COMPARISON OF HOSPITAL ADMISSIONS IN TWO RURAL GREEK PUBLIC HOSPITALS

Zoe Boutsioli, PhD, MSc[1]

[1]Researcher, Health Research Unit, Athens Institute for Education and Research (ATINER), zb5@atiner.gr

ABSTRACT

This paper estimates demand variability in two rural hospitals in Greece. Three effects are tested: the weekend, the summer holiday and the official holiday. The dependent variable is the daily number of total hospital admissions during 2001-2005. We use the method of Ordinary Least Square. Both hospitals present lower total admissions during official holidays. The seasonal variations are more visible in Trikala, than those in Sparta. For Sparta, the impact is statistically insignificant, while for Trikala is both positive and statistically significant. Weekly seasonal effects can also be observed. For both hospitals, daily total admissions decline on weekends compared to the week days. Hospital managers could be based on that result in order to make as accurate as possible decisions about the staff, supplies and beds needed.

INTRODUCTION

The establishment of the Greek National Health System (NHS) in 1983 was based upon the exclusively public health care provision (Tountas, Karnaki, & Pavi, 2002). The role of public hospitals, both urban and rural was upgraded. Many new hospital units, especially in rural and remote areas of Greece were built up. The total health care expenditures (THE) increased significantly (OECD, 2006).

In spite of the legislative actions for private health care services restriction, nowadays, private health care expenditures are almost half of the total health expenditures (Tountas et al., 2005; OECD, 2006). Nevertheless, in rural areas the spread of private health care services was to a lower extent compared to that in urban areas of the country (Souliotis, 2002). The general regional hospitals that exist, one for each city, still keep a master role in the provision of secondary health care services in the Greek population. Characteristically, hospital admissions in public hospitals for general medicine accounted for 1.5 million admissions, in 2000 (ESYE, 2005).

The value of equal access for all citizens in the Greek territory was one of the main issues raised with the law 1397/1983 (Liaropoulos & Tragakes, 1998). The issue of economic efficiency was degraded until recently. From the relevant literature becomes clear that '*Failure to account for uncertainty will lead to biased results, suggesting that hospitals are inefficient*' (Smet, 1998, p. 15). Hence, the way that the number of admissions varies within a certain period of time is very important for hospital managers (Abdel-Aal & Mangoud, 1998; Diaz et al., 2001; Jones et al., 2002; Jones, Joy, & Pearson, 2002; Hussain et al., 2005; Upshur, 2005; Earnest, Chen, & Seow, 2006). An accurate forecasting of future daily admissions can provide to hospital managers useful information in relation to staff and beds needs. For example, it is absolute natural for a hospital manager to wait fewer patients for hospitalization during the summer moths, especially in a region that is not a touristic destination or vice versa (Bentley et al., 2001), and to anticipate more patients during winter months due to influenza and other respiratory related diseases (Fleming, Harcourt, & Smith, 2003).

The purpose of this paper is to compare the number of total admissions in two regional hospitals in Greece during the period 2001-2005. I have used a multivariate model with three explanatory variables to better understand the variations in the number of total

daily hospital admissions. These are the weekend, the official holiday and the summer holiday effects. I have found that about half of the variations of total admissions can be explained by the variations in the three explanatory variables.

METHODS

Data Sources

Daily data on total hospital admissions were collected from two regional public hospitals. The one is located in Trikala city, in central Greece, and the second one is placed in Sparta city, in south part of Peloponnesus and in the lower part of continental Greece. The time period covers five years, from 1/1/2001 to 31/12/2005. Both hospitals are the only providers for secondary health care, and due to lack of a well established and organized primary health care network, they also provide primary health care through their outpatient departments (Tountas, Karnaki, & Pavi, 2002). Primary health care is also provided to the rural population through health stations, established in the whole Greek region after the 1983-1984 health reform (WHO, 1996).

Based on the data of the last census, took place in 2001, the number of permanent population in the prefecture of Trikala is amounted to 132.689 people, and in the prefecture of Laconia, including the city of Sparta 92,811 people[1].

In 2001, the number of total hospital admissions in Trikala reached about 20 thousands admissions, while the same time period, the number of total admissions in the Sparta's public hospital was almost half of that in Trikala, slightly more than 9 thousands admissions. Total admissions as a percentage of the total population accounted for 15% in the city of Trikala, and 10% in the city of Sparta, in 2001 (Figure 1).

