Clinical, demographical characteristics and hospitalisation of 3,010 patients with COVID-19 in Friuli Venezia Giulia Region (Northern Italy). A multivariate, population-based, statistical analysis

Caratteristiche cliniche, demografiche e ricovero di 3.010 pazienti affetti da COVID-19 in Friuli Venezia Giulia. Analisi statistica multivariata su base di popolazione

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WHAT IS ALREADY KNOWN

- **COVID-19 hospitalised population showed a worldwide highest proportion of males and of people with comorbidities such as diabetes, cardiac diseases, and hypertension.**
- **Differences in clinical and demographical variables were found in different countries.**

WHAT THIS PAPER ADDS

- **The study describes a cohort of COVID-19 infected population in Friuli Venezia Giulia, evaluating the probability of hospitalisation or death without hospital admissions as a proxy of a more severe illness.**
- **The flu vaccination showed a potential protective effect on the hospitalisation/death, while pneumococcal vaccination was a proxy of fragile population.**
- **For patients residing in retirements homes, gender and comorbidities affected the probability of a bad course of the disease.**

ABSTRACT

OBJECTIVES: to describe the clinical and demographical characteristics of COVID-19 infected people in the Friuli Venezia Giulia Region (FVG, Northern Italy).

DESIGN: retrospective cohort study with an individual level record linkage procedure of different administrative databases.

SETTING AND PARTICIPANTS: the cohort included 3,010 patients residing in FVG who tested positive for COVID-19 between 1 March and 15 May 2020, 2020. Regional hospital admissions and deaths without hospital admissions up to June 1st, 2020 were analysed. Determinants of the probability of a highly severe illness were investigated in terms of hospitalisations or death without hospital admission.

MAIN OUTCOME MEASURES: COVID-19 patients were identified from regional epidemiological data warehouse. Demographical and clinical variables such as gender, age, patient's comorbidities, vaccinations, ARBs/sartans prescriptions, and geographical residence variables were collected by linking different databases. Descriptive analyses were performed. Logistic multivariate regressions were used to estimate the probability of hospitalisation or death, whichever came first. Model coefficients and odds ratios (OR) were reported.

RESULTS: COVID-19 population in FVG had a mean age of 60 years and 59% were females. The study found that 37% had hypertension while patients with cardiologic diseases, diabetes, and cancer were around 15%; 22% of the cases were residing in retirement homes. Approximately 30% received flu or pneumococcal vaccination and a similar proportion of patients had at least one prescription of ARBs /sartans in the previous 6 months. Statistical models showed a higher probability of a worst course of disease for males, elderly, highly complicated (in terms of resource use) subjects, in the presence of cardiologic diseases, diabetes, and pneumococcal vaccination. People living in retirement homes had a lower probability of hospitalisation/death without hospital admission. The cohort was divided into two groups: COVID-19 patients infected in the territory and infected in retirement homes. Among COVID-19 patients infected in the territory, the probability of hospitalisation/death was higher for males, for older individuals, and for those with comorbidities. Diabetes resulted to be a risk factor (OR 1.79; 95%CI 1.23-2.62), as well as pneumococcal vaccination (OR 1.64; 95%CI: 1.18-2.29), which is a likely proxy of fragile patients with pulmonary disease. The flu vaccination showed a potential protective effect with a 40% lower probability of hospitalisation or death (OR 0.62; 95%CI 0.44-0.85). Among the retirement homes cohort group, a higher probability of a bad course of disease emerged for males and for more complex patients.

CONCLUSIONS: the greatest risk of hospitalisation/death as a measure of more severe illness was confirmed for males, elderly, and for individuals with comorbidities. Flu vaccination seemed to have had a protective effect while pneumococcal vaccination likely identified a group of high-risk patients to be actively monitored. For patients infected in the territory, different hospitalisation strategies were implemented by the regional health districts.

Keywords: COVID-19, retrospective analysis, hospitalisation, logistic regression, vaccination

RIASSUNTO

OBIETTIVI: descrivere le caratteristiche cliniche e demografiche della popolazione affetta da COVID-19 in Friuli Venezia Giulia (FVG), studiare i determinanti della probabilità di aggravamento della malattia in termini di ricovero ospedaliero o di decesso per i pazienti che non hanno subito ricovero.

