

Effects of electroconvulsive therapy on cognition and quality of life in schizophrenia

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ABSTRACT

Introduction: The effects of electroconvulsive therapy (ECT) on quality of life (QoL), and its relationship with symptom and cognitive change remains unclear. We aim to examine the association of QoL changes with psychiatric symptom and cognitive changes among patients with schizophrenia who underwent ECT.

Methods: This is a retrospective cohort study of 132 patients who received ECT from July 2017 to December 2019. Sociodemographic and clinical characteristics were obtained from medical records. Changes in QoL, psychiatric symptoms and cognition function were examined after 6 sessions of ECT. Generalised linear regression was used to examine the associations of Brief Psychiatric Rating Scale (BPRS) scores and Montreal Cognitive Assessment (MoCA) scores with QoL as measured by EQ-5D scores.

Results: The mean (standard error) improvements after ECT were statistically significant for the assessment scales of EQ-5D utility score: 0.77 (0.02) to 0.89 (0.02), $P < 0.001$; EuroQol-5-Dimension (EQ-5D) visual analogue scale score: 66.82 (2.61) to 73.05 (1.93), $P = 0.012$; and EQ-5D subdomain scores. Both improvement in BPRS (adjusted β coefficient -0.446, 95% confidence interval [CI] -0.840 to -0.052) and MoCA (adjusted β 12.068, 95% CI 0.865 to 12.271) scores were significantly associated with improvement in EQ-5D utility scores after adjustment for sociodemographic and clinical characteristics. Improvement of BPRS scores (psychiatric symptoms) was significantly associated with improvement of the patients' mental health that was assessed by EQ-5D subdomain scores of pain (adjusted β coefficient 0.012, 95% CI 0.004 to 0.021) and anxiety (adjusted β coefficient 0.013, 95% CI 0.002 to 0.024). Improvement of MoCA scores (cognitive function) was significantly associated with patients' physical health as assessed by EQ-5D subdomain score of usual activity (adjusted β coefficient -0.349, 95% CI -0.607 to -0.09).

Conclusion: ECT was associated with an overall improvement of QoL among patients with schizophrenia. The improvement of psychiatric symptoms was found to be significantly associated with better mental health while the improvement of cognitive function was associated with better physical health.

Ann Acad Med Singap 2022;51:400-8

Keywords: Cognitive function, electroconvulsive therapy, psychiatric symptoms, quality of life, schizophrenia

INTRODUCTION

Schizophrenia is a severe mental disorder with a profound impact on patients, their families, caregivers and society. The global prevalence of lifetime schizophrenia is 0.2–0.4% without significant differences between sex and ethnicity, nor between

urban and rural environments.¹ The health and economic burden of schizophrenia is significant, given the resources required to provide services to patients and the indirect costs of productivity loss from patients and their caregivers.² Current long-term treatment strategies remain suboptimal for patients with schizophrenia. A

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CLINICAL IMPACT

What is New

- To the best of our knowledge, this is the first study in Singapore to characterise electroconvulsive therapy (ECT)-associated improvement of quality of life among patients with schizophrenia.
- ECT-induced improvement of psychiatric symptoms was found to be significantly associated with better mental health while the improvement of cognitive function was associated with better physical health.

Clinical Implications

- Awareness of the association between ECT and quality of life presents a potential opportunity for the adoption of ECT to improve the outcomes of patients.

subgroup of patients does not respond satisfactorily to existing treatment modalities and experiences symptom relapses over a prolonged period of their life.³ Therefore, the goal of clinicians and healthcare workers has increasingly shifted over time from focusing on the psychiatric symptoms of schizophrenia alone towards functional improvement and quality of life (QoL).⁴

A large amount of effort has been expended to investigate factors affecting QoL in patients with schizophrenia. Younger age, female sex, being married and lower education levels are important sociodemographic factors associated with better QoL in patients with schizophrenia.⁵ Psychiatric symptoms are consistently and negatively associated with QoL domains such as mental health and social relationships.^{6,7} For patients with schizophrenia, positive symptoms such as hallucinations and delusions cause patients to lose touch with reality and impair their daily functioning. Negative symptoms tend to persist longer than positive symptoms, and patients who exhibit significant negative symptoms have particularly poorer functioning in both mental and physical activities.⁸ Comorbid depressive symptoms in patients with schizophrenia have often been associated with impaired mental functioning, suicidal ideation and poorer subjective QoL.⁹⁻¹¹ In addition, cognitive functioning has been identified as an important determinant of QoL in patients with schizophrenia.^{12,13}

