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Research paper

Clinical characteristics and outcomes associated with weekend admissions to psychiatric wards in Taiwan

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ABSTRACT

Objective: This study aimed to investigate whether weekend admissions to psychiatric wards in Taiwan were associated with different patient characteristics or worse clinical outcomes.

Method: Patients with acute psychiatric admissions between 1996 and 2012 were included based on the National Health Insurance Research Database. The patients' baseline characteristics were recorded. The study outcomes included inpatient mortality, length of stay, and readmission within 30 days. Multivariable linear regression and multivariable logistic regression with adjustment for age, sex, diagnosis, and compulsory hospitalization status were performed.

Results: Among 661,709 acute psychiatric admissions, there were 82,450 weekend admissions. The patients with weekend admissions tended to be younger and the proportion of patients with schizophrenia, bipolar affective disorder, substance use disorder, and compulsory hospitalization were higher. Weekend admissions were associated with a shorter length of stay (30.3 days vs. 33.3 days, $p < 0.001$), lower inpatient morality rate (0.07% vs. 0.11%, $p = 0.007$), but higher readmission rate (26.8% vs. 25.3%, $p < 0.001$).

Conclusion: The impact of weekend admission on clinical outcomes was relatively small compared to the differences in demographic and clinical characteristics. Despite the small influence of weekend admission, evaluation of the quality of care provided at weekends requires further attention and research to improve mental health care.

1. Introduction

The current literature reveals that mortality rates are higher in patients admitted to hospitals on weekends than those admitted on weekdays [1]. Poor quality of care and longer inpatient length of stay were also noted [2]. This so-called “weekend effect” can be observed in many healthcare fields, including internal medicine, surgical, pediatric, and obstetric departments [3–7]. On the other hand, research shows that weekend admission is not associated with clinical outcomes [8,9].

The indications and treatments involved in psychiatric hospitalization are quite different from those of medical or surgical illness. Considering the unpredictable disease course of psychiatric patients, weekend admissions are inevitable in many cases. Providing comprehensive care for patients with mental illness is an important issue in the psychiatric field. Nowadays, many specialists are thinking about how to enhance the quality of care for psychiatric patients [10]. Improving the quality of care at the weekend might be crucial because of fewer staff and limited therapeutic resources at weekends. Hence, it is necessary to evaluate the quality of psychiatric inpatient care at weekends.

Little is known about the impact of weekend admission on the quality of care in psychiatric units. A recent study performed in a psychiatric hospital in the UK demonstrated contrasting results that indicated no difference in mortality, but rather shorter length of stay and higher readmission rates for weekend admissions, indicating that patients admitted to psychiatric wards on the weekends may represent a different clinical population than those admitted during the week [11]. The results revealed that patients who were younger, female, or from a minority ethnic group were more likely to be admitted on the weekend [11].

However, potential differences in clinical diagnoses between weekday and weekend admissions are not yet well-explored. Patients admitted at the weekend might have more severe psychiatric illness and higher suicidal or homicidal risk than those admitted on weekdays. The effect of clinical diagnosis on the association between weekend admission and quality of care has not yet been fully explored. Furthermore, whether the findings from a study of psychiatric admissions in the UK can be generalized to other populations is not clear. Knowing more about this issue may help in providing proper

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interventions to improve the quality of care for psychiatric patients. Hence, this study aims to investigate two questions: 1. Are patients admitted to psychiatric wards in Taiwan on the weekend different? 2. Are outcomes different for patients admitted on the weekend?

2. Methods

2.1. Data source

This study utilized Taiwan's National Health Insurance Research Database (NHIRD). NHIRD, a nationwide population-based claims database, was derived from the reimbursement claims of National Health Insurance (NHI) program in Taiwan. NHI is a government-launched, single-payer, and mandatory universal health insurance program, covering >99% of the 23 million citizens of Taiwan [12–14]. For more information about Taiwan's NHI, please refer to "Handbook of Taiwan's National Health Insurance" [15]. The NHIRD collects plentiful health-related data, including the patients' demographic characteristics, clinical diagnosis, prescription records, compulsory hospitalization status, date of admission and discharge, and discharge conditions, including inpatient mortality. The accuracy of clinical diagnosis and prescription records has been documented [16,17]. The overall concordance between claim records in the NHIRD and patient self-reports in the Taiwan National Health Interview Survey was moderate [18]. The NHIRD has been widely used in psychiatric outcome research [19,20]. The Institutional Review Board (IRB) approved this study (approval number NTUH 201505001RINB).

