

Epidemiology

Illness perception and related behaviour in lower respiratory tract infections—a European study

Patricia M Hordijk^{a,*}, Berna D L Broekhuizen^a, Chris C Butler^b, Samuel Coenen^c, Maciek Godycki-Cwirko^d, Herman Goossens^c, Kerry Hood^e, Richard Smith^f, Saskia F van Vugt^a, Paul Little^g and Theo J M Verheij^a on behalf of the GRACE Project Group

^aJulius Centre for Health, Sciences and Primary Care, University Medical Centre Utrecht, Utrecht, The Netherlands, ^bInstitute of Primary Care and Public Health, Cardiff University, Cardiff, UK, ^cLaboratory of Medical Microbiology, Vaccine and Infectious Diseases Institute (VAXINFECTIO), University of Antwerp, Antwerp, Belgium, ^dCentre for Family and Community Medicine, Medical University of Lodz, Lodz, Poland, ^eInstitute for Translation, Innovation, Methodology and Engagement, Cardiff University, Cardiff, UK, ^fPrimary Care Medical Group, University of Southampton Medical School, Southampton, UK and ^gAldermoor Health Centre, University of Southampton, Southampton, UK

*Correspondence to Patricia M Hordijk, Waterhoenhof 50, 3582 DG Utrecht, The Netherlands; E-mail: p.m.hordijk@gmail.com

Abstract

Background. Lower respiratory tract infection (LRTI) is a common presentation in primary care, but little is known about associated patients' illness perception and related behaviour.

Objective. To describe illness perceptions and related behaviour in patients with LRTI visiting their general practitioner (GP) and identify differences between European regions and types of health care system.

Methods. Adult patients presenting with acute cough were included. GPs recorded co morbidities and clinical findings. Patients filled out a diary for up to 4 weeks on their symptoms, illness perception and related behaviour. The chi-square test was used to compare proportions between groups and the Mann-Whitney U or Kruskal Wallis tests were used to compare means.

Results. Three thousand one hundred six patients from 12 European countries were included. Eighty-one per cent ($n = 2530$) of the patients completed the diary. Patients were feeling unwell for a mean of 9 (SD 8) days prior to consulting. More than half experienced impairment of normal or social activities for at least 1 week and were absent from work/school for a mean of 4 (SD 5) days. On average patients felt recovered 2 weeks after visiting their GP, but 21% ($n = 539$) of the patients did not feel recovered after 4 weeks. Twenty-seven per cent ($n = 691$) reported feeling anxious or depressed, and 28% ($n = 702$) re-consulted their GP at some point during the illness episode. Reported illness duration and days absent from work/school differed between countries and regions (North-West versus South-East), but there was little difference in reported illness course and related behaviour between health care systems (direct access versus gate-keeping).

Conclusion. Illness course, perception and related behaviour in LRTI differ considerably between countries. These findings should be taken into account when developing International guidelines for LRTI and interventions for setting realistic expectations about illness course.

Key words: Activities of daily living, bronchitis, cough, general practice, illness behaviour, respiratory tract infections, sick leave.

Introduction

Lower respiratory tract infections (LRTIs) include bronchitis, bronchiolitis and pneumonia. These infections are among the main reasons people seek primary health care. The annual incidence rate of LRTI as diagnosed by general practitioners (GPs) ranges from 28 to 53 per 1000 persons (1,2). Concerns and interference with social roles are often reasons for consulting a GP. Although LRTI seldom leads to serious complications and is mostly self-limiting (3,4), patients are impaired in daily activities including work, resulting in a substantial burden for patients and society (3). Respiratory tract illnesses are the second leading cause of sick leave with an average of 3 days absence from work (5). Impairment in social activities, absence from work and health seeking behaviour during an illness episode are all regarded as elements of illness behaviour. Illness behaviour is defined as the manner in which people behave differentially according to how they perceive, evaluate and respond to symptoms, and is a product of social and cultural conditioning. Illness behaviour differs by region and group for some common infections. De Melker et al. (6) found differences in duration of illness prior to presentation to the GP, and in total illness duration between Eastern and Western Europe in acute tonsillitis. In addition, van der Linden et al. (2) found patients with lower educational level and patients with a non-Western origin consult their GP more frequently. There have been some descriptions of illness perceptions and related behaviour in LRTI, but few studies have followed-up patients for longer than 3 weeks. In addition, the extent of variation in LRTI illness perceptions and related behaviour between regions has not been described (3,4). Knowledge about perceptions and related behaviour of illness in patients with LRTI could help to provide better patient information, design future studies on LRTI and contribute to the development of internationally applicable management guidelines.

