and a modified Charlson Comorbidity Index (CCI) score. The modified

Table 1 Self-reported one-year and lifetime prevalence of chronic cough in China compared to 9 other countries/regions

Country/Region	One-year prevalence	Lifetime prevalence	Reference
China	**4.1%**	**7.0%**	**Present manuscript**
France	4.8%	7.5%	Guilleminault et al. [37]
Germany	4.9%	6.5%	Virchow et al. [15]
Italy	6.3%	9.2%	Incalzi et al. [36]
Japan	4.3%	Not reported	Tobe et al. [38]
South Korea	4.3%	6.2%	Yu et al. [39]
Spain	5.5%	8.2%	Dominguez-Ortega et al. [34]
Taiwan	5.6%	8.3%	Yu et al. [39]
United Kingdom	4.9%	6.2%	McGarvey et al. [11]
United States	5.0%	Not reported	Meltzer et al. [12]

Values represent the weighted prevalence of chronic cough. All cited studies used data from the respective country's/region's version of the National Health and Wellness Survey, using the same methodology as in the current study

CCI score excluded chronic obstructive pulmonary disease (COPD) due to its close association with chronic cough.

Ethics and consent

All NHWS participants read an informed consent statement and provided electronic confirmation of their consent to participate. Respondents who provided consent were assigned a unique code that can only be linked to personal information by a team within Oracle Life Sciences that was not involved in the current study. The NHWS protocols and questionnaires were reviewed and granted an exemption by the Pearl Institutional Review Board (Protocol #20-KANT-228).

Study measures

The NHWS collects information on respondents' sociodemographic and health-related characteristics, all-cause health care resource use (e.g., number of visits to general and specialty health care providers from a list provided) and other health-related outcomes, and diseases experienced and diagnosed. It also includes several validated patient-reported outcome instruments. Depression severity was assessed via the Patient Health Questionnaire 9-item scale (PHQ-9) [41], and anxiety symptoms using the Generalized Anxiety Disorder 7-item scale (GAD-7) [42]. Health-related quality of life was assessed using 3 instruments: the Medical Outcomes Study 12-Item Short Form Survey Version 2 (SF-12v2; QualityMetric Inc., Lincoln, RI, USA) [43–46]; the SF-6D Health Utility Score [45, 46]; and the EuroQol 5-Dimension Health Questionnaire (EQ-5D-5 L™; EuroQol Research Foundation) [47]. Finally, the Work Productivity and Activity Impairment Questionnaire assessed health-related absenteeism (percent work hours missed), presenteeism (percent impairment experienced while at work), and overall work productivity loss (combined absenteeism and presenteeism score) as well as activity impairment (percent impairment of daily non-work activities) during the prior 7 days [48].

Statistical analysis

The unweighted lifetime and annual prevalence of chronic cough were calculated as the number of respondents indicating they had ever experienced daily cough for ≥ 8 weeks (or had experienced daily cough for ≥ 8 weeks within the last 12 months, respectively), divided by the total number of NHWS respondents. Lifetime and annual prevalence calculations were also performed stratified by age category, binary sex, smoking status, and sex stratified by smoking status. To adjust for potential sampling biases, weighted lifetime and annual prevalence estimates were calculated by projecting the unweighted prevalence rates from the study sample to the full urban adult population of China using data from the National Bureau of Statistics in China [40]. Sampling weights were calculated using rake weighting / random iterative methods and were based on age, sex, region, and rurality [49].

For comparisons between respondents who had experienced chronic cough during the prior 12 months and matched respondents who had not (matching strategy described in 'Study population' section above), the matched groups were first compared using kernel density plots to visually compare the propensity score groupings and ensure that their characteristics were balanced (Supplementary Fig. 1). Respondent characteristics and outcomes for each group were then analyzed using descriptive statistics including percentages, means, SDs, medians, and ranges. Characteristics were compared between the matched groups using bivariate analyses (*t*-tests for continuous variables and chi-square tests for categorical variables). Differences with two-tailed *p*-values of < 0.05 were considered statistically significant.

Results

Prevalence of chronic cough among adults in mainland China

A total of 20,051 adult residents of China completed the 2020 NHWS, of whom 1,389 (6.9%) reported having experienced chronic cough (daily cough for ≥ 8 weeks) during their lifetime and 812 (4.0%) during the prior 12 months (Table 2). These proportions were weighted to the 665.8 million total adult national population to estimate a lifetime prevalence of 7.0% (~ 46.4 million individuals) and an annual prevalence of 4.1% (~ 27.2 million individuals) for chronic cough in China.

Current or former smokers of cigarettes or other tobacco products had a significantly higher weighted annual prevalence of chronic cough compared to respondents who had never smoked (7.0% versus 3.1%; $P < 0.001$). The weighted annual prevalence of chronic cough was also statistically significantly different between age categories ($P < 0.001$). The distribution was bimodal, with the highest proportions observed for individuals ≥ 75 years of age (7.4%) and 30–39 years of age (5.0%). A similar trend was found with different age groupings for 50 years and above (50–59, 60–69, ≥ 70 years) (data not shown). The weighted annual prevalence of chronic cough was similar for male versus female respondents (4.2% versus 3.9%). Stratified by smoking status, the unweighted annual prevalence of chronic cough was higher among female than that among male current/formal smokers (10.2% versus 6.3%), however among never smokers, no sex difference was found for the annual chronic cough prevalence (Supplementary Table 3).

