Prevalence and burden of chronic cough in France

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Abstract

Background Chronic cough is a common condition that is associated with lower health-related quality of life and greater healthcare resource use. There are limited data on the prevalence, population characteristics and burden of chronic cough in France.

Methods This was a cross-sectional study based on responses from French adult residents to the 2020 National Health and Wellness Survey. Respondents with chronic cough were compared to 1:3 propensity score-matched controls without chronic cough.

Results The weighted lifetime and 12-month prevalence of chronic cough were estimated as 7.5% and 4.8%, respectively. Respondents with chronic cough reported significantly worse perceived health than matched controls, with lower mean±SD scores of 46.68±9.28 *versus* 50.42±8.26 on the physical health component and 40.32±9.87 *versus* 44.32± 9.69 on the mental health component of the Medical Outcomes Study 12-item Short Form Survey Version 2 survey (p<0.001 for both comparisons). Respondents with chronic cough also had higher rates of moderate-to-severe forms of anxiety (24.4% *versus* 12.4%) and depression (36.4% *versus* 20.2%); higher rates of multiple forms of sleep disturbance; greater impairment of work productivity (38.2% *versus* 25.5%) and other activities (41.8% *versus* 28.2%; p<0.001 for all comparisons). Respondents with chronic cough also had higher rates of all-cause healthcare resource use including emergency room visits, hospitalisation, and overall and specialist healthcare provider visits compared to controls (p<0.001 for all comparisons).

Conclusion Chronic cough is a common condition in France that is associated with lower health-related quality of life and greater healthcare resource utilisation.

Introduction

Chronic cough (cough that persists for ⩾8 weeks [1]) has been associated with acute respiratory infections, certain prescription drugs, and exposure to cigarette smoke and other environmental contaminants, as well as underlying conditions such as asthma and gastro-oesophageal reflux disease [1–3]. The diagnosis and treatment of chronic cough are extremely challenging, often requiring multiple rounds of testing and serial (often off-label) medication trials [1, 4–6]. Previous studies have shown an association of chronic cough with a range of mental and physical health impacts including sleep disturbances, anxiety and depression, as well as negative impacts on the ability to work and enjoy other activities [7–13]. Individuals with chronic cough are also more likely to visit primary, specialist and emergency healthcare providers [6, 11, 14, 15].

Despite the burden of chronic cough on the national healthcare system, it is challenging to obtain accurate estimates of its prevalence. This is due in part to the evolving definition of chronic cough, with earlier guidelines defining chronic cough as cough lasting ⩾3 months [16]. A 2015 meta-analysis estimated an overall prevalence of chronic cough in Europe of 12.7%; however, there was substantial variation between individual European countries [17]. More recent studies based on nationally representative online surveys have

estimated the 12-month prevalence of chronic cough in Spain [18], the USA [15], the UK [14], Germany [19] and Denmark [20]. However, to our knowledge there are no published data on the national prevalence or demographics of chronic cough in many individual European countries, including France.

The objective of the current study was to use a nationally representative survey to determine the 12-month and lifetime prevalence of chronic cough in France, and to describe the sociodemographic characteristics of adults with chronic cough. We also aimed to characterise the health and wellness burden of chronic cough, including impact on work and other activities as well as healthcare resource use (HCRU).

Methods

Study design and sample

The study used data from the 2020 fielding of the National Health and Wellness Survey (NHWS), an international, self-administered, internet-based health survey conducted annually in France, other countries in Europe and Asia, and the USA. The 2020 fielding was administered to the general population panel between December 2019 and March 2020 using a stratified quota sampling framework to ensure survey respondents matched the demographic distribution of adults in France on age and sex. Inclusion criteria for the NHWS were age ⩾18 years, the ability to provide informed consent, and the ability to read and write in French. There were no specific exclusion criteria. Post-data collection weighting was conducted to adjust for the potential sample bias due to age and sex. In the present study, respondents who indicated that they had ever experienced chronic cough (defined as daily cough for ⩾8 weeks) were included in calculations of lifetime prevalence of chronic cough, whereas respondents who indicated that they had experienced chronic cough during the past 12 months were included in calculations of prevalence of 12-month chronic cough. Both weighted and unweighted prevalence estimates were calculated and reported. Respondents who did not experience chronic cough in the past 12 months were retained as a control group. All study respondents underwent informed consent, and respondent information was fully anonymised. The study received an exempt status upon evaluation by the Pearl Institutional Review Board.