Therefore, we aimed to describe illness perceptions and related behaviour in patients visiting their GP with LRTI overall, and identify differences between European regions and types of health care system.

Methods

Study subjects and design

This prospective observational study in primary care is part of the GRACE project (Genomics to combat Resistance against Antibiotics in Community-acquired LRTI in Europe; www.grace-lrti.org). Details on the study population have been reported elsewhere (7). GPs in 16 primary care research networks in 12 European countries included adult patients presenting with LRTI between October 2007 and April 2010. All primary care research networks had access to a minimum of 20 000 patients.

Measurements

GPs recorded co morbidities (diabetes, respiratory and cardiovascular disease), body temperature and respiratory rate.

Patients responded to initial questions about the number of days they had felt ill before consultation and then answered questions about the severity of symptoms (cough, phlegm, shortness of breath, wheeze, blocked/runny nose, chest pain, fever, headache, disturbed sleep and feeling generally unwell) on a 7-point Likert-scale from 0 (not affected) to 6 (as bad as it could be) each day for 28-days or until symptoms resolved in a self-complete diary. This part of the questionnaire was derived from a symptom diary used earlier and is internally reliable, valid and sensitive to change for acute LRTI (8). In addition, each week patients completed the EQ5D questionnaire

items referring to feeling anxious or depressed, answering a 3-point Likert-scale (from *no problem* to *extreme problem*). Patients only recorded these items if they had relevant symptoms during the preceding week. Moreover, there were weekly questions about illness related behaviour represented by questions about over the counter medication (OTC) use, social activities, daily activities (responses on a 7 point Likert-scale), work/school absence and health seeking behaviour. Independent translators performed back translation of the diaries from local languages to English. Patients were telephoned 4 days after inclusion with an offer of support in the sense that they were invited to ask questions on the diary if things were unclear, and research assistants explained the diary as much as possible.

European regions

European regions were defined in two ways:

1. Based on geographical location and economic status, with a cut-off value of US\$ 35 000 per capita for gross domestic product (9,10). This resulted in a North-West region that included England, Belgium (two networks), France, Germany, Sweden, The Netherlands and Wales and a South-East region that included Italy, Poland (three networks), Slovakia, Slovenia and Spain (two networks).
2. Based on whether the primary healthcare system had a gate-keeping role or whether patients had direct access to specialists care (a direct access health system) (11,12). The former included England, Italy, Poland, Slovenia, Slovakia, Spain, The Netherlands and Wales, and the latter Belgium, France, Germany and Sweden.

Outcome measures

The illness course was expressed as duration and severity of symptoms. The total illness duration was calculated by summing the duration of illness prior to consultation plus duration of illness after GP consultation in days. Severity of symptoms was defined by a symptom severity score derived by the sum of scores for the 11 symptoms reported in the patients' diaries scaled from 0 to 100 as a percentage of the maximum possible score. Similarly, the impairment severity score was derived as score for impact on daily activities, calculated from the daily questions on interference with normal and social activities.

Analysis

All missing data, except for the responders versus non-responders comparison, were imputed. Single imputation of missing values was performed by logistic regression analysis using other available patient characteristics to impute missing results. The chi-square test was used to compare proportions between groups and the Mann-Whitney U or Kruskal Wallis tests were used to compare means in variables with non-normal distribution. We evaluated whether differences in outcomes between countries and regions could be fully explained by differences in patients' age, smoking status and/or co morbidity using multivariable logistic regression. For daily symptoms this was performed for day 1, 14 and 28 (shown in note of Fig. 1). Medians were used as the cut-off value for continuous variables.