Table 2 Lifetime and annual chronic cough prevalence estimates among adults in China

Characteristic	Respondents *n* (%) *N* = 20,051	Chronic cough prevalence							
		Lifetime				12-month period			
		Unweighted *n* (%)	*P*-value [A]	Weighted [B] (%)	*P*-value [A]	Unweighted *n* (%)	*P*-value [A]	Weighted [B] (%)	*P*-value [A]
Total	20,051 (100)	1,389 (6.9)	NA	(7.0)	NA	812 (4.0)	NA	(4.1)	NA
Sex			0.998		0.758		0.607		0.345
Male	10,120 (50.5)	701 (6.9)		(7.0)		417 (4.1)		(4.2)	
Female	9,931 (49.5)	688 (6.9)		(6.9)		395 (4.0)		(3.9)	
Age (years)			< 0.001		< 0.001		< 0.001		< 0.001
18–29	4,198 (20.9)	288 (6.9)		(6.8)		175 (4.2)		(4.1)	
30–39	3,900 (19.5)	343 (8.8)		(8.8)		194 (5.0)		(5.0)	
40–49	3,868 (19.3)	271 (7.0)		(6.9)		160 (4.1)		(4.0)	
50–64	5,070 (25.3)	267 (5.3)		(5.4)		153 (3.0)		(3.1)	
65–74	2,741 (13.7)	190 (6.9)		(7.3)		112 (4.1)		(4.4)	
≥ 75	274 (1.4)	30 (10.9)		(12.1)		18 (6.6)		(7.4)	
Smoking status			< 0.001		< 0.001		< 0.001		< 0.001
Never smoked	15,066 (75.1)	852 (5.7)		(5.7)		467 (3.1)		(3.1)	
Current or former smoker	4,985 (24.9)	537 (10.8)		(11.0)		345 (6.9)		(7.0)	

NA, not applicable

[A] *P*-values were calculated separately for unweighted and weighted values using the two-tailed chi-square test

[B] Prevalence data were weighted to national demographic data from the National Bureau of Statistics of China [40]

Sociodemographic characteristics of matched respondents with and without chronic cough

Eleven respondents with chronic cough during the prior 12 months had no qualifying matches, 9 had 1 match, 4 had 2 matches, and the remainder had 3 matches. The matched analyses therefore compared 801 respondents with chronic cough to 2,381 respondents without chronic cough.

Respondents who had experienced chronic cough within the prior 12 months had a mean (SD) age of 43.5 (15.9) years and a median (range) age of 41.0 (18.0–112.0) years, and 51.3% were male (Table 3). Continuous age was used as a matching criterion, but the age group distribution was different between the matched groups ($P < 0.001$). A majority of respondents with chronic cough had a medium or high income (68.5%) and were married or cohabiting (79.3%). Significantly higher proportions of respondents with chronic cough had ≥ 2 sources of health insurance compared to the control group (78.2% versus 61.4%) and a primary insurance type of Urban Resident Basic Medical Insurance (39.8% versus 31.9%), while a significantly lower proportion had a primary insurance type of Urban Employee Basic Medical Insurance (39.0% versus 44.1%; $P < 0.001$ for all comparisons).

Health-related characteristics of matched respondents with and without chronic cough

A significantly greater proportion of respondents with chronic cough had ≥ 1 comorbidity compared to matched controls (37.2% versus 24.7%; $P < 0.001$; Table 4); this group also had a significantly higher mean (SD) unmodified CCI (0.56 [0.94] versus 0.37 [0.79]; $P < 0.001$; Fig. 1). Experiencing chronic cough was also statistically significantly associated with being a current or former smoker (42.3% of respondents with chronic cough versus 27.3% of respondents with no chronic cough) and consuming alcohol (≤ 3 times per week, 60.0% versus 45.7%; ≥4 times per week, 8.7% versus 6.0%; $P < 0.001$ for all comparisons; Table 4).

Individuals with chronic cough had significantly worse mental health than did matched controls. Among the chronic cough group, the mean (SD) score on the PHQ-9 scale of depression symptom severity was 7.48 (5.04) and the mean (SD) score on the GAD-7 scale of anxiety symptom severity was 5.80 (3.99), versus 4.49 (4.66) and 3.42 (3.63), respectively, for the matched control group ($P < 0.001$ for both comparisons; Fig. 1). Significantly more respondents with chronic cough also reported experiencing moderate-to-severe symptoms of depression (30.2% versus 13.2%; $P < 0.001$) and anxiety (18.2% versus 7.5%; $P < 0.001$; Table 4).

Respondents were also asked whether they had ever experienced or been diagnosed with specific medical conditions; they were not asked whether these conditions occurred before or after they experienced chronic cough. Significantly greater proportions of the chronic cough group had ever been diagnosed with each of the respiratory conditions on the list provided ($P = 0.002$ for emphysema and $P < 0.001$ for allergies, asthma, hay fever, chronic bronchitis, and COPD) as well as heartburn ($P < 0.001$) and other conditions (Supplementary Table 1). Significantly more respondents with chronic cough also reported having ever experienced or being diagnosed with each of the sleep-related conditions on

Table 3 Sociodemographic characteristics of respondents with chronic cough, compared to a matched control group