Study measures

Demographic data and health-related characteristics were collected in the NHWS survey. Several validated instruments were used to assess different aspects of physical and mental health. Anxiety symptoms during the prior 2 weeks were self-reported on a scale of 0–21 using the General Anxiety Disorder 7-item questionnaire (GAD-7) [21], and depression symptoms during the prior 2 weeks on a scale of 0–27 using the Patient Health Questionnaire 9-item questionnaire (PHQ-9) [22]. Health-related quality of life (HRQoL) was assessed using the Medical Outcomes Study 12-item Short Form Survey Version 2 (SF-12v2; QualityMetric Inc., Lincoln, RI, USA) [23]. This survey reports on eight health domains used to calculate mental health and physical component summary scores, with a mean±SD score set at 50±10 and higher scores indicating better health. The minimally important difference for the SF-12v2 component and scale scores was 3 points [24]. Responses to SF-12v2 were also used to derive the Short-Form 6-Dimension (SF-6D) health utility score on a scale of 0–1, with 1 representing perfect health [25]. The minimally important difference for the SF-6D health utilities was 0.041 points [25]. Health-related impacts on overall productivity and daily activities were assessed *via* the Work Productivity and Activity Impairment instrument (WPAI), a 6-item validated instrument which consists of four metrics: absenteeism (the percentage of work time missed because of one's health in the past 7 days), presenteeism (the percentage of impairment experienced while at work in the past 7 days because of one's health), overall work productivity loss (an overall impairment estimate that is a combination of absenteeism and presenteeism) and activity impairment (the percentage of impairment in daily activities outside of work because of one's health in the past 7 days) [26]. The extent and type of HCRU in the past 6 months was also determined through questions about hospitalisations and visits to emergency rooms, general/family practitioners and specialist healthcare providers.

Analysis

The overall unweighted lifetime and 12-month prevalence of chronic cough were calculated using the total number of NHWS respondents as denominator. Weighted prevalence estimates, projected to the French population, were generated using Horvitz-Thompson sampling weights calculated using the age and sex distributions reported for France in the 2019/2020 International Data Base of the US Census Bureau [27].

Statistical comparisons were conducted between adults with chronic cough and matched controls without chronic cough based on propensity score matching. Adults who experienced chronic cough in the past 12 months were compared to a propensity score-matched population of adults from the general population (*i.e.*, those who had not experienced chronic cough in the past 12 months) using a 1:3 matching ratio and a caliper width of 0.25 (figure 1). Logistic regression was used to estimate propensity scores based on age, sex, marital status, household income, marital status×household income interaction and a modified
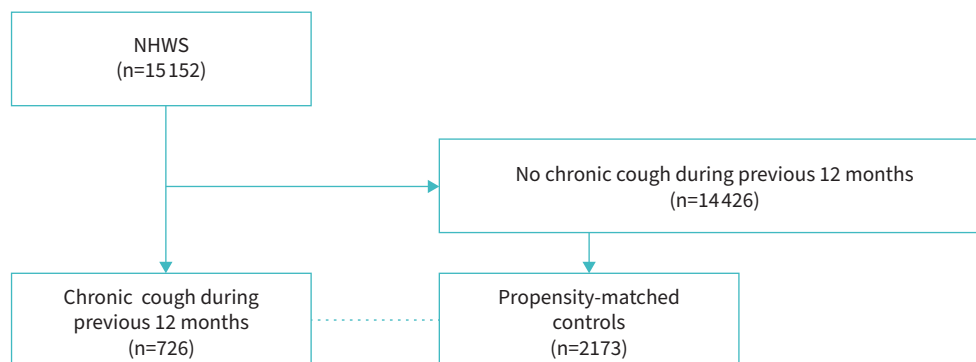
FIGURE 1 Patient disposition diagram. Participants with chronic cough were adult respondents (⩾18 years) to the National Health and Wellness Survey (NHWS) who indicated that they had experienced daily cough for ⩾8 weeks. Controls (indicated by dashed line) were participants with no chronic cough in the prior 12 months who were matched (3:1 ratio) by propensity score to the chronic cough sample on age, sex, marital status, household income, marital status×household income interaction and a modified Charlson comorbidity index that excluded COPD. The caliper width was 0.25.

Charlson comorbidity index (CCI) that excluded COPD, as this condition is commonly associated with chronic cough. Data are reported as mean±SD for continuous variables, and frequency counts (n) and percentages (%) for categorical variables. Statistical comparisons were conducted using Chi-squared and t-tests, as appropriate. Two-tailed p-values of <0.05 were considered statistically significant.