Results

Patient characteristics at inclusion

Three thousand one hundred six patients were included of whom 81% ($n = 2530$) returned their symptom diary. Patients returning

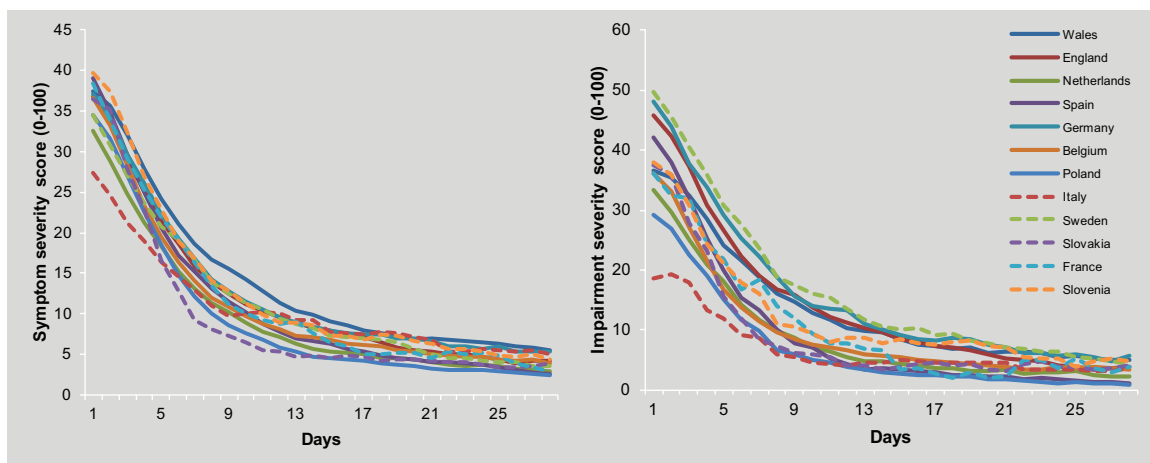


Figure 1. Symptom severity score and impairment severity score in the different countries. No significant differences after adjusting for age, co morbidity and smoking status for symptom severity score day 1, and for impairment severity score day 14.

Table 1. Characteristics of responders and non-responders to the diary recorded by GPs at inclusion

	Responders (<i>n</i> = 2530)	Non-responders(<i>n</i> = 576)	<i>P</i> -value	Missings % (<i>n</i>)
Age, median (IQR)	52 (25)	42 (29)	0.000	0 (0)
Male gender, % (<i>n</i>)	40.2 (1017)	39.8 (229)	0.851	0 (0)
Co morbidity, % (<i>n</i>)	28.0 (707)	26.1 (150)	0.380	0.2 (5)
Smoking, % (<i>n</i>)	26.8 (678)	33.6 (193)	0.001	0.1 (3)
Respiratory rate > 20 per minute % (<i>n</i>)	22.9 (568)	16.5 (91)	0.001	2.5 (78)
Body temperature ≤36 or ≥38, % (<i>n</i>)	20.2 (506)	15.9 (91)	0.019	1.0 (31)
Duration of illness prior to consultation in days, mean (SD)	9.4 (7.8)	10.4 (17.3)	0.561	1.8 (31)

IQR, interquartile range.

their diary were older [median age 52 (range 18–92) versus 42 (18–91)] and less frequently current smokers (27% versus 34%). Regarding clinical findings they more often had increased respiratory rate (≥20 per minute) and abnormal temperature (≤36 or ≥38) at inclusion. (Table 1)

Participants' median age was 52 years, 40% (*n* = 1017) were male, and 28% (*n* = 707) had co morbidities. Ten patients were hospitalized for this illness episode during the 28 day follow up period.

Illness course, perception and related behaviour

Data are presented in Table 2. The mean duration of illness prior to GP consultation was 9 (SD 8) days. Sixty-two per cent (*n* = 1566) of the patients had used one or more OTC medication before consultation. At inclusion almost all patients suffered from acute cough [99% *n* = 2516, 68% (*n* = 1730) of the patients experienced dyspnoea and 84% (*n* = 2118) of the patients felt generally unwell (data not presented)]. Seventy-three per cent (*n* = 1849) of the patients experienced impairment of normal or social activities for at least 7 days. The mean symptom severity score at day 1 was 36 (SD 18) and 4 (SD 7) at day 28. The steepest decline in symptom scores occurred during the first week (Fig. 1). After 4 weeks 79% (*n* = 1991) of all patients felt recovered (Fig. 2). Patients not feeling recovered at day 28 mainly reported cough (73%, *n* = 395 out of 539) and/or phlegm production (58%, *n* = 315 out of 539). Twenty-eight per cent (*n* = 702) of all patients reconsulted their GP for this LRTI episode. Patients were absent from work/school for a mean of 4 (SD 5) days. During the illness episode 27% (*n* = 691) of the patients reported feeling anxious or depressed on at least one occasion.