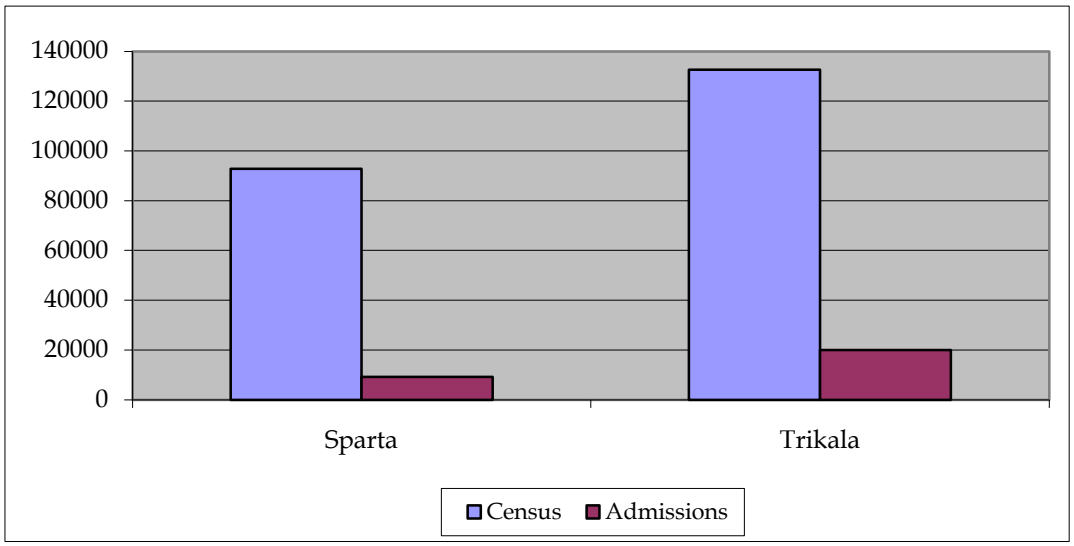


Figure 1. Census and total hospital admissions in Trikala and Sparta, 2001. Source: ESYE, 2008 and author's estimations.

The Model

A multivariate model with three explanatory variables was developed. Three hypotheses were tested. During weekends the number of total hospital admissions draws down. In months July and August total hospital admissions remain unchangeable for touristic areas and decline for non touristic destinations. In time periods close to official holidays the number of total admissions decreases.

For the first hypothesis, I use a dummy variable that takes the value of one (1) when the day is either Saturday or Sunday, and the value of zero (0) when it is not. Similarly, a dummy variable for the summer months is used. It gets the value of one (1) when the month is either July or August and the value of zero (0) when it is not. Last, for the third hypothesis, we have counted 15 official holidays that are celebrated by the whole public servants, including hospital staff. These days include both religious festivities and national days. A dummy variable is also used to estimate the impact of that variable on total hospital admissions. It obtains the value of one (1) when the day is one of the 15 official holidays and the value of zero (0) when it is not.

I applied the Ordinary Least Square (OLS) method to test the above three hypotheses. The E-views econometric package, version 5.1, was used for the analyses.

The weekend effect has been extensively used as an explanatory variable in the forecasting of hospital admissions (Fullerton & Crawford, 1999; Baker et al., 2004; Earnest, Chen, & Seow, 2006; Jones et al., 2009). It has been found that patient flows are lower during the weekends than the rest of the week. Patients in accordance with their doctors decide to be admitted at the beginning of the week and to have their procedures hereafter. Mossialos et al. (2005a; 2005b) have approved for Greece that in obstetrical services there is great demand for leisure by physicians. In that way patients have the opportunity to be discharged before the weekend, if their clinical conditions permit it. Delays that prolong hospitalization due to weekend effect increase the time that patients are exposed to hazards known to occur in hospitals such as medication errors and infection (Law 2519, 1997). Consequently, during weekends the number of total admissions is expected to be lower.