2.2. Study population

A total of 902,967 inpatient records with a psychiatric diagnosis and admitted to psychiatric hospitals or the psychiatric wards of general hospitals between 1996 and 2012 were identified. Inpatient records with patients' age at admission less than or equal to 15 years were excluded (n = 9860). The inpatient records included acute ward admissions, chronic ward admissions, and day hospital admissions. Acute ward inpatients have acute and serious psychiatric symptoms, including self-harm and violence, that are associated with psychiatric symptoms, and the goal of hospitalization is crisis intervention, initiation of pharmacological treatment, and reduced risk of homicide and suicide. On the other hand, the goal of chronic ward and day hospital admission, focusing on patients with deteriorated psychosocial and occupational function, is rehabilitation and functional recovery. Therefore, hospitalizations in chronic wards or day hospital were not included because the treatment goal and course are quite different from those of acute ward treatment (n = 227,759). In addition, 3639 records with a length of acute inpatient hospitalization > 365 days were excluded due to extremely rare conditions. Finally, a total of 661,709 acute psychiatric admissions between 1996 and 2012 were included in this study (Supplementary Fig. S1).

2.3. Patient characteristics

Demographic variables including age at admission and sex were assessed. The patients' clinical diagnoses were categorized into schizophrenia (ICD-9-CM code: 295.x), bipolar affective disorder, (ICD-9-CM code: 296.0, 296.1, 296.4–296.8), major depression (ICD-9-CM code: 296.2 and 296.3), minor depression (ICD-9-CM code: 300.4, and 311.x), dementia (ICD-9-CM code: 290.0–290.4, 294.1, and 331.0–331.2), alcohol use disorder (ICD-9-CM code: 291.x, 303.x, 305.0, 357.5, 425.5, 535.3, 571.0, 571.1, 571.2, and 571.3), substance use disorder (ICD-9-CM code: 292.x, 304.x, 305.2–305.9), adjustment disorder (ICD-9-CM code: 309.x), anxiety disorder (ICD-9-CM code: 300.x except 300.4), and other psychiatric diagnoses. For those with multiple psychiatric diagnoses, only the main diagnosis was used in the analysis. The general medical conditions were measured using the Charlson comorbidity index score, which is the sum of the weighted score of 19 comorbid conditions [21]. The compulsory hospitalization status was also assessed. In addition, patients admitted due to self-harm behaviors were also measured using the external code of ICD-9-CM: E950-E959 [14].

2.4. Exposure and main outcome measurement

Weekend admission was defined as a date of admission that was on a Saturday or Sunday. We evaluated the association between weekend admission and clinical outcomes, including inpatient mortality, rate of psychiatric readmission within 30 days of discharge, and length of stay. Readmission is recognized as a useful indicator of the quality of the previous hospitalization and is found to be associated with symptom severity at discharge [22,23]. Psychiatric readmission was defined as admission of a patient to a psychiatric hospital or a general hospital's psychiatry department within 30 days of discharge. Those with inpatient mortality were excluded in the analyses for psychiatric readmission.

2.5. Statistical analysis

The demographic characteristics and clinical variables among weekday and weekend admission were compared using the chi-square test (for categorical variables) or *t*-test (for continuous variables). Given that one patient might have one or multiple hospitalizations, we used a generalized estimating equations (GEE) model to accommodate the clustering of hospitalizations under individuals [24]. The GEE models were conducted using linear regression with an identity link function for continuous outcome variables or logistic regression with logit link function for dichotomous outcome variables with adjustment for age group, sex, psychiatric diagnoses, self-harm hospitalization, number of psychiatric outpatient visits, Charlson comorbidity index score, and compulsory hospitalization status. Subgroup analyses were conducted to test the effects of weekend admission in different sex, age, and length of stay subgroups.

In order to test the robustness of the study results, we conducted several sensitivity analyses. First, we categorized the length of stay into regular (≤30 days) and prolonged hospitalization (>30 days) and estimated the odds ratio of weekend admission for prolonged hospitalization. Second, most discharges occurred on weekdays; therefore, it might have a different impact on the length of stay for those who were admitted on a weekday or weekend. The distribution of length of stay for admission and discharge on the day of the week was explored. Third, we would analyze the risk of death occurring on a weekday or weekend day, which provides information on the quality of care at the weekend. Finally, we estimated the odds ratios for readmission within 90 and 365 days, respectively.

