teenagers in France [12]. This decision was based on the low incidence of C IMD cases in France, 0.4/100 000 in 2002, compared with the incidence in European countries that had introduced Men C routine childhood vaccination (ranging from 1.9 to 4 cases per 100 000), and took into account the theoretical risk of a capsular switch induced by vaccination. In 2003 and 2004, national incidence of C IMD decreased and the district incidences remained under the alert threshold for serogroup C IMD.

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Original Articles

Surveillance report

'Did you have flu last week?' A telephone survey to estimate a point prevalence of influenza in the Swedish population

L Payne[1,2], S Kühlmann-Berenzon[1], K Ekdahl[1], J Giesecke[1], L Högberg[1], P Penttinen[1]

Sentinel surveillance usually underestimates the true burden of influenza in a population, as individuals must present to medical establishments to be included in the surveillance system. We carried out a telephone survey to estimate the national burden of influenza in the Swedish population for one week during the 2004/05 influenza season. Fixed-line telephone numbers were randomly sampled and households interviewed concerning influenza illness between 14-20 February 2005 (Week 7 of 2005). Questions regarding seasonal influenza vaccination status, symptoms and the impact of illness on daily life were also included. A self-defined influenza prevalence of 7.7% in week 7 of 2005 was estimated. On applying a case definition of 'cough and fever and muscle pain' for influenza like illness, the prevalence decreased to 3.6%. The survey provided insight into the burden of illness in the population further to that estimated through the sentinel surveillance system.

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Key Words: cross-sectional survey, influenza, prevalence, Sweden

Introduction

Influenza A or B viruses circulate every winter in the northern hemisphere, approximately between the months of October and April. Though influenza disease is usually self-limiting, it causes a considerable impact on an individual's daily life, affects the demand for health services and can create economic loss. The burden of influenza falls particularly on groups especially prone to complications or fatal outcome, such as the very young [1], the elderly [2] or the chronically ill.

Assessing the annual level of morbidity due specifically to influenza A or B viruses is however difficult, as the viruses lack pathognomonic features and co-circulate with other respiratory pathogens [3]. Consequently, many surveillance systems across Europe aim to identify a level of illness possibly caused by influenza viruses, i.e., influenza-like illness (ILI). A definitive set of symptoms for a clinical diagnosis of influenza has been difficult to achieve, and the ILI definition varies widely across Europe [4].

Reports of ILI are the basis of the influenza sentinel surveillance system in Sweden, where participating physicians from specific sites across the country report weekly number of ILI cases. No case definition for influenza or ILI is used. Together with laboratory reporting of influenza positive tests, the surveillance system allows a timely overview of the level and duration of influenza circulating in a season. However, the sentinel and laboratory surveillance systems depend on symptomatic individuals presenting to a physician for consultation. They thus underestimate the true burden of illness caused by influenza, since milder cases, clustered family cases, or severely affected individuals living alone, may not seek medical attention.

To understand the difference between measured (surveillance system) and the true burden of influenza illness in the Swedish population, we carried out a survey to estimate a point prevalence of self-reported influenza in the national population during one week

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of the influenza season. Secondary objectives included describing the symptoms experienced, calculating the influenza vaccination uptake during part of the 2004/2005 influenza season, measuring medical consultation, estimating the severity of illness as defined by absence from school or work, and time spent in bed. The survey was planned and realised within a 3 week period, testing a capacity to undertake real-time surveys of the national population and providing useful experience for surveillance in an event of an epidemic threat.

Methods

A cross-sectional retrospective survey was undertaken of a random sample of the Swedish population. The sampling frame was a national register of landline household telephone numbers (SPAR) with the random sample being generated by the organisation holding the register. We contacted households by telephone and following oral consent, interviewed responders (aged 16 years and over) regarding each member of the household.

All questions regarding illness, symptoms and visits for medical attention were asked concerning the week prior to interview: Week 7, 14-20 February 2005. Data collected for each household member included: age, gender, vaccination against influenza that season, having influenza and any of the following: cough, fever, chills or muscle ache/pain. For individuals reporting symptoms, questions were asked about whether an individual had needed to stay in bed for a day or taken time off work or school because of their symptoms. No definition of influenza was provided to interviewees. To compare self-reported influenza status to a case definition for ILI, a closest match to the European Union influenza case definition [5] of 'cough and fever and muscle pain' was applied to the sampled population according to symptoms reported.

