ORIGINAL ARTICLE

Potentially Avoidable Hospital Admissions in Germany

An Analysis of Factors Influencing Rates of Ambulatory Care Sensitive Hospitalizations

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SUMMARY

Background: The concept of ambulatory care sensitive hospitalization (ACSH) is based on the assumption that hospitalization for certain conditions might have been avoided by the timely provision of appropriate care outside the hospital. As preventive care and early treatment are often carried out in the ambulatory setting, ACSH have come to be viewed as an indicator of quality for this sector of the health-care system.

Methods: Factors potentially influencing the regional distribution of ACSH were examined for four conditions—congestive heart failure, angina pectoris, arterial hypertension, and diabetes mellitus—with separate analyses for men and women. A regression analysis was performed on the basis of German nationwide data for the year 2008 (hospital statistics and population statistics). The data covered all areas of Germany.

Results: Each rise in the density of practice based specialists by 1 per 100 000 inhabitants was associated with a 0.1% reduction of ACSH in general and with a 0.3% reduction of ACSH for diabetes among men. A corresponding rise in the density of general practitioners was associated with reductions of ACSH among men by 0.1% for heart failure and by 0.5% for hypertension, yet also with increases of ACSH for angina pectoris (0.2% rise) and for diabetes (0.4% rise). Unemployment, residency in a rural area, and the number of hospital beds available locally were all positively correlated with small rises the ACSH rate. An age of 65 years and older was associated with the highest ACSH rates (0.7% to 3.6%).

Conclusion: Overall, the analyzed variables were only weakly associated with the frequency of ambulatory care sensitive hospitalization. Future studies should consider further aspects such as the quality of care, comorbidities, and participation in healthcare programs.

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In order to assess and further develop the quality of health care provision in Germany, reliable knowledge of differences in quality and areas of possible improvement is a prerequisite. Rates of ambulatory care sensitive hospitalizations as indicators of the quality of ambulatory care can provide valuable indications of quality deficits and their causes (1). Rates of ambulatory care sensitive hospitalizations have become internationally established in recent years as indicators of the quality of regional healthcare provision.

Definition

The Agency for Healthcare, Research, and Quality (AHRQ) defines ambulatory care sensitive conditions (ACSC) as “conditions for which good outpatient care can potentially prevent the need for hospitalization (...)” (1). Billings et al. (2) state that failure to obtain timely, effective ambulatory care can result in avoidable hospital admissions for many common conditions such as asthma, diabetes, congestive heart failure (...). In general, the definition “ambulatory care sensitive hospitalizations” relates to potentially avoidable hospital admissions for the following disorders (3):

- Acute disorders that could have been avoided (for example, through vaccination or other preventive measures)
- Acute disorders that could have been controlled adequately (for example, pneumonia)
- Chronic disorders that could have been controlled to prevent exacerbations (for example, diabetes, hypertension, congestive heart failure).

Since the 1990s a few catalogues of ACSC have been developed to measure the rate of ambulatory care sensitive hospitalizations. In 1992, Weissman et al. published a catalogue (4) which includes 12 disorders. The AHRQ followed in 2001 with a catalogue comprising 16 disorders (1). The UK National Health Service (NHS) in 2009 published a catalogue including 19 disorders (5). Solberg et al. (4) and Weissman et al. (6) published the following criteria for the definition of relevant disorders for measuring the rates of ambulatory care sensitive hospitalizations:

- A minimum rate of hospitalizations
- Clarity in the definition and coding of diagnoses
- Hospitalization potentially avoidable (leading question: is the hospitalization the result of a lack

FIGURE

Rates of ambulatory care sensitive hospitalizations on county level (n = 413) per 100 000 population, 2008 (not age-standardized)

of high quality ambulatory care, rather than, for example, the unavoidable course of a disease?)

- Hospitalization required when disease/symptoms occur(s).

This definition illustrates an important advantage of using ambulatory care sensitive hospitalizations compared with a multitude of other quality indicators: the situation can be described on the basis of routine data and therefore will usually not necessitate any additional efforts at documentation.