Electroconvulsive therapy (ECT) is arguably ranked the first among many effective biological methods of treatment for schizophrenia with a potential of augmenting treatment response from antipsychotics.¹⁴

Even in patients resistant to the gold standard of antipsychotic treatment (clozapine), ECT augmentation can result in up to 50% response rate in both clinical trial and real-world settings. Additionally, there have been reports of cognitive side effects induced by ECT among patients with schizophrenia,^{15,16} while some studies have demonstrated cognitive improvement.^{17,18} Despite the large amount of research into symptomatic and cognitive effects of ECT and ECT-associated improvement of QoL among patients with depression,¹⁹⁻²¹ the impact of ECT on QoL among patients with schizophrenia remains largely unexplored. In 3 studies with small samples (n=46, 30 and 15, respectively),²²⁻²⁴ participants reported an improvement of overall and subdomain QoL scores as assessed by the Quality of Life Scale (QLS);²² World Health Organization Quality of Life (WHOQOL) Scale²³ immediately after acute ECT; or a 36-item short form survey (SF-36) at 3 or 6 months after acute ECT.²⁴ However, the question of whether these improvements were associated with symptomatic and/or cognitive changes with ECT remained unclear.

The present study aimed to examine the changes in QoL with an acute course of ECT treatment, and the potential associations with changes in psychiatric symptoms and cognition in patients with schizophrenia. We hypothesised that both symptom and cognitive improvements are associated with QoL improvement.

METHODS

Study population

This was a retrospective cohort study where medical records of all patients who received ECT at our institution from July 2017 to December 2019 were included. The subgroup of patients with a diagnosis of schizophrenia or schizophrenic spectrum disorder, and with completed Montreal Cognitive Assessment (MoCA) tests before and after 6 ECT sessions, was then selected for analysis. Patients' sociodemographic and clinical characteristics, including ECT information and outcome assessment were collected. Ethical approval to conduct the study was obtained from the National Healthcare Group Domain Specific Review Board (2015/01283) with a waiver of consent for use of the registry data. Patients were referred for ECT by psychiatrists who had made clinical diagnoses based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth/Fifth Edition (DSM-IV/DSM-5), or International Statistical Classification of Diseases, 10th Revision (ICD-10) criteria. ECT was administered 2–3 times a week using a single Thymatron System IV (Somatic Systems Institute, Northampton, US). The ECT treatment algorithm used

bifrontal ECT with 1.0ms pulse width as the initial treatment modality, followed by bitemporal with 0.5ms pulse width. Right unilateral ultra-brief (0.3ms) ECT was occasionally selected for patients to reduce cognitive side effects. All patients received individual, empirically-derived seizure titration dosing for ECT and all ECTs were delivered at 1.5 times the seizure threshold.

Anaesthesia-ECT time interval, propofol dosage, succinylcholine dosage, ECT dosage and electroencephalogram (EEG) postictal suppression (PIS) score were averaged across ECT sessions 2–6 (treatment 1 was a seizure threshold titration session). PIS score was chosen as it was a quick, reliable and valid way for ECT practitioners to rate the quality of seizures in a busy clinical service as part of the Clinical Alliance and Research in Electroconvulsive (CARE) network.^{25,26} We used the Brief Psychiatric Rating Scale (BPRS) to assess changes in psychiatric symptoms. The BPRS is a Likert scale ranging from 1–7 for each item (question) where a clinician or researcher may measure psychiatric symptoms such as depression, anxiety, hallucination, psychosis and unusual behaviour. A lower BPRS score indicates a better mental condition. We used MoCA to assess cognitive functioning in the language that patients were most comfortable with (English, Chinese, Malay or Tamil). The MoCA is a cognitive screening test designed to assist healthcare professionals in detecting mild cognitive impairment, with a lower score indicating worse cognitive function. Patients also reported their QoL using EuroQol-5-Dimension (EQ-5D)-3L, the 3-level version of the EQ-5D questionnaire. EQ-5D contains 5 subdomains including mobility, self-care, usual activity, pain, and anxiety ranging from 1–3 levels, with lower scores indicating better conditions. EQ-5D utility score was calculated according to a formula provided by Luo et al. that reflects the Singapore population norms of QoL.²⁷ For both EQ-5D utility score and a visual analogue scale (VAS) score, a lower score indicated worse QoL. All assessment scales including BPRS, MoCA and EQ-5D were administered with patients 1–2 days pre-ECT and 1–2 days after the 6th ECT session.

