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The relationship between the time factor and in-hospital mortality in the hospitalized patients

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ABSTRACT

Objectives: As in-hospital deaths are encountered by all healthcare professionals, investigating the factors affecting in-hospital mortality may help to reduce the number of deaths. In this study; the relationship between time factor and in-hospital deaths is examined.

Methods: The study included all hospitalized patients who died at Balikesir State Hospital between January 01, 2014 and December 31, 2014. Time of death, workdays, and holidays were examined on a monthly and seasonal basis and at shift change times. In calculating in-hospital mortality, 'Crude Death Rate (CDR)' was used.

Results: The number of in-hospital deaths during the study period was found to be 1418. It was discovered that the number of patients hospitalized per day was 314.6 ± 46.95, the number of hospitalized patients who died per day was 3.88 ± 2.16, and the mean daily CDR was 12.77 ± 7.5. Additionally, CDR was found to be as 7.56 ± 5.5 in males, while it was 5.21 ± 4.55 in females. Moreover, CDR was 13.07 ± 7.52 on workdays, whereas it was 12.07 ± 7.43 on holidays. As for seasons, CDR was found to be as 14.35 ±8.63 in summer, while it was 11.43 ± 7.84 in winter.

Conclusions: In-hospital mortality, the death rate of males was higher than females while their average age was found to be less than females. No change was observed at shift change hours. The mortality rate increased in summer. However, no difference was found between workdays and holidays in terms of mortality rate.

Keywords: Emergency department, mortality rate, crude death rate

Hospital mortality rates are relatively easy to calculate. Administrative data with a high mortality rate are seen as a critical indicator of poor care. It is widely used to highlight clinical failures and thus to encourage hospitals to research and improve the quality of care. Although it has some imperfections, it is believed to be useful measures of hospital performance and is used in the USA, Canada, the Netherlands, Sweden and the UK [1, 2].

Approximately, 370.000-390.000 deaths occur in Turkey per year. While 60% of deaths are determined by hospitals and health centers, 40% of them are identified by the municipal medical offices, community health centers, and family physicians. The majority of deaths are non-judicial 'natural' deaths [3, 4]. In-hospital deaths are problems faced by all healthcare professionals. Although it is impossible to eliminate all these deaths, we may have a chance to reduce them.

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For this purpose, to reveal the cause of death and try to prevent should be the primary target at the hospitals [5]. In addition, investigating all of the factors affecting in-hospital deaths may help reduce these deaths.

In this study, the relationship between the time factor and in-hospital deaths is questioned. Additionally, whether there were time periods in which the rate of deaths increased is investigated and possible solutions are discussed.

METHODS

Study Design and Setting

This study is observational and descriptive. All patients who died in Balikesir State Hospital (BSH) while hospitalized between January 01, 2014 and December 31, 2014 were included in this study. Throughout 2014, the number of deaths at BSH was 1418. The list and information of all patients were obtained from data processing center of BSH. During the planning phase, the date of death, demographic data, service in which they died, and the number of patients on a daily basis was recorded. In calculating in-hospital mortality, mainly "crude death rate" was used. To calculate the crude death rate, the formula; the crude death rate (CDR) = (number of died patients /number of hospitalized patients) × 1000 was used.

To examine the relationship between hospital mortality and time factors, a detailed classification on the basis of death dates, months, and seasons were made. When calculating the difference of mortality in working hours and holidays, all holidays in the country over 2014 (weekend holidays, religious holidays, public holidays) were considered. For the analysis of daily hours, a day was divided into three periods as 08: 00-16: 00, 16: 00-00: 00 and 00: 00-08: 00. In addition, to investigate whether there was a difference in shift changes, mortality was calculated in the form of 2 hour periods; 07: 00-09: 00, 09: 00-11: 00 and so on.

Sample Size Estimation

In this study; no sample size estimation test was used as all patients who died in BSH in 2014 were included in study.

Selection of Participants

All the data regarding patients who died while hospitalized in BSH between January 01, 2014 and December 31, 2014 were obtained from data processing center. All the data related to patients was reached.

Interventions

As it is an observational-descriptive study, no intervention was made by researchers.

Methods and Measurements

Researchers recorded patients' data and tried to examine the time of death, workdays, and holidays on a monthly and seasonally basis and on shift changes.

Outcomes

Patients who died in BSH in 2014 were analyzed in terms of demographic information, the service and the time of death.

Power of the Study

As the study was observational and descriptive, no power analysis was conducted.

Ethics Committee

Approval from the Ethics Committee of Balıkesir University School of Medicine was obtained.