The statistical significance of relationships was assessed by using a 95% confidence interval (CI) or p-value < 0.05. All analyses were performed using SAS version 9.4 (SAS Institute; Cary, North Carolina).

3. Results

3.1. Are patients admitted to psychiatric wards in Taiwan on the weekend different?

Table 1 shows the descriptive statistics of the demographic and clinical factors among weekday and weekend admissions. A total of 226,617 patients with 661,709 acute psychiatric admissions were included. Among 661,709 acute psychiatric admissions, there were 82,450 weekend admissions (12.5%). Patients aged between 26 and 35 years, 36 and 45 years, or were female, were more likely to be admitted at the weekend. Compared with weekday admissions, the proportion of patients with schizophrenia, bipolar affective disorder, alcohol use disorder, other substance use disorder, and compulsory hospitalization were higher for weekend admissions.

Table 1
Clinical characteristics and outcomes of patients with weekday and weekend admissions.

	Weekday	Weekend	Standard difference	Chi-square	p-Value
Number of admission (row %)	579,259 (87.5%)	82,450 (12.5%)			< 0.001
Baseline characteristics					
Age (%)					
16–25	16.0	14.3			
26–35	26.0	28.8			
36–45	25.9	27.3	0.11	820.4	< 0.001
46–65	24.5	23.9			
> 65	7.7	5.7			
Male (%)	57.4	57.0	−0.05	4.2	0.040
Clinical diagnosis (%)					
Schizophrenia	42.1	43.0	0.02	25.8	< 0.001
Bipolar disorder	15.1	17.5	0.06	312.4	< 0.001
Major depression	16.7	14.0	−0.07	382.0	< 0.001
Minor depression	3.9	3.1	−0.04	114.8	< 0.001
Dementia	8.1	7.1	−0.04	103.5	< 0.001
Alcohol use disorder	2.5	2.8	0.02	20.4	< 0.001
Other substance use disorder	1.4	1.6	0.02	32.4	< 0.001
Adjustment disorder	2.5	1.7	−0.06	210.3	< 0.001
Anxiety disorder	1.3	1.0	−0.03	64.3	< 0.001
Other diagnoses	6.4	8.2	0.06	255.5	< 0.001
Charlson comorbid index score (%)					
0	62.4	64.6			
1	21.4	20.6	0.05	164.9	
2	8.3	7.6			
≥ 3	7.9	7.1			
Compulsory hospitalization (%)	1.4	2.1	0.06	285.2	< 0.001
Self-harm hospitalization (%)	1.0	1.8	0.07	461.0	< 0.001
Number of psychiatric outpatient visits (%)					
0	13.8	15.7			
1–10	42.4	41.5	0.05	221.6	< 0.001
11–20	30.5	30.0			
≥ 21	13.4	12.8			

3.2. Are outcomes different for patients admitted on the weekend?

In univariate analysis, weekend admissions were associated with shorter length of stay (30.3 ± 29.4 days vs. 33.3 ± 34.2 days, $p < 0.001$), lower inpatient morality rates (0.07% vs. 0.11%, $p = 0.007$), and higher readmission rates within 30 days after discharge (26.8% vs. 25.3%, $p < 0.001$), compared with weekday admissions (Table 2).

Results of multivariable linear regression (for continuous outcome variables) or multivariable logistic regression (for categorical outcome variables) analysis with adjustment are demonstrated in Table 3. After adjusting demographic characteristics, clinical diagnoses, and compulsory admission status, we found weekend admissions were slightly associated with a higher risk of readmission (1.07, 95% CI [1.05–1.10]). Age 26–65, male sex, compulsory admission, and a diagnosis of schizophrenia and adjustment disorder, were also associated with a higher readmission rate. In contrast, those who had visit psychiatric outpatient clinics in the prior year had lower risk for readmission.

However, the risk of inpatient mortality for patients admitted at the weekend was lower than those admitted on weekdays (0.72, 95% CI [0.55–0.94]). We also noted that inpatient mortality was strongly associated with the patients' age, male sex, higher Charlson comorbidity index score, and self-harm hospitalizations rather than psychiatric diagnosis.

Finally, we found the length of hospital stay for weekend admissions was 2.12 (−2.32, −1.92) days shorter than that for weekday admissions. We found the main determinant for hospital stay length was the clinical diagnosis. In addition, compulsory admission was also associated with shorter hospitalization. Age, sex, and weekend or weekday admission had a slight influence on the length of stay.