The seasonality in hospital admissions is an important issue (Hisnanick, 1994; Abdel-Aal & Mangoud, 1998; Fullerton & Crawford, 1999; Jones, Joy, & Pearson, 2002; Cote, 2005; Hussain et al., 2005; Jones et al., 2009; Lee et al., 2005; Matter-Walstra, Widmer, & Busato, 2006). Hospitals face considerable problems either in summer months (i.e. Spain, Portugal, and Greece) or during the winter (i.e. the UK, Switzerland, Canada, and Finland). The high temperatures during the summer in Mediterranean countries deteriorates the healthiness of specific group of the population, such as the children, the elderly, and those suffer from respiratory and co-related illnesses (Schwartz, 1996; Schwarts, Samet, & Patz, 2004; Linares & Diaz, 2008). Contrary, in Nordic countries the problem of bed availability is more intense during the winter season, where respiratory infections, like influenza are frequently appeared among the population (Semenza et al., 1999). Another source of seasonality is tourism, i.e. Switzerland, where leisure sports, and especially ski/snowboard tourism creates great flexibility in hospital admissions due to orthopedic traumas (Cote, 2005). Similarly, during the summer months in countries with hot weather and high tourism, like Mediterranean countries and New Zealand, the development of sea sport activities and other leisure actions creates more demand for hospitalization (McGregor, Walters, & Wordley, 1999; Bentley et al., 2001). Conclusively, I expect a negative impact of summer holiday variable on total hospital admissions in the city of Trikala – a non touristic destination. For the city of Sparta in Laconia Prefecture, I expect no impact of the summer months variable on total admissions, due to the conservation of the total population of the city at the same level as it is during the winter months. During the summer months the undergraduates leave for vacations, while both the native and foreign tourists arrive for visiting the city of Sparta and around.

Official holiday days relate to statutory days off and it is expected to have a negative impact on total hospital admissions. During these days there is a supply and demand impact on hospital admissions. Patients do prefer to spend these days with their families (the demand effect) which it is also true for all hospital staff as well (the supply effect). The same

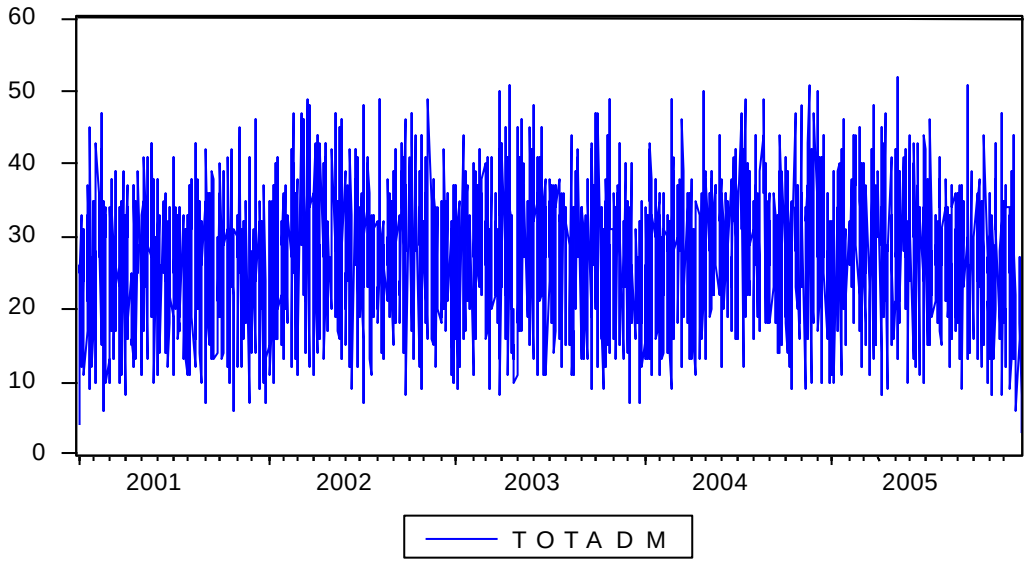
hypothesis has been tested and verified by other researchers as well (Fullerton & Crawford, 1999; Jones, Joy, & Pearson, 2002; Lee et al., 2005).

RESULTS

Total Admissions

The number of total admissions of the two regional hospitals over the five-year period is presented in Figure 2. The mean value for daily total admissions in the hospital of Trikala is 61 with a standard of 17.16 whilst for daily total admissions in the hospital of Sparta the mean is 27 with a standard deviation of 9.43.

