

Evaluate the effect of Electroconvulsive therapy in treatment of children with depression: a systematic review and meta-analysis

Mahdi Talebi¹, Jalal Nourmohammadi², Bashir Emami³, Mahdieh Hasanzadehmoghadam⁴, Dorrin Nikbakht^{5*}

1-Department of Community and Family Medicine, Faculty of Medicine, Mashhad University of Medical Sciences, Iran/Email: Talebimh@mums.ac.ir

2-Master of Nursing, Pediatrics Department, Shahid Hasheminejad Medical Research Center, Mashhad University of Medical Sciences, Iran /Email: Jalal_Nurse@yahoo.com/Orcid:0000-0002-6071-3040

3- Master of Nursing, Management Department, Imam Khomeini Medical Research Center, Kermanshah University of Medical Sciences, Iran/Email: Emamibashir@gmail.com

4- Master of Nursing, Management Department, Mashhad University of Medical Sciences, Iran/Email: Mahdiehhasanzadeh0@gmail.com

5-Instructor of Operating Room, School of Allied Medical Sciences, Alborz University of Medical Sciences, Iran **Correspond Email: Dorrinblue@gmail.com**

Abstract

Background and aim: Due to the lack of evidence on the effectiveness of Electroconvulsive therapy in the treatment of children with depression and the lack of meta-analysis studies in this area in recent years and the consensus of previous studies, the present study aimed to evaluate the effectiveness of Electroconvulsive therapy in the treatment of depressive disorder in children.

Method: all articles published in international databases such as PubMed, Scopus, Science Direct, Embase between January 2000 and March 2022 included. Google Scholar search engine was used; Used PICO strategy to answer the research questions. Data analysis was performed using STATA.V16 software.

Result: In the initial search, 481 studies were identified; full text of 90 articles was reviewed; finally eight articles entered the analysis. Response rate of depression was 71% (ES; 95 CI: 31-100%). Percentage of Cognitive impairment and Seizure related was 45% (ES; 95 CI: 6-85%) and 17% (ES; 95 CI: 0-56%). Mean differences between Pre-treatment and post-treatment was -2.30 (MD; 95 CI (-2.46, -2.13), p=0.00).

Conclusion: It should be noted that children should first undergo medication and psychotherapy, and after resistance to treatment, Electroconvulsive therapy should be used; In general, Electroconvulsive therapy is effective in the treatment process.

Key words: Electroconvulsive therapy, children, depression, mood disorders, adolescents

Introduction

According to reports, the prevalence of diseases related to mental disorders in children has increased significantly in recent years(1). About 47 million children have at least one

depressive disorder(2). Statistics show that in children under the age of 18, the one-year prevalence of mental disorders is 3 to 5 percent worldwide(3). Suicide between the ages of 10 and 24 is the cause of death caused by depression, and depression should be diagnosed and treated legally(4). Medication and psychotherapy are used to treat moderate to severe depression, especially in children(5). However, choosing the right treatment option is very challenging and many factors must be considered to choose the best option(6). According to the available evidence, about 50 to 60 percent of children do not respond to medication and psychotherapy(7). Methods such as electroconvulsive therapy (ECT) are used in adults who are resistant to depression; there are few studies in children and there is not enough evidence to confirm the results(8, 9). However, in adults, ECT is a very appropriate treatment method and its positive effects have been reported and it can be used in a variety of mental disorders(10). According to available reports, about 60 to 80% of adult patients with depression who are resistant to medication have good results with ECT(11, 12). The use of ECT in children has received very little attention; because there is little knowledge about the impact of ECT on treatment outcomes in cocaine, there are legal limitations; however, based on the evidence, ECT is a safe treatment. According to a study, ECT is much safer and more effective in treating adult mood disorders than children(10, 13). There is not enough evidence that ECT not used in children(14). Three indications for the use of ECT in the treatment of pediatric mood disorders have been reported (15):

- 1- Severe major depressive disorder and other mood disorders must be confirmed.
- 2- The symptoms are so severe that they threaten the person's life.
- 3- The patient should not respond properly to at least two treatment methods (medication and psychotherapy).