Statistical analysis

For statistical analysis, all changes in scores were calculated as post-ECT scores minus pre-ECT scores for the 6 ECTs. We recoded the change of MoCA scores into 3 categories: (1) change of MOCA ≥ 2 was recoded into “improvement”; (2) change of MOCA ≤ -2 was recoded into “deterioration”; and (3) other values were recoded

into “no change”. EQ-5D utility scores, VAS scores, EQ-5D subdomain scores and BPRS at pre-ECT and post-ECT were compared using repetitive analysis of variance.

Generalised linear regression was conducted to examine the associations of change in BPRS and MoCA scores with the change in EQ-5D score. EQ-5D utility scores were multiplied by 100 for ease of interpretation. Covariates included in the regression model were patients’ age, sex, number of previous schizophrenia episodes, class of medication prescribed, number of failed medication trials, past ECTs, mean propofol dosage, mean ECT dosage and mean EEG PIS score. Statistical analyses were conducted using SPSS Statistics software version 22.0 (IBM Corp, Armonk, US). Statistical significance was set at $P < 0.05$.

RESULTS

Participants

A total of 132 patients diagnosed with schizophrenia or schizophrenia spectrum disorder were included in the analysis (Table 1). The mean age was 38.9 years (standard deviation 13.8) and 43.9% were female. The majority of the ECTs were bifrontal ECT ($n=117$, 90.2%). The main reason for ECT was a failure of medicines ($n=93$, 70.5%).

Quality of life and clinical outcomes

There were improvements in EQ-5D, BPRS and MoCA scores from pre-ECT to post-ECT. Among those assessments, the mean (standard error) improvements (Fig. 1A) were statistically significant for the assessment scales of EQ-5D utility score: 0.77 (0.02) to 0.89 (0.02), $P < 0.001$; EQ-5D VAS score: 66.82 (2.61) to 73.05 (1.93), $P = 0.012$; EQ-5D subdomain scores of usual activity: 1.36 (0.06) to 1.12 (0.03), $P < 0.001$; and EQ-5D of anxiety: 1.54 (0.06) to 1.27 (0.05), $P < 0.001$.

ECT induced a significant improvement in BPRS score from 51.73 (1.05) to 36.41 (0.76), $P < 0.001$; but no significant change of MoCA score of 18.08 (0.74) to 19.55 (0.71) (Fig. 1B). More patients demonstrated an improvement of MoCA score ($n=57$, 43%) than patients without change of MoCA score ($n=41$, 31%) or with MoCA deterioration ($n=34$, 26%).

Associations between change in quality of life with symptoms and cognitive outcomes

Improvements of BPRS score was significantly associated with improvements of EQ-5D utility score after adjustment for sociodemographic and clinical

Table 1. Patient sociodemographic and clinical characteristics

Patient characteristics		Mean	SD
Age, years		38.9	13.8
Average propofol dosage, mg/kg		62.6	13.8
Average succinylcholine dosage, mg/kg		26.0	4.6
Average ECT dosage, mC		213.9	156.3
Average EEG PIS score		2.5	0.3
Average number of ECT sessions		8.5	3.8
		No.	%
Female		58	43.9
Male		74	56.1
Consent for ECT by others		102	77.3
Own consent for ECT		27	20.5
Number of previous episodes	>3	86	65.2
	0	6	4.5
	1–3	38	28.8
Duration of current episode ^a	Acute (≤12 months)	125	94.7
	Chronic (>24 months)	3	2.3
	Subacute (13–24 months)	2	1.5
Medications used by patients			
Antidepressants ^a	No	91	68.9
	Yes	39	29.5
Antipsychotics other than clozapine ^a	No	9	6.8
	Yes	120	90.9
Benzodiazepines ^a	No	56	42.4
	Yes	73	55.3
Lithium ^a	No	123	93.2
	Yes	6	4.5
Anticonvulsants ^a	No	99	75.0
	Yes	30	22.7
Stimulants ^a	No	127	96.2
	Yes	1	0.8
Clozapine ^a	No	89	67.4
	Yes, with no/minimal response	19	14.4
	Yes, with partial/good response	19	14.4
Failed antipsychotics	≥3	85	64.4
	1–2	36	27.3
	None	7	5.3
ECT modalities	BF	117	90.2
	BT	9	6.8
	RUL	4	3.1
Past ECT treatment ^a	No	80	60.6
	Yes, with no/minimal response	3	2.3
	Yes, with partial/good response	46	34.8

Table 1. Patient sociodemographic and clinical characteristics (Cont'd)

Patient characteristics	Mean	SD
Main reason for ECT ^a		
Failure of medications	93	70.5
High suicide risk	1	0.8
Inadequate oral intake	1	0.8
Intolerable medication side effects	1	0.8
Patient preference	2	1.5
Previous good ECT response	24	18.2
Severe aggression/agitation	4	3.0

