Paediatric ambulatory care sensitive hospitalisation and Italian deprivation index: retrospective multilevel analysis of administrative data from 2008 to 2018 in the Abruzzo Region (Southern Italy)

Ricoveri pediatrici legati alle cure primarie e indice di deprivazione italiano: analisi multilivello retrospettiva di dati amministrativi dal 2008 al 2018 in Abruzzo

Pamela Di Giovanni,[1] Fabrizio Cedrone,[2] Giuseppe Di Martino,[3] Ferdinando Romano,[4] Tommaso Staniscia[2,3]

[1] Department of Pharmacy, "G. d'Annunzio" University of Chieti-Pescara, Chieti
[2] Postgraduate School of Hygiene and Preventive Medicine, "G. d'Annunzio" University of Chieti-Pescara, Chieti
[3] Department of Medicine and Ageing Sciences, "G. d'Annunzio" University of Chieti-Pescara, Chieti
[4] Department of Public Health and Infectious Disease, "Sapienza" University of Rome, Rome

Corresponding author: Fabrizio Cedrone; cedronefab@gmail.com

WHAT IS ALREADY KNOWN

- **Ambulatory Care Sensitive Conditions have been linked to preventable paediatric hospitalisations.**
- **Social and economic factors can be associated with preventable hospitalisations in children also in universal health care systems.**

WHAT THIS PAPER ADDS

- **This is the first study that has linked, over an eleven-year period, the economic deprivation index with preventable hospitalisations in a region of southern Italy providing important indications for health planning.**

ABSTRACT

OBJECTIVES: to estimate and analyse the trend of paediatric hospitalisations for Ambulatory Care Sensitive Conditions (ACSCs) from 2008 to 2018 in a region of southern Italy and to assess the association with the socio-economic deprivation index (DI).

DESIGN: retrospective observational study.

SETTING AND PARTICIPANTS: ACSC hospitalisations in children (≤18 years) were identified. Discharges for ACSC of the Abruzzo Region from 2008 to 2018 were selected and the deprivation index of the municipality of residence was assigned to the hospital discharge record where the patient's residence was reported.

MAIN OUTCOME MEASURES: the rate of paediatric preventable admissions (PPHs) related to ACSC, standardized by age and gender with the direct method, was calculated for the years of observation. The average annual percentage change (AAPC) was calculated with a trend analysis. In addition, the odds ratios (ORs) of hospitalisation for ACSC were calculated using a hierarchical logistic regression model.

RESULTS: 252,513 hospitalisations were examined, of which 16,264 (6.4%) attributable to ACSC. During the study period, the hospitalisation rate decreased from 8.59 per 1,000 to 6.12 per 1,000 residents, with an AAPC of -3.7, which was statistically significant (p<0.05). Furthermore, an association was highlighted between hospitalisations related to ACSC and the deprivation of the municipality of residence. Using as a comparison people residing in the municipalities belonging to the first quintile, the least deprived, the strength of the association between PPHs and DI increased from the third quintile (OR 1.13; CI95% 1.02-1.24) up to the fifth quintile, most deprived (OR 1.14; CI95% 1.01-1.30).

CONCLUSIONS: paediatric patients residing in Abruzzo have a risk of undergoing a preventable hospitalisation associated with an ACSC which depends on the deprivation index of the municipality of residence. Although it is difficult to evaluate the mechanisms involved in the relationship between economic deprivation and hospitalisation, DI can be useful to identify the areas which are most at risk on which to prioritize public health interventions.

Keywords: ambulatory care sensitive conditions, primary care, hospital discharge record, deprivation index

RIASSUNTO

OBIETTIVI: calcolare e analizzare il trend delle ospedalizzazioni pediatriche per patologie sensibili alle cure ambulatoriali (*ambulatory care sensitive conditions*, ACSC) dal 2008 al 2018 in una regione del Sud Italia e indagare l'associazione con l'indice di deprivazione socioeconomica.

DISEGNO: studio osservazionale retrospettivo.

SETTING E PARTECIPANTI: sono stati identificati i ricoveri ACSC in età pediatrica (≤18 anni). Sono state selezionate le dimissioni per ACSC nella regione Abruzzo dal 2008 al 2018 ed è stato assegnato l'indice di deprivazione del comune di residenza alla scheda di dimissione ospedaliera.

