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Does the 'Chinese New Year effect' exist? Hospital mortality in patients admitted to internal medicine departments during official consecutive holidays: a nationwide population-based cohort study

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ABSTRACT

Objective Our study aimed to compare the mortality risk among patients admitted to internal medicine departments during official consecutive holidays (using Chinese New Year holidays as an indicator) with that of weekend and weekday admissions.

Design Nationwide population-based cohort study.

Setting Taiwan's National Health Insurance Research Database.

Patients Patients admitted to internal medicine departments in acute care hospitals during January and February each year between 2001 and 2013 were identified. Admissions were categorised as: Chinese New Year holiday (n=10 779), weekend (n=35 870) or weekday admissions (n=143 529).

Outcome measures ORs for in-hospital mortality and 30-day mortality were calculated using multivariate logistic regression with adjustment for confounders.

Results Both in-hospital and 30-day mortality were significantly higher for patients admitted during the Chinese New Year holidays and on weekends compared with those admitted on weekdays. Chinese New Year holiday admissions had a 38% and 40% increased risk of in-hospital (OR=1.38, 95% CI 1.27 to 1.50, p<0.001) and 30-day (OR=1.40, 95% CI 1.31 to 1.50, p<0.001) mortality, respectively, compared with weekday admissions. Weekend admissions had a 17% and 19% increased risk of in-hospital (OR=1.17, 95% CI 1.10 to 1.23, p<0.001) and 30-day (OR=1.19, 95% CI 1.14 to 1.24, p<0.001) mortality, respectively, compared with weekday admissions. Analyses stratified by principal diagnosis revealed that the increase in in-hospital mortality risk was highest for patients admitted on Chinese New Year holidays with a diagnosis of ischaemic heart disease (OR=3.43, 95% CI 2.46 to 4.80, p<0.001).

Conclusions The mortality risk was highest for patients admitted during Chinese New Year holidays, followed by weekend admissions, and then weekday admissions. Further studies are necessary to identify the underlying causes and develop strategies to improve outcomes for patients admitted during official consecutive holidays.

Strengths and limitations of this study

► This present study was conducted using a nationwide population database, which provided a representative sample of 2 million individuals randomly selected from Taiwan's population.
► This study had sufficient sample size to investigate whether consecutive holidays, here the annual official Chinese New Year holidays, influence the mortality risk for patients admitted to internal medicine departments.
► Using claims-based data, we could not retrieve some information that may confound the findings (ie, lifestyle, physical, psychiatric or laboratory data).

INTRODUCTION

The 'weekend effect' refers to numerous indications that patients admitted to hospitals on weekends have a poorer prognosis and higher mortality rate than those admitted at other times; this has been found across a range of medical conditions.[1–5] Factors potentially contributing to the weekend effect include decreased levels of staffing, lower availability of diagnostic tests or interventions, human factors such as sleep deprivation and fatigue of medical staff working outside of normal hours, and varying patient conditions in terms of disease severity and urgency.[1 2] However, some previous studies have not found a significant association between weekend admission and patient outcomes.[6–8] This inconsistency may be due to differences in the study populations, diseases analysed, disease severities, study designs and sample sizes.[9–11]

In the countries and regions associated with traditional Chinese culture such as China, Hong Kong and Taiwan, there are official consecutive annual holidays for celebrating

the Chinese New Year. In Taiwan, the Chinese New Year holidays span at least 4 days (from New Year's Eve to the third day of New Year), and hospital staffing levels decrease significantly during this period. Although many studies have evaluated the association between weekend admissions and mortality rates, few studies have reported the possible effects of admission during consecutive holidays such as the Chinese New Year.[12] Theoretically, the longer duration of consecutive holidays compared with typical weekends implies the availability of even less manpower and fewer resources in medical institutions. These factors may result in decreased quality of care and a poorer prognosis for patients, but the evidence is still limited, despite being a very important issue for clinical practice, and for healthcare system policies.

Therefore, we conducted a nationwide population-based retrospective cohort study to evaluate whether a 'Chinese New Year effect' as well as a 'weekend effect' exists. We sought to understand how these affect hospital mortality rates among patients admitted to internal medicine departments. We explored the possible influence of consecutive holidays on medical care and patient prognosis, with the aim of identifying key factors relevant to future hospital management and medical establishment policies.