Characteristic	Chronic cough (*N* = 801)	No chronic cough (*N* = 2,381)	*P*-value [A]
Sex [B]			0.800
Male	411 (51.3)	1,234 (51.8)	
Female	390 (48.7)	1,147 (48.2)	
Age (continuous, years) [B]			0.827
Mean (SD)	43.5 (15.9)	43.6 (15.1)	
Median (range)	41.0 (18.0–112.0)	43.0 (18.0–88.0)	
Age (categorical, years)			< 0.001
18–24	92 (11.5)	304 (12.8)	
25–39	270 (33.7)	660 (27.7)	
40–49	160 (20.0)	503 (21.1)	
50–64	150 (18.7)	597 (25.1)	
65–74	112 (14.0)	289 (12.1)	
≥ 75	17 (2.1)	28 (1.2)	
Employment status [C]			0.186
Employed	570 (71.2)	1,691 (71.0)	
Not employed	231 (28.8)	690 (29.0)	
Marital status [B]			0.906
Married or cohabiting with partner	635 (79.3)	1,895 (79.6)	
Single, never married, or divorced / separated	164 (20.5)	478 (20.1)	
Declined to answer	2 (0.2)	8 (0.3)	
Gross household income (categorical, by tertile) [B]			0.827
Low	247 (30.8)	736 (30.9)	
Medium	235 (29.3)	728 (30.6)	
High	314 (39.2)	898 (37.7)	
Declined to answer	5 (0.6)	19 (0.8)	
Education level			0.428
Did not attend school, or declined to answer	10 (1.2)	18 (0.8)	
Less than a 4-year university degree	340 (42.4)	1,007 (42.3)	
4-year university degree or higher	451 (56.3)	1,356 (57.0)	
Prefecture of residence [D]			0.056
Anhui	25 (3.1)	80 (3.4)	
Beijing	73 (9.1)	189 (7.9)	
Chongqing	11 (1.4)	66 (2.8)	
Fujian	36 (4.5)	92 (3.9)	
Gansu	23 (2.9)	40 (1.7)	
Guangdong	117 (14.6)	328 (13.8)	
Guangxi	9 (1.1)	50 (2.1)	
Guizhou	14 (1.7)	43 (1.8)	
Hainan	1 (0.1)	14 (0.6)	
Hebei	39 (4.9)	103 (4.3)	
Heilongjiang	12 (1.5)	46 (1.9)	
Henan	23 (2.9)	77 (3.2)	
Hubei	43 (5.4)	85 (3.6)	
Hunan	33 (4.1)	71 (3.0)	
Inner Mongolia	4 (0.5)	4 (0.2)	
Jiangsu	46 (5.7)	158 (6.6)	
Jiangxi	17 (2.1)	47 (2.0)	
Jilin	10 (1.2)	40 (1.7)	
Liaoning	15 (1.9)	85 (3.6)	
Ningxia	0 (0.0)	3 (0.1)	
Qinghai	0 (0.0)	2 (0.1)	
Shaanxi	26 (3.2)	58 (2.4)	

Table 3 (continued)

Characteristic	Chronic cough (*N* = 801)	No chronic cough (*N* = 2,381)	*P*-value [A]
Shandong	35 (4.4)	119 (5.0)	
Shanghai	68 (8.5)	206 (8.7)	
Shanxi	20 (2.5)	53 (2.2)	
Sichuan	34 (4.2)	98 (4.1)	
Tianjin	15 (1.9)	58 (2.4)	
Xinjiang	0 (0.0)	2 (0.1)	
Yunnan	8 (1.0)	38 (1.6)	
Zhejiang	44 (5.5)	126 (5.3)	
Current primary medical insurance type [E]			< 0.001
Urban Employee Basic Medical Insurance (UEBMI)	312 (39.0)	1,049 (44.1)	
Urban Resident Basic Medical Insurance (URBMI)	319 (39.8)	760 (31.9)	
New Rural Cooperative Medical Scheme (NRCMS)	132 (16.5)	321 (13.5)	
Commercial Insurance	0 (0.0)	0 (0.0)	
Other	14 (1.7)	56 (2.4)	
None	24 (8.2)	195 (8.2)	
Additional insurance used			< 0.001
At least one additional insurance source	626 (78.2)	1,463 (61.4)	
No additional insurance	175 (21.8)	918 (38.6)	

SD, standard deviation. Respondents who reported having chronic cough in the last 12 months were matched 1:3 by chronic cough propensity score (based on age, gender, interaction of marital status and income, and modified Charlson Comorbidity Index, excluding chronic obstructive pulmonary disease) with respondents with no chronic cough in the last 12 months. All values are presented as *n* (%) unless otherwise stated

[A] *P*-values were calculated for categorical variables using the two-tailed chi-square test and for continuous variables using the two-tailed *t*-test

[B] Variable was included in matching strategy

[C] 'Employed' category includes full-time, part-time, and self-employment; 'Not employed' category includes homemakers, students, individuals on short- and long-term disability, and individuals not employed and either seeking or not seeking employment

[D] Regions with no residents in either group were excluded from the table

[E] China's universal medical insurance system includes two major insurance schemes: (1) Urban Employee Basic Medical Insurance (UEBMI) and (2) Urban and Rural Resident Basic Medical Insurance (URRBMI). The UEBMI is a compulsory medical insurance scheme financed by employees and their enterprises. The URRBMI, which integrates the former New Rural Cooperative Medical Scheme (NRCMS) and Urban Resident Basic Medical Insurance (URBMI), covers self-employed individuals, unemployed residents, and those not enrolled in employer-sponsored insurance

the list provided, i.e., insomnia, narcolepsy, sleep apnea, and other sleep difficulties ($P = 0.031$ for the percent diagnosed with narcolepsy and $P < 0.001$ for all other comparisons; Fig. 2). Chronic cough was also significantly associated with regularly experiencing each of the specific sleep problems on the list provided ($P = 0.005$ for difficulty staying awake and $P < 0.001$ for all other listed problems; Supplementary Table 2).

Health-related outcomes of respondents with and without chronic cough during the prior 12 months

Chronic cough was associated with significantly worse health-related quality of life. Among respondents with chronic cough, the mean (SD) score on the SF-12v2 scale was 46.75 (7.53) for the physical component and 44.89 (7.86) on the mental component (a clinically meaningful difference compared to the accepted population benchmark mean of 50), versus 51.11 (7.31) and 49.11 (8.14), respectively, among matched controls ($P < 0.001$ for both comparisons; Table 5). The mean (SD) SF-6D health utility score was significantly lower in the chronic cough group, at 0.64 (0.09) compared to 0.73 (0.13) for the control group ($P < 0.001$)—again, a clinically meaningful difference on this scale. Respondents with chronic cough also had significantly lower mean (SD) scores on the EQ-5D index (0.84 [0.19] versus 0.93 [0.13]; $P < 0.001$) and the EQ-5D VAS (74.85 [18.89] versus 83.20 [17.19]; $P < 0.001$) than did matched controls, indicating a worse health state. The chronic cough group also reported a significantly greater extent of impairment of daily activities, as measured by the mean (SD) percent work absenteeism (10.47 [15.25] among those with chronic cough versus 4.77 [12.34] among those without), work presenteeism (36.70 [27.22] versus 21.27 [25.92]), overall work impairment (40.87 [28.83] versus 23.33 [27.28]), and impairment of non-work-related daily activities (34.89 [26.04] versus 21.36 [24.88]; $P < 0.001$ for all comparisons).