During an annual influenza epidemic, between 5% and 15% of a population suffer an upper respiratory tract infection [6]. By doubling the weekly average of 1% in an assumed 10 week epidemic, we required 1505 individuals (EPI6v.6.0.4). With a 95% CI, 4.2 million people accessible by telephone(SPAR), a lower acceptable limit of 1%, design effect of 2 and an average household size of 2.05 people [7], we needed to interview 734 households. Accounting for a higher response rate due to the national interest in influenza than experienced by recent SMI (Swedish Institute for Infectious Disease Control) telephone interviews [8], a list of 1500 telephone numbers was purchased.

Fifteen trained persons undertook the structured questionnaire interviews over evenings of 22-25 February 2005. Answers were entered directly onto computers using Epidata (v.3.02, Denmark). Three call attempts were made per household over at least two different evenings. Data were cleaned and proportions with confidence intervals calculated in EpiInfo using complex sampling statistics to allow for the design effect (Epi Info v.3.2.2).

Results

Of the 1334 households to whom telephone calls were made, contact was established with 1070, and 872 agreed to participate in the survey. This resulted in a response proportion of 81% and a sample of 2119 individuals. Age was unknown for 15 individuals. Table 1 compares the sample and Swedish population by age group. The average household size was 2.43 persons (range 1-8).

Table 1

Sample (n = 2104) and population (9 011 392) age group distribution, Sweden

Age group (in years)	Sample %	Sample 95% CI	Population* %
0-4	5.9	4.9-7.0	5.4
5-14	14.2	12.4-15.9	12.2
15-29	15.8	14.0-17.7	18.2
30-44	21.6	19.8-23.4	20.9
45-64	26.5	24.1-28.9	26.1
65+	16.0	13.9-18.1	17.2

* From: SCB statistics Sweden [9]

Influenza status

Of people who had an opinion about their influenza status, 160 people of 2090 had influenza, giving a prevalence of 7.7% in Week 7 (95% CI 6.2-9.1, Design Effect= 1.7). Prevalence was highest in the lowest age groups [Table 2].

Table 2

Prevalence of self-reported influenza by age group, week 7, 2005, Sweden

Age group (in years)	Influenza	Total	Prevalence %	95% CI
0-4	19	122	15.6	8.3-22.8
5-14	38	292	13.0	8.5-17.5
15-64	84	1328	6.3	4.8-7.8
65+	19	333	5.7	2.8-8.7
Total	**160**	**2075**		

Note: Age was unknown for 15 individuals

Vaccination uptake

Among the 2096 individuals who knew their vaccination status, 11.6% (95% CI 9.8-13.3) reported having been vaccinated. Seventy five per cent (184/ 243) of those reporting vaccination were aged 65 years or over, with a vaccination uptake among the 65+ age group of 55.1% (95% CI 49.0-61.2)

Symptoms and severity of illness

Table 3 shows the symptoms and severity of illness in individuals reporting influenza versus those not reporting illness.

Table 3

Symptoms and effect of illness by self-reported influenza status, week 7, 2005, Sweden

	Influenza		No Influenza	
	Prevalence (sample size) % (n)	95% CI	Prevalence (sample size) % (n)	95% CI
Symptoms				
Fever	83% (155)	76-90	5% (1888)	4-6
Chills	73% (150)	64-82	4% (1882)	3-5
Cough	80% (159)	73-87	11% (1898)	10-13
Muscle pain	56% (145)	46-66	3% (1876)	2-4
Severity of illness				
Absent from school/work [1]	67% (121)	58-76	26% [2] (200)	19-32
At least one day in bed [1]	76% (122)	68-84	23% [2] (202)	16-29

1. 5-64 years only
2. Only individuals reporting one or more symptoms (fever, chills, cough or muscle pain) were asked for this information

Applying a case definition for Influenza Like Illness (ILI)

When a case definition was applied to data collected, the ILI prevalence was 3.6% (74/2031, 95% CI 2.6-4.7, DE=1.7). Assuming ILI to be a true measure of influenza burden in the population, 41% of self-reported influenza cases had ILI (positive predictive value, 58/141). The sensitivity and specificity of self-defined influenza as a measure of ILI were 87% (58/67) and 96% (1858/1941) respectively [Table 4].