METHODS
Data sources
Taiwan's National Health Insurance Research Database (NHIRD) is an administrative database containing medical records derived from the National Health Insurance (NHI) programme. The NHI programme, established in 1995, is a mandatory single-payer programme administered by the government, which has enrolled more than 99% of the population and formed contracts with 97% of Taiwan's hospitals and clinics. The NHI covers comprehensive medical care and reimburses medical fees for outpatient, inpatient and emergency services. For research purposes, the Health and Welfare Data Science Center, Ministry of Health and Welfare, Taiwan randomly sampled a representative subset of the original NHIRD, comprising 2 million individuals from the NHI Registry for beneficiaries in 2000, which is referred to as the Longitudinal Health Insurance Database (LHID). We conducted a population-based retrospective cohort study using the LHID to retrieve information about patient characteristics and medical care records. To protect patient privacy and data security, all individually identifiable health information was encrypted before releasing the research data.

Study population and procedures
All adult patients, aged ≥20 years, who were admitted to the internal medicine departments of acute care hospitals in January and February during 2001 to 2013 were identified as our study cohort using the LHID. Each admission event was considered as an individual unit of analysis (not collated on a per-patient basis). The date of admission was defined as the index date, and the hospitalisation was defined as the index hospitalisation. Admission events were categorised into three groups according to admission date, namely 'Chinese New Year holiday group,' 'weekend group' and 'weekday group' The Chinese New Year, also known as the Spring Festival or the Lunar New Year, is a very important Chinese festival celebrated at the turn of the traditional lunisolar Chinese calendar. The official length of holidays for celebration is announced by the government of Taiwan and the duration spans at least 4 days each year, sometimes longer if it falls on weekends.

We extracted the yearly dates of the Chinese New Year holidays between 2001 and 2013 from Taiwan's national public holiday lists. Although the exact dates varied every year, the Chinese New Year holidays were always in January and February of the Gregorian calendar. To reduce seasonal differences relating to disease and mortality, the weekend and weekday comparison groups only included admissions in January and February. Admissions to internal medicine departments on Saturday or Sunday comprised the weekend group, while admissions from Monday to Friday (except during the Chinese New Year holidays) comprised the weekday group. Hospitalisations that lasted more than 180 days were excluded to reduce possible outlier effects.

Outcome measures
The two study outcomes were all-cause in-hospital mortality and all-cause mortality within 30 days of the index date. To determine patient status, dates of death were obtained by linking the patient files in the LHID to the National Register of Deaths in Taiwan. In-hospital mortality was defined as death during the period of index hospitalisation, while 30-day mortality was defined as death occurring within 30 days of the index date. The comparison of mortality risk was initially conducted among our three study groups (Chinese New Year holiday, weekend and weekday groups), with the weekday group being the reference group. Further comparisons between the Chinese New Year holiday and weekend groups were also conducted, with the weekend group as the reference group. Subgroup analyses after stratification for age, sex, principal diagnosis and Charlson Comorbidity Index scores were also conducted.

Covariates and potential confounders
The principal diagnosis of hospitalisation and baseline comorbidities (table 1) were retrieved using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes from the inpatient and outpatient claims. The ICD-9-CM codes used for identifying diagnoses and comorbidities are summarised in online supplementary table S1. A pre-existing comorbidity was required to be diagnosed in at least one inpatient or two outpatient services during the 12-month baseline period before the index date.

Table 1 Baseline characteristics of patients admitted on Chinese New Year holidays, weekends and weekdays