Compared to matched controls, significantly greater proportions of the chronic cough group had used in the prior 6 months, for any reason, each of the health care resources on the list ($P < 0.01$ for emergency room visits, hospitalizations, and all specialty and non-specialty health care provider visits; Fig. 3). Chronic cough was also associated with significantly more all-cause visits per person to each of the health care resources on the list

Table 4 Health-related characteristics of respondents with chronic cough, compared to a matched control group

Characteristic	Chronic cough (*N* = 801)	No chronic cough (*N* = 2,381)	*P*-value [A]
CCI			< 0.001
0 comorbidities	503 (62.8)	1,791 (75.2)	
1 comorbidity	206 (25.7)	396 (16.6)	
≥ 2 comorbidities	92 (11.5)	194 (8.1)	
Modified CCI excluding COPD [B]			0.134
0 comorbidities	582 (72.7)	1,813 (76.1)	
1 comorbidity	154 (19.2)	393 (16.5)	
≥ 2 comorbidities	65 (8.1)	175 (7.3)	
Depression symptom severity (PHQ-9 scale) [C]			< 0.001
None–minimal (0–4)	251 (31.3)	1,448 (60.8)	
Mild (5–9)	308 (38.5)	620 (26.0)	
Moderate (10–14)	179 (22.3)	216 (9.1)	
Moderately severe (15–19)	44 (5.5)	73 (3.1)	
Severe (≥ 20)	19 (2.4)	24 (1.0)	
Anxiety symptom severity (GAD-7 scale) [D]			< 0.001
None (0–4)	326 (40.7)	1,657 (69.6)	
Mild (5–9)	329 (41.1)	545 (22.9)	
Moderate (10–14)	122 (15.2)	150 (6.3)	
Severe (≥ 15)	24 (3.0)	29 (1.2)	
Smoking status			< 0.001
Never smoked	462 (57.7)	1,731 (72.7)	
Former smoker	85 (10.6)	205 (8.6)	
Current smoker	254 (31.7)	445 (18.7)	
Alcohol consumption			< 0.001
None	250 (31.2)	1,149 (48.3)	
≤ 3 times per week	481 (60.0)	1,088 (45.7)	
≥ 4 times per week	70 (8.7)	144 (6.0)	
Body mass index (continuous, kg/m^2)			0.727
Mean (SD)	24.25 (8.75)	24.37 (8.56)	
Body mass index (categorical)			0.243
Obese (≥ 30.0 kg/m^2)	77 (9.6)	226 (9.5)	
Not obese / unknown or declined to answer	724 (90.4)	2,155 (90.5)	
Experienced COVID-19 in prior 12 months	35 (4.4)	24 (1.0)	< 0.001
Diagnosed with COVID-19 in prior 12 months	4 (0.5)	3 (0.1)	0.051

CCI, Charlson Comorbidity Index; COPD, chronic obstructive pulmonary disorder; SD, standard deviation. Respondents who reported having chronic cough in the last 12 months were matched 1:3 by chronic cough propensity score (based on age, gender, and CCI, excluding COPD) with respondents with no chronic cough in the last 12 months. All values are presented as *n* (%) unless otherwise stated

[A] *P*-values were calculated for categorical variables using the two-tailed chi-square test and for continuous variables using the two-tailed *t*-test

[B] Variable was included in matching strategy

[C] Depression symptoms over the prior 2 weeks on the 0–27 PHQ-9 scale [41]

[D] Generalized anxiety disorder symptoms over the prior 2 weeks on the 0–21 GAD-7 scale [42]

provided, except for neurologist visits ($P < 0.001$ for all comparisons).

Discussion

The nationally representative nature of the study population in the present manuscript allowed us to more accurately estimate the prevalence of chronic cough and characterize the demographics of chronic cough among Chinese adults. This study estimated that 4.1% of adults in mainland China (~ 27.2 million people) have experienced chronic cough during the prior 12 months, and 7.0% (~ 46.4 million) during their lifetime. The prevalence of chronic cough was similar among men and women. Compared to matched controls, significantly higher proportions of adults reporting chronic cough in the prior 12 months had experienced respiratory, sleep-related, and other conditions; the chronic cough group also had significantly more comorbidities. Respondents with chronic cough also had a lower health-related quality of life, worse depression and anxiety, more impairment of work and other activities, and higher rates of all-cause health care resource use.