Table 4

Influenza-like illness (ILI) status by self-reported influenza status, week 7, 2005, Sweden

	ILI	Not ILI	Total
Influenza	58	83	141
No influenza	9	1858	1867
Total	**67**	**1941**	

Survey logistics

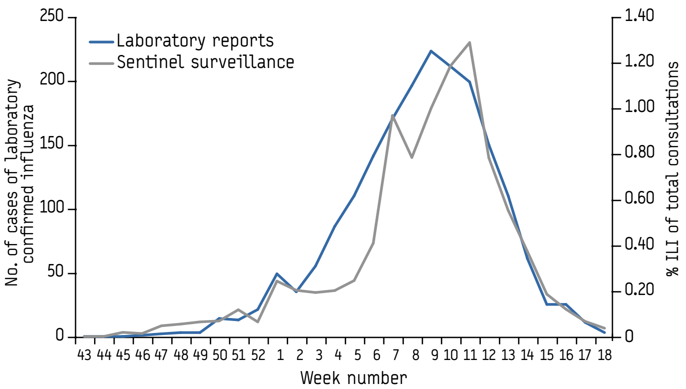
The time taken to complete the protocol, questionnaire, database, telephone number sourcing and recruitment of interviewers was approximately 125 working hours. The basic costs of the survey (telephone list, interviewers and telephone calls) amounted to approximately 3250€. To reach the 1334 households, 2084 call attempts were made, approximating 14 calls per hour per person.

Discussion

This is the first survey undertaken in Sweden to estimate the national burden of influenza during an influenza season. The telephone survey yielded a good response, with 81% of people contacted agreeing to be interviewed. The main survey finding was a point prevalence of 7.7% self-defined influenza in the Swedish population in week 7 of 2005. Due to the different denominator used in the sentinel surveillance (number of consultations), the survey prevalence estimate cannot directly be compared to the sentinel measure of 1.0% ILI activity in week 7 [Figure]. However, according to the surveillance system, Week 7 was 3-4 weeks prior to the peak of influenza activity of the 2004/2005 season.

Figure

Sentinel surveillance for influenza-like illness (ILI) and laboratory confirmed cases, 2004-2005 season, Sweden



There are limitations to the survey method that may have underestimated the prevalence result. Firstly, a slight under-representation of individuals aged 15-29 years, likely to be due to the high level of mobile phone ownership and single households among this age group in Sweden. Secondly, due to the time proximity of the recall period and the survey, some households severely affected by influenza may have been omitted from the survey if household members were unable to answer the telephone.

The design effect of the prevalence measured was lower than expected, suggesting that reported influenza was not highly clustered by household. This could be an artefact due to the small size of households in Sweden. Conversely, it may be that many households in Sweden were concurrently affected by influenza, thus the ratio of between household variance and total variance is small. Results indicate that the burden of self-defined influenza was higher among younger age groups, consistent with reports from the European influenza surveillance system for 2004/2005 [10]. A higher burden of influenza on children would support a widespread distribution of influenza illness in the population.

The self-reported prevalence estimate of 7.7 % influenza is likely to be an overestimate of the prevalence in Sweden in Week 7 of 2005. Reported symptoms show a relatively high prevalence of cough. With fever status also being self-defined, it is likely that other circulating respiratory infections were included as influenza. However, according to laboratory surveillance, respiratory syncytial virus activity during the 2004-05 season was relatively low [11] with 37 cases reported in week 7 [www.smittskyddsinstitutet.se]. Using the ILI case definition, the resulting prevalence was nearly half that of self-reported influenza. Clinical or laboratory confirmation of reported influenza would have allowed a comparison of these measures, but was not possible in this survey.

An indication of the national uptake of influenza vaccination in the 2004/2005 season was obtained. With the assumption that individuals are vaccinated within the first few months of the season, the vaccination uptake among the age group of those aged 65 years and over in Sweden was 55.1%. This was similar to the 51% identified in 2003 [12], much higher than the 30% identified within a representative sample of this age group in one region of Sweden between 1998-2000 [13], but lower than the national 62.7% vaccine coverage in the last season in the United States [14].

Influenza is considered to cause a high burden on society in terms of time, energy and economic impact [15]. This survey identified that among those aged 5-64 years with self-reported influenza, 67% took time off work or school. Furthermore, the high proportion of individuals staying in bed for at least one day due to symptoms highlights the impact on daily life from self-defined influenza morbidity. These results are in line with the findings of a household survey undertaken in France in 2000 that identified a substantial burden of illness due to influenza [16].

