Life Expectancy, Estimated Loss of Life Expectancy, and Medical Expenditures of Persons with Bipolar Disorder (BD) in Taiwan: A Nationwide Population-Based Study

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ABSTRACT

Background: Impacts of bipolar disorder (BD) on life expectancy (LE), loss of life expectancy (L-LE), and medical costs. Previous longitudinal studies have reported various and wide range of estimated LE in individuals after BD diagnosis. This study aimed to address this limitation and assess the impacts of BD on LE, L-LE, and medical costs for BD patients in Taiwan over an 11-year duration using a new semiparametric extrapolation method.

Methods: Data from the National Health Insurance Program of Taiwan were utilized to identify BD patients aged 5-84 years diagnosed between 2009 and 2019. A rolling-over algorithm was used to estimate the survival function of BD patients, and lifetime risk was extrapolated. A matched set of non-depressed individuals from vital statistics based on sex, age, and calendar year of diagnosis were selected for each BD case to estimate LE. L-LE was calculated by comparing LE of BD patients with their matched referents. Lifetime medical costs were calculated by multiplying average monthly medical costs by corresponding survival rates and summing this amount throughout their lifetime.

Results: Results showed that from a total of 101 735 BD patients, the cumulative incidence of BD fluctuated but was higher in females than males during the study period. Anxiety and cardiovascular disease (CVD) were the major comorbidities in BD patients. LE after BD diagnosis decreased with increasing age but was higher in females aged 19-34 (39.78 years) and males aged 19-34 (34.15 years). Compared to matched referents, L-LE was higher in males (18%-34.4%) than in females (14.2%-33.5%). Medical costs per year increased with increasing age for both males and females. However, Lifetime cost was higher in the 51-66 age group for both males (59,931 USD) and females (64,814 USD), respectively.

Conclusion: In conclusion, based on extrapolation methods, it is evident that BD patients experience a shortened life expectancy and economic burdens primarily due to medical costs. This impact is significant for both males and females with BD when compared to the general population.

Keywords: Bipolar disorder, life expectancy, medical costs, extrapolation, estimates

Background

- Bipolar disorders (BD) are prevalent mood disorders characterized by cyclic episodes of both depression and mania with high risk of relapse rates.
- Notably, even in stable episodes (euthymia), BD patients still experience lower functioning and well-being.
- BD impact extends across various domains, affecting high incidence and mortality, suicide risk, work functionality, and societal integration.
- Moreover, BD patients exhibit shortened life expectancy and increased hospital admissions compared to other mental disorders.
- A meta-analysis of 11 cohort studies revealed that BD leads to a wide range of years of potential life lost, from 3 years to 30 years, compared to the general population.
- An emerging concern in the field of psychiatric disorders is understanding the long-term consequences of BD.

Method

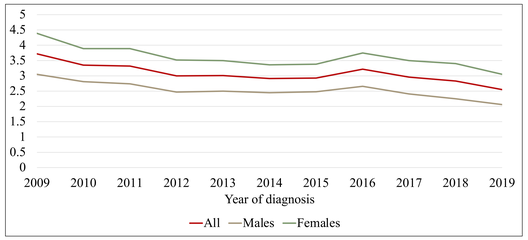
We obtained relevant data from the Health and Welfare Data Science Center, which operates under Taiwan's Ministry of Health and Welfare. We identified BD patients from the cohort data between 2009 and 2019. To identify and validate new cases of BD, we excluded those diagnosed with BD in 1 year prior to 2009. Later, we utilized the International Classification of Diseases, Ninth Revision (ICD-9) codes 296.00-296.06, 296.40-296.46, 296.50-296.56, 296.60-296.66, 296.7, 296.80, 296.89, and the International Classification of Diseases, Tenth Revision (ICD-10) codes F31.0-F31.9 to identify BD patients. The study was authorized by the Institutional Review Board of Tungs' Taichung MetroHarbor Hospital (IRB number: 110034). The inclusion criteria required at least **two outpatient visits or one inpatient visit** with BD as the **first-position diagnosis**, and we defined the **index date** as the first date of admission claims for BD. We identified the youngest age of eligible patients as **5 years** old and later we restricted the maximum age up to **84 years** old based on the highest LE of women in Taiwan. Finally, we followed up with eligible subjects either to the end of the study or death.

