Original Article

The effects of early rehabilitation in high-risk infants with brain injury: a systematic review and meta-analysis

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Background: A meta-analysis was conducted to examine the effects of early rehabilitation on the incidence of sequelae and associated disabilities in high-risk infants with brain injury.

Methods: English and Chinese medical databases including PubMed, Web of Science and Embase, China National Knowledge Infrastructure (CNKI) and Wanfang database, were search from 2005 to 2020 for relevant studies related to rehabilitation in high-risk children with brain injury. Patients who received basic treatment combined with early rehabilitation after brain injury formed the treatment group, and infants who only received basic treatment were considered the control group. The data were statistically analyzed using Stata16.0 analysis software.

Results: A total of 13 studies were included, involving 1,930 patients. Meta-analysis showed that the effective rate of early rehabilitation in the treatment of high-risk children with brain injury was significantly higher than that of the control group without early rehabilitation [odds ratio (OR) =4.98; 95% confidence interval (CI): 3.66 to 6.79]. Early rehabilitation also significantly improved patient adaptability [standardized mean difference (SMD) =0.632; 95% CI: 0.496 to 0.769], gross motor skills (SMD =0.971; 95% CI: 0.705 to 1.236), fine motor skills (SMD =0.904; 95% CI: 0.670 to 1.138), language skills (SMD =0.757; 95% CI: 0.483 to 1.030), and personal-social scores (SMD =0.786; 95% CI: 0.648 to 0.925) compared to patients in the control group. The mental development index (MDI) score (SMD =1.194; 95% CI: 0.839 to 1.549) and the psychomotor development index (PDI) score (SMD =0.973; 95% CI: 0.661 to 1.286) were significantly higher in the treatment group compared to the control group.

Discussion: Early rehabilitation therapy can improve the neuromotor and intellectual development in high-risk infants with brain injury.

Keywords: Brain injury; high-risk children; early rehabilitation treatment; behavioral development; meta-analysis

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Introduction

Neonates in the fetal, delivery, or neonatal periods may be exposed to high-risk factors that lead to brain injury. Such risk factors include premature delivery, low birth weight, perinatal respiratory distress, asphyxia, hypoxic-ischemic encephalopathy, intracranial hemorrhage, hyperbilirubinemia, and pathological jaundice (1). Neonates with brain injury are also at high risk of neurodevelopmental disorders such as cerebral palsy (CP). Statistical analyses have demonstrated that CP is closely related to prenatal or perinatal brain injury, and is the most common physical disability in children. The prevalence in high-income countries is 2.1% (2), and slightly lower in Australia and Europe. While the exact incidence of CP in low-income and middle-income countries is unclear, it appears to be higher than that observed in high-income countries (3). Due to the associated severe physical disabilities and the high risk of infectious diseases in neonates with brain injury, early intervention is crucial.

Rehabilitation experts generally believe that early rehabilitation treatment can be started a few days after the patient's neurological symptoms no longer progress (4). Early rehabilitation therapy is aimed at the plasticity of the brain. If applied during the early "critical period", nervous system functions can change their activity in response to intrinsic or extrinsic stimuli by reorganizing its structure to improve neurological function (5). A large number of studies have shown that early rehabilitation can significantly affect and improve the neural development of infants with congenital brain injury (6), promoting the recovery of motor function, improving intellectual ability, and reducing the incidence of CP and mental retardation. However, the efficacy of early rehabilitation must be systematically and comprehensively evaluated. This meta-analysis assessed the clinical efficacy of early rehabilitation in high-risk children with brain injury. The parameters of interest were effective rate, adaptability, gross and fine motor function, language ability, and personal-social skills. Evaluation indexes included five neurodevelopmental index scores, the intellectual development index, and the motor development index.

We present the following article in accordance with the PRISMA reporting checklist (available at https://dx.doi.org/10.21037/tp-21-380).

Methods

Literature retrieval method

The PubMed, Web of Science, Embase, China National Knowledge Infrastructure (CNKI), and Wanfang databases were searched for relevant literatures published between 2005 and 2020. The search terms applied were as follows: ("high risk infants" or "birth" or "prenatal infants" or "brain injury") and ("brain injury") and ("early rehabilitation intervention" or "rehabilitation intervention" or "treat"). Finally, relevant full-text articles were screened according to the inclusion and exclusion criteria. No language restrictions were applied to the search.

