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Analysis of weekend effect on mortality by medical specialty in Helsinki University Hospital over a 14-year period

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ABSTRACT

Background: The weekend effect, the phenomenon of patients admitted at the weekend having a higher mortality risk, has been widely investigated and documented in both elective and emergency patients. Research on the issue is scarce in Europe, with the exception of the United Kingdom. We examined the situation in Helsinki University Hospital over a 14-year period from a specialty-specific approach.
Materials and methods: We collected the data for all patient visits for 2000–2013, selecting patients with in-hospital care in the university hospital and extracting patients that died during their hospital stay or within 30 days of discharge. These patients were categorized according to urgency of care and specialty.
Results: A total of 1,542,230 in-patients (853,268 emergency patients) met the study criteria, with 47,122 deaths in-hospital or within 30 days of discharge. Of 12 specialties, we found a statistically significant weekend effect for in-hospital mortality in 7 specialties (emergency admissions) and 4 specialties (elective admissions); for 30-day post-discharge mortality in 1 specialty (emergency admissions) and 2 specialties (elective admissions). Surgery, internal medicine, neurology, and gynecology and obstetrics were most sensitive to the weekend effect.
Conclusions: The study confirms a weekend effect for both elective and emergency admissions in most specialties. Reducing the number of weekend elective procedures may be necessary. More disease-specific research is needed to find the diagnoses most susceptible.

1. Introduction

The weekend effect, the phenomenon of patients admitted at the weekend having a higher mortality risk, has been widely investigated [1]. Evidence has been found for [2–10] and against [2,11] disease-specific weekend effects, with conflicting results for stroke [12–15], acute myocardial infarction (AMI) [16–19], and hip fracture [20–22]. In previous studies, systematic reviews and meta-analyses, emergency patients admitted at the weekend suffered higher in-hospital mortality across both medical and surgical diagnoses [23–27], with a larger risk in major teaching hospitals [28,29], with varying specialty-specific [30–36] and disease-specific [26,37–40] results. Emergency patients that were admitted at the weekend were found to have a 3–10 % higher risk than those admitted during the week [41,42], with those admitted at night on the weekend having a 14 % higher risk for in-hospital death [43]. However, it has been argued that the higher mortality rate at weekends is associated with the smaller share of elective admissions [44] or arrival to the emergency department by ambulance [45]. Others have argued it is due to sicker patients at the weekend [46,47] but these differences in mortality persist even after adjusting for severity of illness [48]. In addition to the weekend effect, other patterns of variation in mortality have been found during the day [49].

The Helsinki and Uusimaa Hospital District consists of 23 hospitals, serving almost one-third of the country's population (1.6 million people). The hospital district provides specialized health care to over half a million individuals annually [50] and the university hospital advanced specialized care to the whole of Finland in certain fields, e.g. cleft lip and palate reconstruction, and organ

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transplantation, as well as caring for the most complicated cases in all specialties. Our data span a 14-year period with over 28 million patient visits, forming the largest Nordic weekend effect dataset and one of the largest weekend effect datasets in general so far. The weekend effect has been researched extensively in the United Kingdom, the United States and Australia but with only a handful of disease-specific studies in the Nordic countries [19,21,39,51–53]. We set out to investigate the weekend effect on a specialty-specific basis in order to find which specialties have room for improvement and may benefit from procedural and staffing changes. These findings would allow for accurate allocation of funds. From a health policy standpoint, we feel it is also important to address the question of the pros and cons of centralization of healthcare services. This is a burning issue in many countries, including our own.

2. Materials and methods

We collected the administrative data of the hospital district for all patients admitted during 2000–2013. We included all available variables in our data into models: age, sex, comorbidities, weekday, month and year of admission and discharge, urgency of admission (emergency or elective), main diagnosis, main specialty, level of care (university or secondary hospital and transfers in between) and date of death. We removed patients with treatment only in secondary hospitals in the hospital district, with missing data in key fields or without in-hospital care. We also excluded day-surgery patients and those patients, who were admitted and discharged on the same day, i.e. day cases and short-term emergency admissions, as the purpose of this study was to examine only patients with in-hospital treatment. Patients, who were admitted to the ward for treatment and died during the same day, were included. Similar criteria have been employed in previous studies [54,55]. Patients, whose treatment began in the university hospital and then concluded in a secondary hospital, in addition to those only treated in the university hospital, were included in this study. The reasoning of including only patients treated in the university hospital was to examine how the centralization of the most difficult cases to the university hospital affected the possibility of a weekend effect. We then extracted patients that died during their hospital stay or within 30 days of discharge. These patients were divided into two categories according to urgency of care: elective and emergency, and into 12 specialties: acute psychiatry, anesthesiology, surgery, neurosurgery, otorhinolaryngology, gynecology and obstetrics, oncology, internal medicine, pulmonology, neurology, geriatrics and pediatrics. Only specialties with 50 or more deaths during the study period were included in the study. The main, most costly specialty was used to classify patients in the study. Those patients with anesthesiology as their specialty were those in the intensive care unit (ICU) at the time of their death or discharge.