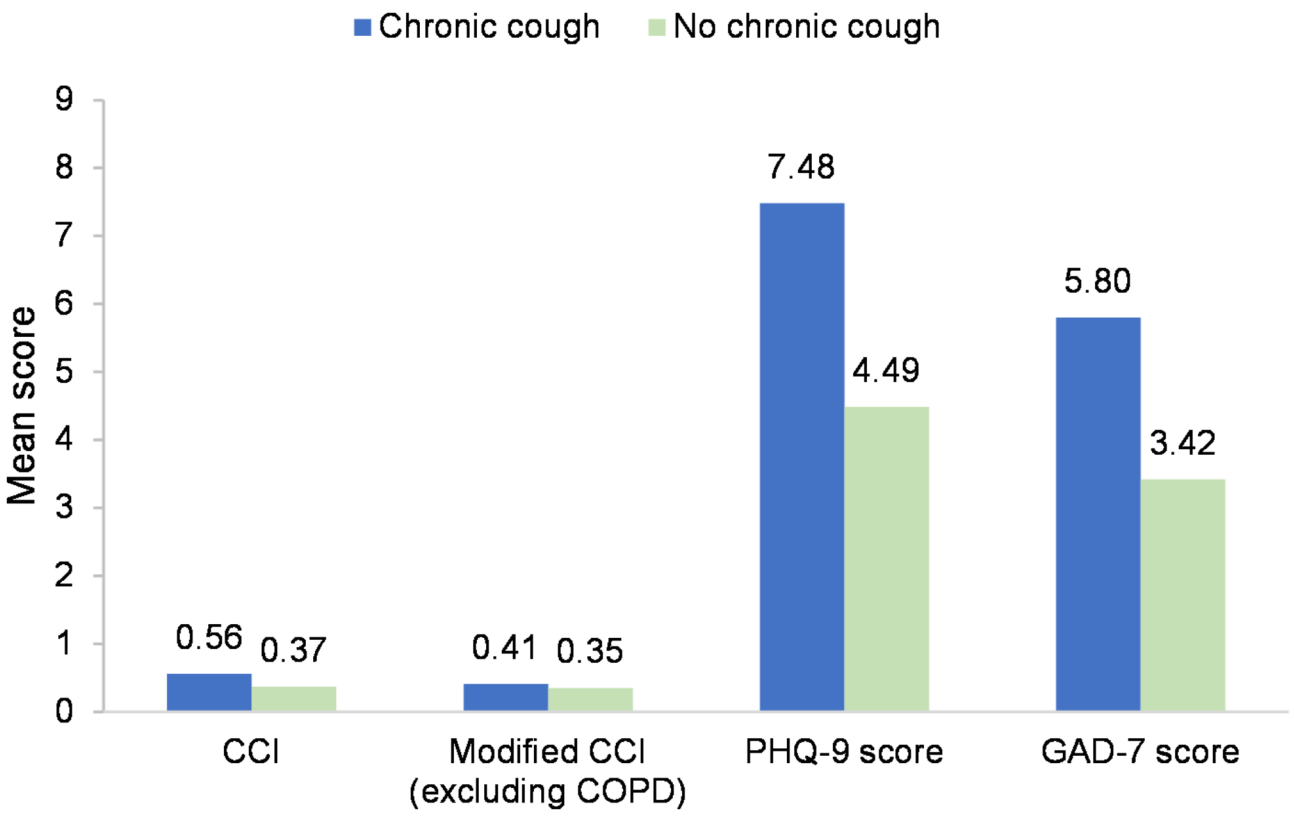

Fig. 1 Health-related characteristics of respondents with chronic cough, compared to a matched control group. CCI, Charlson Comorbidity Index; COPD, chronic obstructive pulmonary disorder; GAD-7, Generalized Anxiety Disorder symptom scale; PHQ-9, Patient Health Questionnaire depression symptom scale. Respondents who reported having chronic cough in the last 12 months were matched 1:3 by chronic cough propensity score (based on age, gender, interaction of marital status and income, and modified CCI, excluding COPD) with respondents with no chronic cough in the last 12 months. Values are displayed as the mean of the continuous scores for each measure. *P*-values were calculated using the two-tailed *t*-test. All values were statistically significantly different ($P < 0.001$) between the chronic cough ($N = 801$) and the no chronic cough ($N = 2{,}381$) groups, except modified CCI ($p = 0.134$)

The estimated 4.1% weighted annual prevalence of chronic cough was lower than the estimated overall prevalence reported by a recent meta-analysis, which was 8.8% among studies that defined chronic cough as daily cough for >8 weeks [35]. However, most of the included studies had small sample sizes and a low-to-moderate grade of evidence [35]. The current study population was larger and more nationally representative than that of most of the studies included in the prior analysis, and prevalence was weighted to the national population to minimize sampling bias. Further, the estimated weighted annual prevalence was lower than the estimated three-year average probability (8.9%) reported from an administrative claims database study among Chinese adults from nine cities in 2015, 2016, and 2017 [50]. However, the prevalence estimated herein is also broadly similar to the findings of equivalent studies that analyzed NHWS data from other countries, which reported a weighted annual prevalence that ranged from 4.3% in Japan and South Korea to 6.3% in Italy and a lifetime prevalence that ranged from 6.2% in South Korea and the UK to 9.2% in Italy (Table 1) [11, 12, 15, 34, 36–39].

The nationally representative nature of the study population also allowed us to characterize the demographics of chronic cough among Chinese adults. Globally, chronic cough is generally associated with older age, with a peak prevalence at ≥50 years of age [51, 52]. In the current study, the numerically highest prevalence of chronic cough was observed among individuals 30–39 and ≥75 years of age, and the mean age of 43.5 years among individuals with chronic cough was lower than in studies that used NHWS data from other countries (US, 50.1 years; Germany, 52.1 years) [12, 15]. Studies of the demographics of chronic cough in China have identified some interesting potential differences compared to other national populations. Our findings are consistent with previous reports that Chinese populations with chronic cough are younger than equivalent populations from other countries, and that there may be a peak prevalence of chronic cough during middle age in China [8, 22, 51, 52]. However, in a study that surveyed a nationally representative sample of approximately 51,000 Chinese adults, Huang et al. reported a mean age of 52.0 years among a group of 1,985 individuals with chronic cough, which is more