BF: bifrontal; BT: bitemporal; ECT: electroconvulsive therapy; EEG: electroencephalogram; PIS: postictal suppression; RUL: right unilateral; SD: standard deviation

^a Data may not add up to the total due to missing values

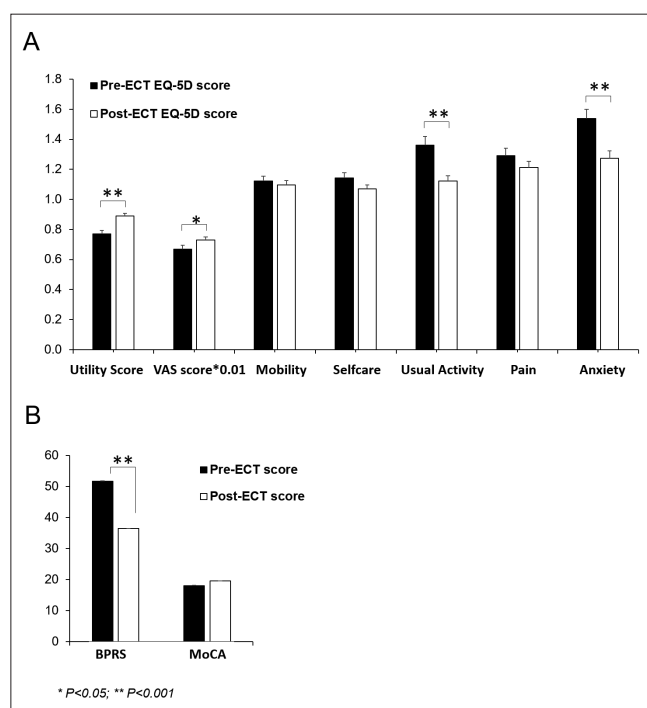


Fig. 1. EQ-5D, BPRS and MoCA assessments before and after ECT treatments. Data as mean (standard error). (A) EQ-5D. (B) BPRS and MoCA. BPRS: Brief Psychiatric Rating Scale; ECT: electroconvulsive therapy; EQ-5D: EuroQol-5-Dimension; MoCA: Montreal Cognitive Assessment; VAS: visual analogue score

characteristics (adjusted β coefficient -0.446, 95% confidence interval [CI] -0.840 to -0.052, $P=0.027$) but was not significantly associated with changes of VAS score (Table 2). Improvements of BPRS scores were also significantly associated with improvement of EQ-5D subdomains of pain (adjusted β coefficient 0.012, 95% CI 0.004 to 0.021, $P=0.005$) and anxiety (adjusted β coefficient 0.013, 95% CI 0.002 to 0.024, $P=0.024$).

Compared to patients without MoCA change, patients with improvement of MoCA scores were significantly associated with improvement of EQ-5D utility score (adjusted β coefficient 12.068, 95% CI 0.865 to 12.271,

$P=0.035$) (Table 3). Similar to BPRS, improvement of MoCA score was not associated with a change of VAS score. Improvement of MoCA scores was significantly associated with improvement of the EQ-5D subdomain score of usual activity (adjusted β coefficient -0.349, 95% CI -0.607 to -0.09, $P=0.008$).

DISCUSSION

The current study demonstrated that ECT was associated with a significant improvement of psychiatric symptoms, cognitive function and improved QoL in patients with schizophrenia or schizophrenia spectrum disorder after 6 ECT sessions 2–3 times a week. Moreover, improvement of psychiatric symptoms was significantly associated with improvement of EQ-5D utility scores, and patients' mental health that was assessed by EQ-5D subdomain scores of pain and anxiety. Improvement of cognitive function was significantly associated with patients' physical health that was assessed by EQ-5D subdomain score of usual activity.

While evidence remains scarce regarding the QoL effect of ECT in patients with schizophrenia, our data demonstrated an improvement of QoL as assessed by EQ-5D after 6 sessions of ECT. This is in agreement with 1 of the few papers documenting quick improvement in QoL of patients with schizophrenia when treated by ECT.²³ As our patients were mostly severely ill patients who were typically referred for ECT due to treatment resistance to several courses of pharmacotherapy (65.2% with previous relapse episodes and 91.7% resistant to antipsychotics) and were in need of a rapid relief of symptoms, ECT has the potential to be a rapid acting treatment option if it can be efficiently delivered to patients to improve QoL quickly.

