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Factors associated with pneumococcal and influenza vaccination in hospitalized people aged ⩾65 years

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SUMMARY

Socioeconomic factors and the patterns of use of health services associated with influenza and pneumococcal vaccination were studied in people aged ⩾65 years admitted to three general hospitals in Spain between 2005 and 2007. The following data were collected: age, sex, risk of pneumonia, educational level, social class, type of household, physician visits, length of time with the same general practitioner, and influenza and pneumococcal vaccination (23vPPV). Associations between variables were assessed using multivariate logistic regression analysis. In total, 1702 patients were included; 59·9% had received 23vPPV and 65·6% influenza vaccine. Older age (OR 1·04, $P<0·001$), living with a partner (OR 1·72, $P=0·003$) and influenza vaccination during the last year (OR 6·64, $P<0·001$) were associated with 23vPPV. Male sex (OR 1·44, $P=0·005$), older age (OR 1·02, $P=0·009$), moderate risk of pneumonia (OR 1·58, $P=0·001$), living with a partner (OR 1·52, $P=0·015$) and frequent physician visits during the last year (1–6 annuals visits (OR 2·65, $P<0·001$); >6 visits (OR 3·83, $P<0·001$)) were associated with influenza vaccination. Coordination between public health and primary-care services may be necessary to improve vaccine uptake.

Key words: Elderly people, influenza vaccine, pneumococcal vaccine, vaccination factors.

INTRODUCTION

The 23-valent pneumococcal polysaccharide vaccine (23vPPV) was licensed 25 years ago in the USA and is currently available in most developed countries. It is recommended in people aged ⩾65 years, and in children aged >2 years at high risk of invasive pneumococcal disease [1]. In 1999, pneumococcal vaccination programmes were introduced in several Spanish regions [2] following international recommendations [1]. During the last two decades several studies have proved the effectiveness of pneumococcal vaccination

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in the elderly [3–6]. However, vaccination coverage of target groups is not optimal. Only a few Spanish studies have reported on vaccine uptake, finding rates of between 35% and 53·1% in different populations [7–9].

In Spain, influenza vaccination has been provided to people aged ⩾65 years and to established risk groups since 1992 [10]. Some studies have reported a steady increase in vaccination uptake during the last few years [11–13], reaching 63·7% in 2003 [13]. Both influenza and pneumococcal vaccination are provided free of charge by the primary healthcare centres (PHCs) of the public Spanish Health Service.

Some studies have shown that differences in 23vPPV vaccination coverage are associated with sociodemographic characteristics and access to health services. The Centers for Disease Control and Prevention in the USA found lower 23vPPV coverage in African-Americans and Hispanics, while higher coverages were positively associated with educational levels and negatively with perceived health status [14]. Another study found higher coverage in people of middle or high socioeconomic status and those who had visited their physician during the last year [15]. Kamal *et al.* identified differences in 23vPPV coverage according to ethnicity, educational level, type of medical insurance and physician visits during the last year [16]. A Dutch study of factors predictive of non-compliance in a programme introducing 23vPPV and influenza vaccination in people aged ⩾65 years found that factors related to the pattern of use of health services associated with vaccination coverage included private medical insurance and difficulties in visiting the physician, as well as age (<75 years) [17]. 23vPPV is normally offered together with the influenza vaccine to patients in whom both are indicated. Studies have also found differences in influenza vaccination coverages which are associated with socioeconomic factors and access to health services [16, 18–20]. Analysing these factors in a Spanish population could provide useful information for the future planning of vaccination campaigns. Therefore, the objective of this study was to evaluate the association between specific socioeconomic factors and the use of health services and pneumococcal and influenza vaccination in hospitalized people aged ⩾65 years.