Interpretation

Because of the low proportion of patients who are admitted to hospital, in relation to a group of patients with, for example, a diagnosis of bronchial asthma or diabetes, the interpretation of the corresponding rates of ambulatory care sensitive hospitalizations is usually done at the regional or national level, rather than at the level of individual physicians or practices. This improves their statistical power and possibilities for interpretation. Since rates of ambulatory care sensitive hospitalizations are subject to many biases—such as

age, morbidity, and social status—they are suitable as a screening instrument rather than as a definitive measure of quality. In most scenarios, additional analyses are needed that include considerations of time trends and healthcare structures. The appropriate interpretation furthermore requires for relevant factors of influence on the patient's side to be considered by adjusting risk (7).

A preliminary literature search found that most studies analyzed as independent variables comorbidities, insurance status, and sociodemographic factors, as well as access to medical services, density of local physicians, and healthcare structures. High rates of ambulatory care sensitive hospitalizations were usually associated with increasing age, comorbidities, lack of access to medical services, no insurance cover, and low income on the patients' part (8–13). The results regarding densities of medical practices and the rate of ambulatory care sensitive hospitalizations are heterogeneous (14–19). For the whole of Germany, our preliminary literature search (09/2012) identified one publication that explicitly focuses on the analysis of ambulatory care sensitive hospitalizations (20).

Method

Our analysis aimed to identify potential factors that influence the rates of regional, ambulatory care sensitive hospitalizations in Germany.

We analyzed as dependent variables ambulatory care sensitive hospitalizations in association with the main diagnoses of congestive heart failure, angina pectoris, essential hypertension, or type 1 and 2 diabetes. We selected these diagnoses in the context of planning our study on the basis of the four cited criteria from Solberg et al. (6) and Weissman et al. (4):

- A minimum rate of hospitalizations: the analysis of the frequency of ambulatory care sensitive hospitalizations in Germany in 2008, while including all 19 disorders from the catalogue compiled by Purdy et al., showed that the four selected chronic diseases were associated with more than 50% of ambulatory care sensitive hospitalizations in Germany.
- Clear definitions and coding of diagnoses: we coded the disorders on the basis of ICD-10 (2010 version) in analogy to the code allocation described by Purdy et al.
- Hospitalization potentially avoidable: by means of high quality ambulatory care, hospitalizations can potentially be avoided. The named four chronic disorders were assessed as suitable by Purdy et al. in the context of ambulatory care sensitive hospitalizations (5).
- Hospitalization required: Disease exacerbation eventually requires hospitalization for the named diseases.

We selected as our units of observation 413 counties and urban districts in Germany. The analyses are based on census data. In order to ensure comparability between the differently sized units of observations, we related the absolute variables each to 100 000 population per county or urban district. In order to avoid biases owing to co-provider effects from neighboring counties or urban districts, we assigned the hospitalizations to patients' residential addresses, rather than the hospitals'. All analyses are sex specific, in order to identify possible differences. The map (*Figure*) shows the sex specific distribution of ambulatory care sensitive hospitalizations in Germany, using the example of congestive heart failure, without risk adjustment.

We analyzed the following independent variables, also at the level of counties or urban districts:

- Sociodemographic variables (age, proportion of single-person households, unemployment rate, household income) (a)
- Life expectancy (b)
- Density of statutory health insurance physicians (general practitioners [GPs] and specialists) (c)
- Hospital bed density (d)
- Geographical infrastructure (rurality, accessibility of the nearest regional center by car in minutes) (e).

Out of these, a) and b) are among the potential factors that might bias the results, which require adjusting

BOX

Description of the data (2008)

Hospital data

- Ambulatory care sensitive hospitalizations in connection with:
 - Congestive heart failure
 - Angina pectoris
 - Arterial hypertension
 - Diabetes mellitus
- Description:
 - 100% sample of inpatient cases; hospitalizations per 100 000 population with reference to counties or urban districts
 - By main diagnoses (2008); based on patient's residential address rather than hospital address
- Hospital beds per 100 000 population

Hospital statistics for Germany.
Published by: Federal Statistical Office.