Differences between countries

Inclusion characteristics of patients differed between countries regarding age, co morbidity, smoking status, respiration rate and body temperature. Moreover, duration of feeling unwell before visiting the GP and OTC medication use differed (Table 2). At day 1, the mean symptom severity score and the mean impairment severity score differed by country. These differences decreased during follow up (Fig. 1). Regarding follow-up, the total illness duration, the percentage of patients reconsulting and the amount of days absence from work (range 2–8) differed per country and country remained independently associated with these outcomes after adjusting for age, co morbidity and smoking status.

Differences between regions: North-West versus South-East

Inclusion characteristics of patients in the North-West region differed from those in the South-East region regarding age, co morbidity, smoking status and body temperature (Table 3).

Patients in the North-West region had higher impairment severity scores during all 28 days and higher symptom severity scores after the first week. The mean difference in impairment severity score and symptom severity score between the North-West region and the South-East region during 28 days was 4 (SD 1) and 1 (SD 1) point respectively (data not presented).

Regarding follow-up, the total illness duration, the percentage of patient reconsulting and the number of days absent from work differed per region, and region remained independently associated with these outcomes after adjusting for age, co morbidity and smoking status.

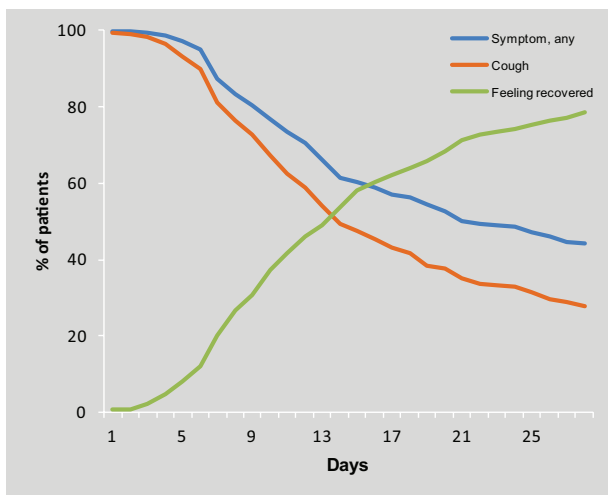


Figure 2. Percentage of patients with any symptom, cough and percentage of patients feeling recovered.

Differences between health care systems: gate-keeping versus direct access

Inclusion characteristic of patients in countries with a direct access health system differed from those in countries with a gate-keeping system regarding co morbidity and respiratory rate (Table 3).

Patients in countries with direct access health system had higher impairment severity scores over all 28 days and higher symptom severity scores after day 5. The mean difference in impairment severity score and symptom severity score during 28 days between countries with direct access versus those who have not was 3 (SD 1) points and 1 (SD 1) point, respectively (data not presented). After adjusting for age, co morbidities and smoking status, health care system was no longer significantly associated with total illness duration and reconsultation rates.

Discussion

Summary of main results

The majority of patients presenting with LRTI in primary care experienced impairment of normal or social activities for at least 1 week and 28% re-consulted their GP at least once more during the 28 days follow-up of this study. More than one out of five patients did not feel fully recovered at the end of this 28 day period. Moreover, we found important differences in total illness duration and illness behaviour, including absence from work/school, between European countries and regions. Differences between patients in countries with a gate-keeping primary health system as compared to patients in a direct-access health system were generally small.