Complications reported include tumors of the central nervous system and acute myocardial infarction, which have been considered as partial contraindications to ECT (15). Review studies have been conducted on the subject of research on whether ECT can be used in adolescents(16, 17). These are old studies, and the response rate for ECT use in children with depression is 63 percent(18). Due to the lack of evidence on the effectiveness of ECT in the treatment of children with depression and the lack of meta-analysis studies in this area in recent years and the consensus of previous studies, the present study aimed to evaluate the effectiveness of ECT in the treatment of depressive disorder in children.

Method

Search strategy

Present study is based on PRISMA guidelines(19), all published studies in international databases such as PubMed, Scopus, Science Direct, Embase on the effect of ECT on childhood depression were reviewed between January 2000 and March 2022. Google Scholar search engine was used. Used PICO strategy to answer the research questions (Table1).

The following keywords were used to search:

(((((("Electroconvulsive Therapy"[Mesh]) OR ("Electroconvulsive Therapy/adverse effects"[Mesh] OR "Electroconvulsive Therapy/analysis"[Mesh] OR "Electroconvulsive Therapy/classification"[Mesh] OR "Electroconvulsive Therapy/complications"[Mesh] OR "Electroconvulsive Therapy/drug effects"[Mesh] OR "Electroconvulsive Therapy/epidemiology"[Mesh] OR "Electroconvulsive Therapy/etiology"[Mesh] OR "Electroconvulsive Therapy/history"[Mesh] OR "Electroconvulsive Therapy/injuries"[Mesh] OR "Electroconvulsive Therapy/methods"[Mesh] OR "Electroconvulsive Therapy/mortality"[Mesh] OR "Electroconvulsive Therapy/psychology"[Mesh] OR "Electroconvulsive Therapy/statistics and numerical data"[Mesh] OR "Electroconvulsive Therapy/therapy"[Mesh])) AND ("Depression"[Mesh] OR "Depressive Disorder"[Mesh] OR "Long-Term Synaptic Depression"[Mesh] OR "Depressive Disorder, Treatment-Resistant"[Mesh] OR "Bipolar Disorder"[Mesh])) OR ("Depression/classification"[Mesh] OR "Depression/complications"[Mesh] OR "Depression/diagnosis"[Mesh] OR "Depression/drug effects"[Mesh] OR "Depression/drug therapy"[Mesh] OR "Depression/mortality"[Mesh] OR "Depression/psychology"[Mesh] OR "Depression/rehabilitation"[Mesh] OR "Depression/statistics and numerical data"[Mesh] OR "Depression/therapy"[Mesh])) OR ("Depressive Disorder/classification"[Mesh] OR "Depressive Disorder/complications"[Mesh] OR "Depressive Disorder/diagnosis"[Mesh] OR "Depressive Disorder/diet therapy"[Mesh] OR "Depressive Disorder/drug therapy"[Mesh] OR "Depressive Disorder/mortality"[Mesh] OR "Depressive Disorder/psychology"[Mesh] OR "Depressive Disorder/rehabilitation"[Mesh] OR "Depressive Disorder/statistics and numerical data"[Mesh] OR "Depressive Disorder/therapy"[Mesh])) OR "Mood Disorders"[Mesh])) AND ("Child"[Mesh] OR "Adult Children"[Mesh] OR "Only Child"[Mesh]).

Inclusion criteria

The selection criteria were RCT studies, observational studies, cohort studies, case reports, case-control and cross-sectional studies that full text of the article was available; age range of all children was under 18 years; Resistant depression. Studies other than these study design were excluded; only articles published in English were selected.

Table1. PICO strategy

PICO strategy	Description
P	Population: children with depression
I	Intervention: of Electroconvulsive therapy
C	Comparison: before and after/ control group
O	Outcome: clinical outcome

Statistical analysis

The collected data were analyzed using STATA.v16 software. I^2 index test was used to evaluate the level of heterogeneity ($I^2 < 50\%$ = low levels, $50 < I^2 < 75\%$ = moderate and $I^2 > 75\%$ = high levels). 95% confidence interval on difference between mean were done with fixed

effect model and in-variance method and effect size with random effect model and REML method.

Result

First search for articles in databases, 481 articles were identified. After importing all articles into EndNote.X8 software, duplicate articles were deleted (n=53). 428 article entered and examined in second stage. At this stage, while reviewing the titles and abstracts of articles, 338 articles unrelated to the present study were excluded. In the third stage, the full text of 90 articles was reviewed. Eventually eight articles that were published between January 2000 and March 2022 and met the inclusion criteria, entered the analysis.