PRINCIPALI MISURE DI OUTCOME: è stato calcolato, per gli anni di osservazione, il tasso dei ricoveri prevenibili in età pediatrica standardizzato per genere ed età con il metodo diretto. È stata valutata la variazione percentuale media annua (AAPC) con un'analisi del trend. Sono stati, inoltre, calcolati gli *odds ratio* (OR) di ospedalizzazione per ACSC attraverso un modello gerarchico di tipo logistico.

RISULTATI: sono stati presi in esame 252.513 ricoveri di cui 16.264 (6,4%) attribuibili a ACSC. Nel periodo di osservazione, il tasso di ospedalizzazione è sceso da 8,59 per 1.000 residenti a 6,12 per 1.000 residenti, con una AAPC di -3,7, che è risultata statisticamente significativa (p<0,05). Si è rilevata, inoltre, un'associazione tra i ricoveri relativi alle ACSC e la deprivazione del comune di residenza. Usando come confronto i residenti nei comuni appartenenti al primo quintile, il meno deprivato, la forza di questa associazione è aumentata dal terzo quintile (OR 1,13; CI95% 1,02-1,24) fino al quinto quintile, più deprivato (OR 1,14; CI95% 1,01-1,30).

CONCLUSIONE: i pazienti pediatrici residenti in Abruzzo hanno un rischio di effettuare un ricovero prevenibile per una ACSC che dipende dall'indice di deprivazione del comune di residenza. Anche se risulta difficile valutare i meccanismi coinvolti nella relazione tra deprivazione economica e ospedalizzazione, l'indice di deprivazione può essere utile per identificare le aree più a rischio su cui indirizzare prioritariamente interventi di sanità pubblica.

Parole chiave: ambulatory care sensitive conditions, assistenza primaria, dimissioni ospedaliere, indice di deprivazione

INTRODUCTION

The Italian National Health Service (SSN) is constantly called to a careful use of its resources and an in-depth analysis of its performance. In this regard, avoidable hospitalisations represent a source of costs that could be spared. Paediatric preventable hospitalisations (PPHs) were defined through the use of ambulatory care sensitive conditions (ACSCs), and represent the potentially preventable hospital activity that a timely ambulatory care could temper, preventing the progression of the disease prior hospitalisation. In the Italian SSN, that is universal and comprehensive publicly-funded, the ACSC rate is an indicator of the quality of primary care.[1,2]

To this purpose, several studies have reported a relationship between increased access to primary care and a decreased risk of preventable hospitalisation.[3]

The socioeconomic status (SES) represents an important determinant of health and the deprivation indexes represent multidimensional measures of material and social resources.[4]

Deprivation index (DI) was used to evaluate the association among different health system outcomes such as hospital mortality or other public health outcomes.[5-7] It is also known that children born in socioeconomically disadvantaged families suffer from a deterioration in the well-being, with consequences that are capable of affecting the rest of life.[8]

OBJECTIVES

The purpose of this study was to estimate and analyse the PPHs rate occurring from 2008 to 2018 and to assess the association between PPHs and the deprivation index in a region of Southern Italy.

DESIGN, SETTING, AND PARTICIPANTS

A retrospective observational study was performed using hospital discharge records (HDRs) collected from 01.01.2008 to 31.12.2018 in Abruzzo, a region located in Southern Italy bordering the Adriatic Sea with approximately 1,300,000 inhabitants. It is organised in four Local Heath Authorities (LHAs) which manage four third-level hospitals. Data were collected from all HDRs through the hospital information system. HDRs include admission and discharge dates, discharge status (categorized as "discharged," "transferred", or "death"), presence of trauma, demographic information (birthplace, residence, gender, and age) and up to 6 discharge diagnoses (1 principal and 5 secondary diagnoses), coded according to the International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM).

Since a set of ACS conditions has not been agreed upon universally,[9] admissions related to the ACS conditions have been extracted from the HDRs following the indications proposed by Lu et al.[10] They took into consideration the recommendations of prior studies in which a panel of primary care physicians indicated which ACS conditions to adopt for paediatric use.[11,12] Inclusion of an admission was limited only to those for which the primary diagnosis was an ACS condition. The coding of the ACS conditions examined in this study is summarized in table 1.

Paediatric hospitalisations related to childbirth or immediately following it were excluded from the study, admissions that took place in the first three days of birth were excluded considering that hospitalisation of a mother who gives birth without complications is about 48 hours. DI used in this study is the one proposed by Caranci et al.[5,13] Due to the long period of time taken into consideration in the present study, both the DIs constructed with the 2001 and 2011 Census data were used.[14] In order to consider the exposure to deprivation, the Authors considered appropriate to assign until the end of 2011 the values of the DI related to the 2001 Census and from 2012 until the end of the study the DI related to the 2011 Census. DI was considered at municipality level in order to combine it with the HDRs in which the municipality of residence is recorded. DI is calculated as the sum of standardized indicators of low education level, unemployment, rented housing, single parent family, and housing density, and represent a proxy of the socioeconomic level of each municipality. DI was used through a breakdown into classes based on population quintiles, from the most deprived (5th quintile) to the least deprived (1st quintile); the latter label identifies the 20% of the population with the lowest index values.