MATERIAL AND METHODS

This was a cross-sectional, descriptive study that formed part of a larger case-control study designed to evaluate 23vPPV effectiveness [21]. Study subjects were non-institutionalized patients aged ⩾65 years admitted to three acute hospitals in two Spanish autonomous communities (Catalonia and Galicia) between May 2005 and January 2007: The Hospital Clinic and Hospital de Bellvitge (Greater Barcelona, Catalonia) and Hospital Juan Canalejo, La Coruña (Galicia). All three are general hospitals serving essentially urban populations, with 861, 920 and 871 beds, respectively, and 45 144, 35 747 and 42 499 annual discharges, respectively. The methods of the case-control study have been previously reported [21]. Briefly, patients aged ⩾65 years hospitalized due to community pneumonia were included. Three control subjects matched by sex, age, date of hospitalization and underlying disease were selected for every case. Patients were located and asked to cooperate in the study on hospital wards [21]. The research protocol was approved by the Ethics and Scientific Committee of each hospital.

Independent variables

Age, sex and underlying disease were obtained from medical records. A short interview with the patient (or with the family when the patient's ability to respond was impaired) collected information on sociodemographic variables and the use of health services. The variables included were: last occupation, educational level (no formal education, complete or incomplete primary, secondary, university and other), type of household ('Who do you live with?' – alone, with partner only, with children, others), the number of physician visits during the last year and the length of time with the same general practitioner. Socioeconomic status was classified according to the last job as unqualified or manual workers (classes IVa, IVb, V) and others (classes I–III) [22].

Patients were classified into three strata according to the risk of pneumonia due to the underlying disease using medical records: high risk (solid organ neoplasia, haematological neoplasia, solid organ transplant, bone marrow transplant, radiotherapy, immunosuppressive therapy, corticosteroid therapy, splenectomy, autoimmune disease, chronic renal failure requiring haemodialysis, nephrotic syndrome, disabling neurological disease or AIDS); moderate risk (asymptomatic HIV infection, diabetes mellitus, heart failure, chronic obstructive pulmonary disease, chronic liver disease, renal failure not requiring haemodialysis) and low risk (none of the conditions mentioned).

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Vaccination status

Patients were considered to have received 23vPPV when the information was recorded in the hospital record or adult vaccination card. Vaccination status was verified by the PHC. Patients were considered as vaccinated only if the vaccine had been given $\geqslant$15 days before the onset of pneumonia for cases or $\geqslant$15 days before the date of hospitalization for controls. The same criteria were used to determine influenza vaccination status. In most cases, information was obtained within 15 days after first contact. The deadline for receiving information was 4 weeks.

Statistical analysis

Associations between study variables and 23vPPV and influenza vaccination were evaluated using bivariate logistic regression analysis. Logistic regression analysis was performed to account for the effects of confounding variables, introducing variables with a value of $P<0{\cdot}25$ in the bivariate analysis and those potentially related to the response. The analysis was performed with SPSS software version 12.0 (SPSS Inc., USA).

RESULTS

A total of 2130 patients were initially screened in the emergency room, of whom 73 were excluded because vaccination status could not be ascertained, leaving 2057 patients, of whom 355 women were excluded due to lack of information on social class. Therefore, 1702 patients were finally included, in whom 23vPPV uptake was 59·9% and 65·6% had received the influenza vaccine during the previous season (Table 1). Patients' characteristics are shown in Table 1.

Bivariate analysis

An association was found between 23vPPV coverage and a moderate risk of pneumonia (OR 1·41, 95% CI 1·02–1·80), age (OR 1·03, 95% CI 1·02–1·05), lower social class (OR 1·40, 95% CI 1·07–1·84), and living with a partner (OR 1·96, 95% CI 1·44–2·67) or with children (OR 1·54, 95% CI 1·12–2·11) (Table 2). In contrast, a negative association was found between 23vPPV coverage and high-medium educational levels compared to those with low levels (OR 0·70, 95% CI 0·55–0·89). 23vPPV was associated with visiting the physician during the last year, the numer of physician visits and the last seasonal influenza vaccination (OR 6·95, 95% CI 5·57–8·69).

Influenza vaccination coverage was associated with a moderate risk of pneumonia (OR 1·87, 95% CI 1·45–2·43), male sex (OR 1·66, 95% CI 1·31–2·10), living with a partner (OR 1·70, 95% CI 1·24–2·31) and the number of physician visits during the last year (Table 3).