	Chinese New Year holidays (n=10 779)	Weekends (n=35 870)	Weekdays (n=143 529)	P value
Age (years)				<0.001
<40	1090 (10.1%)	3684 (10.3%)	14 673 (10.2%)	
40–59	2611 (24.2%)	8734 (24.3%)	37 635 (26.2%)	
60–79	4507 (41.8%)	15 130 (42.2%)	60 821 (42.4%)	
≥80	2571 (23.9%)	8322 (23.2%)	30 400 (21.2%)	
Sex				0.016
Male	6320 (58.6%)	20 544 (57.3%)	83 181 (58.0%)	
Female	4459 (41.4%)	15 326 (42.7%)	60 348 (42.0%)	
Principal diagnosis of hospitalisation				
Pneumonia	1961 (18.2%)	5482 (15.3%)	18 573 (12.9%)	<0.001
Urinary tract infection	621 (5.8%)	1901 (5.3%)	6121 (4.3%)	<0.001
Ischaemic heart disease	553 (5.1%)	2694 (7.5%)	11 058 (7.7%)	<0.001
Heart failure	413 (3.8%)	1438 (4.0%)	5459 (3.8%)	0.194
UGI bleeding	1179 (10.9%)	3705 (10.3%)	13 370 (9.3%)	<0.001
COPD	755 (7.0%)	2137 (6.0%)	7910 (5.5%)	<0.001
Renal disease	360 (3.3%)	1307 (3.6%)	5459 (3.8%)	0.026
Liver disease	775 (7.2%)	2318 (6.5%)	9308 (6.5%)	0.015
Stroke	776 (7.2%)	2641 (7.4%)	9709 (6.8%)	<0.001
Cellulitis	258 (2.4%)	612 (1.7%)	2397 (1.7%)	<0.001
Malignancy	580 (5.4%)	2081 (5.8%)	11 896 (8.3%)	<0.001
Others	2548 (23.6%)	9554 (26.6%)	42 269 (29.4%)	<0.001
Charlson Comorbidity Index score				<0.001
0–2	6116 (56.7%)	19 771 (55.1%)	73 860 (51.5%)	
3–5	3057 (28.4%)	10 405 (29.0%)	41 826 (29.1%)	
≥6	1606 (14.9%)	5694 (15.9%)	27 843 (19.4%)	
Comorbidities				
Hypertension	5920 (54.9%)	20 101 (56.0%)	78 072 (54.4%)	<0.001
Diabetes mellitus	3684 (34.2%)	12 024 (33.5%)	46 893 (32.7%)	<0.001
COPD	3782 (35.1%)	12 007 (33.5%)	47 301 (33.0%)	<0.001
Heart failure	1659 (15.4%)	5759 (16.1%)	21 324 (14.9%)	<0.001
Chronic kidney disease	1566 (14.5%)	5392 (15.0%)	21 121 (14.7%)	0.248
Chronic liver disease	2156 (20.0%)	7226 (20.1%)	30 475 (21.2%)	<0.001
Dementia	648 (6.0%)	2246 (6.3%)	8285 (5.8%)	0.002
Malignancy	1668 (15.5%)	6274 (17.5%)	33 597 (23.4%)	<0.001
Hospital level				0.063
Level 1 (medical centre)	3401 (31.6%)	11 447 (31.9%)	45 930 (32.0%)	
Level 2 (regional hospital)	4911 (45.6%)	15 868 (44.2%)	64 149 (44.7%)	
Level 3 (district hospital)	2467 (22.9%)	8555 (23.9%)	33 450 (23.3%)	
Income level (NTD)				<0.001
Financially dependent	3843 (35.7%)	12 672 (35.3%)	50 163 (34.9%)	
1–19 999	5244 (48.7%)	17 549 (48.9%)	68 823 (48.0%)	
20 000–39 999	1159 (10.8%)	3739 (10.4%)	16 147 (11.3%)	
≥40 000	533 (4.9%)	1910 (5.3%)	8396 (5.8%)	
Urbanisation level				<0.001
1 (Most urbanised)	2487 (23.1%)	8296 (23.1%)	34 457 (24.0%)	
2	2818 (26.1%)	9268 (25.8%)	37 420 (26.1%)	

Continued

Table 1 Continued

	Chinese New Year holidays (n=10 779)	Weekends (n=35 870)	Weekdays (n=143 529)	P value
3	2077 (19.3%)	6828 (19.0%)	27 544 (19.2%)	
4	1835 (17.0%)	6320 (17.6%)	24 419 (17.0%)	
5 (Least urbanised)	1562 (14.5%)	5158 (14.4%)	19 689 (13.7%)	

The categorical variables between groups were compared using X^2 tests.
COPD, chronic obstructive pulmonary disease; NTD, New Taiwan dollars; UGI, upper gastrointestinal.