Population statistics

- Number of residents per county or urban district
- Proportion of population aged 1–5 years
- Proportion of population aged 6–17 years
- Proportion of population aged 18–29 years
- Proportion of population aged 30–49 years
- Proportion of population aged 50–64 years
- Proportion of population aged 65 years or older
- Life expectancy (women)
- Life expectancy (men)
- Number of single-person households in %
- Unemployment rate as proportion of civilian labor force in %
- Household income in € per inhabitant
- Physicians*¹ per 100 000 population
- Specialists*¹ per 100 000 population
- General practitioners*¹ per 100 000 population
- Rurality*²
- Accessibility of the nearest regional center by car in minutes

Source: German population statistics.

Published by: Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR).

*¹ Statutory health insurance physicians working on an ambulatory basis;

*² Proportion of population in counties/urban districts with a population density <150 persons/km²

for risk in the interpretation of data relating to ambulatory care sensitive hospitalizations, whereas c), d), and, partly, e) allow indirect conclusions about the reality of healthcare provision.

Data sources

The data derives from German hospital statistics for 2008 (published by the Federal Statistical Office) on the one hand, and from indicators and maps of the development of rural and urban spaces in Germany and Europe on the other hand (INKAR data, published by the Federal Institute for Research on Building, Urban Affairs and Spatial Development, BBSR) (Box).

Statistical analysis

We developed four linear regression models each for men and women. Our target variables were the rates of ambulatory care sensitive hospitalizations for any one of the four selected disorders. The Gauss-Markov assumptions were tested by using regression diagnostics. Because of outliers among the dependent variables (values for the rate of ambulatory care sensitive hospitalizations exceeded the highest included value by >20%) we excluded a total of seven out of our study's 413 counties and urban districts from the regression analysis. The test for normal distribution shows a right-skewed distribution of the dependent variables. We took logarithms of these variables according to the formula:

$$100\% = \frac{\sum_{k=1}^K \text{cov}[X^k \hat{\beta}^k, Y] + \text{cov}[\hat{\varepsilon}, Y]}{\text{var}(Y)} \equiv \sum_{k=1}^K s(X^k) + s(\hat{\varepsilon})$$

We used Stata/SE 10.0 for our evaluations.

Limitations

For the interpretation of the results, the following limitations of the methods applied need to be considered. For reasons of data availability we can assume that the list of independent variables is not complete. Furthermore, the methods applied do not allow any conclusions regarding causality.

As no correction was made for multiple testing, the results should be interpreted as initial orientation values for the association between independent variables and rates of ambulatory care sensitive hospitalizations.

Results

Descriptive statistics

The results of the descriptive statistics are shown in Tables 1 and 2. They show that rates of ambulatory care sensitive hospitalizations are comparable in men and women, especially in relation to congestive heart failure (mean: women 255.0, men 220.1 hospitalizations per 100 000 population in 2008) and diabetes (mean: women 97.1, men 117.7 hospitalizations per 100 000 population in 2008). For angina pectoris, the documented hospitalization rate is higher in men (213.2 versus 124.9 per 100 000 population in 2008). For arterial

hypertension, the documented hospitalization rate is higher for women (205.6 versus 102.7 per 100 000 population in 2008). On average, a county or urban district has 102 368 female and 98 301 male inhabitants; the standard deviations are similar. The non-age-standardized rates of ambulatory care sensitive hospitalizations vary substantially between regions (Figure). Regarding the independent variables, the regional variance is also considerable (Table 1).

Regression analysis

The six linear regression models analyzing the occurrence of ambulatory care sensitive hospitalizations in relation to congestive heart failure, diabetes, and arterial hypertension for men and women show an explained rate of variance between 44.0 % and 53.0%, whereas the explained rate of variance for hospitalizations owing to angina pectoris is only 19.0% and 21.2% (Tables 3a and 3b). Age is the only factor that is statistically associated with hospitalizations in all four disorders and for women and men. F tests, which analyze all age groups as one variable, showed a statistically relevant positive association between age and all dependent variables.