(a)



(b)

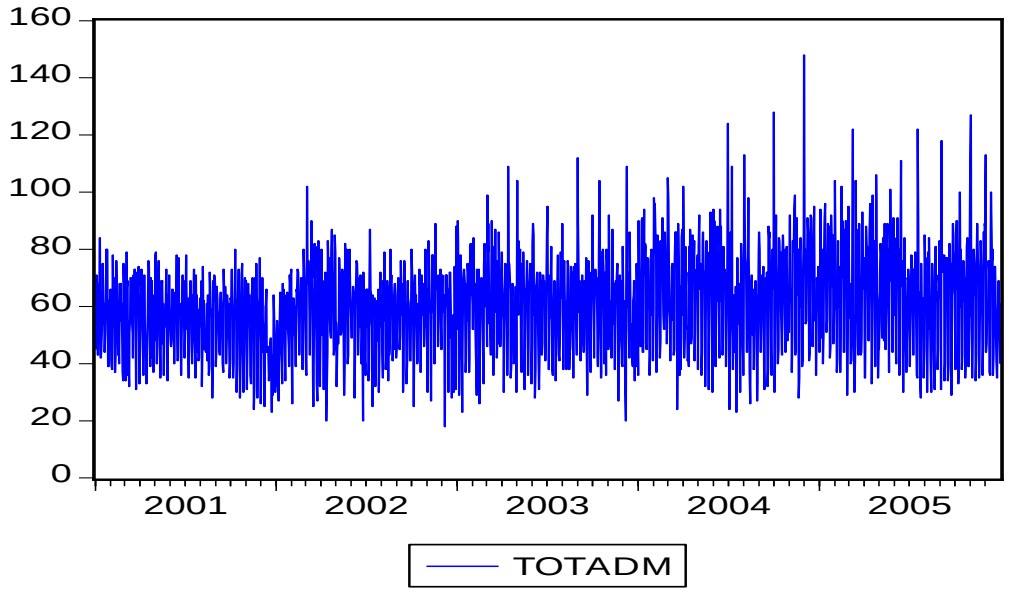


Figure 2. Number of daily total admissions (a) in the General Public Hospital of Sparta, and (b) in the General Public Hospital of Trikala

It is apparent that there is a seasonal variation for total admissions series in both regional cities. Figure 3 shows the mean number of daily total admissions per month. Both hospitals present lower number of total admissions in January, April and December, where the two greatest religious festivals – Christmas and Easter – are celebrated by the Greek Orthodox. However, as far as the summer months are concerned, the seasonal variations are more visible in Trikala, compared to those noticed in Sparta. This means that the population in the city of Sparta remains unchanged during the summer months. A possible explanation for this is that the Prefecture of Laconia, including the capital city of Sparta, is a famous touristic destination[2].