DISEGNO: studio di coorte retrospettivo su base di popolazione basato su dati amministrativi da diverse fonti, incrociati a livello individuale con una procedura anonimizzata di *record linkage*.
SETTING E PARTECIPANTI: la coorte è composta da 3.010 soggetti residenti in FVG, con un test microbiologico positivo per COVID-19 nel periodo 01.03.2020-15.03.2020. Sono stati analizzati i ricoveri avvenuti nelle strutture ospedaliere del FVG fino al 01.06.2020.
PRINCIPALI MISURE DI OUTCOME: i pazienti affetti da COVID-19 sono stati individuati nel *data-warehouse* epidemiologico regionale. Attraverso il *record linkage*, sono state considerate variabili demografiche e cliniche quali il genere, l'età, la complessità del paziente, le vaccinazioni, le prescrizioni di ARBs/sartani e la residenza geografica. Sono state effettuate analisi descrittive univariate e sono stati utilizzati modelli logistici multivariati per stimare la probabilità di morte/ospedalizzazione (quella delle due che sopravviene prima). I risultati sono riportati in termini di *odds ratio* (OR) e intervalli di confidenza al 95%.
RISULTATI: la popolazione affetta da COVID-19 in FVG era caratterizzata da un'età media di 60 anni e composta per il 59% da femmine. Il 37% era affetto da ipertensione, mentre la proporzione di pazienti con patologie cardiache, diabete o tumori si è attestata intorno al 15%. Il 22% dei soggetti risiedeva in residenze per anziani. Circa il 30% era vaccinato per influenza o per pneumococco, una proporzione simile di casi aveva ricevuto almeno una prescrizione di ACE inibitori/sartani nei 6 mesi precedenti alla positività. I modelli statistici hanno messo in evidenza una maggiore probabilità di ricovero o decesso per i maschi, i soggetti più anziani, più complessi (in termine di utilizzo di risorse), con malattie cardiologiche, con diabete e sottoposti a vaccinazione pneumococcica. Per i soggetti residenti in casa di riposo si rileva una minore probabilità di ospedalizzazione o di decesso senza ricovero. La coorte è stata divisa in due gruppi, separando i pazienti positivi per COVID-19 residenti nel territorio da quelli residenti nelle case di riposo. La probabilità di peggioramento della malattia per gli infetti nel territorio è risultata più elevata per i maschi, per i più anziani e i maggiormente complessi, per esempio per storia di diabete (OR 1.79; IC95% 1.23-2.62) o sottoposti a vaccinazione pneumoccoccica (OR 1.64; IC95% 1.18-2.29), probabilmente come *proxy* di fragilità o pregresse malattie polmonari. La vaccinazione antinfluenzale ha mostrato un potenziale effetto protettivo sul verificarsi di ricovero o decesso (OR 0.62; IC95% 0.44-0.85). Relativamente alle persone positive per COVID-19 residenti nelle case di riposo, è stato riportato un rischio di peggiore decorso della malattia per i maschi e per i pazienti maggiormente complessi.
CONCLUSIONI: questo studio ha messo in luce un maggior rischio di aggravamento della malattia negli uomini, nei pazienti anziani e in quelli con patologie preesistenti. La vaccinazione antinfluenzale è risultata associata a un effetto protettivo rispetto all'*outcome* composito utilizzato, mentre la vaccinazione antipneumococcica può essere utilizzata per identificare un gruppo di pazienti ad alto rischio da monitorare in maniera proattiva. Infine, lo studio mostra come le tre Aziende sanitarie regionali del FVG hanno adottato strategie di ricovero eterogenee per i casi residenti nel territorio.

Parole chiave: COVID-19, analisi retrospettiva, regressione logistica, probabilità di ricovero, vaccinazione antinfluenzale, vaccinazione antipneumococcica

INTRODUCTION

Following the first COVID-19 positive cases documented in February 22.02.2020, the global number of infected cases highly increased in Italy according to an exponential trend[1] in the first phase. Approximately 240,000 cases were registered as of June 2020, with almost 90% of patients residing in the Northern Regions.[2,3] Limited information has been available to describe the characteristics of Italian COVID-19 infected patients who needed hospital admission. A study by Inciardi and colleagues[4] analysed demographical and clinical characteristics of 99 hospitalised patients. They found a mean age of 67 years, and a higher proportion of males. In the USA, a study on a cohort of 5,700 patients hospitalised in New York reported similar results with a lower mean age (63 years), a higher proportion of males, and a higher proportion of patients with hypertension, obesity, and diabetes.[5] Different characteristics were found in Georgia, where the analysis of 305 hospitalised patients showed an equal proportion of males and females, and a proportion of 61% of patients older than 65 years.[6] Other studies in different countries have shown variability in the hospitalised populations in terms of gender, age, and comorbidities.[7-10] The association of the severity of illness in patients under therapy with angiotensin receptor blockers (ARBs) and angiotensin-converting enzyme inhibitors (ACEIs) was checked by Li et al[11] and no differences were found. Similar results were found in Spain in another study.[12] Friuli Venezia Giulia is a small Region in the North-East of Italy with a population of 1,215,000 inhabitants and a low population density (155 people per km^2). The number of infected people, tested as of May 15.05.2020, was 3,010 cases. The regional epidemiological data warehouse contains health information on all Friuli Venezia Giulia residents. It is integrated and allows to easily link information from different data sources. The aim of this study was to describe the COVID-19 positive population cohort, hospitalised or not, and to identify with a multivariate logistic model the demographical and clinical variables that influenced the probability of a worse course of the illness in terms of hospitalisations or death without hospital admissions.