In our study population, improvement of BPRS and MoCA scores were significantly associated with an improvement of overall utility score, but this was not the case for VAS score. A possible reason for the discrepancy is that utility score is a validated composite

Table 2. Association of ECT-induced symptomatic change with changes in quality of life (EQ-5D) scores

Dependent variable	Independent variable	Crude			After adjustment ^b		
		β coefficient	95% CI	P value	β coefficient	95% CI	P value
Change of utility score		-0.615	-1.005 to -0.226	0.002 ^a	-0.446	-0.840 to -0.052	0.027 ^a
Change of VAS score		0.037	-0.367 to 0.441	0.858	-0.095	-0.555 to 0.365	0.685
Change of mobility		0.004	-0.002 to 0.010	0.172	0.001	-0.005 to 0.006	0.836
Change of self-care	Change of BPRS score	0.002	-0.005 to 0.008	0.592	-0.001	-0.008 to 0.005	0.679
Change of usual activity		0.006	-0.004 to 0.015	0.231	0	-0.009 to 0.009	0.965
Change of pain		0.01	0.002 to 0.018	0.015 ^a	0.012	0.004 to 0.021	0.005 ^a
Change of anxiety		0.015	0.004 to 0.026	0.006 ^a	0.013	0.002 to 0.024	0.024 ^a

BPRS: Brief Psychiatric Rating Scale; CI: confidence interval; ECT: electroconvulsive therapy; EEG: electroencephalogram; EQ-5D: EuroQol-5-Dimension; VAS: visual analogue scale

^a $P < 0.05$ ^b Adjusted for age, sex, antidepressants, antipsychotics, clozapine, anticonvulsants, previous episodes, past-ECT treatment, number of failed antipsychotics, ECT-anaesthesia time interval, averaged ECT dosing, averaged EEG score and averaged propofol dosage

score calculated from EQ-5D subdomain scores and normalised to a local population's general perception of QoL, whereas VAS score is a subject self-reported score. Evidence has shown that factors such as political structure, social culture and economic conditions may affect the utility values of EQ-5D health states,^{28,29} so an evaluation on the same health problems varied for different countries/social status. For example, affective mood problems such as anxiety/depression had different effects on people from countries with different economic levels.³⁰ Therefore, utility scores could more accurately and objectively reflect the overall improvement of QoL among a population induced by ECT, while the VAS score is more self-biased due to a lack of insight into other patients with schizophrenia. In a comparison study of self-reported QoL among patients with schizophrenia with objective QoL assessed by their primary clinicians, it was found that there was moderate agreement on symptoms and function, less agreement on physical health, and little to no agreement on social relations and occupational aspects of QoL.³¹ In our early study of QoL among patients with mental disorders, we recognised that patients with psychosis lacked self-awareness of their illness and social environment. Consequently, they may develop self-protective strategies and assign meanings to their lives, leading to reporting of better subjective QoL than patients with depression. Thus, although patients with schizophrenia reported a general improvement of both the utility score and VAS score after ECT, VAS may not be a valid measurement of QoL change in the current population.

Improvement of psychiatric symptoms as assessed by the BPRS scale was associated with an improvement of mental health in the EQ-5D subdomain of depression/anxiety and pain. Improvement of cognitive function as assessed by the MoCA scale was associated with an improvement of physical health in the EQ-5D subdomain of usual activity. MoCA score displayed an association with improvement of physical health in the EQ-5D subdomain of self-care after adjustment for sociodemographics and other clinical characteristics. The discrepancy described above may be explained by the structure of the BPRS questionnaire that is designed to assess psychiatric mood including positive, negative and depression symptoms, while MoCA is a screening test for mild and severe cognitive impairment and is more relevant to physical activities.³²

In addition, we found that ECT-associated symptomatic and cognitive improvement had no association with EQ-5D mobility function. One possibility is that ECT had a limited effect on mobility. There was a statistically non-significant improvement of mobility function after

Table 3. Association of ECT-induced cognitive change with changes in quality of life (EQ-5D) scores