Charlson Comorbidity Index scores, which are widely used to determine overall systemic health status and are highly correlated with mortality risk, were calculated based on the ICD-9-CM codes.[13] Hospitals were categorised into three levels according to their government accreditation: level 1, a medical centre; level 2, a regional hospital; and level 3, a district hospital. Socioeconomic status was assessed based on patients' income and the urbanisation level of their place of residence. Since NHI insurance premiums are set nationally by the government according to the income of individuals, income-related insurance premiums were used to estimate the monthly incomes and classified into four intervals (New Taiwan dollars ≥40 000, 20 000–39 999, 1–19 999, and financially dependent). Urbanisation levels were determined using the patient addresses provided in the NHIRD and categorised into five levels, with lower levels reflecting more urbanised locations. Detailed descriptions of the identification of patients' income and urbanisation levels are found in previous studies.[14 15]

Statistical analysis

Categorical variables were compared using X^2 tests. Multivariate logistic regression modelling was used to calculate the ORs and 95% CIs for both in-hospital and 30-day mortality, with adjustment for all baseline characteristics listed in table 1. To evaluate a possible subgroup effect on mortality, the interaction test was performed. Statistical significance was defined as a two-sided probability value <0.05. All analyses were performed using Stata software (V.14; StataCorp, College Station, TX, USA).

Patient and public involvement

The present study was conducted by using deidentified secondary data. The patients and public were not directly involved in this study and the need for consent was waived.

RESULTS

Patient characteristics

We identified 190 178 admissions to departments of internal medicine in January and February for the years 2001–2013, including 10 779 (5.7%) Chinese New Year holiday admissions, 35 870 (18.9%) weekend admissions and 143 529 (75.5%) weekday admissions. As shown in table 1, differences between groups regarding several baseline characteristics including the distribution of age, sex, Charlson Comorbidity Index scores, principal diagnosis for hospitalisation, comorbidities, income and urbanisation level revealed statistical significance. However, the exact percentage differences for most characteristics between groups were small.

Risk of mortality

After adjusting for patient demographics, socioeconomic status, principal diagnoses and comorbidities as listed in table 1, both in-hospital mortality and 30-day mortality were significantly higher among patients admitted on Chinese New Year holidays and weekends than for those admitted on weekdays (table 2). Compared with those admitted on weekdays, patients admitted on the Chinese New Year holidays had a 38% increased risk of in-hospital mortality (OR=1.38, 95% CI 1.27 to 1.50, p<0.001) and a 40% increased risk of 30-day mortality (OR=1.40, 95% CI 1.31 to 1.50, p<0.001). Patients admitted on

Table 2 The risk of all-cause mortality for patients admitted on Chinese New Year holidays, weekends and weekdays

	Chinese New Year holidays (n=10 779)			Weekends (n=35 870)			Weekdays (n=143 529)		
	Deaths, n (%)	OR (95% CI)	P value	Deaths, n (%)	OR (95% CI)	P value	Deaths, n (%)	OR (95% CI)	P value
In-hospital mortality	667 (6.2)	1.38 (1.27 to 1.50)	<0.001	1864 (5.2)	1.17 (1.10 to 1.23)	<0.001	6635 (4.6)	1.00	(Ref)
30-Day mortality	1025 (9.5)	1.40 (1.31 to 1.50)	<0.001	2924 (8.2)	1.19 (1.14 to 1.24)	<0.001	10 464 (7.3)	1.00	(Ref)

The OR was calculated by multivariate logistic regression modelling with adjustments for the baseline characteristics listed in table 1.
Ref, reference.

Table 3 The comparison of risk of all-cause mortality between patients admitted on Chinese New Year holidays and weekends

	Chinese New Year holidays (n=10 779)			Weekends (n=35 870)		
	Deaths, n (%)	OR (95% CI)	P value	Deaths, n (%)	OR (95% CI)	P value
In-hospital mortality	667 (6.2)	1.20 (1.09 to 1.32)	<0.001	1864 (5.2)	1	(Ref)
30-Day mortality	1025 (9.5)	1.20 (1.11 to 1.30)	<0.001	2924 (8.2)	1	(Ref)

The OR was calculated by multivariate logistic regression modelling with adjustments for the baseline characteristics listed in table 1.
Ref, reference.

weekends also had a 17% increased risk of in-hospital mortality (OR=1.17, 95% CI 1.10 to 1.23, p<0.001) and a 19% increased risk of 30-day mortality (OR=1.19, 95% CI 1.14 to 1.24, p<0.001) than those admitted on weekdays (table 2).

Further comparisons between the Chinese New Year holiday group and the weekend group revealed that patients admitted on Chinese New Year holidays had significantly higher risk of both in-hospital (OR=1.20, 95% CI 1.09 to 1.32, p<0.001) and 30-day mortality (OR=1.20, 95% CI 1.11 to 1.30, p<0.001) than those admitted on weekends (table 3).