Inclusion and exclusion criteria for the literature search

The selection of literature was based on the Population, Intervention, Comparison, Outcomes and Study (PICOS) framework. The study population included participants who were clearly diagnosed as high-risk children with brain injury. In the treatment group, high-risk children with brain injury received basic treatment combined with early rehabilitation treatment. In the control group, parents refused rehabilitation treatment for their children and these patients received only basic treatment. The outcome measures included effective rate, adaptability, gross and fine motor function, language ability, and personal-social skills. Indicators included five neurodevelopmental scores, an intellectual development index, and a motor development index. Literature reporting randomized or semi-randomized controlled studies, or retrospective clinical studies were included.

The following exclusion criteria were applied: (I) studies in which patients were not diagnosed as high-risk children or the intervention group was not administered basic treatment; (II) literature containing review articles; (III) literature containing duplicate studies; (IV) reports containing incomplete data, design defects, or unclear conclusions; and (V) studies involving animal experiments.

Literature quality assessment and data extraction

The Cochrane collaboration tool was used to assess the risk of bias in the included literature (7). The six aspects examined were random allocation method; allocation scheme hiding; blinding method; complete outcome data; selective report; and other biases. Two researchers independently conducted the literature evaluation and data extraction. Any disagreements were resolved via discussion and consultation with a third researcher. Data from the included articles, including basic information, research method, research subjects, sample size, indexes, and conclusions, were systematically collated into an electronic database.

Statistical analysis

Statistical analyses were performed with Stata16.0 analysis software. The heterogeneity of the included studies was assessed using Cochran's Q test and I^2 statistics. When $P<0.05$ and $I^2>50\%$, the random effects model was used for meta-analysis, otherwise, the fixed effects model was used. The results of categorical variables were reported

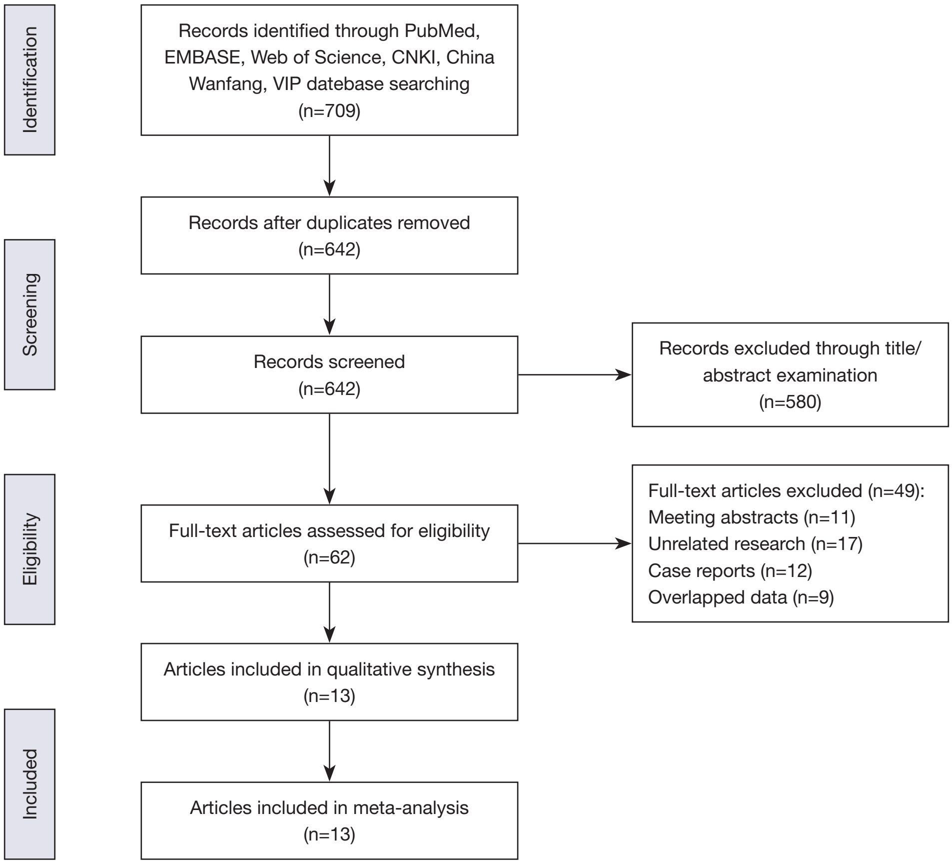


Figure 1 Flow chart of the literature screening process.

as odds ratio (OR) and 95% confidence interval (CI), while the results of numerical variables were reported as standardized mean difference (SMD) and 95% CI. P<0.05 was considered statistically significant. Sensitivity analysis was used to evaluate the reliability of the meta-analysis. Funnel plots were used to analyze publication bias.