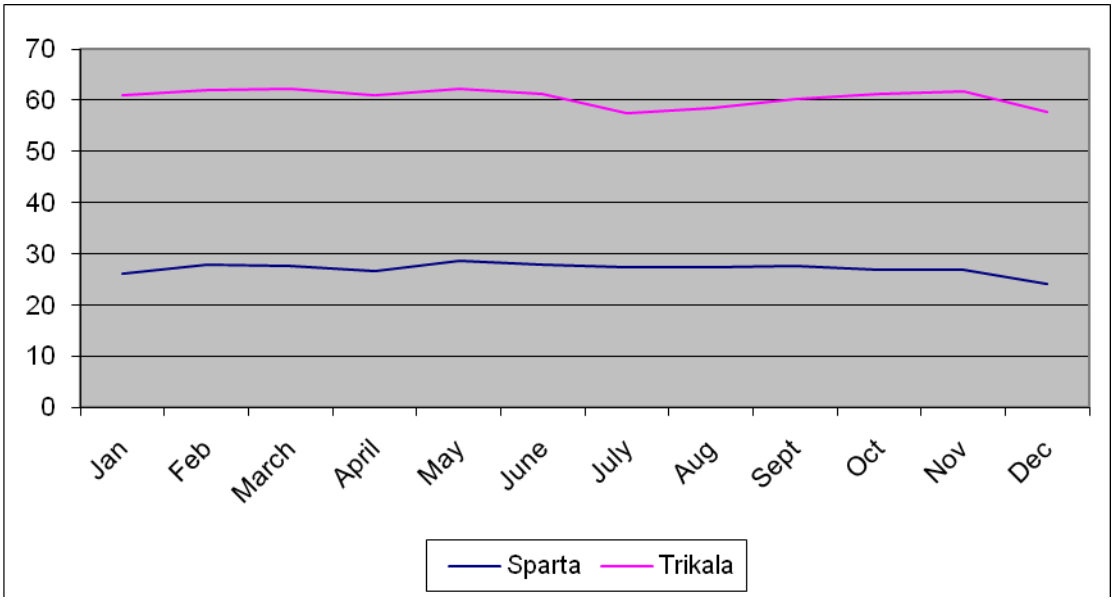


Figure 3. Average numbers of daily total admissions per month, 2001-2005

Weekly seasonal effects can also be observed (Figure 4). The number of total admissions in Trikala hospital is at its highest on Tuesday, while in Sparta hospital it is at its peak on Monday. For both city hospitals, daily total admissions decline considerably on weekends compared to the week days. The fact that in public hospitals in Trikala there is an increase of total admissions on Sunday could be explained by the common practice by doctors to admit their elective patients on Sunday in order to be ready for the pre-surgery examination control and their operation thereupon.

Regression Results

Table 1 shows the regression results of the multivariate model. With this I measure the impact of the three explanatory variables – weekend effect, holiday effect and official holiday effect – on total daily hospital admissions. In the hospital of Trikala, the coefficients of the three explanatory variables are negative and statistically significant at 1% level. In the hospital of Sparta, the two coefficients -weekend and official holiday- are negative and statistically significant at 1% level. The third coefficient of summer holidays explanatory variable is negative but statistically insignificant. During the summer months – July and August – the number of total admissions remains unchangeable, which could be explained from the touristic nature of the city of Sparta in Laconia Prefecture.

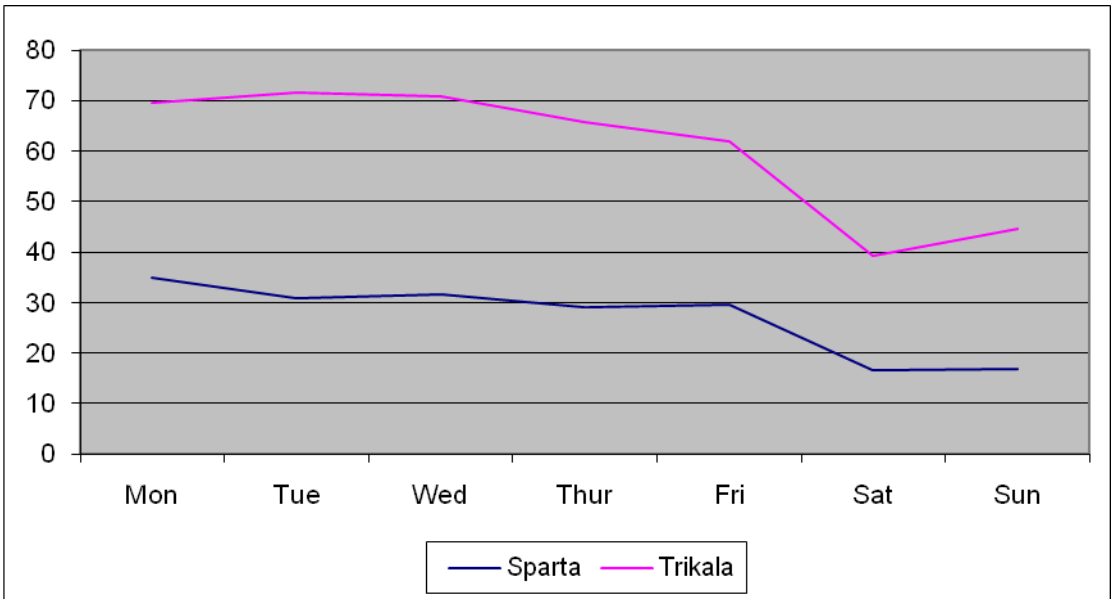


Figure 4. Average numbers of daily total admissions per day of week, 2001-2005

Only slightly over half of the variations in total hospital admissions are explained by the variations in the explanatory variables, as approve the coefficient of determination (R^2).

Table 1. Regression results

	Hospital of Trikala Coefficient (t-statistic)	Hospital of Sparta Coefficient (t-statistic)
Constant	69.19	31.62
	(190.75)	(162.75)
Weekend	-25.68	-14.38
	(-41.08)	(-42.95)
Official holiday	-17.31	-10.69
	(-12.15)	(-14.01)
Summer holiday	-3.63	-0.10
	(-4.82)	(0.24)*
R^2	0.5072	0.5318
R^2 Adjusted	0.5064	0.5310
F-statistic	694.99	689.86
Probability	0.0000	0.0000

Note: All coefficients are statistically significant at 1% level, apart from those noted with (*).