Strengths and limitations of the study

To our knowledge, this is the first study on differences at the country-setting level in illness perception, course and related behaviour in patients with LRTI. The strengths of our study include the large size of the study population representing contrasting European countries and the high rates of follow up. Moreover, the 28-day follow up in our study was longer than most previous studies, which followed patients for 3 weeks or less after their first consultation. Our broad eligibility criteria increase the generalizability of our findings to patients with LRTI seen in routine primary care. We also recognise several potential limitations of our study. First, the representativeness

of the sample at country level is limited in some cases by small numbers recruited in some countries, suggesting possible selection bias. Patients were being managed by GPs who were participating in research, and their practices may not be typical of practices in their country as a whole. However this risk is mitigated by GP training in study methods and using standardised eligibility criteria. Moreover, an analysis of main results was done without France and Italy because few patients were recruited from these sites, causing no significant changes. Second, patient inclusion characteristics differed between countries, although logistic regression suggested that differences in outcomes were not solely explained by differences in inclusion characteristics. Moreover the severity of the disease may have influenced illness behaviour. Finally we did not analyse the effect of antibiotic prescription in this study. Earlier studies within the GRACE-project however found that antibiotic prescribing—the amount and type of antibiotic—had little to no clinically relevant impact on illness course (13,14,15).

Comparison with existing literature

Reconsultation rates during the same illness episode in our study (28%) are in line with findings of earlier studies (16–28%) (16,17). Differences in severity of symptoms and recovery rate by different networks in Europe was shown by Butler et al. (14) in an earlier GRACE study. The majority of patients experienced impairment of normal or social activities during at least 1 week. This is in concordance with the study of Moore et al. (18) which showed patients with LRTI experience moderate to extreme restriction in activities for a median 7 days.

It has been previously found that a liberal approach to sick certification by GPs results in higher levels sickness absence, and more so in Northern European countries compared to Southern European countries, being highest in the Netherlands, Germany and Belgium (19,20). Our finding that the number of days of sick leave was a slightly higher in South-East European countries compared to North-West European countries is therefore surprising. This discrepancy suggests that that LRTI may cause relevant symptoms which are only in part influenced by regulations regarding sickness certification.

To our knowledge, no previous study has compared patients' LRTI consultation behaviour between European countries. The previously mentioned study of Melker de et al. (6) showed differences in days of being ill before presentation with acute tonsillitis.

Interpretation of the results

A difference in illness behaviour by patients recruited in different countries is perhaps the most interesting aspect of this study. These differences reflect (unmeasured) differences such as in culture, socio-economic status and health beliefs rather than geographical location per se.

There were differences in symptom severity score per region and health system, but a difference of 1 point in a scale from 0–100 is unlikely to be clinically important. The small differences between the regions with different health systems could partly be explained by the nature of condition we studied. LRTI is a generally benign, self-limiting illness and few patients directly access secondary health-care facilities, resulting in comparable affected populations between European countries. In some countries the health-system may theoretically be considered as gate keeping, but there might be a gap between policy and practice.

Although LRTI seldom leads to serious complications, patients with LRTI experience impairment in daily activities for a longer

Table 2. Characteristics of patients presenting with cough across different European countries