Results

Prevalence of chronic cough in France

A total of 15 152 individuals who met the inclusion criteria completed the 2020 NHWS, of whom 1124 (7.4%) had experienced chronic cough at any time during their lifetime and 730 (4.8%) had experienced chronic cough during the prior 12-month period (table 1). When weighted to the demographics of the entire adult population of France, the respective prevalence rates were estimated as 7.5% and 4.8%. Lifetime and 12-month chronic cough were both significantly more prevalent in current and former smokers than in individuals who had never smoked (unweighted lifetime prevalence, 8.9% *versus* 5.6%, p<0.001; unweighted 12-month prevalence, 5.9% *versus* 3.5%, p<0.001). The lifetime prevalence of chronic cough was significantly different between age groups (p<0.001), with a peak prevalence of 9.0% (unweighted)/10.2% (weighted) in respondents 18–29 years of age and between region of residence (p=0.011) with the highest prevalence in Paris and surrounding regions (8.8% (unweighted)/9.1% (weighted)). The 12-month prevalence of chronic cough was statistically significantly different among age groups only for the weighted values (p=0.017). There was no statistically significant difference between sexes for prevalence of lifetime or 12-month chronic cough.

Sociodemographic characteristics of adults with chronic cough in previous 12 months

Among the 730 respondents who had experienced chronic cough in the previous 12 months, 60.0% were female and 50.1% were ⩾50 years of age (supplementary table S1). Relative to the broader, unmatched general population (*i.e.*, all NHWS respondents who did not experience chronic cough in the prior 12 months), individuals with chronic cough were most likely to be 50–74 years, to be current smokers, and to be married or living with a partner (p<0.01 for all comparisons). A total of four respondents who had experienced chronic cough in the previous 12 months were not matched, and thus 726 respondents were included in the matched analyses.

Among the 726 matched respondents who had experienced chronic cough in the previous 12 months, 60.3% were female and 50.0% were ⩾50 years of age (table 2). Compared to matched non-chronic cough controls, adults with chronic cough had similar sociodemographic characteristics (age, sex, marital status, household income and region of residence) except having a higher percentage of current or former smokers (66.7% *versus* 54.2%, p<0.001).

Health-related quality of life

As a result of matching, respondents with chronic cough and their matched controls had similar modified CCI scores. Respondents with chronic cough in the previous 12 months had significantly lower scores than

TABLE 1 Lifetime and 12-month prevalence of chronic cough among 2020 National Health and Wellness Survey (NHWS) respondents residing in France

Characteristic	Total NHWS sample n (%)	Chronic cough prevalence							
		Lifetime				12-month			
		Unweighted n (%)	p-value	Weighted[#] %	p-value	Unweighted n (%)	p-value	Weighted[#] %	p-value
Total	15 152 (100)	1124 (7.4)		7.5		730 (4.8)		4.8	
Sex			0.568		0.938		0.186		0.177
Male	6418 (42.4)	467 (7.3)		7.6		292 (4.5)		4.6	
Female	8734 (57.6)	657 (7.5)		7.5		438 (5.0)		5.1	
Age group years			**<0.001**		**<0.001**		0.092		**0.017**
18–29	2734 (18.0)	270 (9.9)		10.2		154 (5.6)		5.9	
30–39	2342 (15.5)	171 (7.3)		7.5		98 (4.2)		4.2	
40–49	2495 (16.5)	169 (6.8)		6.5		112 (4.5)		4.2	
50–64	3764 (24.8)	264 (7.0)		7.1		176 (4.7)		4.6	
65–74	3406 (22.5)	228 (6.7)		6.9		176 (5.2)		5.3	
⩾75	411 (2.7)	22 (5.4)		5.7		14 (3.4)		3.4	
Smoking status			**<0.001**		**<0.001**		**<0.001**		**<0.001**
Never smoked	6910 (45.6)	390 (5.6)		5.8		244 (3.5)		3.6	
Current and former smoker	8242 (54.4)	734 (8.9)		9.0		486 (5.9)		5.9	
Region of residence			**0.011**		**0.005**		0.121		0.076
North-East	3586 (23.7)	244 (6.8)		6.7		170 (4.7)		4.7	
West	3258 (21.5)	237 (7.3)		7.5		157 (4.8)		4.9	
Paris and surroundings (Paris-Île-de-France)	2553 (16.8)	224 (8.8)		9.1		144 (5.6)		5.9	
South-East	3680 (24.3)	284 (7.7)		7.8		177 (4.8)		4.8	
South-West	1985 (13.1)	125 (6.3)		6.4		76 (3.8)		3.9	
None of the above	90 (0.6)	10 (11.1)		10.7		6 (6.7)		5.8	