Qualitative variables were summarized as frequency and percentage, and quantitative variables as median and interquartile range (IQR). Categorical variables were analysed using the chi-square test and quantitative were analysed with non-parametric tests.

Hospitalisation rates for PPH were computed each year as the ratio of the number of PPH and paediatric Abruzzo resident population (≤18) per 1,000, and standardized by age and gender with direct method on the regional population in 2008. Joinpoint regression model (Joinpoint version 4.6.0.0, 2018) was performed to evaluate the time trends of standardized rates and the average annual per-

cent change (AAPC), a summary measure of the trend over a given fixed time interval that is computed as a weighted average of the annual percent change emerging from the Joinpoint model. The final model is based on linear segments connected at joinpoints that represent the best fit of observed data.

Because the hierarchical structure of the data used for this study, in which municipality and LHA represent different level with potential intra cluster correlation, a random-effects multilevel logistic regression model with two levels of cluster (municipality and LHA) was fitted, in which the dependent variables were the PPH during a study period. As suggested by literature[15] for the use of the DI in small municipalities, two models have been implemented: one has examined all the municipalities in the region, the other one only the municipalities with less than 30,000 inhabitants. Subsequently, with post-estimation analysis, the Akaike's Information Criterion (AIC) was calculated to compare the two models. For all analyses, a p-value ≤0.05 was assumed to indicate statistical significance (two-tailed). Data were analysed using the statistical software Stata® version 15.

RESULTS

A total of 252,513 HDRs were included in the study, 16,264 (6.4%) are PPH, as shown in table 1.

ACS condition most frequently related to PPH are gastroenteritis-dehydration (4,586; 28.2%), bacterial pneumonia (3,883; 23.9%), grand mal status and other convulsions (2,120; 13.0%), severe ear, nose, and throat infection (1,477; 9.1%), kidney and urinary infection (1,206; 7.4%), and asthma (1,023; 6.3%). Frequencies of ACS conditions related to an admission in the study period are summarized in table 1. There are significant differences between PPHs and non-PPHs regarding gender (p=0.011), the distribution of the age (p<0.001), and the type of admission, PPHs are often unplanned (p<0.001). There are no significant differences between the groups regarding citizenship (p=0.228), as shown in table 2.

During the study period, the age and gender adjusted PPH rate decreased from 8.59 per 1,000 to 6.12 per 1,000 inhabitants and the AAPC is -3.7 (p<0.05). PPH rates and trend analysis are summarized in the table 3. Table 4 shows age and gender adjusted hospitalisation rates, both combined and PPH, stratified by relative deprivation quintile.

With regard to the fitted multilevel logistic models, the analysis that took into account all the PPHs of the region showed a slight gradient of association between PPH and deprivation index of the municipality of residence (all municipalities), in fact the association increases in strength, compared to the municipalities of the 1st quintile (least deprived), from 3rd quintile (OR 1.11; 95%CI 1.01-1.22) up to those of the 5th quintile, most deprived (OR 1.18; 95%CI 1.05-1.32). In this model, PPH was strongly associated with an emergency hospitalisation (OR 6.24; 95%CI 5.89-6.61) and there were not significant associations with gender and citizenship. Furthermore, the age groups 6-11 years and 12-17 years seemed to be protective with respect to the PPHs if compared with the 0-5-year group with OR 0.77 (95%CI 0.72-0.81) and OR 0.61 (95%CI 0.57-0.65), respectively.