The data on 30-day post-discharge mortality is obtained from the Digital and Population Data Services Agency monthly. This data is routinely followed at our hospital as a quality measure together with hospital mortality and it is available separately for each unit discharging patients. As in many hospitals around the world, this indicator includes all deaths irrespective of their cause of death. We do not have access to death certificates, where the cause of death is stated in our country. It is often difficult or impossible to separate ř̈elatedďeaths from the ünrelatedëven when one does have this information. For example, readmissions following hip and knee surgery may take place on wards giving conservative treatment, not the Clinic of Orthopedics. The patients may have many kinds of conditions: pulmonary embolisms, other cardiovascular problems, anemia etc. Most of these cases would clearly be ř̈elatedälthough this would not be evident only by examining the main diagnosis.

The national legislation of Finland does not necessitate ethics committee approval for registry studies involving no patient intervention. Nevertheless, permission was applied for and granted by the hospital district upon review of the study plan.

2.1. Outcomes

The outcomes examined in this study comprised death during the hospital stay and all-cause mortality within 30 days of discharge. Mortality was investigated by the day of the week of admission in order to explore whether a weekend effect exists in Helsinki University Hospital. Weekend was defined as starting at midnight Saturday morning and ending at midnight on Sunday night. Reliable time stamps were not available in the data and therefore, only dates were available for analysis.

2.2. Statistical analysis

In order to take into account disease severity, we employed the Charlson comorbidity index (CCI) [56,57] and the technique of Ruiz et al. of risk categories [54]. This technique involved the division of the patients in this study into five equal groups based on the crude 30-day mortality rate for each main discharge diagnosis (International Classification of Diseases, ICD-10) involved in this study. We calculated the adjusted odds ratios (OR) with 95 % confidence intervals (CI) using a multivariable logistic regression model including age, sex, weekday, month, year and risk category. R language was used in data analyses (R Core Team. R: A Language and Environment for Statistical Computing, Vienna, Austria: R Foundation for Statistical Computing 2019. https://www.R-project.org/). A p-value of less than 0.05 was considered significant.

3. Results

3.1. Deaths

A total of 1,542,230 in-patients (853,268 emergency in-patients) between 2000 and 2013 were included in the study, with 47,122 deaths in-hospital or within 30 days of discharge (Table 1), for an overall crude mortality rate of 3.1 %. Of these deaths, 37,470 (79.5 %) were associated with emergency patients, for a crude emergency mortality rate of 4.4 % and a crude elective mortality rate of 1.4 %. The majority of deaths occurred in the age group of 70 years of age and older for each specialty, except for acute psychiatry (ages 20−39), oncology (ages 60−69) and pediatrics (ages 0−1).

3.2. Weekend admissions

Overall, 16.7 % (n = 258,017) of patients were admitted at the weekend, i.e. Saturday or Sunday. By specialty, weekend admissions comprised 16.7 % of acute psychiatry patients, 14.4 % of surgery patients, 19.3 % of gynecology and obstetrics patients, 17.6 % of internal medicine patients, 18.5 % of pulmonology patients, 16.0 % of neurology patients, 8.6 % of otorhinolaryngology patients, 22.9 % of pediatrics patients, 25.9 % of anesthesiology patients, 19.1 % of neurosurgery patients, 9.0 % of oncology patients and 21.0 % of geriatrics patients.

3.3. Emergency admissions

Of emergency admissions, surgery ($p = 0.000$), gynecology and obstetrics ($p = 0.039$), internal medicine ($p = 0.000$), pulmonology ($p = 0.002$), neurology ($p = 0.003$), neurosurgery ($p = 0.002$), and oncology ($p = 0.016$) had statistically significant weekend effects in in-hospital mortality (Table 2), with internal medicine ($p = 0.000$)

Table 1
Patient demographics of 1,542,230 in-patients between 2000 and 2013.