MATERIAL AND METHODS

MATERIALS

This retrospective cohort study was based on the analysis of administrative data collected in the health information system of the Friuli Venezia Giulia Region. The regional

epidemiological data warehouse covers the entire population and includes a number of health-related databases, linked at individual level through an anonymous encrypted identifier, which is modified every 6 months to guarantee patient anonymity. Different data sources, usually updated at the end of each month, were updated weekly or daily to allow a database with a short latency.
For this analysis, seven databases were linked:

1. Laboratory register;
2. Hospital discharge register;
3. Pharmaceutical;
4. Vaccinations;
5. Municipal registry;
6. Retirement homes;
7. Adjusted clinical group (ACG) software database.[13]

COVID-19 infected patients were identified from the laboratory database containing all the microbiological testing made in regional facilities. Subjects were defined affected by COVID-19 with at least one positive test for SARS-CoV-2. Hospital discharge registers contain all the information about the hospital admissions occurred in Friuli Venezia Giulia Region. Hospital discharge databases were used to identify positive cases with a hospital admission after a positive test or with a positive test performed during the hospitalisation. The access to intensive care units for the hospitalised patients was also verified. The pharmaceutical prescription database contains all the prescriptions made by the physicians working in the public health system. It was used to analyse the pharmacological treatments of the patients with a positive COVID-19 test in the 6 months before the disease. The study focused on the presence of at least one prescription of ARBs/sartans (ATC codes: C09*). Immunization database contains information on all the vaccines administered to the regional population. It was used to find positive cases with a previous pneumococcal or a flu vaccination for the season 2019-2020. The municipality register is an external data source and contains sociodemographical information about the regional population. It was used to complete the database with the date of death, when timely recorded. The retirement homes database is extracted from an administrative informative system, mainly used for accounting purposes. It was employed to identify COVID-19 positive patients who were residing in that kind of facility as, most likely, these patients represented a cluster of treatment. The adjusted clinical group (ACG) system, developed by the Johns Hopkins Bloomberg School of Public Health, is a territorial grouper that stratifies the population on the base of diagnosis and describes the case mix and the resource utilization. The ACG was used to evaluate comorbidities of the patients with COVID-19 following the Johns Hopkins criteria. Five classes of diseases were defined at high risk of worst outcomes for COVID-19, using both Expanded diagnosis cluster (EDC), Rx-defined morbidity groups (Rx-MG). The five considered conditions were: • cardiovascular disease (including the items «congestive heart failure» and «ischemic heart disease»); • diabetes; • hypertension; • obstructive pulmonary disease (including emphysema, chronic bronchitis, chronic obstructive pulmonary disease, EDC); • cancer.
The resource utilization band variable (RUB) was also considered as an index of complexity. It assumes a value from 0 (no use of health resources) to 5 (high use of health resources). Patients with a positive COVID-19 test from 1 March 1 to 15 May 2020, 2020, residing in Friuli Venezia Giulia at the time of the exam were considered in this study. After an empirical analysis, it was decided to use 14 days of follow-up for the hospitalisations or deaths without hospitalisations.

METHODS

Descriptive analyses were made using contingency tables on the total number of positives, divided into three groups: hospitalised, dead without hospitalisation, non-hospitalised. The frequency was stratified for the different variables of the data set.
A general linear model with a logistic link function was used to estimate the probability of hospitalisation or death without hospital admissions. The general expression of the model adopted is the following:

$$P(Y = y) = \pi(x) = \frac{exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k)}{1 + exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k)}$$

The odds ratio and the 95% confidence intervals (CI) were estimated and the model goodness of fitting was checked using the ROC curves. All the statistical analyses were made using SAS-EG software[14] and R.[15]

RESULTS

UNIVARIATE ANALYSIS

The number of patients with a positive COVID-19 testing up to 15.05.2020 residing in Friuli Venezia Giulia Region was 3,010 (59% females; 1,776 with a mean age of 60 years; 1st quartile 44 years; median 60 years; 3rd quartile 80 years). The proportion of infected who lived in a retirement home was 22%. A higher proportion of infected patients resided in the Health district (HD) 3 (47.9%). The infected patients with cardiac diseases, diabetes, hypertension, and cancer were respectively 15.7%, 14%, 37.7%, and 10%, and mean and median RUB was 2; 660 patients (22%) had 2 or more comorbidities, in terms of ACG variables. Thirty seven percent of patients had received flu vaccination and 32.7% pneumococcal vaccination. Almost 30% had prescriptions of ARBs/sartans in the 6 months preceding the infection (table 1). There were 831 patients (27% of the infected ones) with at least one hospital admission for COVID-19. Men accounted for 54% of hospitalised patients. A higher mean age was

found in the group of hospitalised patients (71 vs 55; t-test <0.0001). Differences emerged in the proportion of patients hospitalised in the different HDs, with higher percentages in the comorbidity groups; almost half of the patients with comorbidities needed hospitalisation. The mean RUB differed between hospitalised and not hospitalised groups (2.8 vs 1.9, t-test <0.0001). By univariate analysis, approximately 40% of patients with a flu/pneumococcal vaccination or ARBs/sartan prescriptions had a hospitalisation (table 1). The number of patients who died without hospitalisation was 112 (77 females) and almost all were above the age of 76 years. Approximately 84% were residing in retirement homes, characterized by higher RUB category, comorbidities, and vaccinated.