Statistical Analysis

The data were analyzed with IBM Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) in Version 22.0 software package with 95% reliability. Pearson product-moment correlation coefficient was conducted to assess the change of the number of studies according to years. $P < 0.05$ was considered statistically significant.

RESULTS

The number of patients who died in BSH during the study period was found as 1418. It was discovered that 314.6 ± 46.95 patients were hospitalized, 3.88 ± 2.16 patients died per day, and the daily average CDR was 12.77 ± 7.5. On the other hand, 59.4% (n = 843) of the patients were male while 40.6% (n = 575) were female. The average age of all patients was 70.36 ± 13.73 (range; 14-102) years. To be more specific, the average age of males was 68.97 ± 13.75 years, while the average age of females was 72.39 ± 13.46 years (*p*

Table 1. The average distribution of CDR and patients died according to the time of death

	Hours	Mean ± SD	Min. - Max.	*p value**
The number of patients died	00:00-08:00	1 ± 1.05	0-4	**< 0.001**
	08:00-16:00	1.6 ± 1.3	0-6	
	16:00-24:00	1.28 ± 1.18	0-7	
CDR	00:00-08:00	3.32 ± 3.67	0-23.95	**< 0.001**
	08:00-16:00	5.22 ± 4.35	0-18.73	
	16:00-24:00	4.23 ± 4.03	0-21.74	

CDR = Crude death rate, SD = standard deviation, *Mann Whitney U

< 0.001). As for CDR, it was found as 7.56 ± 5.5 for males while it was calculated as 5.21 ± 4.55 (p < 0.001) for females. In addition, CDR was found as 8.85 ± 5.93 in patients over the age of 65 while it was 3.92 ± 4.07 in patients under 65 (p < 0.001). 76.23% of the cases (n = 1081) died in intensive care, 10:22% (n = 145) died in oncology services, and 5.21% (n = 74) died in internal services. CDR was found as 9.79 ± 6.54 in intensive care, while it was 2.97 ± 3.14 in services (p < 0.001).

During the examination in which a day was divided into three periods, 25.6% (n = 366) of the cases died between 00: 00-08, 40.9% (n = 585) of the patients died between 08: 00-16, and 32.6% (n: 467) died between 16:00-00:00, respectively. When the number of died patients and CDR according to the time of deaths were investigated, statistically significant difference was found between groups (p < 0.001). In the analysis which investigated the reasons of the difference, it was discovered that all dual pairings were statistically significant (p < 0.0167) (Table 1). In the analysis conducted in 2 hour periods; the highest number of deaths occurred between 23:00-01:00 (11.2%, n = 160) and 13:00-15:00 (10.8%, n = 154). Moreover, between 07:00-09:00 which was the shift change hours, 8.2% (n = 118) of the patients died and of 9.9% (n: 142) of the patients died between 15:00-17:00. However, no statistically significant difference was found in 2 hour periods between groups (p > 0.05).

Table 2. The average distribution of CDR according to months

Crude death rate (per thousand)		
Months	**Mean ± SD**	**Min. - Max.**
January	13.64 ± 6.84	0-26.32
February	9.64 ± 5.27	0-21.98
March	11.49 ± 7.61	0-37.45
April	12.65 ± 6.11	0-27.36
May	12.4 ± 5.9	2.77-28.13
June	12.78 ± 8.53	0-30.72
July	16.33 ± 9.17	2.9-41.92
August	13.91 ± 8.03	0-32.71
September	10.84 ± 6.12	0-21.41
October	15.29 ± 7.31	5.76-40.82
November	13.02 ± 5.64	0-21.9
December	10.85 ± 10.11	0-39.22

CDR = Crude death rate, SD = standard deviation

In July, CDR was found to be as 16.33 ± 9.17. It was found as 15.29 ± 7.31 in October, and in August, it was 13.91 ± 8.03 (Table 2). In summer, CDR was 14.35 ± 8.63, while it was 11.43 ± 7.84 in the winter. A statistically significant difference was found between the groups in terms of number of patients hospitalized and CDR according to the seasons (p < 0.05) (Table 3).

On workdays, CDR was found as 13.07 ± 7.52 while it was 12.07 ± 7.43 on holidays. The number of patients hospitalized on workdays was statistically lower than the number of patients hospitalized on holidays (p < 0.001). There was no statistically significant difference found between the groups in terms of number of patients and CDR (p > 0.05) (Table 4).