Characteristics

The number of children with depression who were treated with ECT were 166 boys and 223 girls, a total 389 and Mean age was 16.71 ± 1.8 years with an age range of 7 to 18 years. Demographic and clinical characteristics of participants in selected studies showed in Table 2.

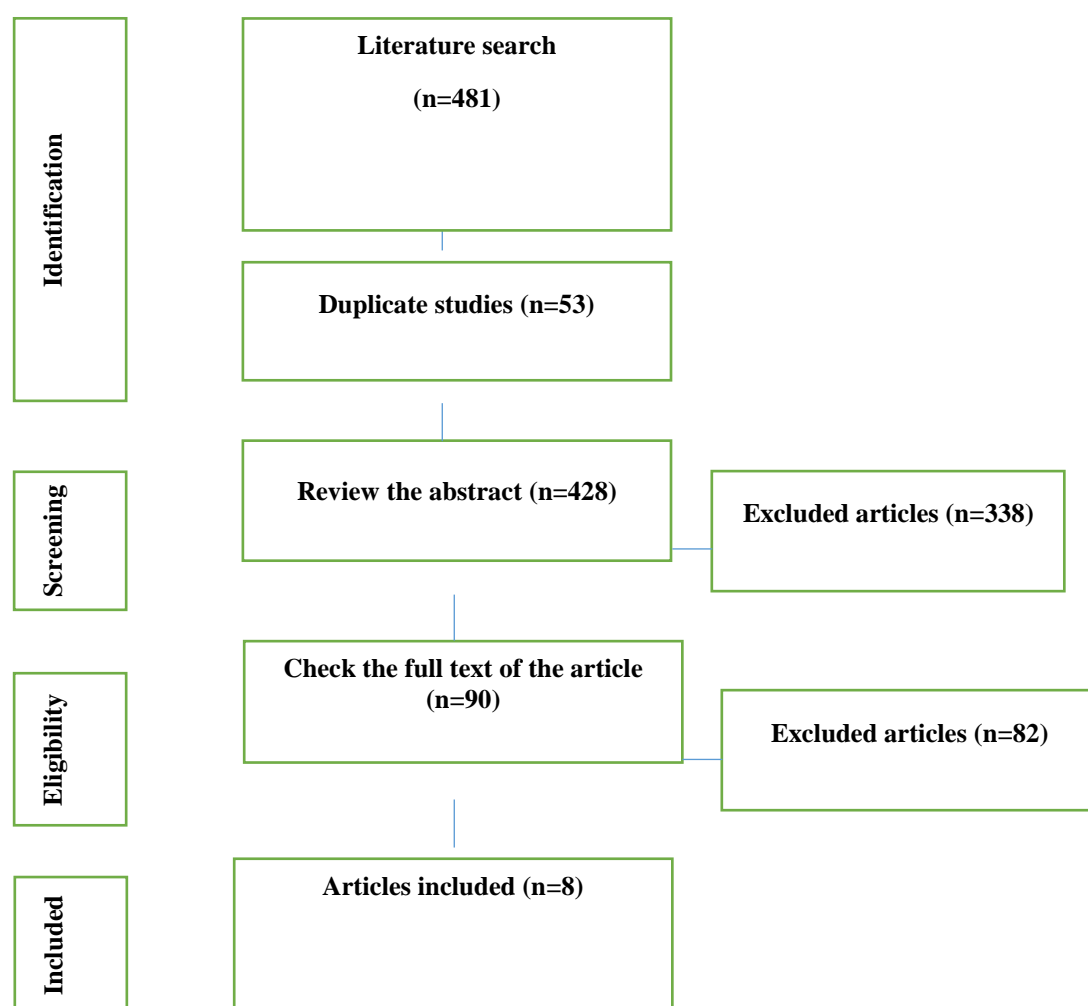


Figure 1. PRISMA flowcharts

Response rate at Depression measure

Response rate of depression was 71% (ES; 95 CI: 31-100%) ($I^2=0.00\%$; $p=1.00$) (Figure2).