Dependent variable	Independent variable	Crude			After adjustment ^b		
		β coefficient	95% CI	P value	β coefficient	95% CI	P value
Change of utility score	MoCA improvement versus no change	15.029	3.567 to 26.491	0.010 ^a	12.068	0.865 to 23.271	0.035 ^a
	MoCA deterioration versus no change	7.345	-5.844 to 20.534	0.275	5.396	-7.804 to 18.597	0.423
Change of VAS score	MoCA improvement versus no change	-4.003	-15.363 to 7.357	0.490	-5.003	-17.775 to 7.768	0.443
	MoCA deterioration versus no change	5.023	-7.670 to 17.717	0.438	3.136	-11.238 to 17.511	0.669
Change of mobility	MoCA improvement versus no change	-0.028	-0.187 to 0.131	0.734	-0.039	-0.199 to 0.121	0.631
	MoCA deterioration versus no change	0.064	-0.114 to 0.241	0.484	-0.02	-0.201 to 0.162	0.830
Change of self-care	MoCA improvement versus no change	-0.125	-0.306 to 0.057	0.178	-0.163	-0.345 to 0.019	0.079
	MoCA deterioration versus no change	0.065	-0.138 to 0.267	0.532	0.144	-0.061 to 0.349	0.169
Change of usual activity	MoCA improvement versus no change	-0.328	-0.590 to -0.066	0.014 ^a	-0.349	-0.607 to -0.090	0.008 ^a
	MoCA deterioration versus no change	-0.204	-0.503 to 0.094	0.180	-0.115	-0.417 to 0.187	0.454
Change of pain	MoCA improvement versus no change	-0.053	-0.284 to 0.177	0.651	0.073	-0.170 to 0.315	0.558
	MoCA deterioration versus no change	0.032	-0.225 to 0.289	0.806	0.057	-0.217 to 0.331	0.684
Change of anxiety	MoCA improvement versus no change	-0.24	-0.558 to 0.079	0.141	-0.143	-0.461 to 0.175	0.378
	MoCA deterioration versus no change	-0.24	-0.599 to 0.119	0.191	-0.157	-0.519 to 0.205	0.396

CI: confidence interval; ECT: electroconvulsive therapy; EEG: electroencephalogram; EQ-5D: EuroQol-5-Dimension; MoCA: Montreal Cognitive Assessment; VAS: visual analogue scale

^a $P < 0.05$ ^b Adjusted for age, sex, antidepressants, antipsychotics, clozapine, anticonvulsants, past-ECT treatment, number of failed antipsychotics, ECT-anaesthesia time interval, averaged ECT dosing, averaged EEG score and averaged propofol dosage

6 sessions of ECT. Another possible explanation is the insensitivity of the 3-level EQ-5D-3L to assess changes in mobility function. The insensitivity of EQ-5D-3L subdomain assessments may also partially explain the observed relatively small effect size and model-fit testing value in the regression analysis for both BPRS score and MoCA change to predict EQ-5D change. Indeed, the 5-level EQ-5D-5L was recently introduced by the EuroQol Group to improve the instrument's sensitivity and to reduce ceiling effects.³³ However, EQ-5D-5L has not been validated in Singapore.

In Western countries, ECT is primarily used in the treatment of treatment-resistant depression. In Asia, ECT is primarily prescribed for patients with treatment-resistant schizophrenia as an augmentation to antipsychotic medicine to alleviate psychotic symptoms. Despite clear evidence of the symptomatic effectiveness of ECT in patients with schizophrenia, there remains a controversy on the cognitive side effects of ECT. Although randomised controlled trials have suggested greater transient memory impairment in treatments of ECT combined with antipsychotics when compared with antipsychotic monotherapy for Chinese patients with schizophrenia,^{16,34} ECT-induced acute cognitive impairments typically resolved within several weeks after the last ECT session.^{35,36} Our results is in agreement with recent studies demonstrating cognitive improvement after ECT in patients with schizophrenia.^{18,37} Future work with multiple cognition assessment tools and a longer follow-up period are needed. The observed ECT-induced cognitive improvement in our study could support an evidence-based indication of ECT for a potential improvement of cognition in patients with schizophrenia.

To date, the number of studies that investigated predictors of ECT efficacy in patients with schizophrenia is limited. The influence of common sociodemographics including age and sex on efficacy of ECT remains unclear. Stenmark et al. reported that no studies have found age to be a predictor of treatment response to ECT in patients with schizophrenia.³⁸ ECT was reported to be significantly more effective in female patients than in male patients suffering from schizophrenia,³⁹ although contrary evidence exists that sex does not influence the ECT dose required to achieve a response among a group of patients with schizophrenia.⁴⁰ In our study, we did not find a correlation of age and sex with ECT-induced changes of QoL. The relevance of this finding is as yet unclear. Individual variations in ECT parameters may limit generalisability of our results.

There were several limitations in our study. Our assessment data were from after a short course of ECT without further follow-up treatments. Patients may

benefit more from a longer course of ECT. The longer-term impact of ECT on QoL and the long-term associations between symptomatic/cognition function and subjective QoL remain unclear, although evidence currently exists on the diminished benefit of ECT on patients' subjective QoL after 1 year of treatment.²² Further interventions, such as maintenance ECT or other ECT augmentation to improve symptoms and cognition function could probably help to maintain QoL improvements. Additionally, other subjective or objective QoL instruments, which have a better sensitivity and clearer differential assessment of patients' mental health and physical health, may be needed to replicate our results. Finally, similar to other retrospective studies with medical records, we cannot rule out the confounding effects of other important factors that were not included in our analysis model, such as the education background of participants and the dosage of medications patients were prescribed.