DISCUSSION

In health systems, information about mortality is needed for identifying needs, planning, financing, and evaluating the effect of services, calculating life ex-

Table 3. The average distribution of inpatients and patients died and CDR according to seasons

	Seasonal (depending on climate)	Mean ± SD	Min. - Max.	*p value*
The number of inpatients	Winter	340.52 ± 38.62	260-418	*< 0.001*
	Spring	319.46 ± 33.36	245-380	
	Summer	295.27 ± 51.03	154-381	
	Autumn	303.6 ± 49.82	161-373	
The number of patients died	Winter	3.84 ± 2.6	0-14	0.730
	Spring	3.83 ± 1.96	0-10	
	Summer	4.04 ± 2.27	0-9	
	Autumn	3.82 ± 1.72	0-8	
Crude death rate (per thousand)	Winter	11.43 ± 7.84	0-39.22	*0.034*
	Spring	12.17 ± 6.54	0-37.45	
	Summer	14.35 ± 8.63	0-41.92	
	Autumn	13.07 ± 6.6	0-40.82	

CDR = Crude death rate, SD = standard deviation

Table 4. The average distribution patients hospitalized and the patients died and on weekdays and holidays

		Mean ± SD	Min. - Max.	*p value**
The number of inpatients	Workdays	304.97 ± 40.1	154-418	**< 0.001**
	Holidays	336.36 ± 53.75	167-411	
The number of patients died	Workdays	3.91 ± 2.24	0-14	0.896
	Holidays	3.84 ± 1.96	0-9	
Crude death rate (per thousand)	Workdays	13.07 ± 7.52	0-39.22	0.089
	Holidays	12.07 ± 7.43	0-41.92	

SD = standard deviation

pectancy, and comparison between settlements, regions and countries [6]. Thus, studies related to in-hospital mortality may guide the hospital staff and provide recommendations for a better health care.

In the study conducted by Cilingiroglu *et al*. [6], 659 patients who died in hospital were examined. They found the mean age of the patients as 60.64 ± 8.17. In addition, the mortality rate was 56.6% in patients over 60 years old. This rate was 1.3% in patients between 30-39 years of age, whereas it was found as 6.9% in patients in the range of 70-104. The rate of males was 53.4%. 37.3% of deaths occurred in the intensive care unit, whereas 35.5% happened in the internal services. As for the death rates according to seasons, 24.4% of deaths occurred in spring, 24.2% happened in summer, 25.6% were in fall and 25.8% were in winter. 35.1%, of deaths occurred in the range of 08: 00-16: 00, 32.8%, occurred in the range of 16:00-00:00, and 31.8% were in the range of 00:00-08:00. No difference was found between weekend and weekdays death rates [6]. In a study conducted with 351 patients, Korkmaz *et al*. [7] found the mean age of the patients as 67.1 ± 0.7 and the rate of males as 62.1%. In addition, they found that 87.5% of in-hospital mortality was over 60 years old. The most frequent deaths occurred in intensive care units (28%). Seventeen percent of deaths occurred in the internal medicine service, 16% occurred in cardiology departments [7].

In another study conducted by Mohammed *et al*. [8], the difference of mortality rate of the patients admitted to the hospital over the weekend and on week-

days was investigated. The authors found that the mortality was higher in patients admitted to the hospital over the weekend. Barba *et al*. [9] examined 'first 48 hours mortality difference' in patients admitted to emergency service during weekdays and weekend. Similar results were obtained in this study. That is to say, the mortality rate was higher in patients admitted to emergency service at weekend [9]. In addition, in both of the studies, it was noted that the number of hospital staff working at weekend was less, and those staff were less experienced, which affected the quality of patient care.

Aylin *et al*. [10] investigated patients admitted to emergency services and died in England between 2005 and 2006. They found that the mortality rate was 10% higher in patients admitted to emergency services and died in hospital at weekend than on weekdays. In a study conducted at the Mayo Clinic; the mortality rate of the patients admitted to intensive care unit (ICU) on weekdays and over the weekend were compared. No significant difference was found between the mortality of patients admitted over the weekend and on weekdays. It was indicated that the number of beds in the hospital, the location of hospital and academic status, clinical severity in patients, and the number of employees had an effect on in-hospital mortality [11].

In our study, the mean age of the patients who died was found as 70.36 ± 13.73. The mean age of males was lower than females. The number of male patients who died was higher than females. Those results were highly compatible with other studies [6,7]. In addition, the results which demonstrated CDR was higher in males than females may be related with the fact that male patients may have been admitted to the hospital due to more serious health problems compared to females. Additionally, in patients over the age of 65, CDR was two times higher than in patients below 65. This data confirmed that the patients over 65 struggle with serious chronic and mortal problems at the hospital.