The regression models for ambulatory care sensitive hospitalizations in women (Table 3a) also show statistically notable results for the variable age in all four models, and in a minimum of three out of four models for the following independent variables:

- Unemployment (positive association; $p < 0.01$ angina pectoris, diabetes mellitus; $p < 0.05$ arterial hypertension)
- Specialist density (negative coefficient; $p < 0.01$ diabetes mellitus; $p < 0.1$ congestive heart failure, arterial hypertension)
- Rurality (positive coefficient; $p < 0.01$ angina pectoris; $p < 0.1$ congestive heart failure, diabetes mellitus)
- Number of hospital beds (positive coefficient; $p < 0.01$ arterial hypertension, $p < 0.05$ diabetes mellitus, $p < 0.1$ congestive heart failure).

The negative coefficient of the variable specialist density reflects the fact that a higher specialist density is associated with lower rates of ambulatory care sensitive hospitalizations. By contrast, unemployment, rurality, and hospital bed number have positive coefficients. Accordingly they are associated with higher rates of hospital admissions. In detail, the regression coefficients show that a rise in the number of women aged 65 and older by one woman per 100 000 population is associated with a 3.4% rise in hospitalizations for congestive heart failure. An increase in the density of specialist physicians by one specialist per 100 000 population is associated with a 0.1% reduction in the number of hospitalizations.

The regression models for the rate of ambulatory care sensitive hospitalizations in men (Table 3b) show statistically relevant results for the variable age and in at least three out of four models for the following independent variables:

TABLE 1

Descriptive statistics, independent variables at district level (n = 413), 2008

Variable	Mean	Standard deviation	Minimum	Maximum
Head of population per county or urban district	200 352	228 089	38 771	3 400 000
Male population per county or urban district	98 301	112 621	18 678	1 700 000
Female population per county or urban district	102 368	119 111	20 093	1 800 000
Proportion of population aged 1 to 5 years	4.979	0.490	3.500	6.600
Proportion of population aged 6 to 17 years	11.753	2.193	6.700	16.600
Proportion of population aged 30 to 49 years	8.377	0.994	6.400	15.000
Proportion of population aged 50 to 64 years	29.137	1.367	25.300	33.900
Proportion of population aged 65 years and older	19.177	1.377	15.500	24.600
Proportion of male population aged 1 to 5 years	20.772	2.208	14.800	27.100
Life expectancy (women)* ¹	82.127	1.088	75.300	85.000
Life expectancy (men)* ¹	77.245	1.508	72.400	80.900
Proportion of single-person households in %	36.355	3.601	29.500	52.400
Unemployment rate as a proportion of civilian labor force in %	8.381	4.278	1.900	21.500
Household income in € per inhabitant	1504.968	197.061	1117.100	2397.000
Physicians* ² per 100 000 population	160.722	55.975	82.000	389.000
Specialists* ² per 100 000 population	96.128	51.276	21.000	314.000
General practitioners* ² per 100 000 population	64.594	8.276	45.000	98.000
Rurality* ³	29.499	30.233	0.000	100.000
Accessibility of nearest regional center by car in minutes	27.131	18.735	0.000	80.000
Hospital beds per 10 000 population	64.200	38.304	0.000	226.000

*¹ Average life expectancy at birth, in years (average of preceding 3 years, using the method of W. Farr)

*² Statutory health insurance physicians providing ambulatory care

*³ Proportion of population in counties/urban districts with a population density <150 inhabitants/km²

- Life expectancy (negative coefficient; $p < 0.01$ congestive heart failure, arterial hypertension, diabetes mellitus; $p < 0.05$ angina pectoris)
- Specialist density (negative coefficient; $p < 0.01$ congestive heart failure, diabetes mellitus; $p < 0.05$ arterial hypertension).

The results reflect that in men an increase in life expectancy by one year is associated with a reduction in the rate of ambulatory care sensitive hospitalizations of between 4.1% and 5.5%. An increase in the density of specialist physicians per 100 000 population is associated with a reduction in the rate of hospitalizations of between 0.1% and 0.3%.

With regard to the density of general practitioners, this is—for women as well as men—associated with a lower rate of ambulatory care sensitive hospitalizations (0.1% to 0.5% if the density is increased by one general practitioner per 100 000 population) in two out of four models (arterial hypertension and heart failure). For the diagnoses angina pectoris and diabetes mellitus, no effect, or a slightly raised rate in hospitalizations, was seen.