Percentage of side effects***Subgroup meta-analysis:***

Percentage of Cognitive impairment was 45% (ES; 95 CI: 6-85%) ($I^2=0.00\%$; $p=0.97$). Percentage of Seizure related was 17% (ES; 95 CI: 0-56%) ($I^2=0.00\%$; $p=1.00$). Percentage of headache was 38% (ES; 95 CI: 0-78%) ($I^2=0.00\%$; $p=0.97$). Percentage of nausea/vomiting was 11% (ES; 95 CI: 0-67%) ($I^2=0.00\%$; $p=0.97$). Percentage of muscle soreness was 33% (ES; 95 CI: 0-89%) ($I^2=0.00\%$; $p=0.67$). Percentage of Fatigue was 62% (ES; 95 CI: 0-63%) (Figure3). Overall Percentage of side effects was 31% (ES; 95 CI: 11-51%) ($I^2=0.00\%$; $p=0.78$). According to test of group differences, there was no differences between Percentage of side effects ($p=0.88$).

Effectiveness of ECT in the treatment of depressive disorder in children

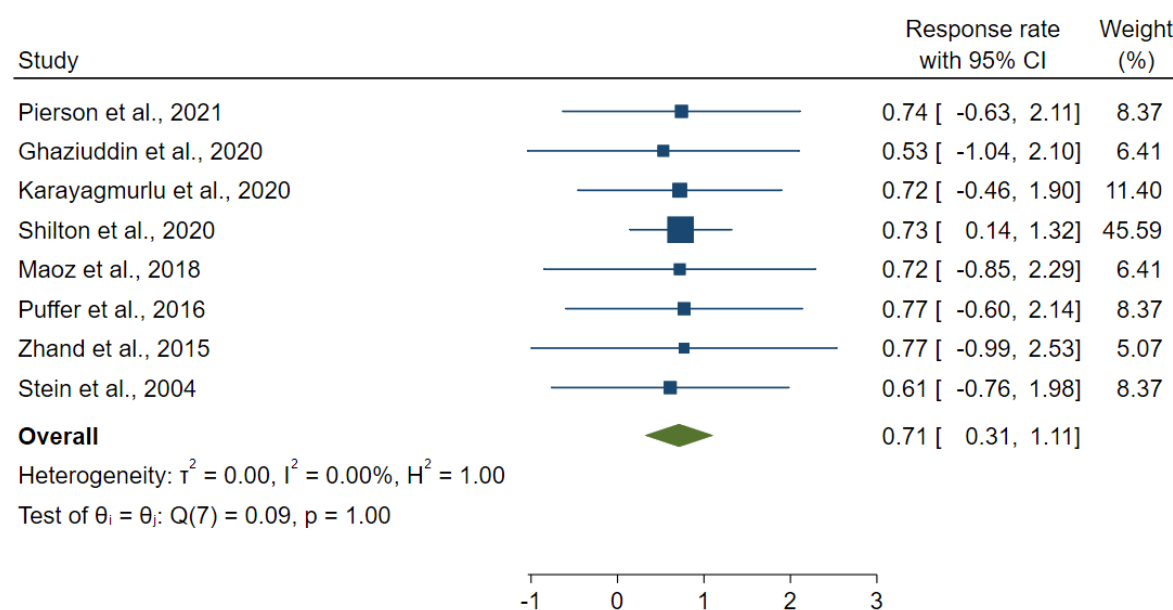
Mean differences between Pre-treatment and post-treatment was -2.30 (MD; 95 CI (-2.46, -2.13), $p=0.00$) ($I^2=96.6\%$; $p=0.00$). According to figure 4, significant change observed between groups. However, ECT is effective in treating depressive disorder in children.

Table2. Demographic and clinical characteristics of participants in selected studies

Study. Years	Number of patients		Range of age	Age (mean \pm SD)	Number of ECT treatments Mean \pm SD	electrode placement type	Measuring tools
	boy	girls					
Pierson et al., 2021 (13)	58	49	10-18	16.5 \pm 1.5	10.5 \pm 1.4	85%, Bifrontal 12%, bitemporal 2%, mixed 1%, unilateral	CGI-I
Ghaziuddin et al., 2020 (4)	24	30	NR	15.8 \pm 1.5	13.7 \pm 4.9	93%, Bilateral 2%, unilateral 6%, mixed	CGI-I
Karayagmurlu et al., 2020 (20)	30	32	7-12	17.11 \pm 1.04	7.84 \pm 4.8	100%, Bitemporal	CGI-I
Shilton et al., 2020 (21)	0	30	11.5-18	16.14 \pm 1.6	16.7 \pm 6.8	100%, Bitemporal	CGI-I
Maoz et al., 2018 (22)	9	27	12-18	17.1 \pm 1.9	24.4 \pm 14.2	69%, Unilateral 25% bilateral	CGI-I
Puffer et al., 2016 (23)	22	29	12-18	16.8 \pm 1.6	9.3 \pm 3.9	71%, Bitemporal 22%, right unilateral 6%, bitemporal plus right unilateral 2% bifrontal	CGI-I