	Acute Psychiatry	Surgery	Gynecology & Obstetrics	Internal Medicine	Pulmonology	Neurology		Pediatrics	Anesthesiology	Neurosurgery	Otorhinolaryngology	Oncology	Geriatrics
Total patients	41286	456305	293536	394866	60056	77204		80936	1345	39774	47126	41876	7920
Total deaths	167	9298	845	20659	4855	2931		455	544	1948	255	4446	719
Crude mortality rate of specialty (%)	0.40	2.04	0.29	5.23	8.08	3.80		0.56	40.45	4.90	0.54	10.62	9.08
Male deaths (% of deaths)	98 (58.7)	5131 (55.2)	0 (0)	10692 (51.8)	3002 (61.8)	1471 (50.2)		248 (54.5)	367 (80.7)	1177 (60.4)	166 (65.1)	2236 (50.3)	368 (51.2)
Deaths in age group (n)													
<20 years old (% of all deaths)	3 (1.8)	97 (1.0)	1 (0.1)	134 (0.6)	10 (0.21)	20 (0.7)	**0–1 years old**	312 (68.6)	7 (1.3)	32 (1.6)	4 (1.6)	98 (2.2)	0 (0)
20–39 (%)	66 (39.5)	176 (1.9)	36 (4.3)	413 (2.0)	59 (1.2)	58 (2.0)	**1–2**	17 (3.7)	29 (5.3)	147 (7.5)	6 (2.4)	214 (4.8)	31 (4.3)
40–49 (%)	37 (22.2)	344 (3.7)	61 (7.2)	885 (4.3)	138 (2.8)	115 (3.9)	**2–5**	38 (8.4)	50 (9.2)	236 (12.1)	15 (5.9)	403 (9.1)	34 (4.7)
50–59 (%)	29 (17.4)	955 (10.3)	166 (19.6)	2277 (11.0)	743 (15.3)	329 (11.2)	**5–10**	28 (6.2)	93 (17.1)	390 (20.0)	44 (17.3)	1034 (23.3)	97 (13.5)
60–69 (%)	19 (11.4)	1564 (16.8)	241 (28.5)	3745 (18.1)	1256 (25.9)	596 (20.3)	**10–15**	41 (9.0)	125 (23.0)	438 (22.5)	66 (25.9)	1410 (31.7)	177 (24.6)
70+ (%)	13 (7.8)	6162 (66.3)	340 (40.2)	13205 (63.9)	2649 (54.6)	1813 (61.9)	**15–20**	16 (3.5)	240 (44.1)	705 (36.2)	120 (47.1)	1287 (28.9)	380 (52.9)
							>20	3 (0.7)					
Emergency deaths (%)	132 (79.0)	6912 (74.3)	611 (72.3)	17473 (84.6)	3998 (82.3)	2643 (90.2)		355 (78.0)	276 (50.7)	1566 (80.4)	162 (63.5)	2746 (61.8)	596 (82.9)

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. Adjusted odds of in-hospital mortality in 853,268 emergency admissions and 688,962 elective admissions.

Specialty	Weekday (monday-Friday)	Weekend (Saturday-sunday)
Acute psychiatry		
emergency	1.484 (0.569–3.870)	1
elective	0.323 (0.066–1.569)	1
Surgery		
emergency	0.835 (0.772–0.904)	1
elective	0.793 (0.662–0.949)	1
Gynecology & obstetrics		
emergency	0.691 (0.487–0.981)	1
elective	0.191 (0.090–0.403)	1
Internal medicine		
emergency	0.835 (0.797–0.875)	1
elective	0.600 (0.522–0.680)	1
Pulmonology		
emergency	0.850 (0.766–0.944)	1
elective	0.730 (0.520–1.024)	1
Neurology		
emergency	0.847 (0.758–0.946)	1
elective	0.433 (0.292–0.641)	1
Otorhinolaryngology		
emergency	0.632 (0.343–1.165)	1
elective	0.478 (0.060–3.790)	1
Pediatrics		
emergency	0.862 (0.670–1.110)	1
elective	0.781 (0.426–1.431)	1
Anesthesiology		
emergency	1.148 (0.868–1.517)	1
elective	[a]	[a]
Neurosurgery		
emergency	0.799 (0.695–0.919)	1
elective	0.894 (0.597–1.339)	1
Oncology		
emergency	0.830 (0.713–0.966)	1
elective	0.952 (0.589–1.539)	1
Geriatrics		
emergency	0.898 (0.696–1.158)	1
elective	0.599 (0.342–1.051)	1

[a] The number of elective anesthesia patients was insufficient to calculate OR.