MULTIVARIATE ANALYSIS: LOGISTIC MODEL RESULTS

A logistic model was used to estimate the probability of the composite study variable (hospitalisation/death without hospitalisation) for the 3,010 infected patients residing in Friuli Venezia Giulia. Higher age, higher RUB, pneumococcal vaccination, and residence in HD1 increase the probability of a worse course of illness (table 2). The area under the ROC curve (figure 1A) was 0.80, index of a good fitting of the model.[16] In terms of odds ratio the probability of hospitalisation/death for women was 60% lower compared to men (OR 0.43; CI95% 0.35-0.52). Increasing age amplified the risk and a similar result was found for patients' comorbidities in terms of RUB. Cardiologic diseases (OR 1.32; 95%CI 1.01-1.72) and diabetes (OR 1.32; 95%CI 1.01-1.73) were the risk factors that increased by 30% the probability of worst outcome. Other comorbidities, flu vaccination, and pharmacological prescriptions had not a significant effect; however, pneumococcal vaccination increased the probability of hospitalisation/death (OR 1.53; 95%CI 1.19-1.97), probably because it caught the effect of pulmonary disease, not identified by the ACG algorithm. The interaction between the two vaccinations had not a significant effect and was excluded. Another variable that affected the outcome variable of the model was the patient's residence in a retirement home. In fact, this group of infected patients had 62% lower probability of a hospital admission (OR 0.38; 95%CI 0.28-0.51). In addition, a geographical effect emerged in terms of HD of residence with a higher probability of worst outcome for people residing in HD1 (figure 2). The cohort was divided into two groups, because in Friuli Venezia Giulia Region a large part of retirement home users is not self-sufficient and receives health assistance 24/7. The hospitalisation in these facilities could be influenced by other exogenous factors as different management strategies.

GROUP 1: infected people residing in the territory

The area under the ROC curve was 0.84 (figure 1B). As for the total cohort, females had a lower probability of worst outcome. Even the increasing age and RUB amplified the risk. Diabetes increased the probability of hospitalisation/death by 79% (OR 1.79; 95%CI 1.23-2.62). An interesting protective effect of flu vaccination was found, with vaccinated patients showing a 40% lower probability of hospitalisation/death (OR 0.62; 95%CI 0.44-0.85). On the other hand, pneumococcal vaccination seemed a risk factor on the probability of bad course of disease, probably identifying patients with pulmonary diseases. A geographical effect was found, with people residing in HD1 and HD2 with a higher probability to be hospitalised compared to HD3 residents (table 3, figure 2).

GROUP 2: infected people residing in retirement homes

The analysis of retirement home patients showed that the only variables to have an effect on the probability of hospitalisation or death (without a hospital admission) were gender and complexity in terms of resource use. Age and RUB were considered as continuous variables because patients were concentrated in few RUB classes and few age classes. A higher RUB increased the probability of worst outcome by 17% (OR 1.17; 95%CI 1.02-1.35). Also in this group, females had a 60% lower probability of worst outcome. In this group, the contribution of deaths in the outcome variable was higher.

Focusing only on the probability of hospitalisation, excluding the deaths, the model showed that the HD of residence was the main player on the probability of hospitalisation; this was due to strategical/managerial reasons.

DISCUSSION

In this study, hospital admissions and death of non-hospitalised patients were investigated as a composite variable, proxy of a bad evolution of the disease, as a healthcare outcome. COVID-19 infected females had a lower probability of hospital admissions respect to males, consistent with other international studies.[4,5,7] Residing in a retirement home was an important determinant in the hospitalisation. Perhaps, hospitalisation among retirement home guests relied on the different strategies adopted by the HD directorates. In the Friuli Venezia Giulia Region, 669 infected cases (22% of all COVID-19 positive individuals) were concentrated in few retirement facilities, often in small municipalities. Different health strategies were adopted, with some HDs deciding to treat patients inside the retirement home, which were prepared for intra-hospitalisation, while other HDs hospitalised the patients. Thus, different strategies were adopted even inside a small Region like Friuli Venezia Giulia, with a central regional directorate. Even with different strategies, the characteristics that most affected the risk of a bad evolution of the disease were age and patients' comorbidities. Focusing on deaths, a higher proportion in females was found. This was due to the older mean age of the women group within retirement homes (87 vs 80) and to the fact that 75% of the infected patients in the retirement homes were females.