The analysis that took into account the PPHs occurred in municipalities with less than 30,000 inhabitants showed

ACSC	ICD-9-CM CODES	No. (%)
Asthma	493	1,023 (6.3)
Bacterial pneumonia	481, 482.2, 482.3, 482.9, 483, 485, 486a	3,883 (23.9)
Cellulitis	681, 682, 683, 686	0 (0.00)
Dental conditions	521, 522, 523, 525, 528	357 (2.2)
Diabetes	250.0, 250.1, 250.2, 250.3, 250.8, 250.9	554 (3.4)
Failure to thrive	783.3, 783.41*	259 (1.6)
Gastroenteritis/Dehydration	558.9, 276.5	4,586 (28.2)
Grand mal status and other convulsions	345, 780.3	2,120 (13.0)
Immunization preventable conditions	032*, 033, 037, 045, 052*, 055*, 056*, 070.2*,070.3*, 072*, 320.0, 390, 391b	191 (1.2)
Iron-deficiency anaemia	280.1, 280.8, 280.9 (limit age to <5 years)	141 (0.9)
Kidney and urinary infection	590, 599.0, 599.9	1,206 (7.4)
Nutritional deficiencies	260, 261, 262, 268.0, 268.1	47 (0.3)
Pelvic inflammatory disease	614c	151 (0.9)
Severe ear, nose and throat infections	382,d 462, 463, 465, 472.1	1,477 (9.1)
Skin grafts with cellulitis	DRG 263, DRG 264	181 (1.1)
Tuberculosis	011, 012, 013, 014, 015, 016, 017, 018	88 (0.5)
Total		16,264 (100)

[a] Excluding patients with a secondary diagnosis of sickle cell (code 282.6) / *Esclusi pazienti con diagnosi secondaria di anemia falciforme (codice 252.6)*
[b] For (320.0), limit ages to 1-5 years, included / *Per il codice 320.0, le età limite sono 1-5 anni, inclusi gli estremi*
[c] Excluded cases with a surgical procedure of hysterectomy (codes 68.3-68.8) / *Esclusi I casi con procedura chirurgica di isterectomia (codici 68.3-68.8)*
[d] Diagnosis 382 excludes any cases with myringotomy with insertion of tubes (code 20.01) / *La diagnosi 382 esclude i casi con miringotomia con inserimento di tubicini per drenaggio (codice 20.01)*

Table 1. Ambulatory Care Sensitive Condition (ACSC) codes and relative admission frequencies during the study period.
Tabella 1. Codifica delle ambulatory care sensitive condition (ACSC) e relative frequenze nel periodo di studio.

DEMOGRAPHIC CHARACTERISTICS	COMBINED (No. 252,513)	PPH (No. 16,264)	NON-PPH (No. 236,249)	P-VALUE
GENDER				
Male	56.5%	55.5%	56.5%	0.011
Female	43.5%	44.5%	43.5%	
Median Age, years (IQR)	4 (0-11)	3 (1-8)	4 (0-11)	<0.001
CITIZENSHIP				
Italian	250,485 (99.2)	16,142 (99.2)	234,343 (99.2)	0.228
European	388 (0.1)	30 (0.2)	358 (0.1)	
Neither	1,640 (0.7)	92 (0.6)	1,548 (0.7)	
ADMISSION TYPE				
Planned	114,978 (45.6)	2,873 (17.7)	112,105 (47.4)	<0.001
Emergency	100,922 (40.0)	12,735 (78.3)	88,187 (37.3)	
Other	36,613 (14.5)	656 (4.0)	35,957 (15.3)	
DEPRIVATION INDEX*				
1st quintile (least deprived)	50,174 (19.9)	2,797 (17.2)	47,250 (20.0)	<0.001
2nd quintile (2nd least deprived)	50,553 (20.0)	2,976 (18.3)	47,486 (20.1)	
3rd quintile (3rd most deprived)	53,356 (21.1)	3,334 (20.5)	50,085 (21.2)	
4th quintile (2nd most deprived)	49,341 (19.5)	3,090 (19.0)	46,305 (19.6)	
5th quintile (most deprived)	49,089 (19.4)	4,066 (25.0)	45,124 (19.1)	

Table 2. Demographic characteristics of all paediatric preventable (PPH) and non-preventable (non-PPH) admissions.
Tabella 2. Caratteristiche demografiche dei ricoveri totali, prevenibili (PPH) e non prevenibili (non-PPH).

similar results. In addition, an association with the female gender (OR 1.06; 95%CI 1.01-1.13) was highlighted. The comparison between the two multivariate models showed a superiority of the one fitted for municipalities under 30,000 inhabitants as shown by the smaller AIC value. Multilevel logistic analysis results and AIC are showed in table 5.

CONCLUSIONS

This observational retrospective study shows a statistically significant reduction in preventable paediatric hospitalisations from 2008 to 2018 in a region of Southern Italy. It also shows an association between PPHs and socioeconomic deprivation status of child's municipality of residence. PPHs accounted for 6.4% of all paediatric hospitalisations over the study period. In a recent Italian study, which took into account the hospitalisations that occurred in a single hospital of a region of Southern Italy, Zucco et al.[16] reported a prevalence of PPH of 10.5%.