. Adjusted odds of 30-day post-discharge mortality in 853,268 emergency admissions and 688,962 elective admissions.

Specialty	Weekday (Monday-Friday)	Weekend (saturday-sunday)
Acute psychiatry		
emergency	1.022 (0.629–1.661)	1
elective	4.080e+07 (0.000–Inf)	1
Surgery		
emergency	1.011 (0.930–1.100)	1
elective	0.948 (0.800–1.124)	1
Gynecology & obstetrics		
emergency	0.981 (0.768–1.254)	1
elective	0.457 (0.260–0.801)	1
Internal medicine		
emergency	0.851 (0.806–0.898)	1
elective	0.938 (0.796–1.105)	1
Pulmonology		
emergency	0.922 (0.818–1.039)	1
elective	0.916 (0.638–1.317)	1
Neurology		
emergency	0.955 (0.824–1.106)	1
elective	0.506 (0.315–0.812)	1
Otorhinolaryngology		
emergency	1.325 (0.805–2.181)	1
elective	0.547 (0.195–1.534)	1
Pediatrics		
emergency	1.025 (0.533–1.970)	1
elective	1.547e+07 (0.00–Inf)	1
Anesthesiology		
emergency	0.936 (0.542–1.617)	1
elective	[a]	[a]
Neurosurgery		
emergency	0.883 (0.713–1.094)	1
elective	0.934 (0.667–1.310)	1
Oncology		
emergency	1.109 (0.962–1.278)	1
elective	1.448 (0.979–2.143)	1
Geriatrics		
emergency	0.851 (0.618–1.170)	1
elective	0.571 (0.228–1.429)	1

[a] The amount of elective anesthesia patients was insufficient to calculate OR.

reaching statistical significance for 30-day post-discharge mortality during the weekend (Table 3).

3.4. Elective admissions

Of elective patients, the highest statistically significant risk for in-hospital mortality was at the weekend for the specialties of surgery (p = 0.012), gynecology and obstetrics (p = 0.000), internal medicine (p = 0.000) and neurology (p = 0.000) (Table 2). Thirty-day post-discharge mortality was statistically highest during the weekend for the specialties of gynecology and obstetrics (p = 0.006) and neurology (p = 0.0047) (Table 3).

3.5. Mortality by year

The overall adjusted odds of mortality reached its peak in 2001 and began to decrease starting in 2008, with a steady decline until the end of the study period in 2013 (Fig. 1A). A statistically significant difference in comparison with 2007, however, was only seen in 2001 (significantly higher) and 2008–2013 (significantly lower). The adjusted odds of mortality during the weekend for all in-patients in all specialties overall rose to its highest point in 2002, followed by a slightly cyclic pattern until the end of 2013 (Fig. 1B). During the period from 2008 to 2012, the risk for mortality was lower during the weekend (Saturday and Sunday) when compared to weekdays (Monday – Friday) for all years except 2010. Nonetheless, only the overall mortality for years 2000–2002 was statistically significantly higher during the weekend, and for the year 2013 significantly lower, than during the week.

3.6. Mortality by sex

Of the 11 specialties with both female and male patients, females had a statistically significant lower risk for in-hospital mortality in the specialties of internal medicine (adjusted OR 0.853, 95 % CI 0.821–0.886), acute psychiatry (0.583, 0.367–0.927), surgery (0.778, 0.731–0.827), pulmonology (0.844, 0.787–0.905), neurosurgery (0.821, 0.727–0.928) and geriatrics (0.779, 0.639–0.951) and for 30-day post-discharge mortality in the specialties of internal medicine (0.910, 0.871–0.951), surgery (0.856, 0.806–0.910), acute psychiatry (0.392, 0.287–0.534), neurosurgery (0.668, 0.568–0.786) and pulmonology (0.770, 0.716–0.828).