Discussion

The present study analyzed the association between sociodemographic factors, physician density, and numbers of hospital beds and the regional distribution of ambulatory care sensitive hospitalizations. It thus adds the German perspective to previous studies on this subject and on potential independent variables, which so far have been conducted almost exclusively in international settings. The main effect of the variables under study on the rate of ambulatory care sensitive hospitalizations was altogether rather slight. The clearest association across all eight models was seen for the variable age, whereas associations with the variables unemployment, life expectancy, density of statutory health insurance physicians, and rurality are weak. The results of the sex specific analyses resemble one another, with the exception that the variables unemployment and number of hospital beds tendentially show an association with ambulatory care sensitive hospitalizations for women, whereas for men, the same is the case for the variable life expectancy. These results are consistent with the internationally published results we explained in the introduction.

TABLE 2

Ambulatory care sensitive hospitalizations per 100 000 inhabitants at district level (n = 413), 2008

Ambulatory care sensitive hospitalizations	Mean	Standard deviation	Minimum	Maximum
Women				
Congestive heart failure	254.98	79.50	115.14	755.15
Angina pectoris	124.90	51.01	28.88	399.36
Arterial hypertension	205.66	88.20	53.82	945.52
Diabetes mellitus	97.09	40.52	41.00	295.20
Men				
Congestive heart failure	220.05	64.98	100.29	505.86
Angina pectoris	213.21	74.94	45.87	587.98
Arterial hypertension	102.65	54.59	27.45	770.87
Diabetes mellitus	117.70	44.49	42.64	346.77

The descriptive statistic shows relevant regional differences among the rates of ambulatory care sensitive hospitalization (not age-standardized). On the basis of the regression analysis, 44–53% of the variance can be explained. Nevertheless, the association between the analyzed independent variables and the rate of ambulatory care sensitive hospitalizations is estimated to be weak.

Some variables are not subject to the influence of health policy (no influence, for example, on the unemployment rate and age structure), whereas other variables (for example, the density of statutory health insurance physicians) are in principle influenced by health political decisions. A higher rate of ambulatory care sensitive hospitalizations in certain population groups can also provide indications of the need for specific healthcare services.

Limitations

Certain methodological limitations have to be borne in mind in interpreting the data. The baseline data relate to a period of only one year. This may well affect the generalizability of the results. Since the applied data represents a census and not a sample, the authors are confident that this shortcoming is moderate.

The variable specialist density comprises all groups of specialists. More precise results could probably be achieved by restricting the groups of specialists (among others, specialists in internal medicine, neurology, surgery, orthopedics and traumatology). In the present study we chose to look at an aggregated variable of all groups of specialists, since the manifestation of the disorders under study, as well as their complications, may necessitate treatment given by different groups of specialists.

We assume that the selection of independent variables is not conclusive. Because of the availability of data, we did not include variables such as quality of

medical care and educational status, for example. The literature search also shows that variables that reflect medical quality have mostly not been included in previous analyses; this is naturally an important topic for future analyses.

When interpreting the negative association between specialist density (statutory health insurance physicians) and the rates of ambulatory care sensitive hospitalizations, it needs to be borne in mind that, on the one hand, regional specialist density is usually positively associated with a higher socioeconomic index (21). On the other hand, the regression models already include relevant socioeconomic variables (for example, household income and unemployment), and this reduces potential biases.

The density of GPs also showed a negative association with the rates of ambulatory care sensitive hospitalizations for arterial hypertension and congestive heart failure. Since the effects are altogether weak and heterogeneous with regard to GP density, the results do not offer any conclusions vis-à-vis differences regarding the role of GPs or specialists. Sundmacher and Busse (20) in 2012 identified an s-shaped association between physician density and the rate of ambulatory care sensitive hospitalizations. The association between physician density and the rate of such hospitalizations should be analyzed in future studies.

Methodologically the analysis might be made more precise if an instrument variable approach were used, to ensure that what is actually being measured is the causal influence of these factors on the rate of ambulatory care sensitive hospitalizations. Furthermore, spatial correlation models could be used, which would control for spatial autocorrelations between districts.

Finally it would make sense methodologically to include potential co-provider effects from statutory health insurance physicians from neighboring counties or urban districts. Spatial models could be used to this end.