The Impact and Implications of the Results on Primary Care and Rural Practice

The decline of hospital admissions during weekends, summer and official holidays should be availed by hospital managers. In that way, they have the chance to create small groups of hospital staff, i.e. a nurse and a doctor, who will go around in the city, in remote

areas and villages and provide primary medicine (i.e. blood tests, heart pressure measurements, urine tests, drugs etc) in old people, people with kinetic problems, and people with special needs. The home based health support for older and other in-need people can reduce mortality and admission to long-term institutional care (Elkan et al., 2001). For high-risk patients with congestive heart failure, the home based intervention (HBI) that comprises a single home visit (by a nurse and pharmacist) is associated with reduced frequency of unplanned readmissions plus out-of-hospital deaths within 6 months of discharge from the hospital (Stewart et al., 1998, Stewart et al., 1999). Also, this practice could have a positive acceptance by people, especially after the implementation of the non-obligatory practice by rural doctors, applied in Greece in 1997. Such a practice could also contribute to the promotion of physical activity (Estabrooks et al, 2003), breastfeeding, (Morrow et al., 1999) and other healthy activities. In Greece, this practice that contributes significantly in primary care and rural practice could be encouraged and applied in many other hospitals in the country, particularly those located close to remote areas and islands that during the summer months face increased demand of patients, most of which are emergency cases (Semenza et al., 1999; Bentley, et al., 2001).

DISCUSSION

This study compares the total admissions in two regional hospitals in the city of Trikala, in Thessaly in Central Greece and in the city of Sparta, in Peloponnesus in South Greece, over the period 2001-2005. Three explanatory variables were tested – the weekend effect, the official holiday effect and the summer holiday effect. To my knowledge this issue has not been investigated in Greece. It was found that in the general hospital of Trikala, the three variables have a negative and strong statistically significant effect on total admissions. However, in the city of Sparta, the summer effect has none statistically significant impact on total hospital admissions. The other two variables have a negative sign and are both strongly statistically significant. These results are in the same line with other previous relevant empirical studies, as they discussed earlier (Abdel-Aal & Mangoud, 1998; Fullerton & Crawford, 1999; Jones, Joy, & Pearson, 2002; Hussain et al., 2005; Upshur et al., 2005; Jones et al., 2009).

More that fifty percent of demand variability is explained by variability of the three explanatory variables. Hospital managers could easily apply a multivariate model, such as this developed in this paper to forecast the hospital demand variability. The knowledge of the total admissions variations can assist hospital managers to receive as accurate as possible decisions about the staff, supplies and beds needed, in the short-run, and health policy makers to plan *a priori*, in an efficient way, the allocation of scarce hospital resources, in the long-run (Jones, Joy, & Pearson, 2002; Hughes & McGuire, 2003; Baker et al., 2004; Cote, 2005; Upshur et al., 2005; Perea-Milla, et al., 2007; Smet, 2007; Jones, et al., 2009).

A limitation of this study is that I use the sum of elective and emergency admissions as the dependent variable in the multivariate model. However, the impact of the independent variables used might be different for each category of hospital admissions – elective and emergency (Diaz, et al., 2001; Jones, Joy, & Pearson, 2002; Perea-Milla, et al., 2007; Jones, et al., 2009). Further research should test separately these effects. Emergency admissions might be less sensitive to the independent variable because of their nature. While, elective admissions can be planned ahead. The possible different effects might help hospital managers to plan in a more effective way the schedule of the staff, at the micro-level, and the capacity (bed) needs, at the medium- macro-level (Hughes & McGuire, 2003; Baker, et al., 2004; Perea-Milla, et al., 2007; Smet, 2007).

More extended models have been developed to forecast hospital demand using most commonly, epidemiological data (Hussain, et al., 2005), and weather and pollution information (Hisnanick, 1994; Diaz, et al., 2001; Jones, Joy, & Pearson, 2002). This is a weakness of the study. The application of such data could explain better the variations in total admissions observed in rural Greek public hospitals.