Multivariate analysis

In the adjusted multivariate analysis, factors independently associated with 23vPPV were age (OR 1·04, 95% CI 1·02–1·06), living with a partner (OR 1·72, 95% CI 1·20–2·46) and influenza vaccination during the previous influenza season (OR 6·64, 95% CI 5·25–8·41) (Table 2).

Factors associated with influenza vaccination (Table 3) were male sex (OR 1·44, 95% CI 1·11–1·87), age (OR 1·02, 95% CI 1·01–1·04), a moderate risk of pneumonia compared to a low risk (OR 1·58, 95% CI 1·20–2·07), living with a partner compared to living alone (OR 1·52, 95% CI 1·09–2·13), and frequent physician visits during the last year [1–6 annual visits (OR 2·65, 95% CI 1·81–3·88) or $>$6 visits (OR 3·83, 95% CI 2·58–5·69)]. In constrast, a high risk of pneumonia was negatively associated with influenza vaccination compared to a low risk (OR 0·77, 95% CI 0·59–0·99).

DISCUSSION

The 23vPPV and influenza vaccine coverages obtained in this study (59·9% and 65·6%, respectively) are similar to the mean coverage found in previous studies [23–25]. Older age was associated with higher vaccination coverage of both vaccines, as in previous studies [14, 18]. Higher 23vPPV and influenza vaccination coverages were found in patients living with partners compared with those living alone. However, the factor most closely associated with 23vPPV was influenza vaccination in the vaccination season before hospital admission. This might be explained by PHC vaccination strategies, which use seasonal influenza vaccination as an opportunity to promote and administer 23vPPV in susceptible patients [17, 26]. Women had lower influenza vaccination coverage, as previously reported [27].

The association between a moderate risk of pneumonia due to the underlying disease and higher

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Table 1. *Patients' characteristics and influenza and pneumococcal vaccination coverage*

	n (%)	Pneumococcal vaccination (%)	Influenza vaccination (%)
Rural/urban			
Rural	233 (13·8 %)	59·2	63·9
Urban	1457 (86·2 %)	60·1	65·8
Sex			
Female	376 (22·1 %)	55·9	56·4
Male	1326 (77·9 %)	61·1	68·2
Age (yr), mean (S.D.)	76·75 (6·72)		
65–74	699 (41·1)	55·2	63·4
75–84	769 (45·2)	64·1	68·7
⩾85	234 (13·7)	60·3	62·0
Risk of pneumonia			
Low	487 (28·6 %)	55·9	61·2
Moderate	613 (36·0 %)	64·1	74·7
High	602 (35·4 %)	59·0	59·8
Social class			
I, II, III	251 (15·0 %)	53·4	65·3
IVa, IVb, V	1422 (85·0 %)	61·6	65·8
Type of household			
Alone	210 (12·3 %)	48·6	58·1
Partner (without children)	796 (46·8 %)	64·9	70·1
Children	593 (34·8 %)	59·2	63·9
Others	103 (6·1 %)	48·5	55·3
Educational level			
⩽Primary	1350 (79·7 %)	61·9	66·2
⩾Secondary	344 (20·3 %)	53·2	63·1
No. visits last year			
None	138 (8·2 %)	41·3	39·1
1–6	813 (48·5 %)	58·3	64·6
>6	724 (43·2 %)	65·6	72·2
Time with same physician			
<60 months	663 (40·9 %)	60·5	64·6
⩾60 months	958 (59·1 %)	60·1	66·9
Influenza vaccination			
No	586 (34·4 %)	30·5	
Yes	1116 (65·6 %)	75·4	
Total	1702 (100 %)	59·9	65·6

influenza vaccination coverage may be explained by the fact that these patients also have more indications for influenza vaccination [28]. As expected, a positive relationship between influenza vaccination and the number of physician visits during the year prior to hospital admission was also found. Other studies have also linked a higher probability of influenza vaccination with greater use of health services [16, 19, 20].

Although some studies have found an association between vaccination coverage and higher socioeconomic and educational levels [14, 16, 19, 29], our results do not support this association. We found higher 23vPPV coverage in patients with both low socioeconomic and educational levels, although the association was not retained in the ajdusted models.