TABLE 3a

Linear regression—women (n = 406 counties and urban districts)

Ambulatory care sensitive hospitalizations (logarithmic hospitalization rate)	Chronic heart failure			Angina pectoris			Arterial hypertension			Diabetes mellitus		
	Coefficient	Std. error	P > t	Coefficient	Std. error	P > t	Coefficient	Std. error	P > t	Coefficient	Std. error	P > t
Proportion of population aged 1 to 5 years	−0.080	0.041	*1	−0.288	0.070	*2	−0.096	0.054	*1	−0.125	0.049	*2
Proportion of population aged 6 to 17 years	−0.005	0.012		0.030	0.020		−0.002	0.015		−0.034	0.014	*2
Proportion of population aged 30 to 49 years	0.011	0.015		0.039	0.025		−0.016	0.020		−0.011	0.018	
Proportion of population aged 50 to 64 years	0.025	0.015		−0.015	0.026		0.041	0.020	*2	−0.004	0.018	
Proportion of population aged 65 years and older	0.034	0.012	*3	0.023	0.020		0.009	0.016		0.007	0.014	
Life expectancy (women)	−0.038	0.012	*3	−0.029	0.020		−0.049	0.015	*3	−0.023	0.014	
Proportion of single-person households	−0.002	0.005		−0.018	0.008	*2	−0.003	0.006		−0.020	0.006	*3
Unemployment rate as a proportion of civilian labor force in %	0.002	0.005		0.023	0.009	*3	0.016	0.007	*2	0.026	0.006	*3
Household income in € per inhabitant	0.000	0.000	*1	0.000	0.000		0.000	0.000		0.000	0.000	
Specialists per 100 000 population	−0.001	0.001	*1	−0.001	0.001		−0.001	0.001	*1	−0.002	0.001	*3
General practitioners per 100 000 population	−0.001	0.002		0.000	0.003		−0.004	0.002	*1	0.001	0.002	
Rurality*4	0.001	0.001	*1	−0.003	0.001	*3	0.001	0.001		0.001	0.001	*1
Accessibility of nearest regional center by car, in minutes	0.000	0.001		0.002	0.001	*1	0.002	0.001	*1	0.001	0.001	
Hospital beds per 10 000	0.001	0.000	*1	0.000	0.001		0.002	0.001	*3	0.001	0.001	*2
Constant	8.037	1.379	*3	7.408	2.328	*3	9.476	1.782	*3	8.346	1.646	*3
	F(17, 388) = 26.35; Prob > F = 0.000; R ² = 0.485; Adj. R ² = 0.467			F(17, 388) = 7.77; Prob > F = 0.000; R ² = 0.218; Adj. R ² = 0.190			F(17, 388) = 23.76; Prob > F = 0.000; R ² = 0.460; Adj. R ² = 0.440			F(17, 388) = 34.96; Prob > F = 0.000; R ² = 0.556; Adj. R ² = 0.540		

*1 Significant (p<0.1). *2significant (p<0.05). *3significant (p<0.01)

*4 Proportion of population in counties/urban districts with a population density of <150 inhabitants/km²

Std, standard error; F, F-statistic; P, p-value (significance value); Prob > F: describes the probability with which R² at the level calculated in a sample is possible, if R² in the baseline total is actually 0. R², coefficient of determination for the explained rate of variance; Adj. R², adjusted coefficient of determination

Conclusion

In sum, our results show that analyzing the regional distribution of ambulatory care sensitive hospitalizations can provide indications of possible deficits in healthcare provision. In our opinion, because of the many influential factors that are also potential sources of bias, the rates of ambulatory care sensitive hospitalizations should be considered to be indirect measures, rather than direct measures, for quality—and if possible, they should be studied in further analyses.

For the purposes of optimizing the statistical models it would be of interest in future studies to analyze additional potential independent variables—for example, aspects of the quality of medical services, comorbidities, educational and insurance status, and participation in healthcare programs. On this basis, decision makers could be supported with the best possible information with regard to reducing the rate of ambula-

tory care sensitive hospitalizations and the improvement of medical services.

Conflict of interest statement

The authors declare that no conflict of interest exists.