The study used the **new semiparametric survival extrapolation** method to estimate LE of individuals with BD following diagnosis. This method was proposed and verified mathematically in the previous studies.[1-3] To ensure a fair comparison between the BD cohort and a referent group, we created a referent group that closely matched the BD cohort in terms of age, sex, and year, using the hazard function of the life table from Taiwan National Vital Statistics and Monte Carlo methods.

Results

- The cumulative incidence of BD fluctuated but was higher in females than males during the study period.

Figure 1. The cumulative incidence rate of bipolar disorder in the Taiwanese population ages 5–84 years, stratified by sex and calendar year of diagnosis



- Poorest LE was found 67-84 age group in both sexes while year of LE was only 8.76 years in males and 11.27 years in females. In other words, the percentage of L-LE due to BD diagnosis was higher in males than in females even when compared to the matched group. Lifetime cost of BD was found higher both in 35-50 and 51-66 age group in both sexes.

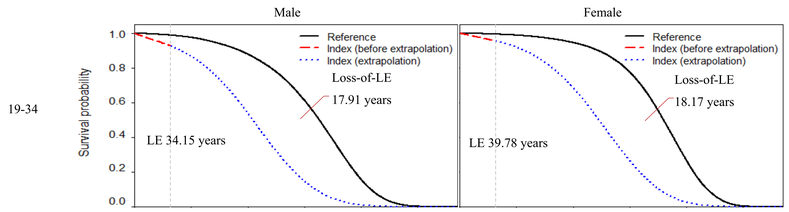
Table 1. Life expectancy, loss of life expectancy, lifetime cost, and cost per life year of BD stratified by sex and age at diagnosis

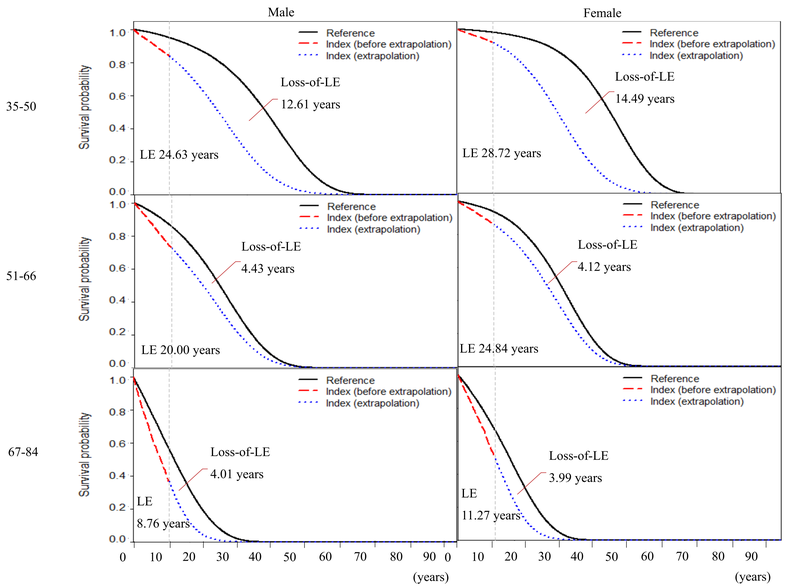
	AGE (N)	DEATH	CFR (%)	AGE (MEAN ± SD)	LE, YEARS (SEM)	LOSS-OF-LE, YEARS (SEM)	LOSS-OF-LE/LE MATCHED GROUP*	LIFETIME COST, USD# (SEM)	COST PER YEAR, USD#
MALE	5-18 (2486)	37	1.48	15.47±3.1	-	-	-	-	-
	19-34 (13200)	545	4.12	27.04±4.61	34.15 (4.82)	17.91 (4.83)	34.4%	48,403 (3,357)	1,861
	35-50 (13370)	1200	8.98	42.76±4.62	24.63 (1.53)	12.61 (1.52)	33.9%	59,853 (2,178)	2,897
	51-66 (9229)	1287	13.95	57.91±4.43	20.00 (1.01)	4.43 (1.02)	18.1%	59,931 (2,536)	3,428
	67-84 (3124)	1141	36.52	74.07±5.01	8.76 (0.39)	4.01 (0.40)	31.4%	34,393 (1,306)	4,008
FEMALE	5-18 (3139)	27	0.86	16.53±1.97	-	-	-	-	-
	19-34 (19384)	489	2.52	27.43±4.61	39.78 (4.17)	18.17 (4.17)	31.4%	48,287 (2,488)	1,680
	35-50 (19667)	893	4.54	42.69±4.64	28.72 (2.28)	14.49 (2.28)	33.5%	56,108 (2,366)	2,388
	51-66 (13343)	1001	7.5	57.99±4.47	24.84 (1.16)	4.12 (1.16)	14.2%	64,814 (2,086)	3,081
	67-84 (4793)	1200	25	74.15±4.86	11.27 (0.51)	3.99 (0.52)	26.1%	40,350 (2,234)	3,705