Comparisons after stratification for age, sex, principal diagnosis and Charlson Comorbidity Index scores

Compared with those admitted on weekdays, patients admitted on Chinese New Year holidays had a significantly higher risk of in-hospital mortality in the following subgroups: those aged 40–59, 60–79 and ≥80 years; both males and females (when analysed separately); those with principal diagnoses of ischaemic heart disease, liver disease, malignancy and others; and all categories of the Charlson Comorbidity Index score (table 4). Patients admitted on Chinese New Year holidays with a principal diagnosis of ischaemic heart disease had the highest increased risk of mortality, with a 3.43-fold increase in risk of in-hospital mortality (OR=3.43, 95% CI 2.46 to 4.80, p<0.001), compared with those admitted on weekdays. When stratified by Charlson Comorbidity Index scores, a higher increase in mortality risk was found for patients admitted on Chinese New Year holidays with higher Charlson Comorbidity Index scores, with ORs of 1.17, 1.39 and 1.67 for patients with Charlson Comorbidity Index scores of 0–2, 3–5 and ≥6, respectively (table 4). The interaction test revealed that the subgroup effect on the mortality was present for the principal diagnoses and Charlson Comorbidity Index. The interactions were not significant for age and sex (table 4). The analyses for weekend admissions revealed a similar pattern although with a smaller effect than the Chinese New Year holiday admissions (table 4). The stratified analyses for 30-day mortality also revealed similar results (table 5).

DISCUSSION

This nationwide population-based retrospective cohort study evaluated whether a 'Chinese New Year effect' and a 'weekend effect' existed in internal medicine departments. Both in-hospital mortality and 30-day mortality were significantly higher for patients admitted on Chinese New Year holidays and weekends than for those admitted on weekdays. The mortality risk of admission on Chinese New Year holidays was the highest, with approximately 40% and 20% increased relative mortality risk than weekday and weekend admissions, respectively. To the best of our knowledge, this is the first study to investigate whether consecutive holidays, here the annual official Chinese New Year holidays, influence the mortality risk for patients admitted to internal medicine departments.

Previous studies have revealed a 'weekend effect,' in which higher mortality risk has been found among patients with a range of diseases, including acute myocardial infarction,[1 2 16] stroke,[3 17 18] aortic aneurysm,[19–21] pulmonary embolism[4 5] and malignancy.[21] A previous study on patients admitted to internal medicine departments revealed an overall 20% increase in relative in-hospital mortality risk (OR=1.20) for weekend admissions compared with weekday admissions.[22] Our results are compatible with these findings in relation to the analyses for weekend admission, with 17% and 19% increases for relative in-hospital and 30-day mortality risk, respectively, among patients admitted to internal medicine departments. Our subgroup analyses stratifying individual principal diagnoses also revealed consistent results, with significant increase of mortality risk among patients admitted on weekends and diagnosed with ischaemic heart disease, stroke (30-day mortality only) and malignancy. Patients admitted on weekends with upper gastrointestinal bleeding were also found to have higher 30-day mortality. Some system factors possibly influence these observed differences in mortality risk between weekends and weekdays. In particular, levels of staffing, number of healthcare providers, availability of diagnostic tests or interventions, specific hospital policies and the well-being (ie, sleep, fatigue) of medical staff.[1 2 10 11 17] The different impact of disease severity between weekend and weekday admissions is also one of the possible explanations for the observed differences in mortality risk according to some

Table 4 Subgroup analyses for the risk of all-cause in-hospital mortality among patients admitted on Chinese New Year holidays and weekends, compared with weekdays, after stratification for age, sex, principal diagnosis and Charlson Comorbidity Index score