Chronic cough was defined as daily cough for ⩾8 weeks. Statistically significant differences (p<0.05) are shown in bold. [#]: prevalence data were weighted to have the same age and sex distribution of overall adult population in France.

matched controls on several measures of physical and mental health (table 3). The respective mean±SD scores were 46.68±9.28 *versus* 50.42±8.26 on the physical health component of the SF-12v2 survey and 40.32±9.87 *versus* 44.32±9.69 on the mental health component, and 0.63±0.11 *versus* 0.69±0.12 on the SF-6D utility index, which exceeded the minimally important difference of 3 and 0.041 points for the SF-12v2 and SF-6D surveys, respectively (p<0.001 for all comparisons). Respondents with 12-month chronic cough also reported significantly higher rates of anxiety (mean±SD GAD-7 anxiety score 6.17±5.21 *versus* 3.82±4.50) and depression (mean±SD PHQ-9 depression score 8.33±6.20 *versus* 5.38±5.60) than matched controls and were significantly more likely to experience moderate-to-severe forms of both anxiety and depression (p<0.001 for all comparisons).

Sleep, work and daily activities
Chronic cough was significantly associated with a higher incidence of all 12 of the specific sleep problems or symptoms included in the NHWS survey (table 4, p<0.001 for all comparisons). Compared with matched controls, respondents with chronic cough during the previous 12 months reported significantly increased rates of impairment of work productivity (absenteeism, 17.82% *versus* 11.22%; presenteeism, 32.67% *versus* 22.49%; total impairment, 38.16% *versus* 25.53%) and of other daily activities (41.76% *versus* 28.18%; p<0.001 for all comparisons; figure 2).

Healthcare resource use
Respondents were asked whether they had used specific healthcare resources during the previous 6-month period for any cause (table 5). Compared to the matched control group, a significantly greater proportion of respondents with chronic cough had visited any healthcare provider, any specialist, a general or family practitioner, and an emergency room; members of this group were also more likely to have been hospitalised (p<0.001 for all comparisons). Specifically, individuals with chronic cough were significantly more likely to have visited an allergist (p=0.006), gastroenterologist (p=0.003), internist (p=0.010), psychiatrist (p=0.016) or pulmonologist (p<0.001). Experiencing chronic cough within the previous

TABLE 2 Sociodemographic characteristics of respondents with chronic cough in the past 12 months, compared to propensity score-matched controls without chronic cough

Characteristic	Total NHWS population	Chronic cough in prior 12 months	Matched without chronic cough[#]	p-value
Respondents n	2899	726	2173	
Sex				0.552
Male	1123 (38.7)	288 (39.7)	835 (38.4)	
Female	1776 (61.3)	438 (60.3)	1338 (61.6)	
Age group years				0.059
18–24	318 (11.0)	97 (13.4)	221 (10.2)	
25–39	711 (24.5)	154 (21.2)	557 (25.6)	
40–49	454 (15.7)	112 (15.4)	342 (15.7)	
50–64	681 (23.5)	174 (24.0)	507 (23.3)	
65–74	672 (23.2)	176 (24.2)	496 (22.8)	
⩾75	63 (2.2)	13 (1.8)	50 (2.3)	
Smoking status				**<0.001**
Never	1236 (42.6)	242 (33.3)	994 (45.7)	
Former	905 (31.2)	187 (25.8)	718 (33.0)	
Current	758 (26.1)	297 (40.9)	461 (21.2)	
Marital status				0.932[¶]
Married or living with partner	1680 (58.0)	424 (58.4)	1256 (57.8)	
Single, never married, divorced or separated	1214 (41.9)	301 (41.5)	913 (42.0)	
Declined to answer	5 (0.2)	1 (0.1)	4 (0.2)	
Household income[+]				0.623
Low	859 (29.6)	201 (27.7)	658 (30.3)	
Medium	1120 (38.6)	288 (39.7)	832 (38.3)	
High	748 (25.8)	193 (26.6)	555 (25.5)	
Declined to answer	172 (5.9)	44 (6.1)	128 (5.9)	
Region of residence				0.326
North-East	702 (24.2)	170 (23.4)	532 (24.5)	
West	611 (21.1)	156 (21.5)	455 (20.9)	
Paris and its surroundings (Paris-Île-de-France)	498 (17.2)	142 (19.6)	356 (16.4)	
South-East	716 (24.7)	177 (24.4)	539 (24.8)	
South-West	352 (12.1)	76 (10.5)	276 (12.7)	
None of the above	20 (0.7)	5 (0.7)	17 426 (5.8)	