CONCLUSION

In summary, ECT induced an overall and quick improvement of QoL among patients with schizophrenia. The improvement of psychiatric symptoms was found to be significantly associated with better mental health while the improvement of cognitive function was associated with better physical health. Several issues remain a concern including the utilisation of a subjective EQ-5D VAS to assess treatment outcomes and the sensitivity of EQ-5D subdomain scales. To the best of our knowledge, this is the first study in the literature to examine association of ECT-induced symptomatic improvement and cognitive function with QoL among patients with schizophrenia. Our pilot study warrants a future prospective and blinded trial to validate current observations to gather valuable information for identifying patient-reported needs for ECT and the benefits of ECT.

REFERENCES

1. Saha S, Chant D, Welham J, et al. A systematic review of the prevalence of schizophrenia. *PLoS Med* 2005;2:e141.
2. Chong SA, Lee C, Bird L, et al. A risk reduction approach for schizophrenia: the early psychosis intervention programme. *Ann Acad Med Singap* 2004;33:630-5.
3. Emsley R, Chiliza B, Asmal L, et al. The nature of relapse in schizophrenia. *BMC Psychiatry* 2013;13:50.
4. Sagayadevan V, Lee SP, Ong C, et al. Quality of life across mental disorders in psychiatric outpatients. *Ann Acad Med Singap* 2018;47:243-52.
5. Picco L, Lau YW, Pang S, et al. Predictors of general functioning and correlates of quality of life: a cross-sectional study among psychiatric outpatients. *Ann Acad Med Singap* 2018;47:3-12.

