Does hospital bed capacity drive diabetes hospital admission?

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Abstract

Aim: Diabetes mellitus causes a high global burden of disease. Complications of diabetes often result in hospitalization raising healthcare costs. According to Roemer's law, there might be a positive relationship between the availability of hospital beds and the use of hospital services. Since diabetes leads to many hospitalizations and high costs, it is important to investigate if the number of hospital beds may lead to a higher number of diabetes long-term complication hospital admissions in several European countries.
Methods: Pearson correlation coefficients were used to assess the association between the number of hospital beds and the number of diabetes hospital admissions in eight European countries: Belgium, Czech Republic, Germany, Italy, Netherlands, Poland, Spain, and United Kingdom.
Results: Pearson correlation coefficient between the number of long-term complications hospital admissions and the number of total hospital beds in eight European countries was 0.91, with a corresponding p-value of 0.002.
Conclusion: There was a strong association between the number of hospital beds and the number of long-term diabetes hospital admissions in eight European countries included in this analysis. This study provides further insight into the differences in several European healthcare systems, suggesting that a strong primary care could be a major context-variable in diabetes hospital admissions.

Keywords: diabetes mellitus, hospital admission, hospital bed capacity, Roemer's law.

Introduction

Diabetes mellitus causes a high global burden of disease (1,2). In Europe, 35 million people were estimated to have diabetes mellitus in 2011 (3). There is an expected increase of 23% in 2030, which will lead to 43 million adults with diabetes (3). Moreover, one in ten deaths in adults was assigned to diabetes in the European region in 2013 (4). The demographic reasons that cause an increase in the prevalence of diabetes mellitus are aging, population growth, and an increase in the number of people with obesity and physical inactivity (5).

Diabetes mellitus

Diabetes mellitus is a chronic disease that causes a person's blood sugar level to become too high (1,6). There are two types of diabetes: type-1 diabetes and type-2 diabetes. Type-1 diabetes results from an autoimmune destruction of the β-cells, causing the pancreas to stop producing the hormone insulin (6). This autoimmune destruction has several genetic predispositions and is also related to different environmental factors. Type-1 diabetes is only present in 5%-10% of individuals with diabetes. Besides type-1, there is type-2 diabetes, which is the most common type of diabetes and is present in approximately 90%-95% of people with diabetes (4,6). With type-2 diabetes, the body has a reduced ability to produce enough insulin, or the body fails to respond on insulin. This type of diabetes is often developed as a result of physical inactivity and obesity, causing insulin resistance (1,4,6).

Individuals with diabetes can develop various complications that could result in disablement or life-threatening health problems (4). Both type-1 and type-2 diabetes cause diseases affecting the heart and blood vessels, eyes, kidneys, and nerves. Patients with type-1 diabetes often develop ketoacidosis as the first complication of the disease (6,7). Ketoacidosis arises from acute hyperglycaemia, a high blood glucose concentration resulting from uncontrolled diabetes (7). This type of complication is mostly inevitable referred to as a short-term complication, whereby the patients often have to be admitted to the hospital (7). Once these patients are diagnosed with diabetes, they control it themselves by insulin-injections that prevent long-term complications. Ketoacidosis rarely occurs spontaneously in patients with type-2 diabetes, which is the reason that this type of diabetes often goes under-diagnosed for many years. Therefore, patients with type-2 complications have a higher risk of developing long-term complications. Long-term type-1 and type-2 diabetes complications that frequently occur include cardiovascular diseases, blindness, kidney failure, and foot ulcers (4).

Diabetes and hospitalization

Complications of diabetes often result in hospitalization and have a significant impact on the length of stay, which result in extremely high healthcare costs (8,9). According to Kanavos et al., inpatient costs for diabetes are higher than outpatient costs, since hospitalized patients require more medical care due to their diabetes-related complications (8). Treatments of diabetes in hospitals are costly, while type-2 diabetes could in a majority of patients be prevented through obesity prevention and lifestyle changes.