	Chinese New Year holidays			Weekends		
	OR (95% CI)	P value	P for interaction	OR (95% CI)	P value	P for interaction
Age (years)			0.273			0.068
<40	1.12 (0.64 to 1.96)	0.686		1.33 (0.97 to 1.81)	0.073	
40–59	1.66 (1.36 to 2.02)	<0.001		1.20 (1.05 to 1.37)	0.008	
60–79	1.35 (1.17 to 1.55)	<0.001		1.25 (1.15 to 1.36)	<0.001	
≥80	1.30 (1.14 to 1.48)	<0.001		1.05 (0.97 to 1.15)	0.240	
Sex			0.838			0.749
Male	1.38 (1.24 to 1.54)	<0.001		1.15 (1.08 to 1.24)	<0.001	
Female	1.37 (1.19 to 1.58)	<0.001		1.18 (1.08 to 1.29)	<0.001	
Principal diagnosis of hospitalisation			<0.001			0.002
Pneumonia	1.01 (0.86 to 1.18)	0.899		1.03 (0.93 to 1.13)	0.618	
Urinary tract infection	1.50 (0.80 to 2.78)	0.203		0.95 (0.60 to 1.50)	0.831	
Ischaemic heart disease	3.43 (2.46 to 4.80)	<0.001		1.52 (1.20 to 1.93)	0.001	
Heart failure	1.19 (0.78 to 1.83)	0.418		1.18 (0.92 to 1.52)	0.196	
UGI bleeding	0.99 (0.63 to 1.56)	0.977		1.17 (0.90 to 1.52)	0.255	
COPD	0.98 (0.62 to 1.53)	0.918		0.97 (0.73 to 1.28)	0.814	
Renal disease	1.26 (0.82 to 1.92)	0.293		1.14 (0.88 to 1.47)	0.334	
Liver disease	1.64 (1.19 to 2.25)	0.002		1.09 (0.86 to 1.38)	0.488	
Stroke	1.31 (0.89 to 1.93)	0.165		1.11 (0.87 to 1.42)	0.392	
Cellulitis	0.87 (0.26 to 2.90)	0.823		0.27 (0.08 to 0.89)	0.031	
Malignancy	1.68 (1.36 to 2.08)	<0.001		1.27 (1.12 to 1.45)	<0.001	
Others	1.63 (1.33 to 1.99)	<0.001		1.31 (1.16 to 1.49)	<0.001	
Charlson Comorbidity Index score			<0.001			0.221
0–2	1.17 (1.02 to 1.35)	0.030		1.12 (1.03 to 1.23)	0.012	
3–5	1.39 (1.20 to 1.61)	<0.001		1.17 (1.06 to 1.28)	0.001	
≥6	1.67 (1.43 to 1.95)	<0.001		1.22 (1.10 to 1.35)	<0.001	

The OR was calculated using patients admitted on weekdays as reference, by multivariate logistic regression modelling with adjustment for all baseline characteristics listed in table 1.
COPD, chronic obstructive pulmonary disease; UGI, upper gastrointestinal.

studies,[2 9 23 24] but not others.[10 25–27] Some studies that have focused on patients diagnosed with upper gastrointestinal bleeding[6 7 28] and stroke[8 29] revealed no significant differences in mortality risk between weekend and weekday admissions. This inconsistency may be attributed to different study populations, study designs, patient diagnoses, severities of illness and sample sizes.[9–11] Further studies with better control for possible confounding factors are necessary.

Although a few previous studies have indicated a peak in the number of deaths during the Christmas/New Year holiday period compared with other periods in Western cultures,[30–32] they only considered and compared the number of deaths according to date using administrative databases of death. They did not evaluate the prognosis or outcomes of patients admitted during these consecutive

holidays and did not consider, or adjust for, baseline characteristics, such as demographics, socioeconomic status or comorbidities according to individual patient data. To the authors' knowledge, only one previous study evaluated the effects of admission on weekends or on consecutive holidays.[12] The previous study, using 3-year data (2000–2002), also found the possible Chinese New Year effect on mortality (OR=1.48 for 30-day mortality), but they did not find a significant weekend effect. The study included all patients who visited the emergency department, without restriction on the department types (eg, internal medicine, surgical or paediatric departments) and without accessing and adjusting the diagnoses for hospitalisation. Our present study, which evaluated all patients admitted to internal medicine department, revealed compatible findings of the Chinese New Year effect. Furthermore,

Table 5 Subgroup analyses for the risk of all-cause 30-day mortality among patients admitted on Chinese New Year holidays and weekends, compared with weekdays, after stratification for age, sex, principal diagnosis and Charlson Comorbidity Index score