ACKNOWLEDGMENTS

I am grateful to an anonymous referee for his guidance and support to accomplish this study. All my thanks go to the hospital staff of the two hospitals – Trikala and Sparta – for their considerable assistance to collect the required data. Also, I would like to thank the Greek National Scholarship Foundation (IKY) for its financial support to my postgraduate studies.

REFERENCES

Abdel-Aal R.E., & Mangoud, A.M. (1998). Modeling and forecasting monthly patient volume at a primary health care clinic using univariate time-series analysis. Computer Methods and Programs in Biomedicine, 56, 235-247. [MEDLINE]

Baker L.C., Phibbs, C.S., Guarino, C., Supina, D., & Reynolds, J.L. (2004). Within-year variation in hospital utilization and its implications for hospital costs. Journal of Health Economics, 23, 191-211. [MEDLINE]

Bentley, T., Meyer, D., Page, S., & Chalmers, D. (2001). Recreational tourism injuries among visitors to New Zealand: An explanatory analysis using hospital discharge data. Tourism Management, 22, 373-381.

Cote, M.J. (2005). A note on 'Bed allocation techniques based on census data'. Socio-Economic Planning Sciences, 39, 183-192.

Diaz, J., Alberdi, J.C., Pajares, M.S., Lopez, C., Lopez, R., Lage, M.B., & Otero, A. (2001). A model for forecasting emergency hospital admissions: Effect of environmental variables. Journal of Environmental Health, 64, 9-15. [MEDLINE]

Earnest, A., Chen, I.C. M., & Seow, E. (2006). Exploring if day and time of admission is associated with average length of stay among inpatients from a tertiary hospital in Singapore: An analytic study based on routine admission data. BMC Health Services Research, 6, 6. [MEDLINE]

Elkan, R., Kendrick, D., Dewey, M., Hewitt, M., Robinson, J., Blair. M., Williams, D., & Brummell, K. (2001). Effectiveness of home based support for older people: Systematic review and meta-analysis. BMJ, 323(7315), 719-25. [MEDLINE]

Estabrooks, P.A., Glasgow, R.E., Dzewaltowski, D.A. (2003). Physical activity promotion through primary care. JAMA, 289(22), 2913-2916. [MEDLINE]

ESYE - General Secretariat of the National Statistical Service of Greece. (2008). Health data 1980-2005. Athens: ESYE.

Fleming, D., Harcourt, S., & Smith, G. (2003). Influenza and adult hospital admissions for respiratory conditions in England 1989-2001. Communicable Disease and Public Health, 6(3), 231-7. [MEDLINE]

Fullerton, K.J., & Crawford, V.L. (1999). The winter bed crisis – quantifying seasonal effects on hospital bed usage. Quarterly Journal of Medicine, 92, 199-206. [MEDLINE]

Gaynor, M., & Anderson G. Uncertain demand, the structure of hospital costs and the cost of an empty bed. Journal of Health Economics, 14, 291-317. [MEDLINE]

Hisnanick, J.J. (1994). Forecasting the demand for inpatient services for specific chronic conditions. Journal of Medical Systems, 18, 9-21. [MEDLINE]

Hughes, D., & McGuire, A. (2003). Stochastic demand, production responses and hospital costs. Journal of Health Economics, 22, 999-1010. [MEDLINE]

Hussain, S., Harrison, R., Ayres, J., Walter, S., Hawker, J., Wilson, R., & Shukur, G. (2005). Estimation and forecasting hospital admissions due to influenza: Planning for winter pressures. The case of the West Midlands, UK. Journal of Applied Statistics, 32, 191-205.

Jones, S.S., Evans, R.S., Allen, T.L., Thomas, A., Haug, P.J., Welch, S.J., & Snow, G.L. (2009). A multivariate time series approach to modelling and forecasting demand in the emergency department. Journal of Biomedical Informatics, 42, 123-139. [MEDLINE]

Jones, S.A., Joy, M.P., & Pearson, J. (2002). Forecasting demand of emergency care. Health Care Management Science, 5, 297-305. [MEDLINE]

Lee, L.H., Swensen, S.J., Gorman, C.A., Moore, R.R., & Wood, D.L. (2005). Optimizing weekend availability for sophisticated tests and procedures in a large hospital. American Journal of Managed Care, 11, 553-558. [MEDLINE]

Liaropoulos, L., & Tragakes, E. (1998). Public/private financing in the Greek health care system: Implications for equity. Health Policy, 43, 153-169. [MEDLINE]