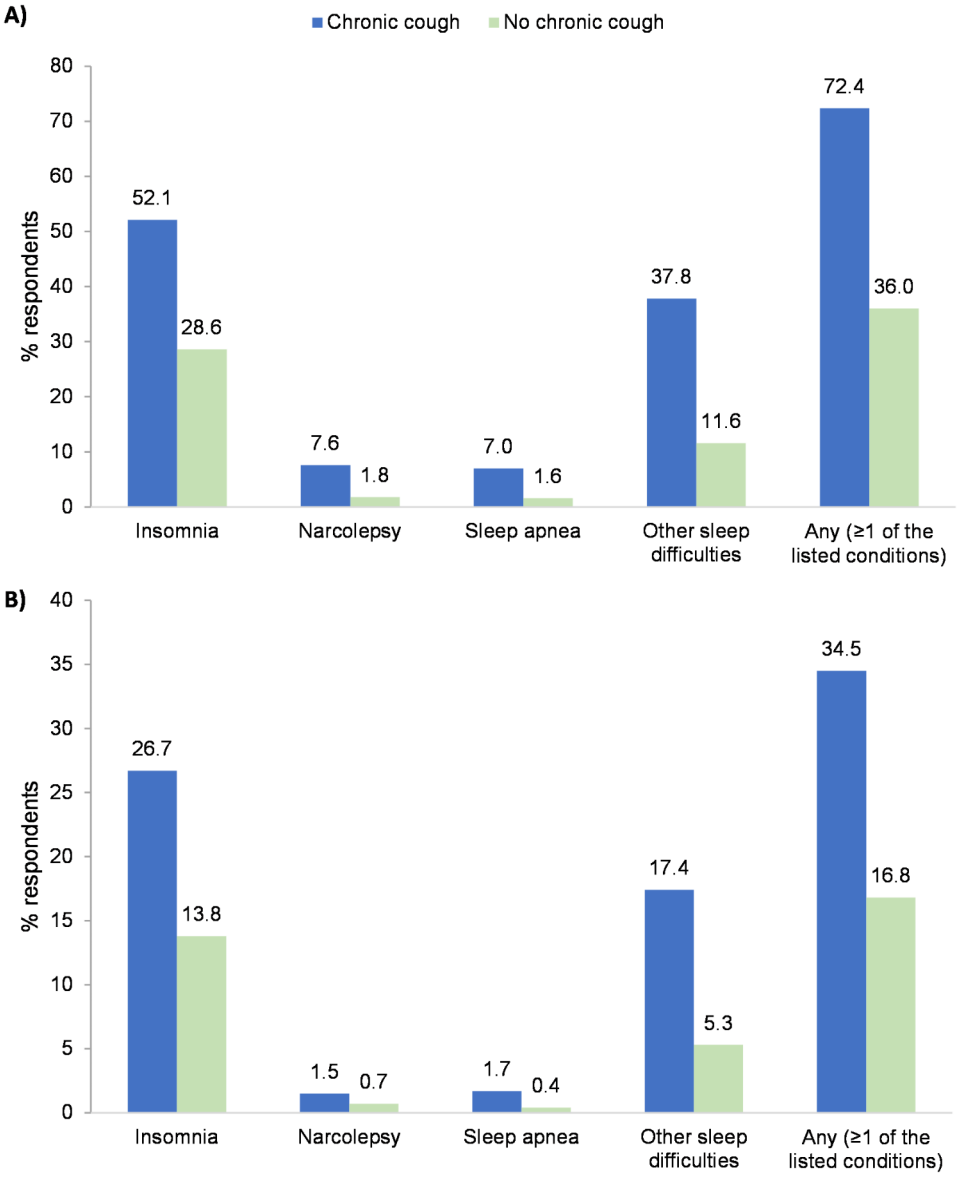

Fig. 2 Percent of respondents with chronic cough **A**) ever experiencing sleep-related conditions during the prior 12-month period and **B**) ever diagnosed with sleep-related conditions, compared to a matched control group. Respondents who reported having chronic cough in the last 12 months were matched 1:3 by chronic cough propensity score (based on age, gender, interaction of marital status and income, and modified Charlson Comorbidity Index, excluding chronic obstructive pulmonary disease) with respondents with no chronic cough in the last 12 months. *P*-values were calculated using the two-tailed chi-square test. All values were statistically significantly different between the chronic cough ($N=801$) and the no chronic cough ($N=2,381$) groups ($p=0.031$ for the percent diagnosed with narcolepsy; $P<0.001$ for all other comparisons)

consistent with the demographics of the condition in Western nations [5]. The use of different definitions of chronic cough (≥ 8 weeks in the current study versus ≥ 3 months in Huang et al.; the latter definition was based on that of chronic bronchitis) may explain this discrepancy, highlighting the importance of consistent definitions of chronic cough.

Further, studies in other countries have consistently found that chronic cough is strongly associated with female sex, potentially due to a more sensitive cough reflex among women [11, 12, 15, 26, 31, 51–57]. However, as comprehensively reviewed by Bai et al. [51], almost all studies that have reported the sex distribution of chronic cough in Chinese populations have identified either a weaker female preponderance than is seen in most studies from other countries, a roughly equal prevalence among men and women, or even a slight male preponderance [5, 10, 17–19, 22, 24, 26, 27, 58]. Our finding that men and women had a similar prevalence of chronic cough may be explained by the higher prevalence of smoking among men compared to women. In an additional analysis, we found that the proportion of current

Table 5 Health-related outcomes for respondents with chronic cough, compared to a matched control group

Outcome	Chronic cough (*N* = 801)	No chronic cough (*N* = 2,381)	*P*-value [A]
Health-related quality of life (SF-12v2 scale) [B]			
Physical component summary score	46.75 (7.53)	51.11 (7.31)	< 0.001
Mental component summary score	44.89 (7.86)	49.11 (8.14)	< 0.001
SF-6D utility score [C]	0.64 (0.09)	0.73 (0.13)	< 0.001
Physical functioning score	47.81 (8.96)	51.87 (8.00)	< 0.001
Role physical score	43.45 (8.45)	48.89 (8.52)	< 0.001
Bodily pain score	43.21 (8.00)	48.74 (8.72)	< 0.001
General health score	47.15 (11.13)	50.57 (10.59)	< 0.001
Vitality score	52.60 (9.20)	55.91 (10.91)	< 0.001
Social functioning score	43.97 (8.32)	48.83 (8.56)	< 0.001
Role emotional score	38.62 (10.13)	44.99 (10.15)	< 0.001
Mental health score	47.59 (7.93)	50.80 (8.36)	< 0.001
EQ-5D-3 L [D]			
EQ-5D index	0.84 (0.19)	0.93 (0.13)	< 0.001
EQ-5D VAS	74.85 (18.89)	83.20 (17.19)	< 0.001
Activity impairment (% impairment of non-work daily activities)	34.89 (26.04)	21.36 (24.88)	< 0.001
Work productivity impairment (% of work hours); employed respondents only [E]	(*N* = 570)	(*N* = 1,691)	
Absenteeism	10.47 (15.25)	4.77 (12.34)	< 0.001
Presenteeism	36.70 (27.22)	21.27 (25.92)	< 0.001
Total work productivity impairment	40.87 (28.83)	23.33 (27.28)	< 0.001