	Belgium (<i>n</i> = 327)	England (<i>n</i> = 196)	France (<i>n</i> = 30)	Germany (<i>n</i> = 171)	Italy (<i>n</i> = 43)	Poland (<i>n</i> = 506)	Slovakia (<i>n</i> = 130)	Slovenia (<i>n</i> = 69)	Spain (<i>n</i> = 492)	Sweden (<i>n</i> = 92)	The Nether- lands (<i>n</i> = 277)	Wales (<i>n</i> = 197)	Total (<i>n</i> = 2530)	<i>P</i> -value
Demographics and co morbidity														
Age, median (IQR)	52 (25)	56 (18)	54 (24)	50 (21)	58 (23)	44 (15)	44 (19)	52 (19)	49 (30)	58 (21)	56 (23)	58 (22)	52 (25)	0.000
Male gender, % (<i>n</i>)	44.6 (146)	35.2 (69)	30.0 (9)	36.8 (63)	37.2 (16)	37.4 (189)	42.3 (55)	40.6 (28)	40.2 (198)	31.5 (29)	44.0 (122)	47.2 (93)	40.2 (1017)	0.093
Co morbidity, % (<i>n</i>)	33.9 (111)	27.6 (54)	30 (9)	32.2 (55)	20.9 (9)	21.9 (111)	16.9 (22)	14.5 (10)	26.2 (129)	27.2 (25)	33.6 (93)	40.1 (79)	27.9 (707)	0.000
Smoking, % (<i>n</i>)	32.3 (105)	17.9 (35)	16.7 (5)	28.8 (49)	32.6 (14)	35.8 (181)	31.5 (41)	27.5 (19)	29.9 (146)	22.8 (21)	19.6 (54)	28.6 (56)	28.8 (726)	0.000
GP recorded														
Respiratory rate > 20 per minute % (<i>n</i>)	27.0 (88)	17.9 (35)	36.7 (11)	26.3 (45)	7.0 (3)	19.8 (100)	12.4 (16)	7.2 (5)	29.4 (144)	17.4 (16)	22.0 (61)	27.4 (54)	22.9 (578)	0.000
Body temperature ≤36 or ≥38, % (<i>n</i>)	21.7 (71)	18.4 (36)	10.0 (3)	17.6 (30)	4.7 (2)	25.5 (129)	26.9 (35)	15.9 (11)	26.0 (128)	15.2 (14)	11.2 (31)	9.6 (19)	20.1 (509)	0.000
28 day diary results														
Duration of illness prior to consultation in days, mean (SD)	6.8(5.6)	10.0(6.1)	9.0(6.4)	9.2(9.3)	11.5(18.1)	6.9(6.5)	5.3(3.6)	12.0(12.0)	8.4(7.7)	12.2(8.8)	12.7(12.1)	9.1(6.5)	8.7(8.3)	0.000
Over the counter medication before consultation % (<i>n</i>)	61.5 (201)	67.9 (133)	80.0 (24)	52.0 (89)	46.5 (20)	65.2 (330)	37.7 (49)	72.5 (50)	61.2 (301)	65.2 (60)	66.8 (185)	62.9 (124)	61.9 (1566)	0.000
Anxiety and/or depression day 1 ^a , % (<i>n</i>)	23.9 (78)	17.9 (35)	36.7 (11)	22.2 (38)	30.2 (13)	47.8 (242)	9.2 (12)	29.0 (20)	24.0 (118)	20.7 (19)	18.4 (51)	27.4 (54)	27.3 (691)	0.000
Anxiety and/or depression day 14 ^a , % (<i>n</i>)	13.4 (37)	15.4 (28)	22.2 (6)	13.5 (21)	14.6 (6)	21.5 (81)	7.8 (9)	17.2 (10)	12.2 (51)	13.1 (11)	8.8 (20)	22.6 (35)	14.9 (315)	0.000 ^c
Anxiety and/or depression day 28 ^a , % (<i>n</i>)	19.6 (33)	10.9 (11)	20.0 (3)	9.7 (12)	22.7 (5)	21.9 (42)	9.7 (10)	17.1 (6)	12.3 (29)	15.7 (8)	11.6 (14)	28.0 (26)	15.8 (199)	0.001 ^c
Total illness duration, mean (SD) ^b	19.3(8.7)	23.7 (10)	21.5(8.5)	21.5(10.2)	20.0(8.5)	17.0(8.2)	16.3(5.6)	23.3(11.4)	21.5(10.2)	26.7(11.9)	24.8(12.4)	20.5(8.5)	20.4 (10)	0.000
Not feeling recovered at 28 days, % (<i>n</i>)	20.2 (66)	21.9 (43)	26.7 (8)	35.1 (60)	58.1 (25)	16.2 (82)	11.5 (15)	29 (20)	13.2 (65)	16.3 (15)	23.5 (65)	38.1 (75)	21.3 (539)	0.000 ^c
Reconsult GP service, % (<i>n</i>)	30.0 (98)	24.0 (47)	20.0 (6)	35.1 (60)	11.6 (5)	22.3 (113)	62.3 (81)	17.4 (12)	35.0 (172)	15.2 (14)	20.6 (57)	18.8 (37)	27.7 (702)	0.000
Days absent from work, mean (SD)	3.2(4.3)	3.1(4.4)	1.9(3.6)	5.8(7.4)	1.7(3.3)	3.9(5.1)	8.4 (6)	5.8(5.8)	3.0(4.3)	4.4(5.3)	2.6(4.4)	4.0(6.3)	3.9(5.3)	0.000

IQR = interquartile range.

^aIn patients with symptoms in prior week: week 1, *n* = 2528; week 2, *n* = 2116; week 4, *n* = 1260.^bIf recovered after 28 days of follow-up (*n* = 1991).^cLogistic regression with correction for age, smoking and co morbidities shows no significant association with country.