This survey has provided useful insights into the burden of Influenza and ILI in Sweden during a week of the 2004/05 influenza season. It proved to be logistically feasible to be undertaken in a short time and economically viable. With repetition inter and intra seasons, this survey is a tentative step towards developing a comparative scale between sentinel surveillance measures and the true burden of influenza in the population. Such a development would provide a useful tool towards monitoring and interpreting influenza activity in Sweden and throughout Europe, supporting pandemic preparedness.

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ORIGINAL ARTICLES

Surveillance report

COMPLETENESS OF MALARIA NOTIFICATION IN THE NETHERLANDS 1995-2003 ASSESSED BY CAPTURE-RECAPTURE METHOD

S Klein[1], A Bosman[2]

In 1999 in the Netherlands, the duty to notify malaria was transferred from physicians to laboratories by the new Infectious Diseases Law. To evaluate the effect of this change, we aimed to estimate completeness of malaria notification in the Netherlands from 1995-2003. We calculated it relative to sentinel laboratory and hospital admission data. Using the two-source capture-recapture method (CRM), we estimated the total number of cases to assess the completeness relative to this number.

The completeness of notification relative to sentinel data was 18.2 % (95% CI of 15.7-20.7) from 1995-1998 and 56.4 % (95% CI of 47.0-65.8) for 2000-2003. The completeness relative to the number of malaria cases admitted to the hospital was 35.1 % for the period 1995-2003. The estimated numbers of cases of malaria between 1995 and 1998 were 3123 (95% CI of 2796-3449) and 5043 (95% CI of 4343-5742) between 2000 and 2003. The completeness relative to this numbers changed from 35.5 % (95% CI of 32.1-39.7) in 1995-1998 to 36.1 % (95% CI of 31.7-41.9) for the years 2000-2003. Laboratory-based notification has significantly increased the absolute number of malaria notifications, but there was no change in completeness relative to hospital admissions. The increase in estimated malaria cases may be artificial, due to the extent of violation of CRM requirements over the study period.

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Key words : Capture-recapture, malaria, notification system

Introduction

Since the new infectious diseases law was implemented in the Netherlands on 1 April 1999, laboratories are legally obliged to report malaria cases to the Municipal Health Service (GGD). Before this time, notification was only the responsibility of physicians. To evaluate this structural change in the Dutch notification system, this study, carried out in September 2004, aimed to estimate the completeness of malaria notifications in the Netherlands from 1995-2003. In this context, completeness refers to the proportion of cases detected by the notification system. It is generally assumed that malaria, like many other infectious diseases, is underreported [1,2]. Van Hest et al. investigated a total number of 774 malaria cases (95% CI of 740-821) and a completeness of notification on 40.2 % in the Netherlands in 1996 using three-source CRM [3].

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Methods

Data Sources, Case Definition and Matching Algorithms

The sentinel register (12 voluntarily reporting laboratories at the moment) included the variables month and year of birth, gender, postal code, place of residence and day of onset/date of diagnosis. The variables which were reported to the notification register included the date of notification, year of birth, date of diagnosis, date of onset, postal code, gender, reporting GGD, method of diagnosis, and the species of plasmodium. The Dutch morbidity registration organisation provided hospital admission data on principal diagnosis malaria (ICD-9 code 084* - * meaning all species of malaria) with the variables pathogen, date of admission, date of discharge, year of registration, year of birth, gender, postal code and place of residence after discharge. A case of malaria in this study was defined as a person with a positive blood smear for a plasmodium species.

We matched data first by using the following identifiers: year of birth, gender, year of diagnosis/request/admission (if missing: year of onset/sample) and 4-digit postal code, using an algorithm in MS-Excel®. To correct for late notification, we used safety margin of 30 days around the date of diagnosis in the GGD data and these matching pairs we reviewed manually.

We searched for additional matches in the remaining non-matched cases, using a second algorithm. This algorithm used the same identifiers, but without postal code, for the GGD records without a valid postal code (e.g. unknown, missing, abroad, homeless). To be confident we reviewed these matching pairs manually, comparing the date of diagnosis with the date of admission (+/- 3 days, hospital data) and the species (hospital data and laboratory data).

Completeness of notification

The completeness of notification was assessed by searching for cases which were also on the notification register as in the sentinel laboratory register or hospital admission register, respectively. To calculate the completeness (C) of notification relative to sentinel laboratory data we used the formula: $C = a/b*100\%$ where a is the