The prevalence shown in this study is lower even if compared with international studies performed in the United States and Europe.[10,17,18] The reasons for this difference can be explained by several causes. First of all, from the quality of the HDRs, in fact, the PPHs are extracted from the HDRs through the coding in the principal diagnoses of the ACSC. HDRs are not completed for epidemiological, but only for administrative purposes and the main diagnosis recorded does not necessarily correspond to the cause of hospitalisation, but could represent a condition that maximizes the remuneration system. Another explanation could be the different coding system that has been chosen; in fact, some studies selected only some pathological conditions or have been conducted in countries

YEAR	ADJUSTED RATE (95%CI)
2008	8.59 (8.46;8.72)
2009	8.00 (7.88;8.12)
2010	8.02 (7.89;8.14)
2011	7.80 (7.67;7.92)
2012	7.26 (7.13;7.39)
2013	7.31 (7.17;7.44)
2014	7.23 (7.11,7.35)
2015	6.41 (6.27,6.53)
2016	6.13 (6.01;6.25)
2017	6.02 (5.90;6.13)
2018	6.12 (6.00,6.24)
Average annual percent change	-3.7 (-4.3;-3.0)
p-value	<0.05

Table 3. Age- and gender-adjusted paediatric preventable hospitalisation (PPH) rate x1,000 inhabitants and trend analysis over the study period.
Tabella 3. Tasso di ospedalizzazioni pediatriche prevenibili ogni 1.000 residenti, aggiustato per genere ed età, e analisi del trend nel periodo di studio.

YEAR	ADMISSION RATE X1,000 (95%CI)									
	COMBINED					PPH				
	1ST QUINTILE	2ND QUINTILE	3RD QUINTILE	4TH QUINTILE	5TH QUINTILE	1ST QUINTILE	2ND QUINTILE	3RD QUINTILE	4TH QUINTILE	5TH QUINTILE
2008	22.97 (21.72-24.12)	25.36 (24.09-26.64)	24.40 (23.19-25.62)	28.20 (26.78-29.63)	21.50 (20.37-22.63)	1.33 (1.25-1.40)	1.47 (1.39-1.55)	1.40 (1.31-1.49)	1.81 (1.68-1.94)	1.64 (1.51-1.76)
2009	22.93 (21.83-24.03)	24.24 (22.99-25.49)	22.96 (21.80-24.11)	26.71 (25.30-28.11)	20.01 (19.05-20.98)	1.43 (1.35-1.51)	1.58 (1.51-1.66)	1.57 (1.49-1.66)	1.77 (1.65-1.88)	1.60 (1.49-1.71)
2010	22.17 (21.07-23.27)	23.39 (22.08-24.70)	23.01 (21.75-24.26)	25.01 (23.65-26.38)	20.98 (19.99-21.98)	1.34 (1.26-1.41)	1.47 (1.40-1.54)	1.50 (1.41-1.60)	1.73 (1.61-1.84)	1.66 (1.55-1.78)
2011	21.34 (20.26-22.42)	21.93 (20.69-23.17)	22.95 (21.76-24.14)	22.48 (21.15-23.81)	20.82 (19.88-21.76)	1.30 (1.23-1.38)	1.45 (1.37-1.52)	1.49 (1.40-1.59)	1.59 (1.48-1.69)	1.59 (1.55-1.78)
2012	20.11 (19.08-21.13)	19.36 (18.29-20.44)	22.02 (20.81-23.23)	19.58 (18.59-20.56)	20.40 (19.33-21.46)	1.16 (1.09-1.24)	1.17 (1.09-1.25)	1.38 (1.26-1.49)	1.25 (1.17-1.33)	1.62 (1.50-1.74)
2013	19.52 (18.50-20.54)	19.54 (18.48-20.59)	21.81 (20.65-22.97)	18.88 (17.86-19.90)	19.66 (18.60-20.72)	1.06 (0.99-1.14)	1.20 (1.10-1.29)	1.50 (1.40-1.61)	1.10 (1.01-1.19)	1.71 (1.58-1.84)
2014	19.47 (18.48-20.47)	18.69 (17.66-19.71)	20.32 (19.27-21.37)	18.04 (17.12-18.96)	19.55 (18.54-20.57)	1.11 (1.04-1.19)	1.10 (1.01-1.18)	1.30 (1.24-1.37)	1.20 (1.13-1.28)	1.70 (1.57-1.82)
2015	19.40 (18.36-20.45)	18.42 (17.41-19.42)	19.85 (18.79-20.91)	17.81 (16.94-18.67)	17.86 (16.95-18.77)	1.07 (1.00-1.14)	1.06 (0.99-1.14)	1.27 (1.20-1.34)	1.17 (1.10-1.24)	1.58 (1.47-1.70)
2016	19.39 (18.29-20.50)	18.18 (17.21-19.15)	19.42 (18.37-20.46)	16.78 (15.90-17.65)	17.36 (16.41-18.30)	1.00 (0.94-1.06)	0.95 (0.88-1.02)	1.13 (1.04-1.21)	0.93 (0.86-1.00)	1.47 (1.36-1.58)
2017	17.86 (16.74-18.97)	18.46 (17.45-19.47)	18.50 (17.39-19.61)	16.41 (15.49-17.33)	16.95 (15.97-17.92)	0.90 (0.84-0.97)	0.96 (0.88-1.04)	1.14 (1.04-1.24)	0.95 (0.88-1.02)	1.50 (1.37-1.62)
2018	17.22 (16.14-18.30)	18.72 (17.57-19.87)	18.74 (17.62-19.87)	16.67 (15.72-17.63)	18.15 (17.07-19.23)	0.88 (0.82-0.95)	1.16 (1.07-1.26)	1.12 (1.03-1.20)	0.99 (0.92-1.06)	1.31 (1.20-1.41)
Δ%*	-5.70	-6.64	-5.66	-11.53	-3.35	-33.60	-20.90	-20.43	-45.11	-20.01