Results

Selection of literature

After screening the databases, a total of 709 documents were retrieved. Review of the title, summary, and full text articles resulted in the exclusion of 647 unqualified documents and finally, 62 articles were selected. Further review of the full text articles excluded 49 documents such as conference summaries, case reports, and duplicate literature. Finally, 13 studies met the selection criteria (8-20) and were included in this meta-analysis (*Figure 1*). All 13 reports were from the Chinese literature. There was a total of 1,930 patients, including 1,000 cases of early rehabilitation treatment in the experimental group and 930 cases in the control group. The characteristics of the included literature are shown in *Table 1*.

Results of the meta-analysis

Effective rate

All 13 studies documented the effective rate of the treatment group and the control group. The data showed that the heterogeneity of each study was small (I^2=0.0%, P=0.885), and the fixed effects model was used. The results of the meta-analysis showed that the effective rate in infants receiving early rehabilitation was significantly higher than that in patients without early rehabilitation (OR =4.98; 95% CI: 3.66 to 6.79; P<0.001; *Figure 2*).

Neurodevelopmental indicators

Of the 13 included references, 5 articles (8,11,13,16,17)

Table 1 The basic characteristics of the included literature

No.	First author	Year	Study timeframe (year.month)	No. patients (treatment/ control)	Follow-up time (months)	Gender ratio (M/F)	Study design	Evaluation criteria	Outcomes measured
1	Cao W (8)	2008	2005.1–2006.1	195/176	12	238/128	Retrospective	Gesell	①+②+③+④+⑤
2	Huang Y (9)	2007	2002.3–2005.10	46/46	12	57/35	Retrospective	CDCC	⑥+⑦
3	Su Y (10)	2014	2013.5–2014.5	85/70	12	83/72	Retrospective	Gesell	NR
4	Gao J (11)	2014	2011.1–2013.1	15/15	6	18/12	Retrospective	Gesell	①+②+③+④+⑤
5	Qu X (12)	2013	2010.1–2012.6	53/44	24	67/30	Retrospective	CDCC	⑥+⑦
6	Ma J (13)	2020	2017.1–2019.2	75/75	12	77/73	Retrospective	Gesell + CDCC	①+②+③+④+ ⑤+⑥+⑦
7	Peng H (14)	2017	2013–2015	100/100	18	132/68	Retrospective	Gesell	NR
8	Yang C (15)	2014	2009.1–2012.7	85/76	12	111/50	Retrospective	CDCC	⑥+⑦
9	Chen X (16)	2010	2008.2–2009.12	118/100	12	123/95	Retrospective	Gesell	①+②+③+④+⑤
10	Zhang L (17)	2018	2016.12–2018.2	52/52	NR	58/46	Retrospective	Gesell	①+②+③+④+⑤
11	Liu Z (18)	2018	2016.4–2017.4	72/72	NR	73/71	Retrospective	CDCC	⑥+⑦
12	Ding Y (19)	2015	2012.1–2012.6	30/30	NR	NR	Retrospective	CDCC	⑥+⑦
13	Wang B (20)	2016	2012.1–2015.12	74/74	12	80/68	Retrospective	CDCC	⑥+⑦

Outcomes: ① adaptability DQ; ② large sports DQ; ③ fine motor DQ; ④ language DQ; ⑤ social behavior DQ; ⑥ PDI; ⑦ MDI. M, male; F, female; NR, not reported; CDCC, Children's Developmental Center of China; DQ, developmental quotient; PDI, psychomotor developmental index; MDI, mental developmental index.