Linares, C., & Diaz, J. (2008). Impact of high temperatures on hospital admissions: Comparative analysis with previous studies about mortality (Madrid). European Journal of Public Health, 18, 3, 317-322. [MEDLINE]

Matter-Walstra, K., Widmer, M., & Busato, A. (2006). Seasonal variation in orthopedic health services utilization in Switzerland: The impact of winter sport tourism. BMC Health Services Research, 6, 25. [MEDLINE]

McGregor, G.R., Walters, S., & Wordley, J. (1999). Daily hospital respiratory admissions and winter air mass types, Birmingham, UK. International Journal of Biometeorology, 43, 21-30. [MEDLINE]

Morrow, A.L., Guerrero, M.L., Shults, J., Calva, J.J., Lutter, C., Bravo, J., Ruiz-Palacios, G., Morrow, R.C., & Butterfoss, F.D. (1999). Efficacy of home-based peer counseling to promote exclusive breastfeeding: A randomized controlled trial, Lancet, 353(9160), 1226-1231. [MEDLINE]

Mossialos, E., Allin, S., Karras, K., & Davaki, K. (2005). An investigation of Caesarean sections in three Greek hospitals: The impact of financial incentives and convenience. European Journal of Public Health, 15, 288-95. [MEDLINE]

Mossialos, E., Costa-Fonta, J., Davaki, K., & Karras, K. (2005). Is there 'patient selection' in the demand for private maternity care in Greece? Applied Economic Letters, 12, 7-12.

Perea-Milla, E., Pons, S.M., Rivas-Ruiz, F., Gallofre, A., Navarro Jurado, E., Navarro Ales, M.A., et al. (2007). Estimation of the real population and its impact on the utilization of health care services in Mediterranean resort regions: An ecological study. BMC Health Services Research, 7, 13. [MEDLINE]

OECD. (2006). Health Data 2006. Paris: OECD.

Schwartz, J., Samet, J.M., & Patz, J.A. (2004). Hospital admissions for heart disease: the effects of temperature and humidity. Epidemiology, 15, 755-761. [MEDLINE]

Schwartz, J. (1996). Air pollution and hospital admissions for respiratory disease. Epidemiology, 7, 20-28. [MEDLINE]

Semenza, J.C., McCullough, J.E., Flanders, W.D., McGeehim, M.A., & Lumpkin, J.R. (1999). Excess hospital admissions during the July 1995 heat wave in Chicago. American Journal of Preventive Medicine, 16, 269-277. [MEDLINE]

Smet, M. (2007). Measuring performance in the presence of stochastic demand for hospital services: An analysis of Belgian general care hospitals. Journal of Production Annals, 27, 13-29.

Souliotis, K. (2002). The role of private sector in the Greek Health Care Services. Athens: Papazisis (in Greek).

Stewart, S., Pearson, S., & Horowitz, J.D. (1998). Effects of a home-based intervention among patients with congestive heart failure discharged from acute hospital care. Archives of Internal Medicine, 158(10), 1067-1072. [MEDLINE]

Stewart, S., Marley, J.E., & Horowitz, J.D. (1999). Effects of a multidisciplinary, home-based intervention on planned readmissions and survival among patients with chronic congestive heart failure: A randomized controlled study, Lancet, 354(9184), 1077-1083. [MEDLINE]

Tountas, Y., Karnaki, P., & Pavi, E. (2002). Reforming the reform: The Greek National Health System in transition. Health Policy, 62, 15-29. [MEDLINE]

Tountas, Y., Karnaki, P., Pavi, E., & Souliotis K. (2005). The 'unexpected' growth of the private health sector in Greece. Health Policy, 74,167-180. [MEDLINE]

Upshur, R. E. G., Moineddin, R., Crighton, E., Kiefer, L., & Mandani, M. (2005). Simplicity within complexity: Seasonality and predictability of hospital admissions in the province of Ontario 1988-2001 – a population-based analysis. Health Services Research, 5(1), 13. [MEDLINE]

WHO. (1996). Health Care Systems in Transition – Greece. Copenhagen: WHO.

[1] See: http://www.statistics.gr/gr_tables/S1101_SAP_1_TB_DC_01_01_Y.pdf, accessed in February 4, 2009

[2] (http://flyradio.gr/index.php?option=com_content&task=view&id=465&Itemid=1).