According to Roemer et al., hospital costs relate to the supply of beds (10). Roemer's law states that *"in an insured population, a hospital bed built is a filled bed"* (11). The study of Roemer and his colleagues found a positive relationship between the availability of hospital beds and the use of hospital services (10,11). Previous research has provided both confirmatory and contradictory evidence for the Roemer's law (12-16). Since diabetes leads to many hospitalizations and high costs, it is important to investigate if the number of hospital beds is associated with a higher number of diabetes long-term complication hospital admissions in several European countries.

Methods

To study the association between the number of hospital beds and the number of diabetes hospital admissions in eight European countries, a correlation

analysis was performed. This study uses statistical data from the OECD (Organization for Economic Co-operation and Development) for the analyses of the correlation between the number of hospital beds and the number of diabetes hospital admissions (17). Furthermore, the differences and similarities between the number of hospital beds and the number of diabetes hospital admissions are addressed through a critical discussion of the comprehensive literature.

Data-collection

The correlation analysis was done between eight European countries: Belgium, Czech Republic, Germany, Italy, Netherlands, Poland, Spain, and United Kingdom. These countries were chosen, since the indicators for the number of hospital beds and diabetes hospital admissions were available in the OECD database (17). Furthermore, these countries allow for comparison because of their contrasting healthcare systems and geographical settings. The OECD, founded in 1961, is an international economic organization with 34 countries addressing the challenges facing the world economy. The OECD statistical database includes data and meta-data for OECD countries and selected non-member economies.

Variables

For the correlation analysis, two indicators were used: 'total hospital beds per 1000 population' and 'diabetes long-term complications hospital admission rate per 100,000 population'. Data of all variables were from the same year, 2009, to achieve greater comparability. The OECD statistics contains two variables of diabetes hospital admission: short-term and long-term complications hospital admissions. Diabetes short-term complications hospital admissions consist of all non-maternal/non-neonatal hospital admissions with a principle diagnosis code of diabetes short-term complications (17). This type of hospital admission deals with acute complications, like ketoacidosis. Conversely, diabetes long-term complications hospital admissions consist of all non-maternal/non-neonatal hospital admissions with principal diagnosis code of diabetes long-term complications (17). In this study the indicator diabetes long-term complications hospital admission was chosen, since patients with long-term complications can be prevented and treated outside the hospital, while patients who have ketoacidosis should be admitted to the hospital.

Furthermore, the variable 'total hospital beds per 1000 population' was also obtained from the OECD database to enhance comparability. According to the OECD, total hospital beds constitute all hospital beds which are regularly maintained and staffed and immediately available for the care of admitted patients (17).

Data analysis

The Pearson correlation-test was performed to examine the association between the number of hospital beds and the number of diabetes long-term complications hospital admissions in eight European countries. A p-value of ≤ 0.05 was considered statistically significant. SPSS, version 20.0 was used for the analyses.

Results

Data were collected from eight European countries. Figure 1 describes the prevalence of diabetes mellitus in these European countries, where Germany has the highest and the United Kingdom the lowest prevalence of diabetes (18).

The result from the comparison between the number of hospital beds per 1000 population and the number of diabetes long-term complications hospital admissions per 100,000 population in eight European countries shows a strong positive trend. The Pearson correlation coefficient for the cross-sectional relation between the number of hospital beds and the number of diabetes hospital admissions was 0.91, with a corresponding p-value of 0.002 (Table 1). This means that there is an association between the number of hospital beds and the number of diabetes long-term complications hospital admissions in the eight European countries studied.