Note: #Adjusted exchange rate: 1 dollar (US) = 30.93 NTD (New Taiwan Dollar); *The life expectancy of age-, sex-, and calendar year–matched referents was defined as the life expectancy after diagnosis of bipolar + the loss of life expectancy for bipolar; CFR: Case Fatality Rate; LE: Life Expectancy; SEM: Standard Error of Mean; SD: Standard Deviation

- The **black lines** show LE of the sex- and age-matched referents, while the red lines represent data from the BD group and **the blue lines** indicate extrapolation from the BD group. L-LE is the area between the curve for the matched referents and that for the BD group. It was found that L-LE decreased with increasing age for both males and females. The highest L-LE was observed in the age group of 19-34 years, with a loss of 17.91 years in males and 18.17 years in females. On the contrary, the lowest L-LE was observed in the age group of 67-85 years, with 4.01 years in males and 3.99 years in females.

Figure 2. Life expectancy (LE) and loss of life expectancy after diagnosis of BD, stratified by sex and age (in years) at diagnosis (Continued).





- The differences between the two methods were less than 5% in terms of relative biases, indicating a high degree of accuracy in the extrapolation.

Table 3. Validation of the extrapolated estimates of life expectancy after diagnosis of BD based on 6 years of follow-up of the BD cohort compared with 11 years of actual follow-up stratified by age and gender, calculated by the Kaplan-Meier analysis

	N	AGE AT DIAGNOSIS	CENSORING RATE AT END OF 6TH YEAR, %	ESTIMATE USING THE EXTRAPOLATION BASED ON THE FIRST 6 YEARS TO THE 11TH YEAR, MONTHS	ACTUAL FOLLOW-UP OF 11 YEARS BY KAPLAN-MEIER ESTIMATE, MONTHS	RELATIVE BIAS, %
MALE						
19-34	7659	27.09±4.60	97.49	125.69±0.70	125.67±0.27	0
35-50	7635	42.87±4.61	95.27	120.18±0.94	119.99±0.34	0.2
51-66	4948	57.78±4.34	92.70	113.27±1.41	113.13±0.54	0.1
67-84	1729	74.39±5.02	78.89	82.02±3.90	86.19±1.15	-4.8
FEMALE						
19-34	10909	27.90±4.47	98.48	127.13±0.85	127.75±0.17	-0.5
35-50	11647	42.82±4.64	97.61	125.14±0.90	125.56±0.20	-0.3
51-66	7347	57.75±4.37	96.07	121.37±1.25	121.57±0.36	-0.2
67-84	2603	74.14±4.78	86.55	98.93±2.97	98.82±0.86	0.1

Conclusion

In summary, semiparametric extrapolation efficiently effective to estimate the life expectancy of bipolar disorder patients. Specifically, BD can lead to a shortened LE and economic burdens, primarily due to medical costs. While the impact on males may be significant, it is important to recognize that both males and females with BD experience these detrimental effects when compared to the general population.

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