Table 4 shows the results of the subgroup analyses. Age or sex was not a moderator for the effect of weekend admission on readmission within 30 days; however, the effect of weekend admission was only significant among those with a short length of stay (≤ 30 days). In addition, there was also an interaction between age and weekend admission on the length of stay. The difference in length of stay declined among the older age groups. None of age, sex, and length of stay statistically significantly modified the effect of weekend admission on

Table 2
The clinical outcomes of weekend and weekday admission.

	Weekday (N = 579,259)	Weekend (N = 82,450)	T-value or Chi-square	p-Value
Length of stay				
Average, mean ± SD	33.3 ± 34.2	30.3 ± 29.4	26.1	< 0.001
Categorized, n (column %)				
≤ 30 days	342,564 (59.1)	50,859 (61.7)		
> 30 and ≤ 90 days	211,428 (36.5)	29,076 (35.3)	404.7	< 0.001
> 90 days	25,267 (4.4)	2515 (3.1)		
Inpatient mortality, n (%)	616 (0.11)	61 (0.07)	7.4	0.007
Readmission, n (%)				
Within 30 days	146,490 (25.3)	22,092 (26.8)	86.2	< 0.001
Within 90 days	213,886 (36.9)	31,684 (38.4)	70.0	< 0.001
Within 365 days	317,558 (54.8)	46,681 (56.6)	94.1	< 0.001

Table 3
The effect of weekend vs. weekday admission, age, sex, diagnosis, and compulsory admission on clinical outcomes.

	Readmission with 30 days, OR (95% CI)	Inpatient mortality, OR (95% CI)	Length of stay, β coefficient (95% CI)
Weekend vs. weekday admission	1.07 (1.05–1.10)	0.72 (0.55–0.94)	−2.12 (−2.32, −1.92)
Age, 16–25 years as reference			
26–35	1.06 (1.02–1.09)	1.47 (0.96–2.24)	0.34 (0.02, 0.67)
36–45	1.09 (1.05–1.12)	2.18 (1.45–3.27)	0.48 (0.14, 0.81)
46–65	1.07 (1.03–1.11)	4.11 (2.77–6.10)	1.75 (1.41, 2.08)
>65	0.74 (0.71–0.78)	11.23 (7.52–16.78)	1.49 (1.06, 1.91)
Male vs. female	1.32 (1.29–1.34)	1.60 (1.35–1.89)	0.94 (0.72, 1.16)
Clinical diagnosis			
Schizophrenia	1.19 (1.08–1.31)	1.30 (0.54–3.15)	50.02 (48.64, 51.39)
Bipolar disorder	0.87 (0.79–0.96)	1.25 (0.53–2.98)	38.97 (37.59, 40.35)
Major depression	0.85 (0.77–0.94)	0.83 (0.35–1.97)	33.97 (32.60, 35.34)
Minor depression	0.72 (0.64–0.80)	0.23 (0.07–0.75)	26.64 (25.28, 28.00)
Dementia	0.93 (0.84–1.03)	1.38 (0.56–3.37)	38.67 (37.26, 40.07)
Alcohol use disorder	0.72 (0.64–0.80)	0.65 (0.23–1.82)	27.33 (25.96, 28.69)
Other substance use disorder	0.72 (0.63–0.81)	0.37 (0.08–1.85)	28.51 (27.11, 29.90)
Adjustment disorder	1.14 (1.02–1.26)	0.38 (0.08–1.89)	23.59 (22.22, 24.95)
Anxiety disorder	0.65 (0.57–0.74)	0.28 (0.05–1.76)	29.44 (27.93, 30.95)
Other diagnoses	0.86 (0.78–0.95)	2.44 (0.99–6.01)	32.12 (30.74, 33.51)
Charlson comorbid index score (0 as reference)			
1	0.96 (0.94–0.98)	1.13 (0.91–1.40)	−1.56 (−1.77, −1.36)
2	0.91 (0.88–0.95)	1.41 (1.09–1.83)	−2.23 (−2.53, −1.94)
≥3	0.91 (0.87–0.95)	1.69 (1.32–2.16)	−3.00 (−3.32, −2.68)
Compulsory hospitalization	3.33 (3.18–3.50)	0.39 (0.15–1.04)	−4.98 (−5.49, −4.48)
Self-harm hospitalization	0.97 (0.89–1.06)	2.67 (1.61–4.43)	−4.07 (−4.56, −3.57)
Number of psychiatric clinics visits (0 as reference)			
1–10	0.83 (0.81–0.85)	0.71 (0.58–0.86)	1.32 (1.06, 1.58)
11–20	0.76 (0.74–0.78)	0.67 (0.54–0.85)	0.96 (0.66, 1.25)
≥21	0.72 (0.69–0.75)	0.70 (0.52–0.95)	−0.90 (−1.26, −0.55)

inpatient mortality.