Figure 1. Prevalence of diabetes mellitus (percent) in eight European countries

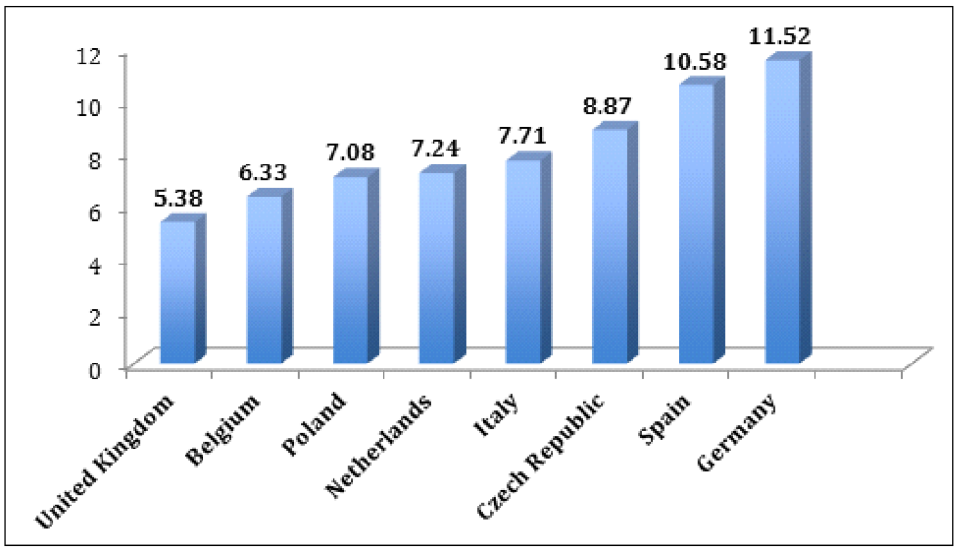


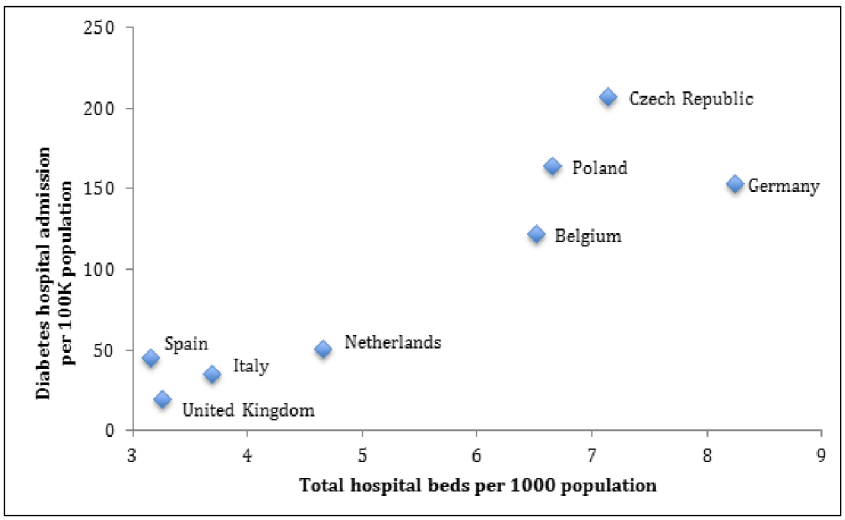
Table 1. Correlation of diabetes long-term complication hospital admissions and total hospital beds

		Total hospital beds
Diabetes long-term complication hospital admissions	Pearson Correlation	0.911*
	Sig. (2-tailed)	0.002
	N	8

*Correlation is significant at the 0.01 level (2-tailed).

The scatterplot below shows the relationship between diabetes long-term complications hospital admissions and the number of total hospital beds (Figure 2). It seems that there are two separated groups. The United Kingdom, Spain, Italy, and the Netherlands have lower rates of diabetes long-term

Figure 2. The relationship between diabetes long-term complications hospital admission and the number of total hospital beds in eight European countries



complications hospital admissions and lower rates in the number of total hospital beds. On the contrary, Belgium, Poland, Germany and the Czech Republic have higher rates of diabetes long-term complications hospital admissions and higher rates in the number of total hospital beds.