	Chinese New Year holidays			Weekends		
	OR (95% CI)	P value	P for interaction	OR (95% CI)	P value	P for interaction
Age (years)			0.010			0.006
<40	1.17 (0.75 to 1.83)	0.494		1.21 (0.93 to 1.58)	0.148	
40–59	1.82 (1.55 to 2.14)	<0.001		1.33 (1.19 to 1.48)	<0.001	
60–79	1.41 (1.27 to 1.58)	<0.001		1.25 (1.17 to 1.34)	<0.001	
≥80	1.23 (1.09 to 1.38)	0.001		1.05 (0.98 to 1.13)	0.171	
Sex			0.447			0.471
Male	1.42 (1.30 to 1.56)	<0.001		1.20 (1.14 to 1.27)	<0.001	
Female	1.35 (1.20 to 1.52)	<0.001		1.16 (1.08 to 1.25)	<0.001	
Principal diagnosis of hospitalisation			<0.001			<0.001
Pneumonia	1.04 (0.91 to 1.20)	0.547		1.07 (0.98 to 1.18)	0.122	
Urinary tract infection	0.97 (0.59 to 1.60)	0.901		0.96 (0.71 to 1.31)	0.816	
Ischaemic heart disease	2.65 (1.98 to 3.54)	<0.001		1.31 (1.07 to 1.59)	0.007	
Heart failure	1.01 (0.71 to 1.44)	0.943		1.13 (0.93 to 1.38)	0.232	
UGI bleeding	1.22 (0.90 to 1.66)	0.197		1.22 (1.01 to 1.48)	0.038	
COPD	0.79 (0.55 to 1.13)	0.196		0.83 (0.67 to 1.04)	0.101	
Renal disease	1.34 (0.95 to 1.89)	0.093		0.98 (0.78 to 1.21)	0.824	
Liver disease	1.78 (1.41 to 2.24)	<0.001		1.12 (0.94 to 1.32)	0.199	
Stroke	1.42 (1.05 to 1.91)	0.022		1.22 (1.01 to 1.47)	0.036	
Cellulitis	1.34 (0.63 to 2.88)	0.450		0.68 (0.35 to 1.31)	0.244	
Malignancy	1.92 (1.59 to 2.30)	<0.001		1.40 (1.25 to 1.56)	<0.001	
Others	1.46 (1.23 to 1.74)	<0.001		1.31 (1.18 to 1.45)	<0.001	
Charlson Comorbidity Index score			<0.001			<0.001
0–2	1.10 (0.98 to 1.24)	0.117		1.09 (1.02 to 1.18)	0.018	
3–5	1.39 (1.23 to 1.57)	<0.001		1.14 (1.06 to 1.23)	0.001	
≥6	1.90 (1.67 to 2.16)	<0.001		1.39 (1.28 to 1.51)	<0.001	

The OR was calculated using patients admitted on weekdays as reference, by multivariate logistic regression modelling with adjustment for all baseline characteristics listed in table 1.
COPD, chronic obstructive pulmonary disease; UGI, upper gastrointestinal.

our study has investigated each different principal diagnosis of hospitalisation and further adjusted these factors and performed subgroup analyses to evaluate the possible different effect among each admission diagnosis. Since interaction tests revealed a subgroup effect of principal diagnosis for hospitalisation (p<0.001 for interaction), such information may be important for clinical application and policymakers. The inconsistent findings of a weekend effect may be caused by different study designs and the broad inclusion criteria in the previous study.[12]

The underlying causes of the 'Chinese New Year effect' are likely to be similar to those associated with poorer prognosis for patients admitted on weekends than weekdays. These include a decrease in several aspects of the availability of healthcare resources and the abovementioned human factors. Moreover, in many clinical settings, the scarcity of healthcare resources,

especially staffing, is much more pronounced and extended during the Chinese New Year holidays compared with typical weekends. A reduction in the number of specialist staff members available on normal working days can affect the quality of medical care, causing poorer patient prognosis.[33] This problem may exist in most hospitals or care units in the periods closer to Chinese New Year, because hospital staff members may arrange their schedules so they have consecutive days off. These prolonged periods, with decreased staffing and resources, and increased duty time of personnel (especially physicians), may further affect the quality of care. However, the difference of disease severity between the Chinese New Year holiday and weekend/weekday admissions is also a potential reason for the higher mortality among Chinese New Year holiday admissions. Previous studies have argued