* delta percentage variation between the first and last year of observation / *variazione percentuale fra il primo e l'ultimo anno di osservazione*

Table 4. Age- and gender-adjusted admission rate (combined and PPH) per 1,000 inhabitants for each deprivation index quintile.
Tabella 4. Tassi aggiustati per genere ed età di ospedalizzazioni pediatriche totali e prevenibili ogni 1.000 residenti per ogni quintile dell'indice di deprivazione.

VARIABLE	ALL MUNICIPALITIES	MUNICIPALITIES WITH LESS THAN 30,000 INHABITANTS
	OR (95%CI)	OR (95%CI)
GENDER (females vs males)	1.02 (0.97-1.06)	1.06 (1.01-1.13)
AGE CLASS		
0-5	Ref.	Ref.
6-11	0.77 (0.72-0.81)	0.78 (0.72-0.84)
12-17	0.61 (0.57-0.65)	0.63 (0.58-0.68)
CITIZENSHIP		
Italian	Ref.	Ref.
European	1.19 (0.71-1.99)	0.83 (0.38-1.82)
Neither	0.91 (0.67-1.23)	0.70 (0.46-1.06)
ADMISSION TYPE		
Planned	Ref.	Ref.
Emergency	6.24 (5.89-6.61)	6.16 (5.72-6.63)
Other	0.29 (0.20-0.42)	0.29 (0.18-0.46)
DEPRIVATION INDEX		
1st quintile (least deprived)	Ref.	Ref.
2nd quintile (2nd least deprived)	1.01 (0.92-1.11)	1.03 (0.93-1.14)
3rd quintile (3rd most deprived)	1.11 (1.01-1.22)	1.13 (1.02-1.24)
4th quintile (2nd most deprived)	1.12 (1.01-1.24)	1.11 (0.99-1.24)
5th quintile (most deprived)	1.18 (1.05-1.32)	1.14 (1.01-1.30)
Akaike Information Criterion	57,479.13	34,788.68

Table 5. Results of multilevel logistic regression.
Tabella 5. Risultati della regressione logistica multilivello.

where another diagnosis coding was used (ICD-10 instead of ICD-9-CM). Furthermore, the low prevalence of these events could reflect the quality of primary care provided to patients in terms of outpatient care and preventive strategies existing in Abruzzo Region.

The first three ACS conditions most frequently recorded in this study, i.e., gastroenteritis-dehydration, bacterial pneumonia, and grand mal status and other convulsions are in line with the literature, representing the conditions that most often require preventable hospitalisation in paediatric population.[19,20]

In the present study, age is inversely associated with PPH and this is consistent with the literature, which describes that younger children are more frequently hospitalised.[10,16,17] The data here presented show, in fact, that the 0-5 age group is the most associated with preventable hospitalisation. In any case, the relationship between age and PPHs is complex, in a study, for example, the association with the age group >11 years is shown.[21] These differences must be read in the light of the various methodologies used for coding preventable hospitalisations for diseases typically more associated with earlier ages than adolescence. The same theory can be extended to gender differences. In the present study, the association of PPHs occurs with the female gender if the analysis is restricted to the least populated municipalities, whereas the model that examined the hospitalisations of the whole region showed no differences. The national study conducted by Lu et al[10] reports an association of PPHs with the male gender, but the reasons for this relationship are unclear.