VARIABLE		COVID-19 CASES IN FRIULI VENEZIA GIULIA REGION							
		HOSPITALIZED PATIENTS		DEATHS WITHOUT HOSPITALIZATION		NOT HOSPITALIZED OR DEATHS WITHOUT HOSP.		TOTAL CASES	
		No.	% (RAW)	No.	% (RAW)	No.	% (RAW)	No.	% (RAW)
GENDER	Female	385	46.3	77	68.8	1,314	63.6	1,776	59.0
	Male	446	53.7	35	31.3	753	36.4	1,234	41.0
AGE CLASS (YEARS)	0-30	26	3.1	0	0.0	455	22.0	481	16.0
	31-45	42	5.1	0	0.0	276	13.4	318	10.6
	46-60	137	16.5	0	0.0	638	30.9	775	25.7
	61-75	225	27.1	5	4.5	275	13.3	505	16.8
	76+	401	48.3	107	95.5	423	20.5	931	30.9
RETIREMENT HOME	No	631	75.9	18	16.1	1,692	81.9	2,341	77.8
	Yes	200	24.1	94	83.9	375	18.1	669	22.2
HEALTH DISTRICT	1	211	25.4	3	2.7	417	20.2	631	21.0
	2	248	29.8	43	38.4	647	31.3	938	31.2
	3	372	44.8	66	58.9	1,003	48.5	1,441	47.9
RUB	0	34	4.1	0	0.0	314	15.4	348	11.7
	1	168	20.3	11	9.8	726	35.6	905	30.4
	2	106	12.8	7	6.3	349	17.1	462	15.5
	3	268	32.4	29	25.9	402	19.7	699	23.5
	4	119	14.4	26	23.2	138	6.8	283	9.5
	5	131	15.9	39	34.8	110	5.4	280	9.4
CARDIAC DISEASE	No	589	71.3	68	60.7	1,853	90.9	2,510	84.3
	Yes	237	28.7	44	39.3	186	9.1	467	15.7
DIABETES	No	648	78.5	27	24.1	1,885	92.4	2,560	86.0
	Yes	178	21.5	85	75.9	154	7.6	417	14.0
HYPERTENSION	No	341	41.3	38	33.9	1,475	72.3	1,854	62.3
	Yes	485	58.7	74	66.1	564	27.7	1,123	37.7
CANCER	No	672	81.4	93	83.0	1,899	93.1	2,664	89.5
	Yes	154	18.6	19	17.0	140	6.9	313	10.5
FLU VACCINATION	No	407	49.0	17	15.2	1,467	71.0	1,891	62.8
	Yes	424	51.0	95	84.8	600	29.0	1,119	37.2
PNEUMOCOCCAL VACCINATION	No	425	51.1	23	20.5	1,577	76.3	2,025	67.3
	Yes	406	48.9	89	79.5	490	23.7	985	32.7
ARBS/SARTANS	No	436	52.5	78	69.6	1,530	74.0	2,044	67.9
	Yes	395	47.5	34	30.4	537	26.0	966	32.1

Table 1. Univariate analysis: description of the cohort of patients with COVID-19 who were hospitalised or who died with/without hospitalisation in Friuli Venezia Giulia Region, March-May 2020.
Tabella 1. Analisi univariata: descrizione della coorte di pazienti COVID-19 positivi ospedalizzati o deceduti con/senza ospedalizzazione in Friuli Venezia Giulia, marzo-maggio 2020.

The focus on infected population not residing in retirement facilities allowed to highlight hospitalisation determinants of the infection in the Region. In this study, diabetes increased the risk of hospitalisation, in line with other works,[5,17-19] whereas anti-flu vaccination showed a protective effect. In USA, a recent study showed a negative association between flu vaccination and mortality for COVID-19.[20] Another work in Brazil[21] found better outcomes for flu vaccinated patients. Anyways, it cannot be excluded that vaccination caught the effect of another latent variable, such as a major attention to individual health care. On the other hand, pneumococcal vaccinated patients had a higher risk of a bad evolution of the illness, a finding likely to represent a proxy of pulmonary disease. Differently from flu vaccination provided to people older than 65 years, in Friuli Venezia Giulia, in the last years, the selection of the population eligible for pneumococcal vaccination changed and followed different criteria. One of the most used was to admit to vaccination people with a high level of fragility, evaluated by the general practitioner, regardless of age. The effect caught by the pneumococcal vaccination is important, because it allows to identify people with pulmonary diseases not reached by the ACG algorithm, which could also be useful within a COVID-19 preventive policy. The effect of lower hospital admission in infected people with a flu vaccination is also interesting, especially because adjusted for age and comorbidities. The interaction between the two vaccinations was considered in the models, but the effect was not relevant and the variable was excluded.