3.7. Mortality by specialty

During the study period, the annual crude mortality rate decreased for acute psychiatry patients from 0.4 % in 2000 to 0.3 % in 2013. A similar decline was also seen for surgery (from 2.4 % in 2000 to 1.7 % in 2013), gynecology and obstetrics (0.30 % in 2000, 0.29 % in 2013), internal medicine (5.7 % in 2000, 4.7 % in

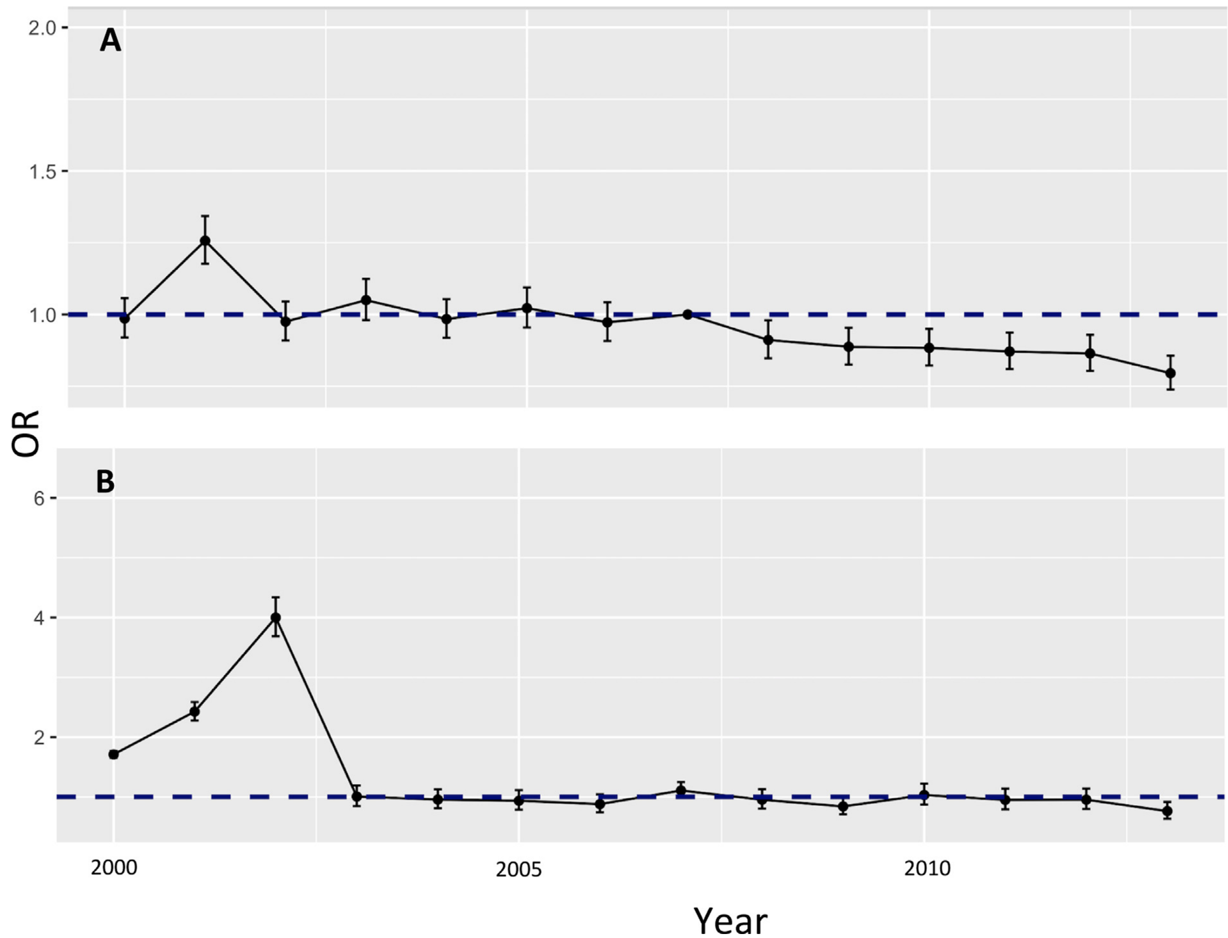

Fig. 1. **A**. The overall adjusted odds ratio (OR) by year from 2000 to 2013. 2007 is the base line (OR = 1). Fig. 1**B**. The overall adjusted odds ratio (OR) for weekday admissions (OR = 1) versus weekend admissions by year.