Although the Italian National Health Service is universal, there is an association between the socioeconomic level of the municipality of residence and the probability of PPHs. Disadvantaged population groups experience the highest risk of hospital admission for ACSCs, this has been confirmed in both adulthood and paediatric age using different indicators such as income level.[22,23]

In the literature, many of the factors associated with preventable hospitalisations concern peculiar characteristics of the patient himself such as the presence or absence of insurance coverage,[24] continuity of care,[25] the underlying pathology,[26] or ethnicity[25,27] as well as the individual socioeconomic status. The deprivation indicator here used represents a context and non-individual indicator which can help in planning interventions for improving primary care directed to specific groups or specific context, supported by studies that are interested in more fragile demographic groups. In fact, improving the quality of health care, containing simultaneously costs, continues to be a fundamental priority for national and regional health services and health inequalities still represent an element that must be measured and faced-off by public health interventions. Further studies are needed to understand the complex relationship between socioeconomic status and paediatric health outcomes for ACSCs.

Another topic of interest in literature concerns the urban or rural context of the citizen and the quality of care.[28] The Abruzzo Region has some peculiarities: the urban context is restricted to the area between the cities of Pescara and Chieti, while the remaining part of the region is represent-

ed by small municipalities that can be considered rural. In the present analysis, excluding the larger municipalities as suggested by the literature,[15] it can be said with sufficient certainty the investigated context is homogeneous.

Results of this study must be seen in the light of some limitations, first of all the PPH represents a heterogeneous group of clinical entities involving a broad age group ranging from 0 to 18 years and the use of an aggregate indicator could be misleading and, consequently, could not intercept specific health needs. Secondly, since in the HDR there is information of municipality of residence, the deprivation index was aggregated by municipality and not at the census level, the study could lose "resolving power".

In conclusion, the present study demonstrates an association between the DI and preventable hospitalisations in children in a region of Southern Italy. In order to improve the population's health in Abruzzo Region, to avoid both direct and indirect preventable costs, the deprivation index can be useful to identify the areas most at risk on which to prioritize public health interventions.

Conflicts of interest: none declared.

Acknowledgments: the Authors want to thank Nicola Caranci (Regional Health and Social Agency of Emilia Romagna) for the great spirit of sharing and collaboration that make this study possible which sheds light on the issue of inequalities in Abruzzo Region. The Authors would also thank "Ufficio governo dei dati flussi informativi e mobilità sanitaria", Dipartimento Sanità, Regione Abruzzo (Italy) for data collection.