Discussion

This study examined the association between the number of hospital beds and the number of diabetes long-term complications hospital admissions in eight European countries. The Pearson correlation analysis showed a strong association between the number of hospital beds and the number of diabetes hospital admissions. As addressed in the introduction, a positive relationship between the availability of hospital beds and the use of hospital services is supported by previous research (10-13). These studies examined the general use of hospital services, whereas the current study examined the use of hospital services regarding diabetes mellitus. Furthermore, the correlation analysis showed two separated groups, where Belgium, Poland, Germany, and the Czech Republic have higher rates of diabetes hospital admissions and hospital beds than the United Kingdom, Spain, Italy, and the Netherlands.

Propensity to hospitalize

Previous research has indicated that race, gender, education and income level influence hospitalization rates (19). The propensity to hospitalize (PTH) could be due to the hospitals themselves, or the patient preference to stay at a hospital instead of receiving ambulatory care (14). Hospitals with higher rates of hospitalization admit a greater proportion of patients with mild complications. Furthermore, they are less vigorous in the diagnosis and treatment of diabetes.

Strong primary care

Alternatively, lower hospitalization rates could be attributable to a strong primary care and outpatient clinics, since they provide better possibilities to coordinate and monitor health (20-22). In a strong primary care, the social and family context of patients are taken into account (23). According to the literature, this generalist approach has positive effects on health. It leads to better health outcomes, lower costs, and a higher quality of care. Furthermore, a strong primary care can be monitored better. Additionally, the general practitioner is considered as the gatekeeper (23,24). General practitioners give care for relatively low costs and avoid hospitalization.

The Nivel Institute described in a report that the United Kingdom, Spain, Italy, and the Netherlands have a strong primary care, whilst Belgium and Germany have a relatively weaker primary care (23). In contrast, Belgium and Germany have fewer primary care organizations, which are often single-handed practices and based on co-payments (23). Furthermore, these countries have a strong emphasis on freedom of choice for both the healthcare professionals and the patients. Other countries with a relatively weak primary care are located in Central and Eastern Europe (CEE), like Poland and the Czech Republic (23,25). Before the fall of the iron curtain, these countries were not primary care oriented. The main aim of these healthcare systems was care for specific groups like the military and employees of important companies. Moreover, the government had a strong centrally organised position and the head of the hospital was responsible for the distribution of services and resources, resulting in a bureaucratic hierarchy. Since Poland and the Czech Republic became members of the European Union, they introduced reforms towards a more primary care oriented system. Still, they have a lot to achieve.

Limitations

This study has several limitations. Firstly, this study is limited to eight European countries, which is a small number for a statistical analysis. However, there was a strong association even though only eight countries were studied. These eight countries were chosen for their contrasting healthcare systems and geographical setting, which gives an overall view of Europe. Secondly, although there was a correlation

between the number of hospital beds and the number of diabetes hospital admissions, this correlation should not be interpreted as causal. Finally, the impact of potential determinants was not included in this study. Since this was a small study, it was chosen not to control for important context factors like culture or type of healthcare system. In future research, important determinants for hospital utilization should be taken into account.

Conclusion

This study confirms Roemer's law, showing a strong positive relationship between the number of hospital beds and the number of diabetes long-term complications hospital admissions. This study provides further insight into the differences in several European healthcare systems, suggesting that a strong primary care could be a major context-variable in diabetes hospital admissions. Governments should focus more on primary healthcare policies, to improve the quality of care and to lower the number of hospital admissions for patients with diabetes mellitus. In conclusion, further research is needed to examine this association more in-depth, considering other determinants such as, for example, the reimbursement system.

Conflicts of interest: None declared.