3.3. Results of sensitivity analysis

In sensitivity analyses, we found weekend admission had a lower risk of prolonged hospitalization (OR = 0.92, [0.91, 0.94]), which is consistent with our primary analysis using length of stay as a continuous variable. In the analyses for the distribution of length of stay based on the day of the week of discharge, the results showed weekend admissions have a shorter length of stay, regardless of whether the patients were discharged on a weekday or weekend (see Supplementary Table S1). In terms of occurrence of death on the day of week, we found that the mortality rate was no different across the days of the week (p-value = 0.76) (see Supplementary Table S2). Finally, we analyzed the readmission rate using different time frames and the results remained consistent. The readmission risk of weekend admission was 1.06 (1.03–1.08) for 90-day readmission and 1.06 (1.04–1.08) for 365-day readmission.

4. Discussion

4.1. Main findings

To our knowledge, this is the first study to use a nationwide database to investigate the clinical characteristics and outcomes associated with weekend admissions to acute psychiatric wards. The patient characteristics of weekend and weekday admissions were different. The proportion of patients with schizophrenia, bipolar affective disorder, alcohol use disorder, and other substance use disorder were higher for weekend admissions. Compulsory admissions were also higher on the weekend. The effects of weekend admissions on clinical outcomes were small but statistically significant. The results showed that weekend admissions were associated with a shorter length of stay and lower inpatient mortality but higher readmission rate.

In our findings, about 42% of psychiatric inpatients had a main diagnosis of schizophrenia, around 16% had major depression, and 15% had bipolar affective disorder. Among the common psychiatric

Table 4
The effect of weekend admission in different gender, age, and length of stay subgroups.

Clinical outcome	Readmission, OR (95% CI)	Inpatient mortality, OR (95% CI)	Length of stay, β coefficient (95% CI)
Weekend vs. weekday admission			
Overall	1.07 (1.05–1.10)	0.72 (0.55–0.94)	−2.12 (−2.32, −1.92)
Gender			
Male	1.07 (1.03–1.10)	0.77 (0.56–1.06)	−1.96 (−2.23, −1.70)
Female	1.08 (1.04–1.12)	0.63 (0.39–1.02)	−2.29 (−2.60, −1.99)
Age groups			
16–25	1.10 (1.03–1.17)	NA	−2.72 (−3.25, −2.19)
26–35	1.08 (1.03–1.12)	0.70 (0.38–1.31)	−2.46 (−2.85, −2.08)
36–45	1.08 (1.04–1.13)	0.48 (0.23–0.98)	−2.27 (−2.64, −1.89)*
46–65	1.06 (1.00–1.12)	0.86 (0.56–1.32)	−1.69 (−2.09, −1.29)*
> 65	1.14 (1.00–1.31)	0.76 (0.47–1.23)	−1.04 (−1.74, −0.34)*
Length of stay			
≤30 days	1.10 (1.06–1.13)*	0.75 (0.55–1.01)	
>30 and ≤90 days	1.03 (1.00–1.06)	0.71 (0.40–1.25)	
>90 days	0.92 (0.83–1.01)	0.27 (0.04–1.97)	

* Statistical significance was noted for the interaction between weekend and patient's age, gender or length of stay.

diagnoses, the proportions of schizophrenia, bipolar affective disorder, alcohol use disorder, and other substance use disorder were higher for weekend admissions, while depressive disorder and dementia were proportionately lower. Patients with substance-related disorders, schizophrenia, or bipolar affective disorders might be associated with higher violent or suicidal risk; therefore, they are more likely to visit the emergency department and be admitted unexpectedly during the weekend. In contrast, patients with depressive disorder or dementia are more likely to be admitted to psychiatric wards from outpatient department referrals, which only operate during the week.