6. Bengtsson-Tops A, Hansson L. Clinical and social needs of schizophrenic outpatients living in the community: the relationship between needs and subjective quality of life. *Soc Psychiatry Psychiatr Epidemiol* 1999;34:513-8.
7. Hansson L, Sandlund M, Bengtsson-Tops A, et al. The relationship of needs and quality of life in persons with schizophrenia living in the community. A Nordic multi-center study. *Nord J Psychiatry* 2003;57:5-11.
8. Lee J, Lee TS, Remington G. Schizophrenia: no health without physical health. *Ann Acad Med Singap* 2014;43:248-9.
9. Fenton WS. Depression, suicide, and suicide prevention in schizophrenia. *Suicide Life Threat Behav* 2000;30:34-49.
10. Reine G, Lancon C, Di Tucci S, et al. Depression and subjective quality of life in chronic phase schizophrenic patients. *Acta Psychiatr Scand* 2003;108:297-303.
11. Roy A, Thompson R, Kennedy S. Depression in chronic schizophrenia. *Br J Psychiatry* 1983;142:465-70.
12. Ueoka Y, Tomotake M, Tanaka T, et al. Quality of life and cognitive dysfunction in people with schizophrenia. *Prog Neuropsychopharmacol Biol Psychiatry* 2011;35:53-9.
13. Woon PS, Chia MY, Chan WY, et al. Neurocognitive, clinical and functional correlates of subjective quality of life in Asian outpatients with schizophrenia. *Prog Neuropsychopharmacol Biol Psychiatry* 2010;34:463-8.
14. Tor PC, Mok YM. Psychiatric neurostimulation in Singapore. *Ann Acad Med Singap* 2016;45:270-2.
15. Petrides G, Malur C, Braga RJ, et al. Electroconvulsive therapy augmentation in clozapine-resistant schizophrenia: a prospective, randomized study. *Am J Psychiatry* 2015;172:52-8.
16. Wang W, Pu C, Jiang J, et al. Efficacy and safety of treating patients with refractory schizophrenia with antipsychotic medication and adjunctive electroconvulsive therapy: a systematic review and meta-analysis. *Shanghai Arch Psychiatry* 2015;27:206-19.
17. Tor PC, Ying J, Ho NF, et al. Effectiveness of electroconvulsive therapy and associated cognitive change in schizophrenia: a naturalistic, comparative study of treating schizophrenia with electroconvulsive therapy. *J ECT* 2017;33:272-7.
18. Vuksan Ćusa B, Klepac N, Jakšić N, et al. The effects of electroconvulsive therapy augmentation of antipsychotic treatment on cognitive functions in patients with treatment-resistant schizophrenia. *J ECT* 2018;34:31-4.
19. Giacobbe P, Rakita U, Penner-Goeke K, et al. Improvements in health-related quality of life with electroconvulsive therapy: A meta-analysis. *J ECT* 2018;34:87-94.
20. Güney P, Ekman CJ, Hammar Å, et al. Electroconvulsive therapy in depression: improvement in quality of life depending on age and sex. *J ECT* 2020;36:242-6.
21. Huang CJ, Huang YH, Lin CH. Factors related to the changes in quality of life for patients with depression after an acute course of electroconvulsive therapy. *J ECT* 2017;33:126-33.
22. Chanpattana W, Kramer BA. Acute and maintenance ECT with flupenthixol in refractory schizophrenia: sustained improvements in psychopathology, quality of life, and social outcomes. *Schizophr Res* 2003;63:189-93.
23. Garg R, Chavan BS, Arun P. Quality of life after electroconvulsive therapy in persons with treatment resistant schizophrenia. *Indian J Med Res* 2011;133:641-4.
24. Kumar S, Saldanha D, Chaudhury S. Efficacy of electroconvulsive therapy and its impact on quality of life of patient: A longitudinal study. *Medical Journal of Dr DY Patil Vidyapeeth* 2020;13:373-8.
25. Francis-Taylor R, Ophel G, Martin D, et al. The ictal EEG in ECT: A systematic review of the relationships between ictal features, ECT technique, seizure threshold and outcomes. *Brain Stimul* 2020;13:1644-54.
26. Nobler MS, Sackeim HA, Solomou M, et al. EEG manifestations during ECT: effects of electrode placement and stimulus intensity. *Biol Psychiatry* 1993;34:321-30.
27. Luo N, Wa P, Thumboo J, et al. Valuation of EQ-5D-3L health states in Singapore: modelling of time trade-off values for 80 empirically observed health states. *Pharmacoeconomics* 2014;32:495-507.
28. Galante J, Augustovski F, Colantonio L, et al. Estimation and comparison of EQ-5D health states' utility weights for pneumococcal and human papillomavirus diseases in Argentina, Chile, and the United Kingdom. *Value Health* 2011;14:S60-4.
29. Kiadaliri AA, Eliasson B, Gerdtham UG. Does the choice of EQ-5D tariff matter? A comparison of the Swedish EQ-5D-3L index score with UK, US, Germany and Denmark among type 2 diabetes patients. *Health Qual Life Outcomes* 2015;13:145.
30. Freeman A, Tyrovolas S, Koyanagi A, et al. The role of socioeconomic status in depression: results from the COURAGE (aging survey in Europe). *BMC Public Health* 2016;16:1098.
31. Sainfort F, Becker M, Diamond R. Judgments of quality of life of individuals with severe mental disorders: patient self-report versus provider perspectives. *Am J Psychiatry* 1996;153:497-502.
32. Innocenti A, Cammisuli DM, Sgromo D, et al. Lifestyle, physical activity and cognitive functions: the impact on the scores of montreal cognitive assessment (MoCa). *Arch Ital Biol* 2017;155:25-32.
33. Herdman M, Gudex C, Lloyd A, et al. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Qual Life Res* 2011;20:1727-36.
34. Zheng W, Tong G, Ungvari GS, et al. Memory impairment following electroconvulsive therapy in chinese patients with schizophrenia: meta-analysis of randomized controlled trials. *Perspect Psychiatr Care* 2018;54:107-14.
35. Kim HS, Kim SH, Lee NY, et al. Effectiveness of electroconvulsive therapy augmentation on clozapine-resistant schizophrenia. *Psychiatry Investig* 2017;14:58-62.
36. Kumar CN, Phutane VH, Thirthalli J, et al. Resolution of cognitive adverse effects of electroconvulsive therapy in persons with schizophrenia: a prospective study. *Indian J Psychol Med* 2017;39:488-94.
37. Jiang Y, Zhang H, Wang Z, et al. Effects of modified electroconvulsive therapy on the cognitive function and blood parameters in female patients with schizophrenia. *Int J Clin Exp Med* 2015;8:1349-55.
38. Stenmark L, Popielek K, Bodén R, et al. predictors of treatment response to electroconvulsive therapy in schizophrenia—A nationwide registry-based study. *Schizophrenia Bulletin Open* 2020;1:1-10.
39. Bloch Y, Ratzoni G, Sobol D, et al. Gender differences in electroconvulsive therapy: a retrospective chart review. *J Affect Disord* 2005;84:99-102.
40. Manohar H, Subramanian K, Menon V, et al. Does gender influence electroconvulsive therapy sessions required across psychiatric diagnoses? A 5-year experience from a single center. *J Neurosci Rural Pract* 2017;8:427-30.