As more critically ill patients are followed in the intensive care units, higher death rates in these services may be accepted as normal. Monitoring critically ill patients in intensive care not in the internal or surgical services is medically and maybe legally correct. In this case; the mortality rate is expected to be higher in intensive care units than any other services. The mortality rate of intensive care of BSH was found as 76.23%. Compared to other studies conducted in Turkey, our intensive care mortality rate was higher than other services [6, 7].

In the part of the study in which the day was divided into three and mortality rate was calculated, we encountered some interesting results beyond our expectations. In our preliminary estimation; we thought that the mortality rate might have increased in evening and especially at night. Because; we thought that the number of employees in most units was higher and health care workers might be more dynamic during the daytime [8, 9]. In addition, as the study was conducted in a state hospital; doctors were less accessible in the evening or at night. However, the results obtained were contradictory with our expectations. In our study, the death rate and CDR were statistically higher in the range of 08:00-16:00 than the other two periods. In the study conducted by Çilingiroglu *et al*. based on the same time interval, no significant difference was found among the three time intervals. In this case; it is clear that health workers carefully monitor the patients in intensive care services during day and night. The results obtained from the three time period of the day confirmed those results.

Shift change hours are important for health care workers. When the shift is changed, the treatment and monitoring of the patients should be carefully carried out at the same time. We investigated whether shift change had an effect on in-hospital mortality by conducting 2-hour analysis. In most of the hospitals, 15:00-17:00 and 07:00-09:00 are the shift change times. Fortunately, we found that the mortality rate did not increase in those two time intervals. Moreover, in our study, we discovered that the most frequent deaths occurred in the range of 23:00-01:00.

Whether months and seasons have an effect on mortality rates was examined. For instance; we investigated whether the death rates increase in cold weather in winter or increased use of motor vehicle in summer affects the mortality. We found that CDR was significantly higher in summer than the other seasons. As for months, the death rate and CRD were significantly higher in July, August and October. Çilingiroğlu *et al*. [6] did not find a difference in terms of seasons. In our study, the reason why summer was higher than other seasons can be related to the factor that Balıkesir is located on the İstanbul-Bursa-Izmir traffic route and is also a popular host to many tourist districts. That is

to say, the high intensity of vehicles and traffic causes many accidents in summer. Another data supporting this information is that the death rate was higher in July, August and October. Thus; these months are round-trip months for people who are on vacation. Nevertheless; in this study, if we had obtained the data including the causes of deaths, we might have had better estimations in seasonal and monthly analysis. We also examined whether there was a difference between workdays and holidays in terms of mortality rates. This time parameter has actually attracted the attention of many researchers, and many studies conducted on it. However, some researchers compared the mortality rates of the patients admitted to hospital on holidays with workdays; while some others investigated the mortality rates of in-patients in terms of workdays and holidays [8-10]. In this study, we examined the mortality rates of in-patients on workdays and holidays. However, contrary to our expectations (the number of the staff working at weekend was less, and those staff were less experienced), no statistically significant difference was found between workdays and holidays. In some studies the number of the patients admitted to the hospital during the holidays was generally higher than those admitted on working days [8-10]. In a study conducted at the Mayo Clinic; the mortality rate of the patients admitted to intensive care units on weekdays and weekend was compared, and no statistically significant difference was found [11].

Limitations

If we had been able to investigate the data including the causes of deaths, we might have better questioned the relationship between the mortality rates and time factor. Another limitation is that the study is retrospective. A third limitation is that the study was single-centered.

CONCLUSION

In-hospital mortality, the mortality rate was higher in males, and their mean age was found to be less than women. Moreover, the mortality rate was higher between 08:00-16:00. No increase or decrease was observed at shift change times. The mortality rate increased in summer. No statistically significant difference was found between workdays and holidays in terms of mortality rate. In future studies; better results can be obtained if in-hospital causes of death, emergency service waiting times and additional diseases of the deceased can be examined. Multicenter studies are needed on this subject.

Authors' Contribution

Study Conception: VE, MY, MEE, UK; Study Design: VE, MY, MEE, UK; Supervision: VE, MY, MEE, UK; Funding: MEE, UK; Materials: VE, MY; Data Collection and/or Processing: VE, MY, MEE; Statistical Analysis and/or Data Interpretation: VE, MY, MEE, UK; Literature Review: VE, MY; Manuscript Preparation: VE, MY, MEE, UK and Critical Review: VE, MY.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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