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TABLE 3b

Linear regression—men (n = 406 counties and urban districts)

Variable	Chronic heart failure			Angina pectoris			Arterial hypertension			Diabetes mellitus		
	Coefficient	Std. error	P > t	Coefficient	Std. error	P > t	Coefficient	Std. error	P > t	Coefficient	Std. error	P > t
Proportion of population aged 1 to 5 years	−0.052	0.038		−0.215	0.066	***	−0.083	0.056		−0.087	0.050	* ¹
Proportion of population aged 6 to 17 years	−0.014	0.011		0.033	0.018	* ¹	0.012	0.016		−0.049	0.014	* ³
Proportion of population aged 30 to 49 years	0.011	0.014		0.050	0.024	* ²	−0.007	0.020		0.009	0.018	
Proportion of population aged 50 to 64 years	0.022	0.014		−0.015	0.024		0.066	0.021	* ³	−0.015	0.018	
Proportion of population aged 65 years and older	0.034	0.011	* ³	0.036	0.019	* ¹	0.003	0.016		0.013	0.014	
Life expectancy (men)	−0.053	0.010	* ³	−0.041	0.017	* ²	−0.050	0.015	* ³	−0.055	0.013	* ³
Proportion of single-person households	−0.002	0.005		−0.021	0.008	* ³	−0.002	0.007		−0.017	0.006	* ³
Unemployment rate as a proportion of civilian labor force in %	−0.004	0.005		0.016	0.009	* ¹	0.010	0.007		0.012	0.007	* ¹
Household income in € per inhabitant	0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	
Specialists per 100 000 population	−0.001	0.000	* ³	−0.001	0.001		−0.001	0.001	* ²	−0.003	0.001	* ³
General practitioners per 100 000 population	−0.001	0.002		0.002	0.003		−0.005	0.002	* ²	0.004	0.002	* ¹
Rurality ^{*4}	0.000	0.001		−0.004	0.001	* ³	0.001	0.001		0.001	0.001	
Accessibility of nearest regional center by car, in minutes	0.000	0.001		0.004	0.001	* ³	0.003	0.001	* ²	0.001	0.001	
Hospital beds per 10 000	0.000	0.000		0.000	0.001		0.002	0.001	* ³	0.001	0.001	
Constant	8.863	1.086	* ³	7.847	1.852	* ³	7.795	1.583	* ³	10.058	1.405	* ³
	F(17. 388) = 33.63; Prob > F = 0.000; R ² = 0.546; Adj. R ² = 0.530			F(17. 388) = 8.8; Prob > F = 0.000; R ² = 0.240; Adj. R ² = 0.212			F(17. 388) = 25.25; Prob > F = 0.000; R ² = 0.475; Adj. R ² = 0.456			F(17. 388) = 28.73; Prob > F = 0.000; R ² = 0.507; Adj. R ² = 0.489		

*¹ Significant (p<0.1). *²significant (p<0.05). *³significant (p<0.01)

*⁴ Proportion of population in counties/urban districts with a population density of <150 inhabitants/km²

Std, standard error; F, F-statistic; P, p-value (significance value); Prob > F: describes the probability with which R² at the level calculated in a sample is possible, if R² in the baseline total is actually 0. R², coefficient of determination for the explained rate of variance; Adj. R², adjusted coefficient of determination

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KEY MESSAGES

- Across the four analyzed diseases, age showed the strongest association with ambulatory care sensitive hospitalizations (an increase in the population aged 65 and older by 1% was associated with an increase in ambulatory care sensitive hospitalizations by 0.7% to 3.6%).
- A high density of statutory health insurance physicians was associated—for both GPs and specialists—with a reduced rate of ambulatory care sensitive hospitalizations in connection with the diagnoses congestive heart failure and hypertension (0.1% for higher density of specialists; 0.1–0.5% for higher density of GPs).
- A higher density of specialists was associated with a reduced rate in ambulatory care sensitive hospitalizations for diabetes too (0.2–0.3%).
- Rurality and hospital beds showed no conclusive association with rates of ambulatory care sensitive hospitalizations with regard to the disorders under study.
- The following influential factors would be of particular interest for inclusion in future studies: morbidity, participation in healthcare programs, quality of healthcare services, educational status.

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