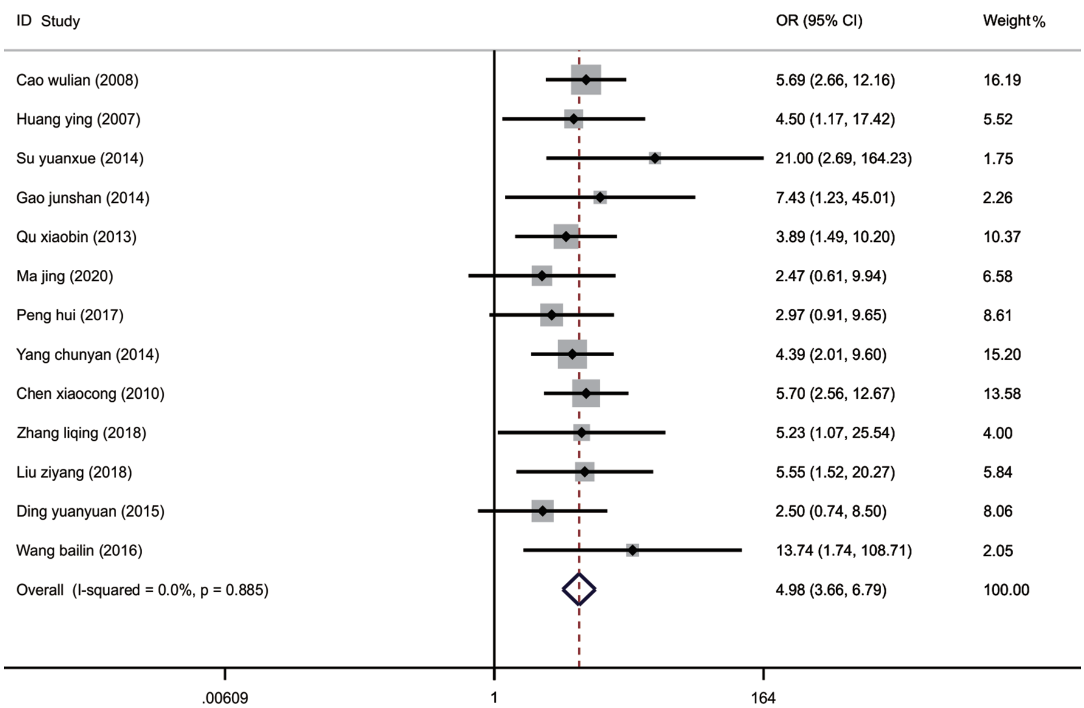


Figure 2 A forest map showing the effective rate of treatment in patients with or without early rehabilitation.

assessed neurodevelopmental indicators, including adaptability, gross motor skills, fine motor skills, language ability, and personal-social skills. After merging the data, heterogeneity was small for adaptability (I^2=0.0%; P=0.415) and personal-social skills (I^2=13.4%; P=0.329). The heterogeneity of gross motor skills (I^2=65.6%; P=0.020), fine motor skills (I^2=56.5%; P=0.056), and language ability (I^2=69.0%; P=0.012) was large, and the random effects model was adopted. After rehabilitation treatment, patients performed significantly better in terms of adaptability (SMD =0.632; 95% CI: 0.496 to 0.769; P<0.001; *Figure 3A*), gross motor skills (SMD =0.971; 95% CI: 0.705 to 1.236; P<0.001; *Figure 3B*), fine motor skills (SMD =0.904, 95% CI: 0.670 to 1.138; P<0.001; *Figure 3C*), language ability (SMD =0.757; 95% CI: 0.483 to 1.030; P<0.001; *Figure 3D*), and personal-social skills (SMD =0.786; 95% CI: 0.648 to 0.250; P<0.001; *Figure 3E*) compared to patients in the control group.

Intellectual and motor development

Seven studies (9,12,13,15,18-20) investigated intellectual development and motor development in high-risk infants with brain injury. After data merging, intellectual development (I^2=82.4%; P<0.001) and motor development (I^2=78.3%; P<0.001) of each study were found to be highly heterogeneous, and the random effects model was adopted. The results showed that both the mental development index (MDI) score (SMD =1.194; 95% CI: 0.839 to 1.549; P<0.001; *Figure 4A*) and the psychomotor development index (PDI) score (SMD =0.973; 95% CI: 0.661 to 1.286; P<0.001; *Figure 4B*) were significantly higher in the treatment group compared to the control group.