De Andrés *et al*. [18] and Sarria & Timoner [27] found higher influenza vaccination coverages in municipal areas with <10 000 inhabitants. Our results do not support this association, since coverage in patients from rural (<10 000 inhabitants) and urban (⩾10 000 inhabitants) areas were very similar both for 23vPPV (59·2% and 60·1%, respectively) and influenza vaccination (63·9% and 65·8%, respectively). However, this variable was not included in the study design and sampling procedures.

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Table 2. *Association between pneumococcal vaccination in people aged ⩾65 years and study variables in bivariate and multivariate analyses*

	n	Bivariate OR (95%CI)	*P* value	Multivariate OR (95%CI)	*P* value
Rural/urban					
Rural	233				
Urban	1457	1·03 (0·78–1·38)	0·795		
Sex					
Female	376				
Male	1326	1·24 (0·98–1·56)	0·068		
Age, yr (mean)	76·75	1·03 (1·02–1·05)	<0·001	1·04 (1·02–1·06)	<0·001
Risk					
Low	487				
Moderate	613	1·41 (1·02–1·80)	0·005		
High	602	1·14 (0·89–1·45)	0·301		
Social class					
I, II, III	251				
IVa, IVb, V	1422	1·40 (1·07–1·84)	0·014		
Type of household					
Alone	210				
Partner (without children)	796	1·96 (1·44–2·67)	<0·001	1·71 (1·20–2·46)	0·003
Children	593	1·53 (1·12–2·11)	0·008	1·30 (0·91–1·88)	0·151
Others	103	0·99 (0·62–1·60)	0·996	1·08 (0·62–1·91)	0·778
Educational level					
Primary or less	1350				
Secondary or more	344	0·69 (0·55–0·89)	0·003		
No. visits last year					
None	138				
1–6	813	1·98 (1·38–2·87)	<0·001		
>6	724	2·70 (1·87–3·93)	<0·001		
Time with the same physician					
<60 months	663				
⩾60 months	958	0·98 (0·81–1·21)	0·885		
Influenza vaccination					
No	586				
Yes	1116	6·95 (5·57–8·69)	<0·001	6·64 (5·25–8·41)	<0·001

Strengths and limitations

A potential limitation of our study is the exclusion of women who had not worked or who identified themselves as housewives, as there was not sufficient information to categorize the social class. 23vPPV and influenza vaccination coverages were analysed in these women before exclusion (23vPPV 60·3%, influenza vaccine 60·0%) and were compared to the remaining female patients (23vPPV 55·9%, influenza vaccine 56·4%), with no significant differences being found (23vPPV, $P=0·225$; influenza vaccine, $P=0·322$).

Another possible limitation is the potential information bias associated with self-report or proxy reporting (interview with patient or relatives on admission), especially with respect to the validity of sociodemographic factors and the use of health services. To minimize this bias we obtained clinical data and other demographic data from medical records. In addition, the vaccination status was checked using vaccination cards or PHC records.

This study was based on hospitalized patients. Therefore, the cases are not representative of the general population, although they are representative of hospitalized cases in the areas studied, because they were recruited from the reference hospitals for each area. In addition, from the public health perspective, one of the most important objectives of vaccination is to avoid hospitalization due to influenza and pneumococcal disease in this particular age group. Our results are consistent with other studies carried out in samples from the general population [14, 16, 18, 19, 25, 27], suggesting that selection bias did not compromise the study results. Knowledge of the factors

Table 3. *Association between influenza vaccination in people aged ⩾65 years and study variables in bivariate and multivariate analyses*