REFERENCES

1. Bottle A, Millett C, Xie Y, Saxena S, Wachter RM, Majeed A. Quality of primary care and hospital admissions for diabetes mellitus in England. J Amb Care Man 2008;31(3):226-38.
2. Magan P, Alberquilla A, Otero A, Ribera JM. Hospitalizations for ambulatory care sensitive conditons and quality of primary care: their relation with socioeconomic and health care variables in the Madrid regional health service (Spain). Med Care 2011;49(1):17-23.
3. Caminal J, Starfield B, Sánchez E, Casanova C, Morales M. The role of primary care in preventing ambulatory care sensitive conditions. Eur J Public Health 2004;14(3):246-51.
4. Braveman PA, Cubbin C, Egerter S, et al. Socioeconomic status in health research: one size does not fit all. JAMA 2005;294(22):2879-88.
5. Caranci N, Biggeri A, Grisotto L, Pacelli B, Spadea T, Costa G. The Italian deprivation index at census block level: definition, description and association with general mortality. Epidemiol Prev 2010;34(4):167-76.
6. Restivo V, Cernigliaro A, Palmeri S, Sinatra I, Costantino C, Casuccio A. The Socio-Economic Health Deprivation Index and its association with mortality and attitudes towards influenza vaccination among the elderly in Palermo, Sicily. J Prev Med Hyg 2018;59(4) Suppl 2:E26-30.
7. Lillini R, Quaglia A, Vercelli M. Registro Mortalità Regione Liguria. Building of a local deprivation index to measure the health status in the Liguria Region. Epidemiol Prev 2012;38(3-4):180-87.
8. Pickett KE, Wilkinson RG. The ethical and policy implications of research on income inequality and child well-being. Pediatrics 2015;135 Suppl 2:S39-47.
9. Gibson OR, Segal L, Mcdermott RA. A systematic review of evidence on the association between hospitalisation for chronic disease related ambulatory care sensitive conditions and primary health care resourcing. BMC Health Ser Res 2013;13(1):336.
10. Lu S, Kuo DZ. Hospital charges of potentially preventable pediatric hospitalizations. Acad Pediatr 2012;12(5):436-44.
11. Garg A, Probst JC, Sease T, Samuels ME. Potentially preventable care: ambulatory care-sensitive pediatric hospitalizations in South Carolina in 1998. South Med J 2003;96(9):850-58.
12. Shi L, Samuels ME, Pease M, Bailey WP, Corley EH. Patient characteristics associated with hospitalizations for ambulatory care sensitive conditions in South Carolina. South Med J 1999;92(10):989-98.
13. Caranci N, Costa G. Un indice di deprivazione a livello aggregato da utilizzare su scala nazionale: giustificazioni e composizione dell'indice. In Costa G, Cislaghi C, Caranci N (eds). Le disuguaglianze di salute. Problemi di definizione e di misura. Salute e Società. Milano, Franco Angeli, 2009; pp. 58-78.
14. Rosano A, Pacelli B, Zengarini N, Costa G, Cislaghi C, Caranci N. Update and review of the 2011 Italian deprivation index calculated at the census section level. Epidemiol Prev 2020;44(2-3):162-70.
15. Pasetto R, Caranci N, Pirastu R. Deprivation indices in small-area studies of environment and health in Italy. Epidemiol Prev 2011;35(5-6) Suppl 4:174-80.
16. Zucco R, Pileggi C, Vancheri M, Papadopoli R, Nobile CGA, Pavia M. Preventable pediatric hospitalizations and access to primary health care in Italy. PloS One 2019;14(10):e0221852.
17. Medford-Davis LN, Shah R, Kennedy D, Becker E. Factors associated with potentially preventable pediatric admissions vary by diagnosis: findings from a large state. Hosp Pediatr 2016;6(10):595-606.
18. Weeks WB, Ventelou B, Paraponaris A. Rates of admission for ambulatory care sensitive conditions in France in 2009-2010: trends, geographic variation, costs, and an international comparison. Eur J Health Econ 2016;17(4):453-70.
19. Pirani M, Schifano P, Agabiti N, Davoli M, Caranci N, Perucci CA. Potentially avoidable hospitalisation in Bologna, 1997–2000: temporal trend and differences by income level. Epidemiol Prev 2006;30(3):169-77.
20. Coller RJ, Kelly MM, Ehlenbach ML, Goyette E, Warner G, Chung PJ. Hospitalizations for ambulatory care-sensitive conditions among children with chronic and complex diseases. J Pediatr, 2018;194:218-24.
21. Flores G, Abreu M, Chaisson CE, Sun D. Keeping children out of hospitals: parents'and physicians' perspectives on how pediatric hospitalizations for ambulatory care-sensitive conditions can be avoided. Pediatrics 2003;112(5): 1021-30.
22. Chen PC, Tsai CY, Woung LC, Lee YC. Socioeconomic disparities in preventable hospitalization among adults with diabetes in Taiwan: a multilevel modelling approach. Int J Equity Health 2015;14:31.
23. Pickett KE, Wilkinson RG. Child wellbeing and income inequality in rich societies: ecological cross sectional study. BMJ 2007;335(7629):1080-86.
24. Weissman JS, Gatsonia C, Epstein AM. Rates of avoidable hospitalization by insurance status in Massachusetts and Maryland. JAMA 1992;268(17):2388-94.
25. Cheng SH, Chen CC, Hou YF. A longitudinal examination of continuity of care and avoidable hospitalization: evidence from a universal coverage health care system. Arch Intern Med 2010;170(18):1671-77.
26. Bindman AB, Grumbach K, Osmond D, et al. Preventable hospitalizations and access to health care. JAMA 1995;274(4):305-11.
27. O'Neill SS, Lake T, Merrill A, Wilson A, Mann DA, Bartnyska LM. Racial disparities in hospitalizations for ambulatory care-sensitive conditions. Am J Prev Med 2010;38(4):381-88.
28. Ansari Z, Barbetti T, Carson NJ, Auckland MJ, Cicuttini F. The Victorian ambulatory care sensitive conditions study: rural and urban perspectives. Soz Praventivmed 2003;48(1):33-43.