VAS, visual analog score. Respondents who reported having chronic cough in the last 12 months were matched 1:3 by chronic cough propensity score (based on age, gender, interaction of marital status and income, and modified Charlson Comorbidity Index, excluding chronic obstructive pulmonary disease) with respondents with no chronic cough in the last 12 months. Values are presented as mean (standard deviation)

[A] *P*-values were calculated using the two-tailed *t*-test

[B] Health-related quality of life on the Medical Outcomes Study 12-Item Short Form Survey Version 2 (SF-12v2), which is calculated with a mean (standard deviation) score of 50 [10], with higher scores representing better health [43, 44]

[C] Health utility score with a scale of 0–1 derived from the SF-12v2, with higher scores representing better health [45]

[D] Health state on the EuroQol 5-Dimension Health Questionnaire scale of 0–1 (composite index score) or 0–100 (VAS), with higher scores representing better health [47]

[E] Information collected using the Work Productivity and Activity Impairment questionnaire [48]

and former smokers was five times higher among men than women. However, the prevalence of chronic cough among male smokers was lower than that among female smokers. Among never smokers, we found no difference in the prevalence between men and women (data not shown). Smoking could be an effect modifier which at least partially contributed to the observed sex differences in China compared to the global pattern of a strong female preponderance [5, 8, 10–12, 17–19, 22, 24, 39, 51, 52, 58]. The smoking distribution in additional analyses varied by age and sex, suggesting that the overall demographics of chronic cough in China may be due to a higher prevalence of the condition among younger men than is seen elsewhere in the world [8, 22, 51]. Our analysis thus contributes further evidence that the sex distribution of chronic cough in China differs from that observed in many Western nations.

Our study confirms previous reports from China and other countries that chronic cough is more common among individuals with a history of smoking cigarettes [5, 11, 12, 15, 20, 22, 23]. However, more than half (57.7%) of the current study population who reported experiencing chronic cough had never smoked, which is consistent with other reports from China [5, 8, 22]. It has previously been suggested that the distinct demographics of chronic cough in China may be driven at least partially by cigarette smoking, since Chinese men (and particularly young men) have one of the highest rates of cigarette smoking in the world while Chinese women have one of the lowest [8, 22, 51, 59, 60]. However, our findings are consistent with previous reports suggesting that other factors are also involved. For example, in the current study, chronic cough was significantly associated with lower-coverage forms of health insurance (i.e., Urban Resident rather than Urban Employee insurance), which may reflect lower socioeconomic status and less access to health care [61]. Air pollution and occupational or residential exposures, which were not assessed in the current study, have also been suggested as potential risk factors for chronic cough in China, which has one of the highest levels of air pollution in the world; however, the relationship between these variables and chronic cough remains poorly understood [16, 21, 29, 51, 62–64].

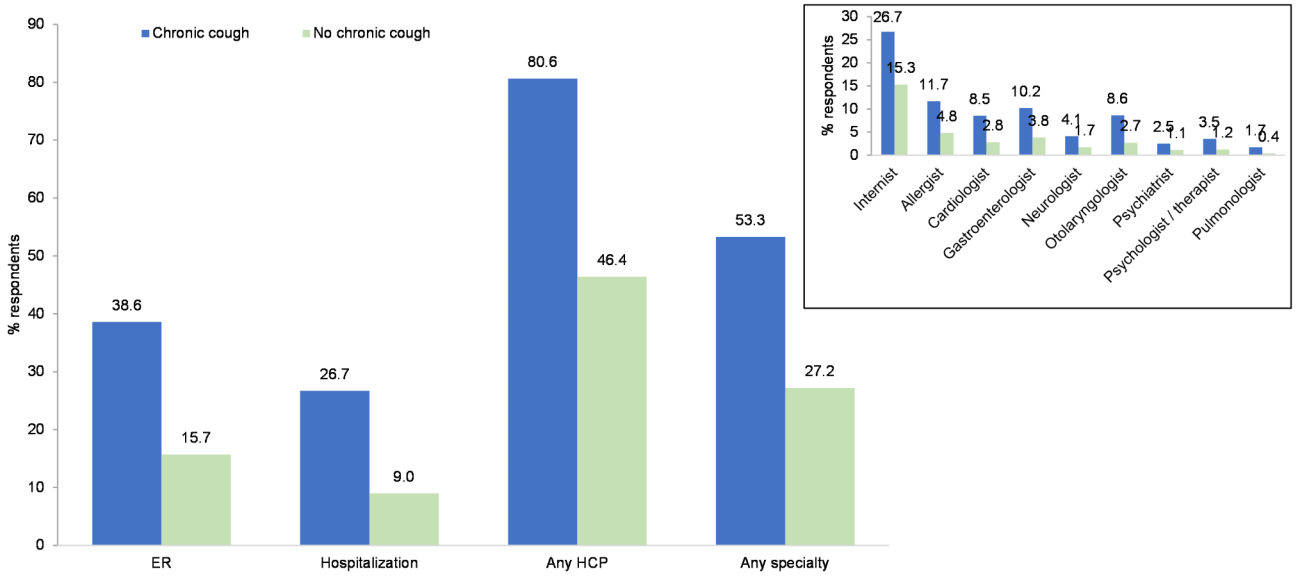

Fig. 3 Health care resource use within the prior 6 months by respondents with chronic cough, compared to a matched control group. ER, emergency room; HCP, health care provider. Respondents who reported having chronic cough in the last 12 months were matched 1:3 by chronic cough propensity score (based on age, gender, interaction of marital status and income, and modified Charlson Comorbidity Index, excluding chronic obstructive pulmonary disease) with respondents with no chronic cough in the last 12 months. *P*-values were calculated using the two-tailed chi-square test. All values were statistically significantly different between the chronic cough ($N=801$) and the no chronic cough ($N=2,381$) groups ($p=0.004$ for the percent visiting a psychiatrist during the last 6 months; $P<0.001$ for all other comparisons). Inset shows health care resource use by specialty

Our study comprehensively assessed the health-related characteristics and outcomes of adults with chronic cough. Adults with chronic cough had significantly worse health and health-related outcomes than matched controls, and higher proportions of this group had experienced health-related impairment of sleep, work, and other daily activities. They also reported more frequent use of a range of specialty and non-specialty health care resources. These findings add to the body of evidence that chronic cough represents a serious health burden in China in terms of physical and mental health, quality of life, work productivity, and health care resource use [5, 9, 10, 22, 29]. Our results are supported by a retrospective observational study of a nationwide claims database in China, which concluded that chronic cough is common among medical insurance users, leading to substantial utilization of medical resources and posing a significant burden on healthcare in China [50].