2013), pulmonology (from 7.4 % in 2000 to 5.8 % in 2013), neurology (3.9 % in 2000, 3.7 % in 2013), neurosurgery (5.7 % in 2000, 3.8 % in 2013) and geriatrics (8.2 % in 2000, 7.2 % in 2009). An increase in crude mortality rate was seen for otorhinolaryngology (0.1 % in 2000, 0.9 % in 2013), pediatrics (0.5 % in 2000, 0.7 % in 2013), anesthesiology (32.0 % in 2006, 44.5 % in 2008) and oncology (7.6 % in 2000, 10.7 % in 2013). For both geriatrics and anesthesiology, data was only available for a portion of the entire study period (geriatrics 2000–2009, anesthesiology 2006–2008) due to changes in designation of specialty.

4. Discussion

The aim of our study was to examine the possibility of a weekend effect in Helsinki University Hospital. We observed a statistically significant higher risk for in-hospital and 30-day post-discharge mortality for most specialties for elective admissions and many specialties for emergency admissions. Surgery, internal medicine, neurology, and gynecology and obstetrics were most sensitive to the weekend effect.

When examining the difference in crude mortality rates of Saturday and Sunday admissions versus Wednesday admissions, we see a total of 3701 more deaths at the weekend potentially attributable to the weekend effect (surgery n = 725, internal medicine n = 1,906, pediatrics n = 16, oncology n = 209, neurosurgery n = 227, anesthesiology n = 0, gynecology and obstetrics n = 23, neurology n = 385, acute psychiatry n = 3, pulmonology n = 140, otorhinolaryngology n = 26, geriatrics n = 41).

Acute psychiatry, otorhinolaryngology, pediatrics, anesthesiology and geriatrics had no statistically significant weekend effects. This coincides with previous studies on acute psychiatry [58,59], pediatric and geriatric patients [24,60]. Mortality was highest among ICU patients Friday through Monday [61], with a similar pattern in this study but our results did not, however reach statistical significance.

The fluctuation of mortality by year can be explained by several occurrences. At the beginning of 2001, two secondary hospitals were joined to the university hospital. In 2001, the thrombolysis of stroke patients was centralized to the university hospital, and the round-the-clock on-call procedural cardiology service began [62]. In 2002, the hospital board decided to centralize certain rare and difficult treatments to the university hospital. This path was continued in 2003 with the centralization of oncologic surgery, pulmonary surgery and rare procedures (less than 50/year) to the university hospital. 2003 also marked the opening of the new emergency department at the university hospital, the centralization of more difficult emergency patients to the department, as well as a new clinical data processing system [63]. The entire treatment of ST-elevation myocardial infarctions was centralized to the university hospital in April 2005. During 2006, a chain of organizational rearrangement began, with the goal of eliminating redundant and overlapping processes and operations [64]. During the end of 2010 and 2011, the beginning of the renovation of the main university hospital building caused many specialties to been moved around the city [62].

In almost every specialty in both in-hospital and 30-day post-discharge mortality, we see a statistically significant weekend effect in elective patients, which is in line with a recent systematic review and meta-analysis [65]. Weekend admissions numbered one-fifth to one-half of those during the week in all specialties except anesthesiology, where the amount of admissions was fairly similar from one day of the week to the next.

In order to rectify these problems, some have propagated the idea of a seven-day-a-week service. In this regard, promising results have been seen among internal medicine patients with a seven-day hospitalist program [66]. As a means to combat the weekend effect, the National Health Service (NHS) of England has employed four priority clinical standards for emergency hospital care: time to first consultant review, access to diagnostics, access to consultant directed interventions and ongoing consultant review. However, a three-year study found no significant effect of these interventions on the weekend effect [67]. Beginning in 2013, the specialty of emergency medicine was founded in Finland in an attempt to streamline the workings of the emergency department. The effects of emergency physicians are not yet visible in these data as coding for the specialty was not started until 2014.

A recent editorial criticized weekend effect research as not examining the pathways of care leading up to hospital admission, and that this is the more likely cause of the weekend variation in mortality rather than a dip in the quality of care [68]. Nonetheless, in our healthcare system, the pathway to hospital admission is the same weeknights and weekends, and yet, we still saw a weekend effect. This weekend effect was also only significant in certain specialties and no weekend effect was found among intensive care patients, the sickest patients of them all.