Data are presented as n (%) unless indicated otherwise. Chronic cough was defined as daily cough for ⩾8 weeks. Statistically significant differences (p<0.05) are shown in bold. NHWS: National Health and Wellness Survey. [#]: respondents from the NHWS population without chronic cough in the prior 12 months were matched using a propensity score (ratio 3:1) to the chronic cough sample. Matching variables/covariates included age, sex, marital status, household income, marital status×household income interaction and a modified Charlson comorbidity index that excluded COPD. [¶]: >20% of cells in this category have expected cell counts of <5. Chi-squared results may be invalid. [+]: household income categorised as low, medium or high. Low: <€20 000; medium: €20 000–39 999; high: ⩾€40 000.

12 months was also significantly associated with higher numbers of all-cause emergency room visits (0.68 visits per person *versus* 0.30 for matched controls), hospitalisations (0.60 *versus* 0.24), specialist provider visits (4.77 *versus* 2.95) and overall healthcare provider visits per person (7.31 *versus* 4.73) (p<0.001 for all comparisons; figure 3) in the prior 6 months.

In an age-segregated analysis of HCRU among individuals with chronic cough in the past 12 months (data not shown), older age groups had a significantly higher mean number of visits to any healthcare provider (p=0.041), general or family practitioners (p<0.001), cardiologists (p<0.001), otolaryngologists (p=0.008) or pulmonologists (p<0.001) than did younger age groups, but fewer visits to allergists (p<0.001), internists (p=0.046) or psychologists/therapists (p=0.002). In a similar analysis segregated by sex, female respondents had a significantly higher mean number of visits to general or family practitioners (p<0.001) while male respondents had significantly more visits to cardiologists (p=0.003) and neurologists (p=0.036). There was no significant difference between sexes in the overall number of healthcare provider visits.

Discussion

In this study, we analysed data from a nationally representative sample, enabling us to generate a more robust analysis of the prevalence, demographics and burden of chronic cough among residents of France. The estimated lifetime and 12-month prevalence of chronic cough in France was 7.5% and 4.8%,

TABLE 3 Health-related quality of life measures of respondents with chronic cough in the past 12 months, compared to propensity score-matched controls without chronic cough

| Summary score	Chronic cough in prior 12 months	Matched controls without chronic cough[#]	p-value
Respondents n	726	2173	
CCI, modified (without COPD), mean±SD	0.41±1.00	0.37±0.94	0.297
SF-12v2, mean±SD			
Physical component	46.68±9.28	50.42±8.26	**<0.001**
Mental component	40.32±9.87	44.32±9.69	**<0.001**
SF-6D Utility Index, mean±SD	0.63±0.11	0.69±0.12	**<0.001**
GAD-7 anxiety score, mean±SD[¶]	6.17±5.21	3.82±4.50	**<0.001**
Anxiety, n (%)			**<0.001**
None (0–4)	331 (45.6)	1406 (64.7)	
Mild (5–9)	218 (30.0)	497 (22.9)	
Moderate (10–14)	121 (16.7)	193 (8.9)	
Severe (15–21)	56 (7.7)	77 (3.5)	
PHQ-9 depression score, mean±SD[+]	8.33±6.20	5.38±5.60	**<0.001**
Depression, n (%)			**<0.001**
None–minimal (0–4)	239 (32.9)	1207 (55.5)	
Mild (5–9)	223 (30.7)	528 (24.3)	
Moderate (10–14)	150 (20.7)	262 (12.1)	
Moderate–severe (15–19)	69 (9.5)	129 (5.9)	
Severe (20–27)	45 (6.2)	47 (2.2)	

Chronic cough was defined as daily cough for ⩾8 weeks. Statistically significant differences (p<0.05) are shown in bold. CCI: Charlson comorbidity index; SF-12v2: Medical Outcomes Study 12-item Short Form Survey Version 2; SF-6D: Short-Form 6-Dimension; GAD-7: General Anxiety Disorder 7-item questionnaire; PHQ-9: Patient Health Questionnaire 9-item. [#]: propensity score-matched to chronic cough sample on age, sex, marital status, household income, marital status×household income interaction and a modified CCI that excluded COPD. [¶]: anxiety symptoms over the prior 2 weeks on the GAD-7 scale of 0–21. [+]: depression symptoms over the prior 2 weeks on the PHQ-9 scale of 0–27.

respectively. Lifetime chronic cough significantly differed between age groups, smoking status and region of residence, while 12-month prevalence significantly differed only by smoking status. Chronic cough during the previous 12-month period was associated with significantly poorer scores on several validated