VARIABLE		LOGISTIC MODEL: PROBABILITY OF HOSPITALIZATION OR DEATH FRIULI VENEZIA GIULIA REGION					
		ESTIMATE	STANDARD ERROR	PR > CHI²	SIGN.	ODDS RATIO	(CI95%)
INTERCEPT		1.3907	0.2579				
GENDER	F vs M	-0.8326	0.0982	<.0001	*	0.435	(0.358-0.527)
AGE	0-30 vs 76+	-32.782	0.2641	<.0001	*	0.038	(0.022-0.062)
	31-45 vs 76+	-21.438	0.2277			0.117	(0.074-0.182)
	46-60 vs 76+	-19.007	0.1724			0.149	(0.106-0.209)
	61-75 vs 76+	-0.9071	0.1480			0.404	(0.301-0.539)
RUB	0 vs 5	-1.2674	0.2729	<.0001	*	0.282	(0.164-0.477)
	1 vs 5	-0.8812	0.2045			0.414	(0.277-0.618)
	2 vs 5	-0.6929	0.2168			0.500	(0.326-0.764)
	3 vs 5	-0.4445	0.1749			0.641	(0.454-0.902)
	4 vs 5	-0.2558	0.1867			0.774	(0.537-1.116)
CARDIOLOGIC DISEASES	YES vs NO	0.2798	0.1361	0.0398	*	1.323	(1.013-1.728)
DIABETES	YES vs NO	0.2810	0.1372	0.0405	*	1.324	(1.012-1.734)
HYPERTENSION	YES vs NO	-0.0174	0.1200	0.8846		0.983	(0.776-1.242)
CANCER	YES vs NO	0.00807	0.1475	0.9564		1.008	(0.755-1.347)
FLU VACCINATION	YES vs NO	-0.2443	0.1302	0.0607	*	0.783	(0.606-1.009)
PNEUMOCOCCAL VACCINATION	YES vs NO	0.4275	0.1291	0.0009	*	1.533	(1.191-1.976)
ARBS/SARTANS	YES vs NO	0.1297	0.1085	0.2320		1.138	(0.920-1.407)
RETIREMENT HOME	YES vs NO	-0.9521	0.1497	<.0001	*	0.386	(0.287-0.516)
HEALTH DISTRICT	1 vs 3	0.3127	0.1243	0.0340	*	1.367	(1.071-1.744)
	2 vs 3	0.1704	0.1086			1.186	(0.958-1.47)

Table 2. Odds ratios of hospitalization or death of patients with COVID-19 in Friuli Venezia Giulia Region, according to selected variables.
Tabella 2. OR di ospedalizzazione o di morte dei pazienti con COVID-19 in Friuli Venezia Giulia, in base alle variabili selezionate.

VARIABLE		LOGISTIC MODEL: PROBABILITY OF HOSPITALIZATION OR DEATH TERRITORY					
		ESTIMATE	STANDARD ERROR	PR > CHI²	SIGN.	ODDS RATIO	(CI95%)
INTERCEPT		1.6417	0.3912				
GENDER	F vs M	-0.7924	0.1157	<0.0001	*	0.453	(0.360-0.567)
AGE	0-30 vs 76+	-3.5134	0.2839	<0.0001	*	0.030	(0.017-0.051)
	31-45 vs 76+	-2.3740	0.2503			0.093	(0.057-0.151)
	46-60 vs 76+	-2.1346	0.1993			0.118	(0.080-0.174)
	61-75 vs 76+	-1.2940	0.1806			0.274	(0.192-0.389)
RUB	0 vs 5	-1.3659	0.4020	0.0052	*	0.255	(0.114-0.554)
	1 vs 5	-1.0324	0.3589			0.356	(0.173-0.711)
	2 vs 5	-0.8876	0.3639			0.412	(0.198-0.829)
	3 vs 5	-0.6978	0.3311			0.498	(0.255-0.938)
	4 vs 5	-0.2818	0.3766			0.754	(0.356-1.565)
CARDIOLOGICAL DISEASE	YES vs NO	0.3733	0.2006	0.0627		1.453	(0.981-2.155)
DIABETES	YES vs NO	0.5848	0.1919	0.0023	*	1.795	(1.234-2.620)
HYPERTENSION	YES vs NO	-0.0315	0.1600	0.8437		0.969	(0.707-1.324)
CANCER	YES vs NO	0.1266	0.2013	0.5295		1.135	(0.765-1.686)
FLU VACCINATION	YES vs NO	-0.4772	0.1657	0.0040	*	0.620	(0.446-0.855)
PNEUMOCOCCAL VACCINATION	YES vs NO	0.4981	0.1690	0.0032	*	1.646	(1.181-2.291)
ARBS/SARTANS	YES vs NO	0.2025	0.1396	0.1469		1.224	(0.930-1.608)
HEALTH DISTRICT	1 vs 3	0.3896	0.1459	0.0034	*	1.476	(1.109-1.966)
	2 vs 3	0.4108	0.1353			1.508	(1.157-1.967)

Table 3. Odds ratios of hospitalization or death of patients with COVID-19 residing in Friuli Venezia Giulia Region who are not in retirement home, according to selected variables.
Tabella 3. OR di ospedalizzazione o morte in pazienti con COVID-19 residenti in Friuli Venezia Giulia che non si trovano in casa di riposo, in base alle variabili selezionate.