Table 3. Characteristics of patients presenting with cough by region and health system

	North-West (N = 1290)	South-East (N = 1240)	P-value	Gate-keeping health system N = 1910	Direct access health system N = 620	P-value
Demographics and co morbidity						
Age, median (IQR)	54.0 (23)	48.0 (26)	0.000	50.5 (16.2)	51.8 (16.5)	0.121
Male gender, % (n)	41.2 (531)	39.2 (486)	0.330	40.3 (770)	39.8 (247)	0.463
Co morbidity, % (n)	33.0 (426)	22.7 (281)	0.000	26.6 (509)	32.4 (201)	0.018
Smoking, % (n)	25.3 (325)	32.4 (401)	0.000	28.7 (546)	29.2 (180)	0.422
GP recorded						
Respiratory rate > 20 per minute % (n)	24.0 (310)	21.7 (268)	0.084	21.9 (418)	25.8 (160)	0.025
Body temperature ≤36 or ≥38, % (n)	15.8 (204)	24.6 (305)	0.000	20.5 (391)	19.1 (118)	0.242
28 day diary results						
Duration of illness prior to consultation in days, mean (SD)	9.7 (8.6)	7.8 (8.0)	0.000	8.9 (8.6)	8.4 (7.6)	0.169
Over counter medication before consultation % (n)	63.3 (816)	60.5 (750)	0.082	62.4 (1192)	60.3 (374)	0.189
Anxiety and/or depression day 1 ^a , % (n)	22.2 (286)	32.7 (405)	0.000	28.5 (545)	23.5 (146)	0.008
Anxiety and/or depression day 14 ^a , % (n)	14.3 (158)	15.6 (157)	0.427	15.2 (240)	13.8 (75)	0.235
Anxiety and/or depression day 28 ^a , % (n)	15.9 (107)	15.7 (92)	0.938	15.9 (143)	15.6 (56)	0.501
Total illness duration, mean (SD) ^b	22.3 (10.5)	18.7 (9.3)	0.000	20.2 (10.1)	21.1 (10)	0.041 ^c
Not feeling recovered at 28 days, % (n)	25.7 (332)	16.7 (207)	0.000	20.4 (390)	24.0 (149)	0.033 ^c
Reconsult GP service, % (n)	24.7 (319)	30.9 (383)	0.000	27.4 (524)	28.7 (178)	0.285
Days absent from work, mean (SD)	3.6 (5.2)	4.2 (5.3)	0.037	3.9 (5.2)	4.1 (5.6)	0.251

IQR = interquartile range.

^aIn patients with symptoms in prior week: week 1, n = 2528; week 2, n = 2116; week 4, n = 1260.^bIf recovered after 28 days of follow-up (n = 1991).^cLogistic regression with correction for age, smoking and co morbidities shows no significant association with region or health system.

period of time. Addressing this impairment explicitly in the context of country level may make patients feel more reassured and could adequately reduce unnecessary reconsultation.

Conclusion

Patients presenting with LRTI in primary care react differently to symptoms, with striking differences between European countries in illness behaviour such as number of days absent from work. This could be related to cultural and socio-economic differences. Type of health system does not seem to have an important effect on recovery related outcomes. The differences in illness perception and related behaviour between regions should be taken into account when developing international guidelines and patient information for LRTI.

Acknowledgments

We would like to thank the entire GRACE team, including Prof. Joanna Coast for their diligence, expertise and enthusiasm. We are indebted to all of the patients who consented to be part of GRACE, without whom this study would not have been possible. Finally special thanks to Ted van Essen for helpful comments. The work reported on in this publication has been financially supported through the European Science Foundation (ESF), in the framework of the Research Networking Programme TRACE (www.esf.org/trace).

Declaration

Funding: 6th Framework Program of the European Commission (Reference: LSHM-CT-2005-518226), Research Foundation Flanders (Belgium) (G-0274-08N). The funding sources were not involved in the design, conduct, analysis and interpretation of the data, nor in the writing and decision to submit the paper.

Ethical approval: All research sites obtained ethical and competent authority approval from their local organizations. Patients who fulfilled the inclusion criteria were given written and verbal information on the study and asked for informed consent.

Conflict of interest: none.