	n	Bivariate OR (95%CI)	*P* value	Multivariate OR (95%CI)	*P* value
Rural/urban					
Rural	233				
Urban	1457	1·08 (0·81–1·45)	0·577		
Sex					
Female	376				
Male	1326	1·65 (1·31–2·10)	<0·001	1·44 (1·11–1·87)	0·005
Age, yr (mean)	76·75	1·01 (0·99–1·024)	0·225	1·02 (1·01–1·04)	0·009
Risk					
Low	487				
Moderate	613	1·87 (1·45–2·43)	<0·001	1·57 (1·2–2·07)	0·001
High	602	0·94 (0·74–1·21)	0·641	0·76 (0·59–0·99)	0·049
Social class					
I, II, III	251				
IVa, IVb, V	1422	1·01 (0·77–1·35)	0·899		
Type of household					
Alone	210				
Partner (without children)	796	1·69 (1·24–2·31)	0·001	1·51 (1·09–2·13)	0·015
Children	593	1·27 (0·93–1·76)	0·135	1·22 (0·87–1·72)	0·245
Others	103	0·89 (0·56–1·44)	0·643	0·93 (0·56–1·56)	0·785
Educational level					
Primary or less	1350				
Secondary or more	344	0·87 (0·68–1·12)	0·274		
No. visits last year					
None	138				
1–6	813	2·83 (1·96–4·11)	<0·001	2·65 (1·81–3·88)	<0·001
>6	724	4·04 (2·77–5·91)	<0·001	3·83 (2·58–5·69)	<0·001
Time with the same physician					
<60 months	663				
⩾60 months	958	1·11 (0·90–1·37)	0·325		

associated with vaccination in hospitalized patients is crucial in order to plan vaccine strategies for this age group.

The main strengths of the study are its size and the reliability of data collection, as previously reported [21]. In summary, we found that influenza and pneumococcal vaccination coverages were influenced by sociodemographic factors and the use of health services. Efforts should be made to increase vaccination in population groups not sufficiently reached by current vaccination schedules. This will require better coordination between public health services and PHC staff. The seasonal influenza vaccination campaign could provide a good opportunity to increase both influenza and pneumococcal vaccination coverages.

APPENDIX

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DECLARATION OF INTEREST

None.