VARIABLE		LOGISTIC MODEL: PROBABILITY OF HOSPITALIZATION OR DEATH RETIREMENT HOMES					
		ESTIMATE	STANDARD ERROR	PR > CHI²	SIGN	ODDS RATIO	(CI95%)
INTERCEPT		-1.7685	0.9125				
GENDER	F vs M	-0.9499	0.1975	<0.0001	*	0.387	(0.262-0.568)
AGE		0.0166	0.0103	0.1087		1.017	(0.996-1.038)
RUB		0.1616	0.0702	0.0213	*	1.175	(1.025-1.350)
CARDIOLOGIC DISEASES	YES vs NO	0.1380	0.1910	0.4698		1.148	(0.789-1.669)
DIABETES	YES vs NO	-0.0150	0.2034	0.9411		0.985	(0.660-1.466)
HYPERTENSION	YES vs NO	0.00142	0.1876	0.9940		1.001	(0.693-1.447)
CANCER	YES vs NO	-0.0924	0.2254	0.6818		0.912	(0.584-1.416)
FLU VACCINATION	YES vs NO	0.0471	0.2368	0.8422		1048	(0.660-1.673)
PNEUMOCOCCAL VACCINATION	YES vs NO	0.3178	0.2074	0.1254		1.374	(0.917-2.070)
ARBS/SARTANS	YES vs NO	-0.0955	0.1841	0.6037		0.909	(0.633-1.303)
HEALTH DISTRICT	1 vs 3	0.3280	0.2731	0.1774		1.388	(0.813-2.379)
	2 vs 3	-0.2142	0.1912			0.807	(0.554-1.173)

Table 4. Odds ratios of hospitalization or death of patients with COVID-19 residing in retirement homes in Friuli Venezia Giulia Region, according to selected variables.
Tabella 4. OR di ospedalizzazione o morte nei pazienti con COVID-19 residenti in case di cura in Friuli Venezia Giulia, in base alle variabili selezionate.

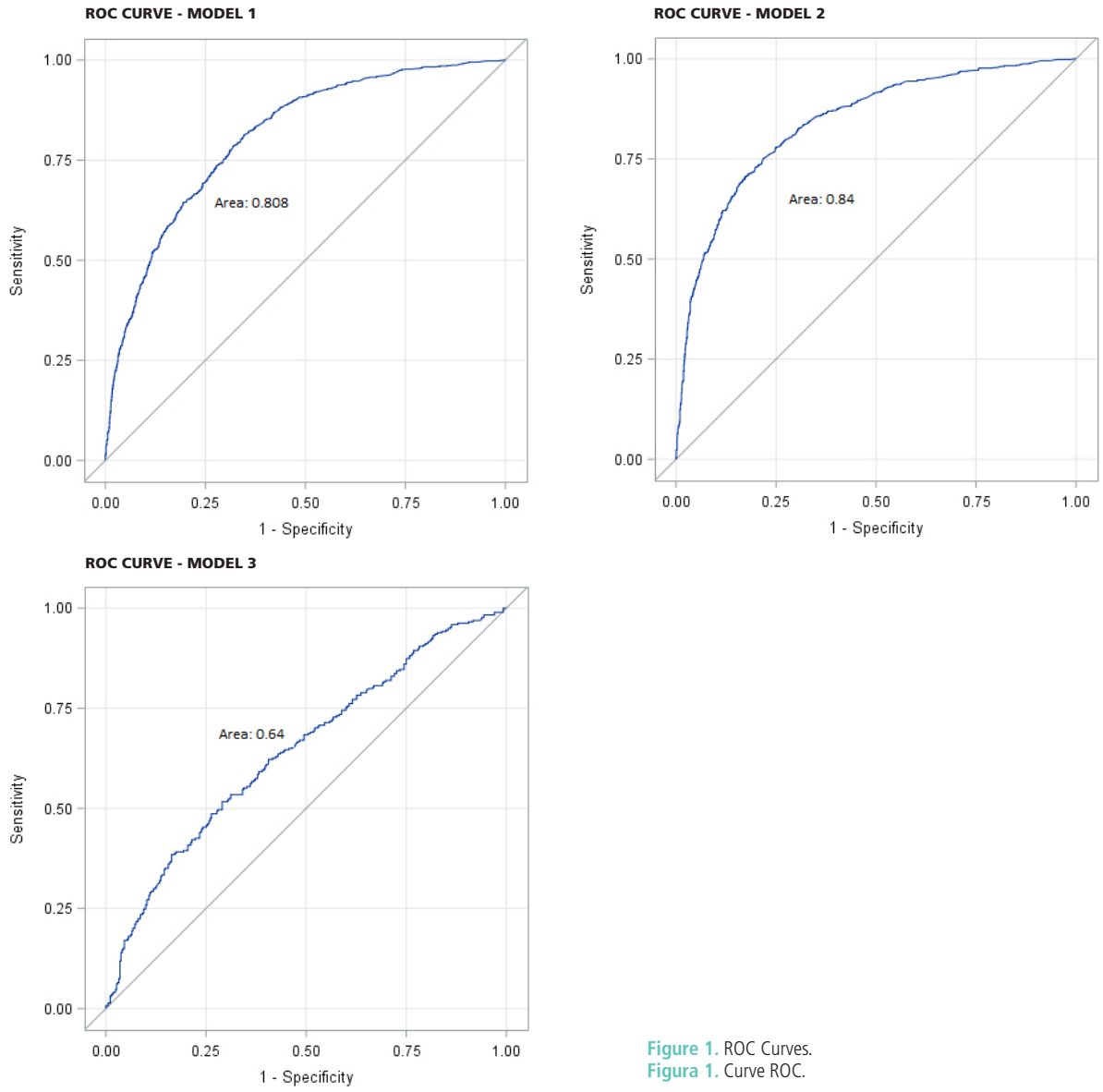

Figure 1. ROC Curves.
Figura 1. Curve ROC.