that patients admitted during the weekends are sicker than those admitted during weekdays, which may contribute to the higher mortality of weekend admissions than that of weekday admissions.[34 35] A previous study conducted in the UK compared the National Early Warning Scores between emergency medical admissions on weekends with admissions on weekdays in four acute hospitals. The National Early Warning Scores were used as a proxy of patient severity, which was calculated based on scoring seven variables (ie, respiration rate, oxygen saturations, any supplemental oxygen, temperature, systolic blood pressure, heart rate and level of consciousness). That study found that patients admitted on weekends had higher National Early Warning Scores than on weekdays.[34] Another study in the UK further argued that higher mortality rates among emergency patients admitted to hospitals on weekends reflect a lower probability of admission on weekends.[35] Although these previous studies did not evaluate the consecutive holidays and internal medicine departments specifically, we must consider this information when interpreting the observed Chinese New Year effects. Although we adjusted for possible confounding factors as far as possible when conducting analyses, we could not directly evaluate the disease severity through the claim-based data set. Regardless of the causes, our study demonstrates the considerable increased risk of mortality in internal medicine patients admitted on Chinese New Year holidays that cannot be neglected. This is evident from the 1.6% and 2.2% absolute increase and the 38% and 40% relative increase in risk for in-hospital and 30-day mortality, respectively, compared with weekday admissions. In particular, these effects are especially concerning for patients with a principal diagnosis of ischaemic heart disease, with a 3.43-fold increase in in-hospital mortality risk among those admitted on Chinese New Year holidays than those admitted on weekdays.

We found differences in the case mix between Chinese New Year holiday/weekend and weekday admissions in our sample based on principal diagnosis. For example, the proportion of pneumonia, urinary tract infection and cellulitis diagnoses was higher in the Chinese New Year holiday group, but there was a lower proportion of ischaemic heart disease and malignancy diagnoses, compared with the weekday/weekend groups. This finding implies that the difference in healthcare-seeking behaviour and caregiving policy may exist between Chinese New Year holiday/weekend and weekday. For example, the proportional difference in ischaemic heart disease may be attributable partly to higher number of admissions related to elective cardiac investigation/procedures during weekdays than Chinese New Year holiday/weekend, because elective management was usually arranged during normal working days; during weekends or consecutive holidays, usually, only the emergency intervention can be implemented. Additionally, some previous evidence has shown that the diagnostic coding behaviour may be

different during the weekend and weekday work,[36 37] although the underlying cause is not well understood; this may also be a possible reason for the diagnostic discrepancy between the Chinese New Year holiday and weekend/weekday groups. In addition to the medical resources and quality of care issues, it is therefore important to consider how the factors mentioned may confound the findings of the current investigation.

The main strength of this study is the nationwide population-based design using LHID, which provided a representative sample of 2 million individuals randomly selected from Taiwan's population. This sufficient sample size allowed specific evaluation of the impact of consecutive holiday admissions, using Chinese New Year holidays as an example, on patients admitted to internal medicine departments, which to date remained unknown. Nevertheless, our study has several limitations. First, we could not retrieve some important information that may affect mortality (ie, lifestyle, physical, psychiatric or laboratory data from NHIRD). Additionally, information about disease severity and urgency of the condition cannot be accessed directly using claim-based data, which is a major limitation in our study. Despite our attempts to address confounding variables with the study design, it is possible that unidentified confounding factors influenced the results. Second, although we conducted the subgroup analyses after stratification for principal diagnosis associated with hospitalisation, we did not access the specific effects for each individual principal diagnosis and instead performed a holistic analysis for internal medical inpatients. Moreover, dividing patients according to several principal diagnoses leads to decreased statistical power which may obscure the real effects. Due to variance in clinical problems, management and treatment strategies, and disease-specific factors for each disease, further large-scale studies designed to focus on individual diseases are necessary. Third, owing to the anonymity policy of NHIRD, only deidentified data could be accessed; thus, we were unable to evaluate patients, or access detailed medical records directly, to confirm the accuracy of diagnoses or outcomes. However, the accuracy of diagnoses of many diseases identified using ICD-9-CM codes in NHIRD has been validated in previous studies and found to be high.[38–42] Further, hospitals or doctors in Taiwan would be heavily fined if incorrect diagnosing or coding occurred. Moreover, mortality data were obtained by linking the LHID to the National Register of Deaths in Taiwan, which minimised the potential for bias in this outcome measure. Thus, the validity of diagnoses and outcomes in our study should be acceptable.

CONCLUSIONS

This nationwide population-based cohort study revealed that both in-hospital mortality and 30-day mortality after hospital admission were significantly higher for Chinese New Year holiday and weekend admissions than for weekday admissions among patients admitted to internal

medicine departments. The mortality risks were highest overall for patients admitted on Chinese New Year holidays. Further studies are required to identify the underlying causes of the 'Chinese New Year effect,' and to develop strategies to improve outcomes for patients admitted during official consecutive holidays.

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