We are very well aware that analyses like this, based on administrative data and lacking data on some important potential confounders allow only very cautious conclusions concerning the root causes behind the observations. The majority of elective patients are treated during the week and this decrease of elective admissions during the weekend has been proposed as an explanation for the weekend effect [69]. While some of these patients may be sicker patients admitted on the weekend for monitoring before elective procedures on a Monday, many of these patients are operated on during the weekend in order to shorten waiting times for elective procedures. This is done as extra work on top of a regular 40-h work week. The same applies for on-call shifts during the weekend, which are 24–28 h in length. The specialties, where a weekend effect is seen amongst emergency patients, are some of the more intense, laborious on-call specialties, e.g. internal medicine, gynecology and obstetrics and neurosurgery, where there is less of a chance for rest. Long working hours and lack of sleep are known to increase the risk of accidents and serious medical errors cumulatively, with risk increasing after 8 h and doubling after only 12 h of work [70]. During the weekend, it is quite common for medical students or junior residents to be on call in secondary hospitals. Lack of experience may delay the transfer of these patients to the university hospital, increasing risk of mortality. The specialty of anesthesiology in this study is in practice made up of only intensive care patients. We found no significant weekend effect in any category among these patients, which could speak to the effect of more senior staffing on the weekend effect.

Our organization remained very stable with the same catchment area during the study period. We believe this is often not the case with organizations of this size. Thus, we believe the generalizability of our results is better than in many other studies. They serve as potentially valuable signals of where problems may occur. Other organizations can (and should) explore the state of affairs at their own organization.

Centralization of services does not eliminate the weekend effect in itself, if all the while, attention is not paid to ensuring expertise of uniform quality at the unit where patients are referred to at the weekend. Patient processes must be planned in such a way that they are resilient to staff rest periods. Round-the-clock operation of health care always requires sufficient expert resources and excellent planning of treatment processes.

4.1. *Strengths of this study*

Such a broad study has not been published in the Nordic countries previously. Our study complements past findings and adds an important specialty-specific perspective. The Finnish healthcare system is publicly funded with a small private sector caring for patients at a primary-care level. The vast majority of specialized health care is provided by the public sector. Consequently, all inhabitants receive necessary treatment regardless of financial or insurance status. No private on-call hospitals exist in Finland. As a result, this prevents possible skewing of the patient material due to treatment of healthier patients in private hospitals. Hence, our data set is an excellent representation of the specialized in-hospital treatment provided in the Helsinki metropolitan area. The population of Finland is quite homogenous, with only 7% of the inhabitants of foreign descent [71], providing a rather uniform patient set. Homogeneity eliminates some genetic variability in regard to mortality and, thus, is yet another strength of this study.

4.2. *Limitations of this study*

There are some limitations to our study. Our patient information was collected from administrative data, which are notoriously sensitive to various problems, e.g. clinical coding errors and missing data. We were also unable to take into account disease severity as we only had access to diagnosis codes. Thus, we were forced to apply the aforementioned risk category technique in order to take into account disease severity in some way. However, a recent Danish study showed a weekend effect even after adjustment for severity of illness [48]. Time stamps for admission were unreliable. Therefore, we were unable to take into account off-hours admissions during the week. For several specialties, the risk of mortality was highest on a Friday or Monday. This may be caused by admissions Friday evenings or early Monday mornings. Weekend staffing begins on Friday at 3:30pm and ends on Monday at 8:00am in our hospital district. Consequently, patients admitted late Friday or early Monday could skew the weekend effect.

5. Conclusion

Surgery, internal medicine, neurology, and gynecology and obstetrics were most sensitive to the weekend effect. Disease-specific weekend effects must be examined more closely, especially in these four specialties. By finding the specific diagnoses that would best benefit from increased and senior staffing and by examining diurnal changes in mortality, funds can be allotted more appropriately to improve patient safety and decrease mortality.

Complete elimination of elective admissions at the weekend may overburden staff during the week and prolong wait times for procedures insufferably but the limitation of elective admissions at the weekend may be necessary. The implementation of certain guidelines for weekend elective admissions, e.g. in the spirit of day surgery criteria, could decrease risk for hospital mortality among these patients. Further studies are needed to clarify this important topic.

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Declaration of Competing Interest

None.

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