Sensitivity analysis

The stability of the meta-analysis results were further assessed by sensitivity analysis. The results were presented in the figures: the treatment effectiveness (*Figure 5*), neurodevelopmental adaptability score (*Figure 6A*), gross motor skill score (*Figure 6B*), fine motor skill score (*Figure 6C*), language score (*Figure 6D*), and personal-social score (*Figure 6E*) sensitivity. The combined results of the MDI score (*Figure 7A*) and the PDI score (*Figure 7B*) showed little change and low sensitivity, confirming that the results of this meta-analysis were robust and reliable.

Publication bias

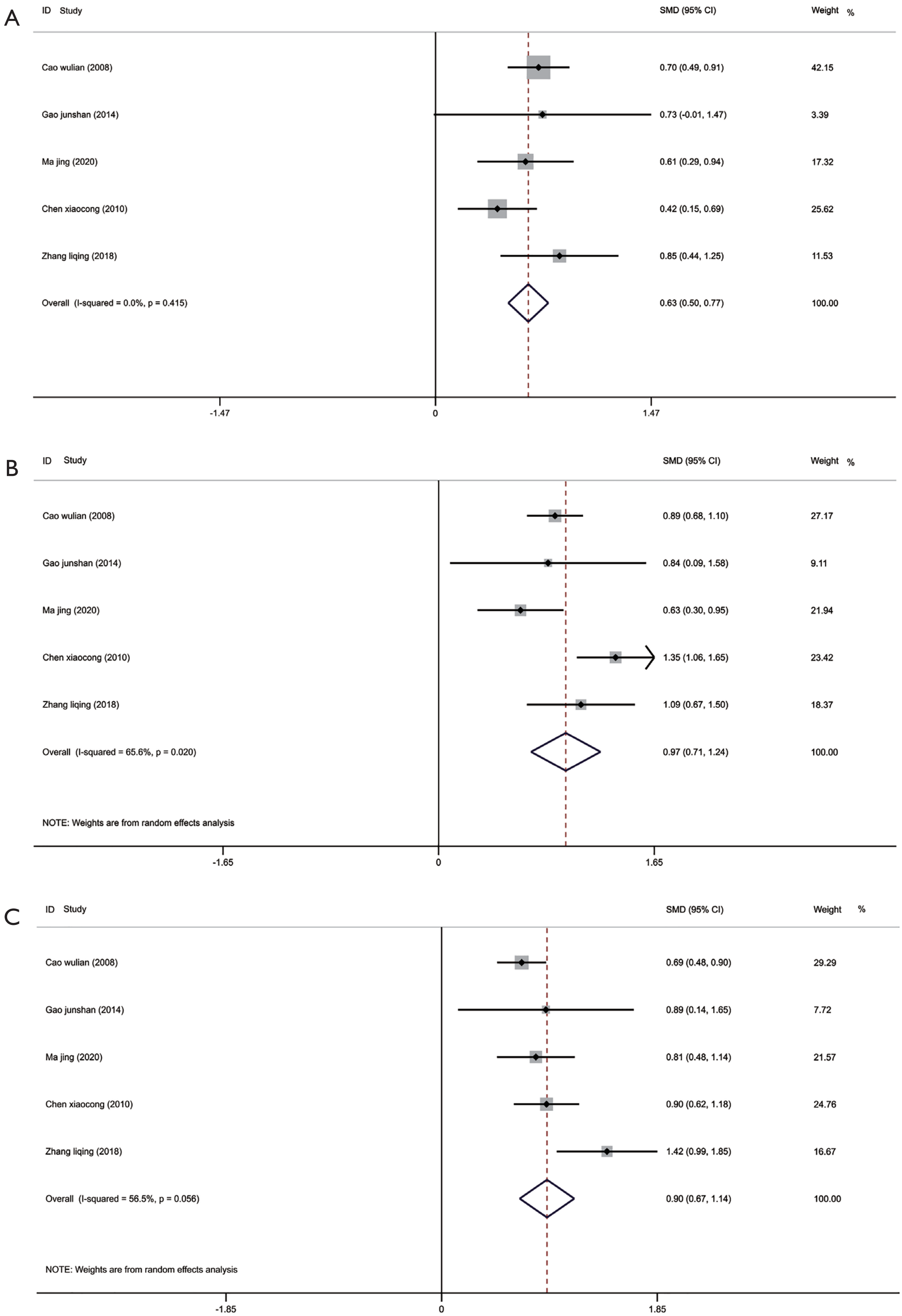
Funnel plots were used to detect possible publication bias. *Figure 8* shows that the funnel plot of the effective rate of treatment is symmetrical, and the bias of the results is small. There was default publication bias as the number of articles studied by nerve development index, MDI score and PDI score below 10, and funnel plot analysis was not conducted.