REFERENCES

1. **Centers for Disease Control and Prevention.** Prevention of pneumococcal disease. Recommendations of the Advisory Committee on Immunization Practices (ACIP). *Morbidity and Mortality Weekly Report* 1997; **46**: 1–24.
2. **Salleras L, *et al.*** 23-valent pneumococcal vaccine [in Spanish]. In: Salleras L, ed. *Vacunaciones preventivas*, 2nd edn. Barcelona: Masson, 2003, pp. 363–398.
3. **Hedlund J, *et al.*** Effects of a large-scale intervention with influenza and 23-valent pneumococcal vaccine in elderly people: a 1 year follow-up. *Vaccine* 2003; **21**: 3906–3911.
4. **Butler JC, *et al.*** Pneumococcal polysaccharide vaccine efficacy. An evaluation of current recommendations. *Journal of the American Medical Association* 1993; **270**: 1826–1831.
5. **Domínguez A, *et al.*** Effectiveness of pneumococcal vaccination for elderly people in Catalonia (Spain): a case-control study. *Clinical Infectious Diseases* 2005; **40**: 1250–1257.
6. **Jackson LA, Neuzil KM.** Pneumococcal vaccine. In: Plotkin S, Orenstein W, Offit P, eds. *Vaccines*, 5th edn. Philadelphia: Saunders Elsevier, 2007, pp. 569–604.
7. **Batalla J, *et al.*** Pneumococcal vaccination coverage among people aged ⩾65 years in Catalonia [in Spanish]. In: Campins M, Moraga F, eds. *Vacunas*. Barcelona: Prous Science, 2002, pp. 173–180.
8. **Vila Córcoles A, *et al.*** Coverage and association with clinical variables of antipneumococcal vaccination of the population over 65 years old in Tarragona-Valls. *Revista Española de Salud Publica* 2005; **79**: 645–654.
9. **Vila-Córcoles A, *et al.*** Evolution of vaccination rates after the implementation of a free systematic pneumococcal vaccination in Catalonian older adults: 4-years follow-up. *BMC Public Health* 2006, **6**: 231.
10. **Ministerio de Sanidad y Consumo. Salud Pública. Promoción de la Salud y Epidemiología.** Vacunación en adultos. Recomendaciones. Año 2004. (http://www.msc.es/en/ciudadanos/proteccionSalud/vacunaciones/docs/recoVacunasAdultos.pdf). Accessed 21 April 2010.
11. **Batalla J, *et al.*** Influenza vaccination coverage in Catalonia [in Spanish]. *Vacunas* 2001; **2**: 130–134.
12. **Mayo Montero E, *et al.*** Evolution of the degrees of influenza vaccine (flu shot) coverage in Spain throughout the 1993–2001 period. Analysis by Autonomous Communities. *Revista Española de Salud Pública* 2004, **78**: 481–492.
13. **Vazquez-Fernández del Pozo S, *et al.*** Changes in influenza vaccination coverage in Spain from 2001 to 2003. Analysis by autonomous communities. *Gaceta Sanitaria* 2007; **21**: 10–17.
14. **Centers for Disease Control and Prevention.** Influenza and pneumococcal vaccination levels among persons aged ⩾65 years – United States, 2001. *Morbidity and Mortality Weekly Report* 2002; **51**: 1019–1024.
15. **Centers for Disease Control and Prevention.** Influenza and pneumococcal vaccination coverage levels among persons aged greater than or equal to 65 years – United States, 1973–1993. *Morbidity and Mortality Weekly Report* 1995; **44**: 506–507, 513–515.
16. **Kamal KM, Madhavan SS, Amonkar MM.** Determinants of adult influenza and pneumonia immunization rates. *Journal of the American Pharmaceutical Association* 2003; **43**: 403–411.
17. **Opstelten W, *et al.*** Introducing a pneumococcal vaccine to an existing influenza immunization program: vaccination rates and predictors of noncompliance. *American Journal of Medicine* 2001; **111**: 474–479.
18. **de Andres AL, *et al.*** Influenza vaccination among the elderly Spanish population: trend from 1993 to 2003 and vaccination-related factors. *European Journal of Public Health* 2007;**17**: 272–277.
19. **Centers for Disease Control and Prevention.** Public health and aging: influenza vaccination coverage among adults aged ⩾50 years and pneumococcal vaccination coverage among adults aged ⩾65 years – United States, 2002. *Morbidity and Mortality Weekly Report* 2003; **52**: 987–992.
20. **Jiménez-García R, *et al.*** Compliance with influenza and pneumococcal vaccination among patients with chronic obstructive pulmonary disease consulting their medical practitioners in Catalonia, Spain. *Journal of Infection* 2007; **54**: 65–74.
21. **Domínguez A, *et al.*** Effectiveness of the Pneumococcal Polysaccharide Vaccine in Preventing Pneumonia in the Elderly. *European Respiratory Journal*. Published online: 14 January 2010. doi:10.1183/09031936.00171309.
22. **Domingo-Salvany A, *et al.*** Proposal for a social class measure. Working Group of the Spanish Society of Epidemiology and the Spanish Society of Family and Community Medicine. *Atención Primaria* 2000; **25**: 350–363.
23. **Kissling E, *et al.*** 'I-Move' towards monitoring seasonal and pandemic influenza vaccine effectiveness: lessons learnt from a pilot multi-centric case-control study in Europe, 2008–9. *Eurosurveillance* 2009; **14**: pii = 19388.
24. **Dijkstra F, *et al.*** Long time trends in influenza-like illness and associated determinants in The Netherlands. *Epidemiology and Infection* 2009, **137**: 473–479.
25. **Christenson B, Lundbergh P.** Comparison between cohorts vaccinated and unvaccinated against influenza

and pneumococcal infection. *Epidemiology and Infection* 2002; **129**: 515–524.
26. **Kyaw MH, *et al.*** Influenza and pneumococcal vaccine distribution and use in primary care and hospital settings in Scotland: coverage, practice and policies. *Epidemiology and Infection* 2002; **128**: 445–455.
27. **Sarria A, Timoner A.** Determinants of influenza vaccination in persons 65 years of age and older. *Revista Española de Salud Pública* 2002; **76**: 17–26.
28. **Bayas JM, Campins M.** Vaccinations for immunocompetent adults with chronic diseases: cardiovascular diseases, chronic obstructive pulmonary disease, diabetes mellitus and hepatopathy [in Spanish]. *Vacunas* 2006; **7** (Suppl. 1): 80–85.
29. **Schoefer Y, *et al.*** Determinants of influenza and pneumococcal vaccination in patients with chronic lung diseases. *Journal of Infection* 2007; **55**: 347–352.