Zhand et al., 2015 (24)	8	5	15–18	16.84±0.8	14±4.5	62%, Right unilateral with D'Elia placement 38.4%, bitemporal	CGI-I
Stein et al., 2004 (25)	15	21	13–18	17.56±1.9	17.03±5.9	88.9%, Bifrontotemporal 11.1%, unilateral nondominant (D'Elia) to bilateral	CGI-I

SD: Standard deviation; CGI-I: Clinical Global Impression



Random-effects REML model

Figure 2. Forest plot showed Response rate at Depression measure

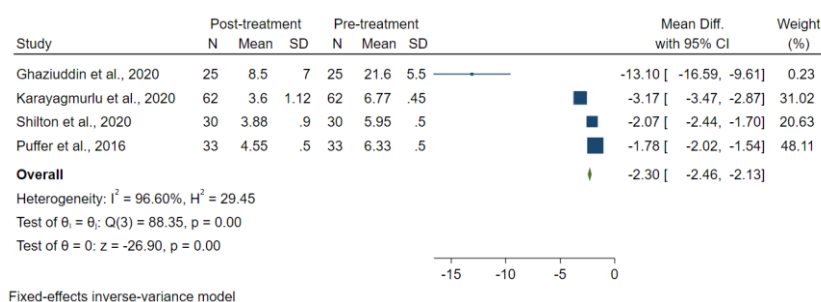


Figure 4. Forest plot showed Effectiveness of ECT in the treatment of depressive disorder in children

Discussion

The aim of this study was to evaluate the effectiveness and response to ECT treatment in children with depression who were resistant to treatment; Side effects of ECT were also

evaluated. From the searches conducted from 2000 to March 2022, 8 studies with inclusion criteria were found, which were collected and reviewed by meta-analysis studies. Older studies were very few and over the last 5 years studies on the subject of research have increased. Heterogeneity between studies was very low and the results of this study can provide sufficient evidence.