Discussion

Brain injury affects the development of nervous system functions in newborns, and can result in motor function and cognitive function development disorders. Nervous system dysfunction can cause CP, cognitive impairment, behavioral abnormalities, epilepsy, and the like. The multiple sequelae caused by brain injury can exert a heavy economic and mental burden on children and their families. Therefore, early intervention, clinical prevention, and effective treatment measures are of great significance in preventing brain injury in high-risk infants. Early detection and prevention can help correct the sequelae of brain injury. Therefore, it is particularly important to strengthen the management of preventive health care, early intervention, and rehabilitation of high-risk infants.

After early brain injury in high-risk infants, if positive stimulation is given, new functional pathways can be constructed. For example, unconventional nerve synapses can be generated through axon bypass projection and unusual dendrite bifurcation. In early life, benign environmental stimulation and exercise therapy for high-risk infants with brain injury can allow for recovery of the damaged brain, promote intellectual development, improve prognosis, and reduce the incidence of sequelae such as CP (21). Early intervention for high-risk children with brain injury is crucial and may include traditional intervention, music therapy, early intervention involving parents, and the early Denver model (22). This meta-analysis mainly focused on basic treatment combined with early rehabilitation therapy.

The 13 studies included in this meta-analysis all documented the effective rates of treatment. The effective rate of early rehabilitation in high-risk infants with brain injury was 84.71–98.82%, which was significantly higher than the effective rate of 59.09–83.78% observed in patients who did not receive early rehabilitation. Studies have suggested that the incidence of abnormal motor and intellectual development is 8–10 times greater in high-risk infants compared to normal infants, and the incidence of CP is 3%. However, if high-risk infants are given prompt


A
ID Study
SMD (95% CI)
Weight %
Cao wulian (2008)
0.70 (0.49, 0.91)
42.15
Gao junshan (2014)
0.73 (-0.01, 1.47)
3.39
Ma jing (2020)
0.61 (0.29, 0.94)
17.32
Chen xiaocong (2010)
0.42 (0.15, 0.69)
25.62
Zhang liqing (2018)
0.85 (0.44, 1.25)
11.53
Overall (I-squared = 0.0%, p = 0.415)
0.63 (0.50, 0.77)
100.00
-1.47
0
1.47
B
ID Study
SMD (95% CI)
Weight %
Cao wulian (2008)
0.89 (0.68, 1.10)
27.17
Gao junshan (2014)
0.84 (0.09, 1.58)
9.11
Ma jing (2020)
0.63 (0.30, 0.95)
21.94
Chen xiaocong (2010)
1.35 (1.06, 1.65)
23.42
Zhang liqing (2018)
1.09 (0.67, 1.50)
18.37
Overall (I-squared = 65.6%, p = 0.020)
0.97 (0.71, 1.24)
100.00
NOTE: Weights are from random effects analysis
-1.65
0
1.65
C
ID Study
SMD (95% CI)
Weight %
Cao wulian (2008)
0.69 (0.48, 0.90)
29.29
Gao junshan (2014)
0.89 (0.14, 1.65)
7.72
Ma jing (2020)
0.81 (0.48, 1.14)
21.57
Chen xiaocong (2010)
0.90 (0.62, 1.18)
24.76
Zhang liqing (2018)
1.42 (0.99, 1.85)
16.67
Overall (I-squared = 56.5%, p = 0.056)
0.90 (0.67, 1.14)
100.00
NOTE: Weights are from random effects analysis
-1.85
0
1.85