TABLE 4 Proportions of respondents with chronic cough in the past 12 months regularly experiencing sleep problems, compared to propensity score-matched controls without chronic cough

Problem or symptom	Chronic cough in prior 12 months	Matched controls without chronic cough[#]	p-value
Respondents, n	726	2173	
Difficulty falling asleep	333 (45.9)	716 (32.9)	**<0.001**
Waking during night[¶]	250 (34.4)	538 (24.8)	**<0.001**
Waking up several times	270 (37.2)	549 (25.3)	**<0.001**
Waking up too early	208 (28.7)	392 (18.0)	**<0.001**
Sleep apnoea	81 (11.2)	94 (4.3)	**<0.001**
Leg cramps/leg problems	127 (17.5)	217 (10.0)	**<0.001**
Waking up to go to the bathroom	259 (35.7)	516 (23.7)	**<0.001**
Night sweats/hot flashes	107 (14.7)	207 (9.5)	**<0.001**
Pain	109 (15.0)	174 (8.0)	**<0.001**
Poor quality of sleep	234 (32.2)	399 (18.4)	**<0.001**
Daytime sleepiness	170 (23.4)	224 (10.3)	**<0.001**
Difficulty staying awake	63 (8.7)	73 (3.4)	**<0.001**
Other	10 (1.4)	19 (0.9)	0.238

Data are presented as n (%) unless indicated otherwise. Chronic cough was defined as daily cough for ⩾8 weeks. Statistically significant differences (p<0.05) are shown in bold. [#]: propensity score-matched to chronic cough sample on age, sex, marital status, household income, marital status×household income interaction and a modified Charlson comorbidity index that excluded COPD. [¶]: waking during the night defined as waking during the night and not being able to get back to sleep.
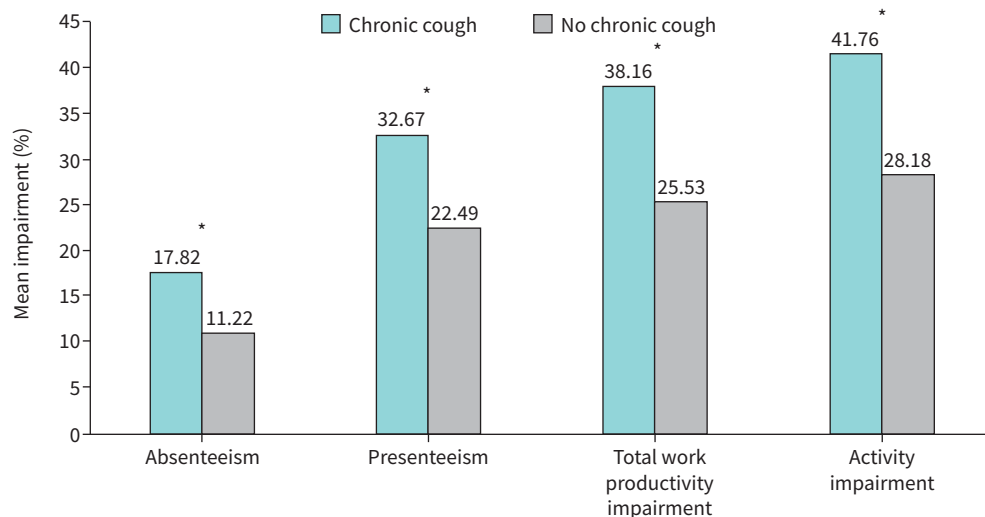
FIGURE 2 Work and activity impairment among respondents with chronic cough in the past 12 months, compared to propensity score-matched controls without chronic cough. Chronic cough was defined as daily cough for ⩾8 weeks. Controls were propensity score-matched to the chronic cough sample on age, sex, marital status, household income, marital status×household income interaction and a modified Charlson comorbidity index that excluded COPD. Values represent mean impairment % in prior 7 days of: absenteeism, missed work hours; presenteeism, impaired work hours; total work productivity impairment (combined impact of absenteeism and presenteeism); activity impairment, non-paid activity impairment. Statistically significant differences (p<0.05) are marked with an asterisk.

patient-reported outcome measures that assess physical and mental health and HRQoL, as well as with higher rates of HCRU and negative impacts on sleep, work and other daily activities.