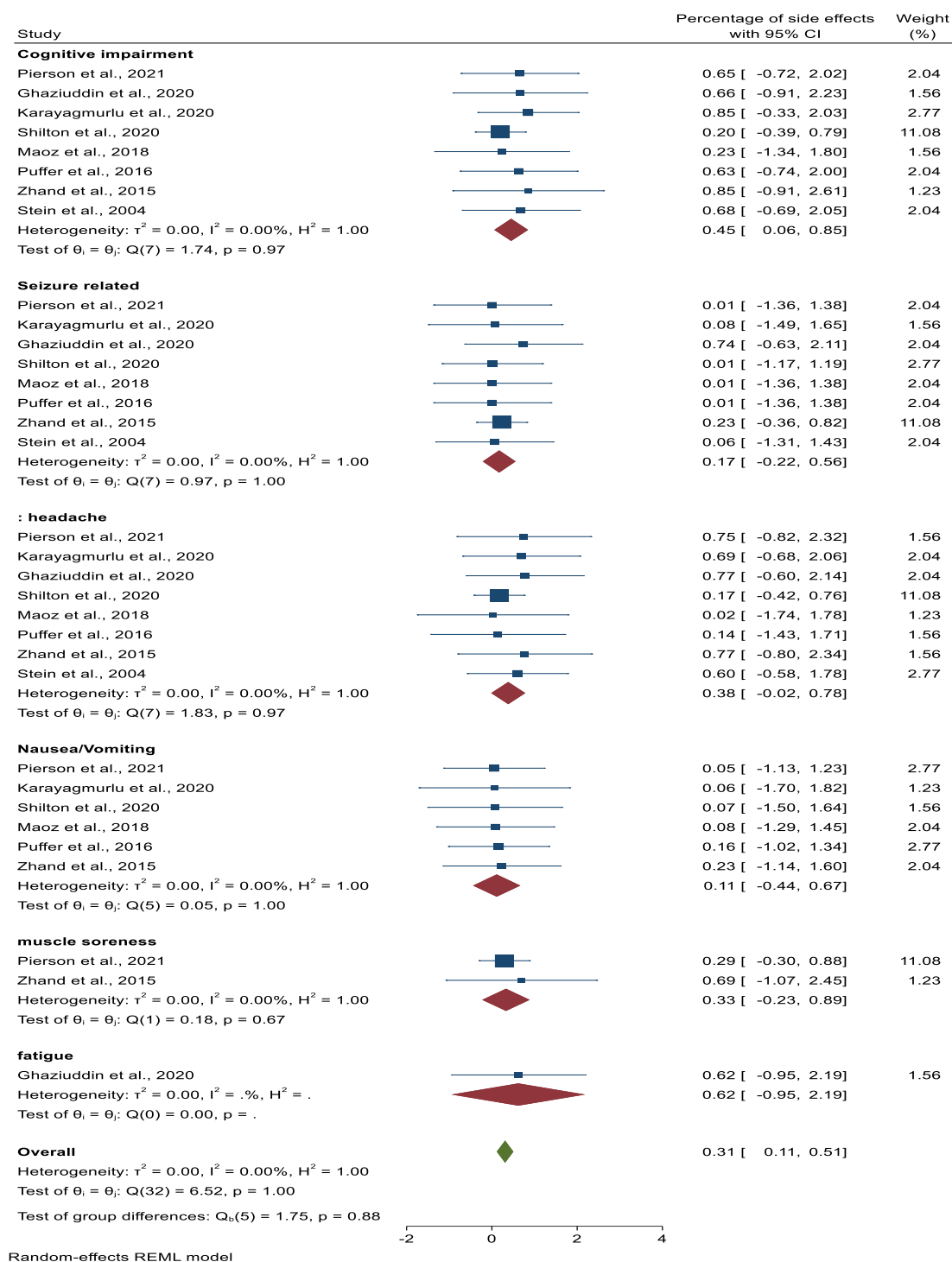


Figure 3. Forest plot showed Percentage of side effects

However, high heterogeneity was observed in the mean changes in depression score before and after treatment. According to the meta-analysis, all 8 studies reported a response rate, and the overall response rate for ECT was 71%, ranging from 31% to 100%. Similar findings have been reported in previous studies examining the effects of ECT in children(26, 27); It is noteworthy that the findings of studies in the adult population are similar(11, 12, 28). Castaneda-Ramirez et al., 2020 in a Systematic review reported the overall response rate for ECT in children is 71%, which is consistent with the present meta-analysis. In all studies, CGI was the most reliable and common tool for measuring response rates. Side effects reported in the studies included headache, nausea, vomiting, muscle aches, and fatigue. Present meta-analysis showed Percentage of Cognitive impairment, Seizure related, headache, nausea/vomiting, muscle soreness and Fatigue were 45%, 17%, 38%, 11%, 33% and 62%, respectively. However, the amount of side effects reported in the studies was very different and only one study reported fatigue; other complications were not included in the meta-analysis; Therefore, reporting the actual incidence of side effects seems difficult. In any case, we can refer to the findings of the present study because we have examined the common side effects. According to studies, cognitive side effects after ECT are short-lived and resolve over time. Studies have shown that depression affects the brain in growing children, and the use of ECT can be considered a neuroprotector(29, 30). Seizures and nausea/vomiting were complications that had a much lower incidence rate than other complications. None of the studies reported post-ECT mortality in children, and a search of databases found no studies that looked at mortality. Therefore, current evidence suggests that there is no risk of mortality in children with depression if ECT is used properly.

Conclusion

Eight studies on the subject were found that after meta-analysis it was found that Response rate at Depression measure in children is 71%, also ECT can be very effective in treating depression in children; It should be noted that children should first undergo medication and psychotherapy, and after resistance to treatment, ECT should be used; In general, ECT is effective in the treatment process. Randomized clinical trial studies not found, it is suggested to conduct Randomized clinical trial studies with high sample size and follow-up period to provide stronger evidence regarding the effectiveness of ECT. Also, more studies should be done in the age group under 18 years.

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