The proportion of compulsory admissions on the weekend was higher than that on weekdays. Our findings were not consistent with a previous UK-based study [11]. The difference in clinical characteristics might partially explain the higher percentage of compulsory admissions at the weekend. In addition, according to the Mental Health Act in Taiwan, the criteria for compulsory admission include patients who refuse to be admitted, who are in a psychotic state that results in an inability to manage personal affairs, along with a high risk of violence or self-harm. The application of compulsory admission is performed by two psychiatrists, and the decision is made after review by the Mental Illness Mandatory Assessment and Community Treatment Review Committee, which includes multidisciplinary professionals [25]. Compulsory admission in Taiwan is usually initiated based on the risk of violence or suicide, rather than the motivation to receive treatment. These criteria explain the finding that compulsory admissions were more common at weekends in Taiwan. Compared to Taiwan, the UK has broader criteria in applying for compulsory admission [26]. Therefore, the rate of compulsory admission in Taiwan was much lower ($<2\%$ in our study sample) than the rate in a UK-based study (27%) [11]. This finding was similar to one study conducted in a psychiatric hospital in Taiwan, reporting a rate of compulsory admission of 4% [27]. A recent NHRID study also showed that in a comparison of approximately 70,000 people who consented to hospitalization, only 0.96% of these individuals were compulsorily hospitalized [28]. Another possible explanation for the lower rate of compulsory admission in Taiwan than that in most Western countries may be that the influence of family members on patients' decision to receive treatment is greater in Asian countries.

The readmission rate for weekend admission within 30 days was higher than that for weekday admission; however, the effect size was small (adjusted OR: 1.07; 95% CI [1.05–1.10]). The consistent results of analysis using 90-day and 365- day follow-up period support the robustness of our findings. Patients' sex, compulsory hospitalization status, and some clinical diagnoses were stronger predictors for the readmission rate than weekend admission. Weekend admission indicates an unexpected hospitalization; thus, the high readmission rates for weekend admissions could be partially explained by underlying symptom severity and risk of violence or suicide. In addition, the quality of the hospitalization might also contribute to the higher readmission rate. During the weekend, patients were cared for by on-duty medical professionals then they would be transferred to regular medical staff. Therapeutic rapport would be relatively difficult to established. However, the length of stay was much longer than that for medical or surgical hospitalization. Thus, the impact of initial treatment on the weekend on clinical outcome might be attenuated.

We found the length of stay was shorter for weekend admissions. The results of sensitivity analyses, revealing weekend admission had a lower risk of prolonged hospitalization, and weekend admissions have a shorter length of stay, no matter whether the patients were discharged on a weekday or weekend, both support the robustness of our finding. Generally, weekend admission was associated with severe mental disorder and high risk of violence and suicide, and longer hospitalization may be expected [29]. However, this was not the case in this study. Our finding was compatible with those of a UK-based study [11]. The phenomenon of a shorter length of stay but higher readmission rates may be explained by the fact that patients with weekend admissions have hidden, unsolved problems, such as poor social support, low motivation to receive treatment, and incomplete treatment course. Furthermore, the effect of a higher proportion of substance use disorders in weekend admissions may also have an impact on the length of hospital stay. The proportion of patients with comorbid substance use disorder may be higher for weekend admissions. Among patients with alcohol or substance use disorder, psychotic or mood symptoms could improve rapidly after discontinuation of alcohol or substance use. However, these patients generally have low motivation for further treatment and stay in hospital for a shorter period. Substance-related disorders are found to be negatively correlated with length of stay [29]. Moreover, our results were compatible with previous studies utilizing NHIRD, revealing a longer length of psychiatric hospitalization compared with that in other countries. The length of stay of psychiatric inpatient treatment in Taiwan was around 30 to 40 days on average [12,28] or a median length of stay of 35.0 days [30]. This phenomenon might reflect the high accessibility to medical facilities, limited resources of community care, and low copayment under the NHI system in Taiwan.

Regarding inpatient mortality, the rate of inpatient mortality was 1.1 deaths per 1000 admissions for weekday admissions, and 0.7 deaths per 1000 admissions for weekend admissions. The mortality rate was no difference across the day of week. Unlike most of the findings in other healthcare fields, our study shared similar finding to the study in psychiatric hospital in England [11], showing psychiatric weekend admissions were not associated with an increase in mortality rates. A recent systemic review and meta-analysis of the weekend effect in UK hospitals indicated the studies related to weekend effect had high levels of heterogeneity, and not all the studies had significant findings in mortality rate [7]. In our study, both groups had low mortality rates. We found the most important predictor of inpatient mortality in psychiatric wards were old age. The proportion of older patients among weekend admission was lower than weekday admission. Older psychiatric patients may have more medical conditions. Although we adjusted for the effect of age in our model, there was a statistically significant difference between the two groups' mortality rates. The effect of underlying medical conditions might partially contribute to the finding that inpatient mortality for weekday admissions was higher than weekend admissions.