The prevalence rates we estimated for the French population are lower than the previously reported overall global (9.6%) and European (12.7%) means reported in a 2015 meta-analysis [17]. However, while the

TABLE 5 Healthcare resource use in the past 6 months by respondents with chronic cough in the past 12 months, compared to propensity score-matched controls without chronic cough

Healthcare resource	Chronic cough in prior 12 months	Matched controls without chronic cough[#]	p-value
Respondents n	726	2173	
Emergency room visits	0.68±2.39	0.30±1.79	**<0.001**
Hospitalisations	0.60±2.07	0.24±1.45	**<0.001**
Any healthcare provider visits	7.31±10.38	4.73±6.79	**<0.001**
Total visits to any of the below specialties	4.77±8.25	2.95±5.32	**<0.001**
Allergist	0.14±0.97	0.04±0.30	**0.006**
Cardiologist	0.28±2.11	0.18±1.53	0.237
Gastroenterologist	0.13±0.59	0.07±0.31	**0.003**
General/family practitioner	2.36±2.73	1.77±2.34	**<0.001**
Internist	0.14±1.14	0.03±0.32	**0.010**
Neurologist	0.06±0.31	0.05±0.29	0.438
Nurse practitioner/physician assistant	0.67±4.18	0.37±3.11	0.072
Otolaryngologist	0.05±0.25	0.05±0.41	0.993
Psychiatrist	0.44±2.85	0.18±1.12	**0.016**
Psychologist/therapist	0.34±2.75	0.19±1.43	0.171
Pulmonologist	0.16±0.58	0.03±0.27	**<0.001**

Data are presented as mean±SD unless indicated otherwise. Chronic cough was defined as daily cough for ⩾8 weeks. Statistically significant differences (p<0.05) are shown in bold. #: propensity score-matched to chronic cough sample on age, sex, marital status, household income, marital status×household income interaction and a modified Charlson comorbidity index that excluded COPD.
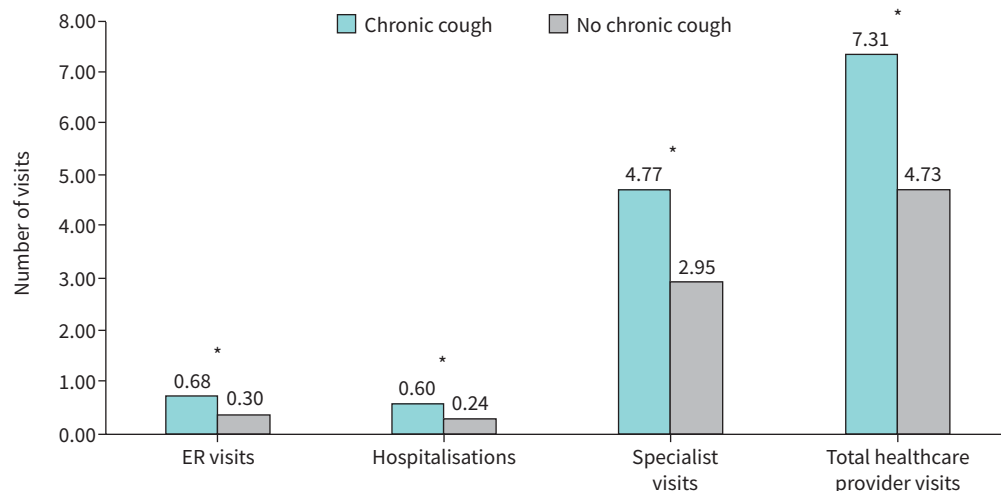
FIGURE 3 Healthcare resource use in the past 6 months among respondents with chronic cough in the past 12 months, compared to propensity score-matched controls without chronic cough. Chronic cough was defined as daily cough for ⩾8 weeks. Controls were propensity score-matched to the chronic cough sample on age, sex, marital status, household income, marital status×household income interaction and a modified Charlson comorbidity index that excluded COPD. Values represent mean visits to different healthcare providers during the prior 6 months. Statistically significant differences ($p < 0.05$) are marked with an asterisk. ER: emergency room.

2015 meta-analysis included France in the 0–5% prevalence category, a specific value was not provided for the country and no studies set in France were included in the analysis. It is thus possible that the prevalence of chronic cough in France was not accurately reflected in the meta-analysis. By contrast, our estimated prevalence rates are similar to those reported for Spain (8.2% (lifetime)/5.5% (12-month)) [18], the USA (5.0% 12-month) [15], the UK (6.2% (lifetime)/4.9% (12-month)) [14], Germany (6.5% (lifetime)/4.9% (12-month)) [19] and Denmark (3.8% 12-month) [20] by authors using the same definition of chronic cough and comparable survey-based methods as the current study. In the present study, the weighted lifetime prevalence of chronic cough ranged from 6.4 in the South-West region to 9.1 in Paris and surrounding regions. It is possible that the higher lifetime rate of chronic cough observed among residents of densely populated, urban Paris and its surroundings may reflect the previously documented connection between chronic cough and exposure to particulates and other forms of air pollution [28, 29].