This study used validated instruments to comprehensively survey a large, nationally representative sample of the adult population of mainland China. Our matching strategy rigorously compared adults who had experienced chronic cough within the prior 12 months to a control group of survey respondents who had not. The assessment of a general population sample rather than the specialist samples (e.g., cough clinic attendees) included in many previous Chinese studies allowed us to generate a broader analysis of the characteristics of people living with chronic cough in China and of the national health-related burden of the disease for individuals and the health care system. Our findings bolster the existing literature reporting a distinct demographic pattern in China that merits further study.

However, this study is also subject to some known limitations. Although we used a sampling and weighting strategy designed to minimize sampling bias, some degree of sampling bias may remain, which may affect the accuracy of the weighted prevalence estimates for the full national population. The NHWS likely under-represents people without access to or comfort with online surveys, including less healthy older adults, institutionalized individuals, and individuals with severe health conditions or disabilities. Study measures were self-reported and may be subject to recall and other biases; to mitigate these issues, the survey questions focused on recent timeframes (e.g., prior week or month) when possible and the list of answers to potentially sensitive questions included "don't know" and "prefer not to answer" options. Further, the data presented in this study are derived from the 2020 fielding of the NHWS, which was administered during the earliest stages of the COVID-19 pandemic. As research on the SARS-CoV-2 virus continues to evolve, its impact on the prevalence of chronic cough remains uncertain [65, 66]. However, we believe the impact of the pandemic was minimal as strict lockdown measures implemented across the country likely limited exposure to respiratory infections and environmental triggers.

Conclusions

In conclusion, chronic cough affects approximately 27.2 million adults per year in China and is associated with worse health, worse health-related quality of life, work productivity loss, impairment of daily activities, and increased all-cause health care resource use. Our findings are consistent with those of many previous Chinese studies and add to the literature on the characteristics of the general population living with chronic cough. Improved treatment options are needed to reduce the individual and health care system burden of the disease.

Abbreviations

CCI	Charlson Comorbidity Index
COPD	Chronic obstructive pulmonary disease
EQ-5D-5L	EuroQol 5-Dimension Health Questionnaire
GAD-7	General Anxiety Disorder 7-item scale
GERD	Gastroesophageal reflux disease
NWHS	National Health and Wellness Survey
PHQ-9	Patient Health Questionnaire 9-item scale
SF-12v2	Medical Outcomes Study 12-item Short Form Survey Version 2
WPAI	Work Productivity and Activity Impairment
SF-6D	Short-Form 6-Dimension

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12890-025-03661-6.

Supplementary Material 1

Acknowledgements

The authors thank Cath Ennis, PhD, in collaboration with ScribCo for medical writing assistance.

Author contributions

Conception, design or planning of the study: E.F.Interpretation of the results: K.L., V.W.L., L.C., K.X., A.M., N.A.W., and H.D. Drafting of the manuscript: H.D.Critically reviewing or revising the manuscript for important intellectual content: K.L., V.W.L., L.C., K.X., A.M., N.A.W., H.D., and E.F. All authors approve the final version to be published and agree to be accountable for all aspects of the work.

Funding

This study was funded by Merck Sharp & Dohme LLC, a subsidiary of Merck & Co., Inc., Rahway, NJ, USA.

Data availability

Data for these analyses were made available to the authors through third-party license from Oracle Life Sciences, a commercial data provider in the United States. As such, the authors cannot make these data publicly available. Other researchers can access these data by purchasing a license through Oracle Life Sciences. Inclusion criteria specified in the Methods section would allow other researchers to identify the same cohort of patients we used for these analyses. Interested individuals may refer to https://www.oracle.com/life-sciences/real-world-evidence/ for more information on accessing these data.

Declarations

Ethics approval and consent to participate

All NHWS participants read an informed consent statement and provided electronic confirmation of their consent to participate. Respondents who provided consent were assigned a unique code that can only be linked to personal information by a team within Oracle Life Sciences that was not involved in the current study. The NHWS protocols and questionnaires were reviewed and granted an exemption by the Pearl Institutional Review Board (Protocol #20-KANT-228. KN-NHWS-NC20 The 2020 China National Health and Wellness Survey Patient Centered Research Program).

Consent for publication

Not applicable.

Competing interests

Kefang Lai has received honoraria from AstraZeneca, Chiesi, Circassia, Daiichi Sankyo (China), GSK, Merck & Co., Inc., Shionogi Inc., and Novartis; he has received research funding and other support from AstraZeneca, Chiesi, Circassia, Daiichi Sankyo (China), GSK, Merck & Co., Inc., and Novartis. Vicky W Li and Nate A Way are employees of Oracle Life Sciences, Seattle, WA, USA which received funding to conduct this study from Merck Sharp & Dohme LLC, a subsidiary of Merck & Co, Inc., Rahway, NJ, USA. Ashley Martin was an employee of Oracle Life Sciences, Seattle, WA, USA which received funding to conduct this study from Merck Sharp & Dohme LLC, a subsidiary of Merck & Co, Inc., Rahway, NJ, USA, at the time of the study. Helen Ding and Eileen Fonseca are employees of Merck Sharp & Dohme LLC, a subsidiary of Merck & Co., Inc., Rahway, NJ, USA and shareholders in Merck & Co., Inc., Rahway, NJ, USA. Lin Chen and Kai Xia are employees of MSD China and shareholders in Merck & Co., Inc., Rahway, NJ, USA.

Received: 24 October 2024 / Accepted: 14 April 2025
Published online: 13 May 2025

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