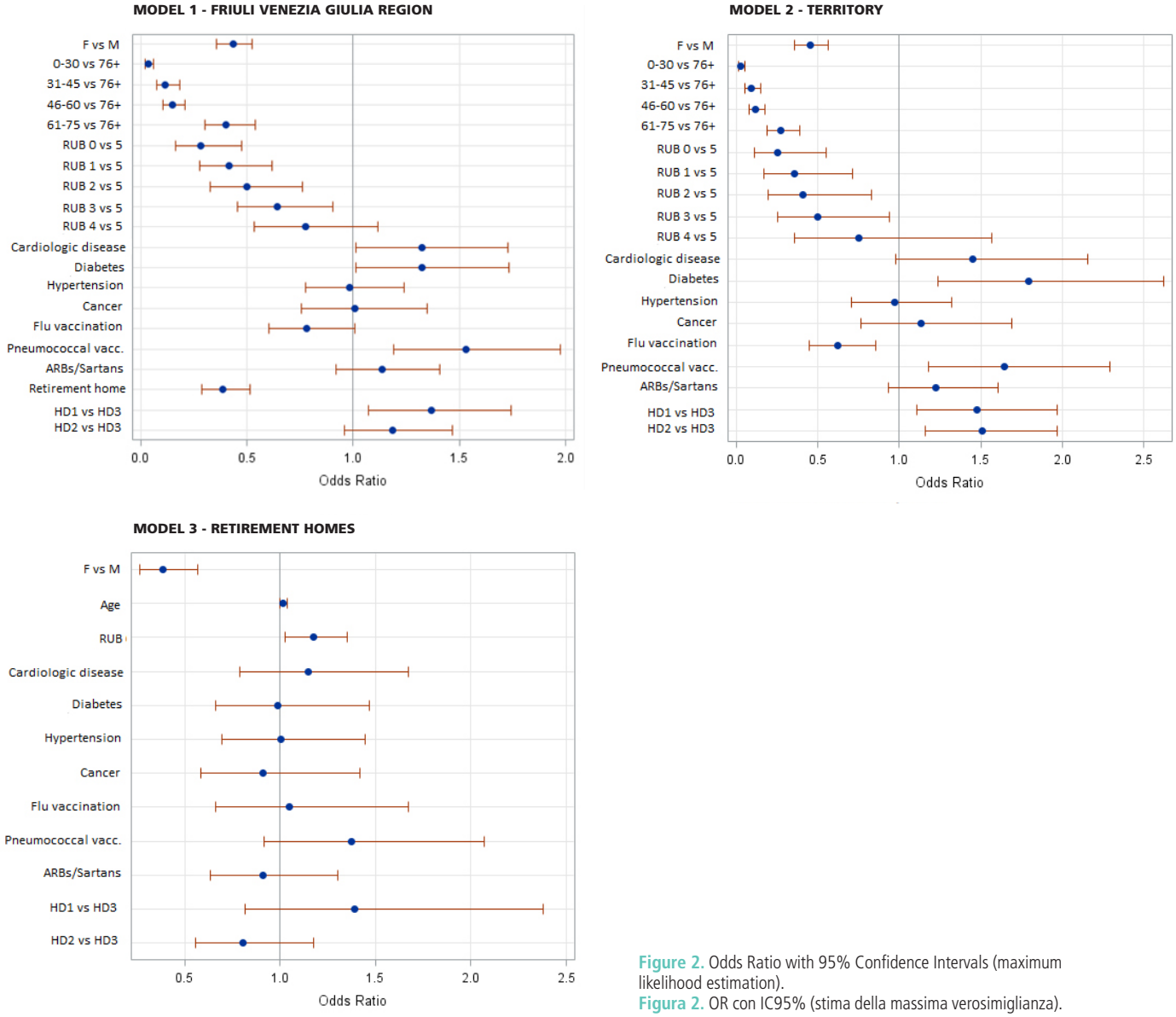

Figure 2. Odds Ratio with 95% Confidence Intervals (maximum likelihood estimation).
Figura 2. OR con IC95% (stima della massima verosimiglianza).

LIMITATIONS OF THE STUDY

A limitation of the study was that data extracted from administrative database did not allow to adjust the model for personal variables such as body mass index or smoke attitude. Another limitation was that no information about patients' clinical course of disease or about pharmaceutical therapy were available.

CONCLUSIONS

In the total cohort and in the territory, where the deaths without hospital admission were a residual part, the estimated statistical model showed, net of age, gender, and comorbidities, a potential protective effect of flu vaccination that needs to be investigated further in future studies. Heterogeneity among HDs was also identified in terms of hospitalisation. In retirement homes, the deaths without hospitalisations had a higher impact on the outcome. A further step could be to verify, using statistical modelling, the relationship between different strategies adopted by the HDs and health outcomes such as mortality, using survival tools, both for retirement homes and territory population.

Conflicts of interests: none declared.

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