References

- Winchester CC, Macfarlane TV, Thomas M, Price D. Antibiotic prescribing and outcomes of lower respiratory tract infection in UK primary care. *Chest* 2009; 135: 1163–72.
- Van der linden M, Westert G, de Bakker D, Schellevis F. *Tweede nationale studie naar ziekten en verrichtingen in de huisartspraktijk*. Utrecht, Bilthoven: NIVEL/RIVM 2004.
- Hopstaken RM, Coenen S, Butler CC *et al*. Prognostic factors and clinical outcome in acute lower respiratory tract infections: a prospective study in general practice. *Fam Pract* 2006; 23: 512–9.
- Verheij T, Hermans J, Kaptein A, Mulder J. Acute bronchitis: course of symptoms and restrictions in patients' daily activities. *Scand J Prim Health Care* 1995; 13: 8–12.
- Leoni T, Biffl G, Guger A. *Fehlzeitenreport 2007 - Krankheits- und unfallbedingte*. WIFO 2008.
- de Melker RA, Touw-Otten FW, Kuyvenhoven MM. Transcultural differences in illness behaviour and clinical outcome: an underestimated aspect of general practice? *Fam Pract* 1997; 14: 472–7.
- van Vugt SF, Broekhuizen BD, Lammens C *et al*. Use of serum C reactive protein and procalcitonin concentrations in addition to symptoms and signs to predict pneumonia in patients presenting to primary care with acute cough: diagnostic study. *BMJ* 2013; 346: f2450.
- Watson L, Little P, Moore M, Warner G, Williamson I. Validation study of a diary for use in acute lower respiratory tract infection. *Fam Pract* 2001; 18: 553–4.
- Composition of macro geographical (continental) regions, geographical sub-regions, and selected economic and other groupings. 2011. <http://unstats.un.org/unsd/methods/m49/m49regin.htm> (accessed on August 1, 2012).
- Per Capita GDP in US Dollars. United Nations Stat. Div. 2011. <http://unstats.un.org/unsd/snaama/Introduction.asp> (accessed August 1, 2012).
- European observatory on health systems and policies. WHO. 2012. <http://www.euro.who.int/en/who-we-are/partners/observatory/health-systems-in-transition-hit-series/hit-summaries> (accessed on August 1, 2012).
- Bíró A. Copayments, gatekeeping, and the utilization of outpatient public and private care at age 50 and above in Europe. *Health Policy* 2013; 111:24–33.
- Brookes-Howell L, Hood K, Cooper L *et al*. Clinical influences on antibiotic prescribing decisions for lower respiratory tract infection: a nine country qualitative study of variation in care. *BMJ Open* 2012; 2:1–7.
- Butler CC, Hood K, Verheij T *et al*. Variation in antibiotic prescribing and its impact on recovery in patients with acute cough in primary care: prospective study in 13 countries. *BMJ* 2009; 338: b2242.
- Little P, Stuart B, Moore M *et al*. Amoxicillin for acute lower-respiratory-tract infection in primary care when pneumonia is not suspected: a 12-country, randomised, placebo-controlled trial. *Lancet Infect Dis* 2013; 13: 123–9.
- Macfarlane J, Prewett J, Rose D *et al*. Prospective case-control study of role of infection in patients who reconsult after initial antibiotic treatment for lower respiratory tract infection in primary care. *BMJ* 1997; 315: 1206–10.
- Holmes WF, Macfarlane JT, Macfarlane RM, Hubbard R. Symptoms, signs, and prescribing for acute lower respiratory tract illness. *Br J Gen Pract* 2001; 51: 177–81.
- Moore M, Little P, Rumsby K *et al*. Predicting the duration of symptoms in lower respiratory tract infection. *Br J Gen Pract* 2008; 58: 88–92.
- Osterkamp R, Rohn O. Being on Sick Leave: Possible Explanations for Differences of Sick-leave Days Across Countries. *CESifo Econ Stud* 2007; 53: 97–114. <http://cesifo.oxfordjournals.org/cgi/doi/10.1093/cesifo/ifm005> (accessed September 27, 2014).
- Gimeno D, Benavides FG, Benach J, Amick BC. Distribution of sickness absence in the European Union countries. *Occup Environ Med* 2004; 61: 867–9. <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1740673&tool=pmcentrez&rendertype=abstract> (accessed September 27, 2014).