References

1. OECD. Health at a Glance 2013: OECD Indicators Paris: OECD Publishing; 2013. Available from: http://dx.doi.org/10.1787/ health_glance-2013-en (Accessed: January 5, 2016).
2. OECD. Cardiovascular Disease and Diabetes: Policies for Better Health and Quality of Care Paris: OECD Publishing; 2015. Available from: http:/ / dx.doi.org/ 10.1787/ 9789264 233010-en (Accessed: January 5, 2016).
3. International Diabetes Federation. IDF Diabetes Atlas, 5th ed. Brussels, Belgium: IDF, 2011.
4. International Diabetes Federation. IDF Diabetes Atlas. Brussels, Belgium: IDF, 2013.
5. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes estimates for the year 2000 and projections for 2030. Diabetes Care 2004;27:1047-53.
6. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care 2010;33:62-9.
7. Kitabchi AE, Umpierrez G, Murphy M, Barrett E, Kreisberg R, Malone J, et al. Hyperglycemic crises in diabetes. Diabetes Care 2004;27:94-102.
8. Kanavos P, van den Aardweg S, Schurer W. Diabetes expenditure, burden of disease and management in 5 EU countries. London: London School of Economics, 2012.
9. Villoro R, Zozaya N, Hidalgo A, Oliva J, Rubio M. Key Cost Drivers Of Type 2 Diabetes Mellitus: an International Literature Review. Value Health 2014;7:340-1.
10. Delamater PL, Messina JP, Grady SC, WinklerPrins V, Shortridge AM. Do more hospital beds lead to higher hospitalization rates? A spatial examination of Roemer's Law. PloS One 2013;8:e54900.
11. Shain M, Roemer M. Hospital costs relate to the supply of beds. Mod Hosp 1959;92:71-3.
12. Wennberg JE, Fund C. Variation in Use of Medicare Services among Regions and Selected Academic Medical Centers: Is More Better? Dartmouth: Commonwealth Fund, 2005.
13. Ginsburg PB, Koretz DM. Bed availability and hospital utilization: estimates of the "Roemer effect". Health Care Financ Rev 1983;5:87-92.
14. Shwartz M, Peköz EA, Labonte A, Heineke J, Restuccia JD. Bringing Responsibility for Small Area Variations in Hospitalization Rates Back to the Hospital: The Propensity to Hospitalize Index and a Test of the Roemer's Law. Med Care 2011;49:1062-7.
15. Alexander JA, Lee SYD, Griffith JR, Mick SS, Lin X, Banaszak-Holl J. Do market-level hospital and physician resources affect small area variation in hospital use? Med Care Res Rev 1999;56:94-117.
16. Van Doorslaer EK, Van Vliet RC. "A built bed is a filled bed?" An empirical re-examination. Soc Sci Med 1989;28:155-64.
17. OECD. OECD Health Statistics Paris: OECD Publishing; 2013. Available from: http:/ / www.oecd-ilibrary.org/ social-issues-migration-health/data/oecd-health-statistics_health-data-en (Accessed: January 5, 2016).
18. International Diabetes Federation. IDF Diabetes Atlas update poster, 6th ed. Brussels, Belgium: International Diabetes Federation, 2014.

19. Pasley B, Lagoe R, Marshall N. Excess acute care bed capacity and its causes: the experience of New York State. Health Serv Res 1995;30:115-31.

20. Griffiths P, Murrells T, Dawoud D, Jones S. Hospital admissions for asthma, diabetes and COPD: is there an association with practice nurse staffing? A cross sectional study using routinely collected data. BMC Health Serv Res 2010;10:276-86.

21. Jackson G, Walker BO, Smith J, Papa D, Field A. Hospital admissions for people with diagnosed diabetes: challenges for diabetes prevention and management programmes. N Z Med J 2009;122:13-21.

22. Westert G, van den Berg M, Zwakhals S, Heijink R, de Jong J, Verkleij H. Dutch Health Care Performance Report 2010. Biltohoven, The Netherlands: Rijksinstituut voor Volksgezondheid en Milieu RIVM, 2010.

23. Groenewegen PP, Dourgnon P, Gress S, Jurgutis A, Willems S. Strengthening weak primary care systems: Steps towards stronger primary care in selected Western and Eastern European countries. Health Policy 2013;113:170-9.

24. Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. Milbank Q 2005;83:457-502.

25. Kornai J, Eggleston K. Choice and solidarity: the health sector in Eastern Europe and proposals for reform. Int J Health Care Finance Econ 2001;1:59-84.