Similar to the previously published results of a cross-sectional study of a representative panel of adults responding to the German NHWS, the lifetime prevalence of chronic cough in the present study was significantly different between age groups, with a peak prevalence in respondents 18–29 years of age [19]. Studies of individuals with chronic cough attending specialist cough clinics have generally reported an older mean age [9–11], which may reflect the time taken for assessment, initial treatment attempts and specialist referral. Our analysis of HCRU segregated by age group suggests that there may also be differences in healthcare seeking behaviour by age that contribute to the younger mean age of individuals with chronic cough in the current general population-based sample compared to previous studies conducted at specialist clinics.

Our finding of an association between chronic cough and smoking is also in line with previous reports from multiple countries [13, 20, 30–32]. However, the lack of a statistical association between chronic cough and sex in the current population sample differs from the results of many previous studies [6–8, 10–13, 15, 16, 20, 33–35]. Although specialty chronic cough clinics show female predominance of chronic cough [7, 8, 35], the same pattern is not necessarily observed in population-based studies. Of note, the systematic literature review by SONG *et al.* [16] reported a sex-specific pooled prevalence of 9.6% among males and 8.6% among females. Furthermore, another study looking at the sex distributions of individuals with chronic cough noted that certain regions of China had higher male-to-female ratios [36]. Similar results were reported in the Canadian Longitudinal Study on Aging, with more males than females reporting chronic cough at baseline (15.2% *versus* 12.7%); [37] after adjusting for age and smoking status, the incidence of chronic cough was still slightly higher among males. Our findings suggest that there may be sex-related differences in healthcare-seeking behaviour among individuals with chronic cough, which

may contribute to this phenomenon. Further investigation is needed to characterise and understand the sex-specific prevalence and epidemiology of chronic cough in France.

The current study confirmed previous reports that chronic cough is associated with poorer individual health and HRQoL, as well as increased rates of all-cause primary, secondary and emergency HCRU and lost work productivity [6–15].

The study was subject to a few limitations. Despite using a probability sampling framework and post-data collection weighting technique, sampling bias may exist for unadjusted demographic characteristics. However, compared with propensity score-matched non-chronic cough controls, adults with chronic cough had similar sociodemographic characteristics (age, sex, marital status, household income and region of residence) to adults without chronic cough, thus we do not expect the unadjusted factors results to bias the results presented here. The survey-based methodology did not allow causality to be determined and depended on self-reported measures with no independent confirmation available, potentially introducing recall and self-presentation biases. The survey design sought to minimise these biases by focusing on recent timeframes whenever possible, using validated and well-established patient-reported outcome measures, and allowing respondents to select "don't know" and "refuse to answer" options for questions referring to potentially sensitive information. The proportion of current and former smokers was significantly higher among the chronic cough group compared to matched controls, which may have led to an overestimation of the specific impact of chronic cough on HRQoL and HCRU, as other smoking-related comorbidities may have also contributed to the differences in these outcomes. However, we matched using age, sex, marital status, household income, marital status×household income interaction and a modified CCI that excluded COPD to help reduce this bias. Finally, the data reported here are derived from the 2020 fielding of the NHWS, which was administered to an age- and sex-representative sample of adults in France between December 2019 and March 2020, *i.e.*, during the earliest stages of the COVID-19 pandemic in France. Data on the SARS-CoV-2 respiratory virus continues to unfold, and its effects on the prevalence and characteristics of chronic cough are not yet known [38, 39]. The prevalence of chronic cough among the study population may therefore differ from the prevalence of chronic cough in France before, or during subsequent phases of, the COVID-19 pandemic. Further, the pandemic may have affected respondents' healthcare-seeking behaviour, potentially with a greater impact on the behaviour of individuals with prevalent chronic cough during the early phases of the pandemic. The extent to which the pandemic affected the study's findings related to HCRU is not known.

Conclusions

In conclusion, we estimated that 7.5% of adult residents of France have experienced chronic cough during their lifetime, and 4.8% within the previous 12 months. We confirmed reports from other countries that chronic cough is associated with higher rates of anxiety and depression, reduced HRQoL, increased use of healthcare system resources, and negative impacts on sleep, work and other daily activities. These analyses will inform future efforts to improve the diagnosis, management and treatment of chronic cough in France, and to characterise and reduce the impacts on the healthcare system.

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