In terms of subgroup analysis, we found the effect of weekend admission on readmission within 30 days was only statistically significant among those with a short length of stay (≤ 30 days). We thought that although weekend admission has a negative impact on quality of treatment initially, if the duration of treatment prolonged, the adverse effect of weekend admission would attenuate gradually. We also found age was a moderator for the association between weekend admission and length of stay. The older age group is, the difference in length of stay is smaller. Of interest, the length of stay was positively associated with age. To sum up, the older group generally needed a longer duration for hospitalization; therefore, the effect of weekend admission among older patients was relatively weak.

4.2. Strengths and limitations

The major strength of our study is the large sample size of over 660,000 patients receiving psychiatric hospital care in a nationwide population-based claims database, which covers $>99\%$ of the 23 million citizens of Taiwan. The database provides important information about the characteristics of psychiatric inpatients in Taiwan, including mortality and other quality indicators. Furthermore, we conducted a novel analysis for psychiatric diagnosis regarding the association of weekend admission and clinical outcomes.

However, there are several limitations of this study. Firstly, some important information was not available in the NHIRD. For example, the number of on-duty staff, bed availabilities, and medical resources at the weekend varied markedly across hospitals. In addition, patients'

symptom severity, functional level, and the community mental health care and social support systems they could reach also influence clinical outcomes. Therefore, our results were confounded by these unmeasured factors. Secondly, the distribution of psychiatric inpatient resource was unequal and limited in some areas of Taiwan. Those who needed to be hospitalized at the weekend might delay admission due to the lack of acute beds and receive treatment in the emergency department first. The misclassification might lead to a difference between weekend and weekday admission trending to zero. Thirdly, we used psychiatric readmission, length of stay, and inpatient mortality as proxy measures of quality of care. However, these indicators might not be sensitive to reflecting the quality of care at the weekend. Fourthly, the causes of mortality were not clear. Among 681 inpatient mortalities, we found there was 61 cases (9.0%) transferred to general medical wards and there were 23 cases (3.3%) discharged due to suicide. The causes for the remaining mortalities are unknown. Whether there is a difference in the cause of inpatient mortality remains unclear. Fifthly, since we defined weekend admission based on the date of admission, the weekend effect may not be totally demonstrated in our study. The weekend effect may start on Friday evening rather than on Saturday, and end on Monday morning rather than Sunday. Furthermore, admissions on holidays were not classified as weekend admissions in our study. However, these misclassifications would attenuate the difference between weekdays and the weekend. Finally, we estimated the difference between weekend and weekday admission in Taiwan's healthcare setting; our results may not be generalizable to other populations.

4.3. Implications

Our findings reveal that patients who were younger, female, with a diagnosis of schizophrenia, bipolar affective disorder, alcohol use disorder, and other substance use disorder were more likely to be admitted at the weekends than patients without these characteristics. Weekend admissions had a shorter length of stay but higher readmission rate. These findings may reflect that specific psychiatric patients especially lack proper mental health care at the weekend and hospital care may have had limited effects for them. In general, high suicide or violent risk is a major indication for psychiatric admission, especially in weekend admissions. Our findings suggest that rather than risk assessments, need assessment might be a more important issue in providing good quality mental health care.

5. Conclusion

Our study revealed that weekend admission was associated with a shorter length of stay and lower inpatient mortality but higher readmission rate. Analyzing the patients' clinical characteristics, we found patients admitted at the weekend were different from those admitted on weekdays. The impact of weekend admissions on clinical outcomes was relatively small compared to the effects of demographic and clinical characteristics. Despite the small influence of weekend admissions, evaluation of the quality of care on weekends requires further attention and research to improve mental health care.

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Availability of data and materials

The NHIRD is held by the Taiwan Ministry of Health and Welfare (MOHW). Transmission or sharing the database was not allowed. However, any researcher interested in accessing this dataset can submit an application form to the MOHW requesting access.

Declaration of Competing Interest

All authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.genhosppsych.2019.07.001.

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