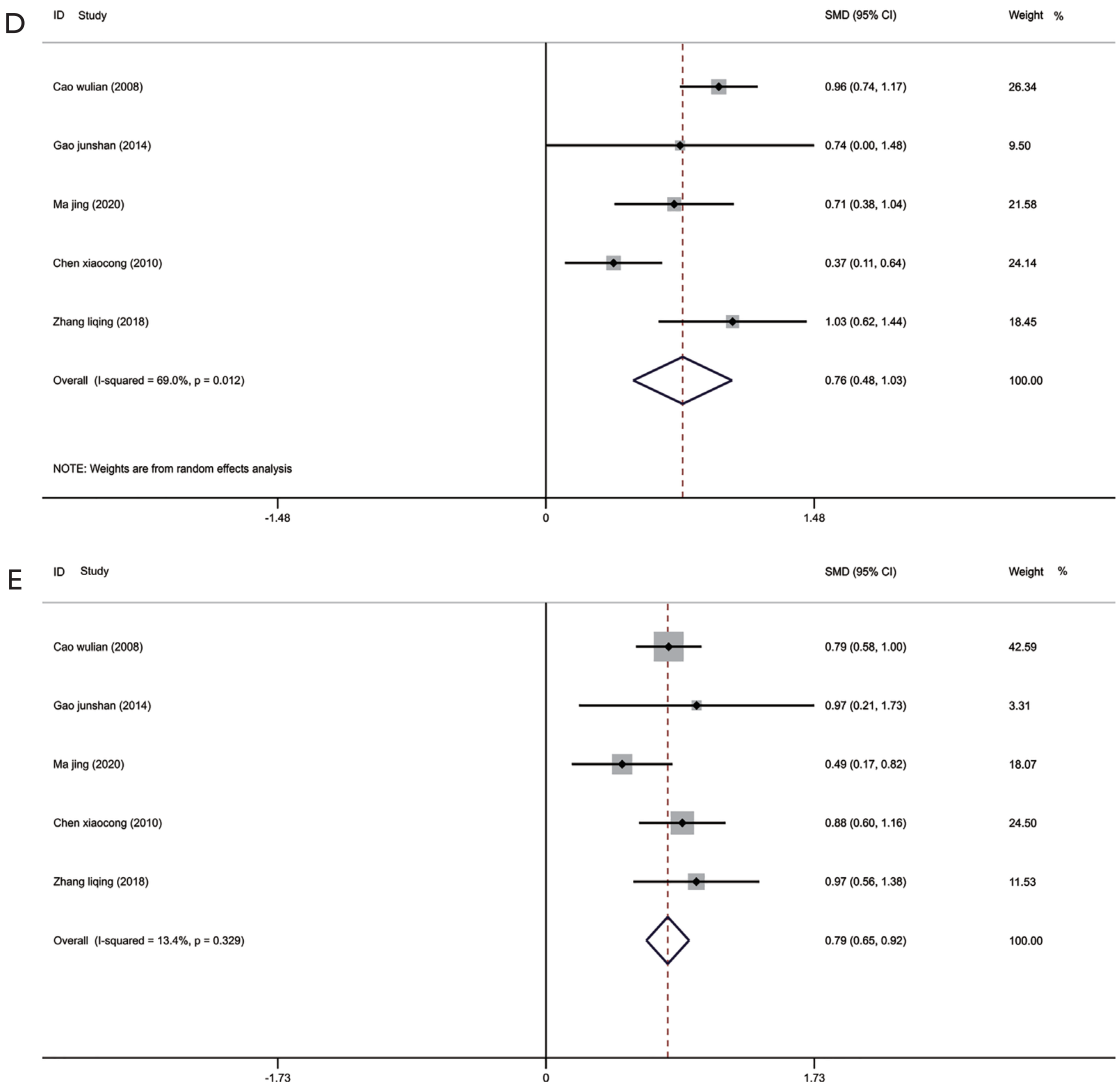


Figure 3 Forest maps showing the neurodevelopmental indicators for high-risk infants with brain injury. (A) Adaptive scores; (B) gross motor score; (C) fine motor score; (D) language score; (E) personal-social score.

access to early intervention, more than 90% will fully recover (23). Furthermore, early intervention not only improves the motor function of children but can also help to improve their intellectual development (24).

High-risk children with brain injury can show defects in cognitive ability, including reduced vision mastery, poor gross motor skills, and decreased attention retention ability (25). In this meta-analysis, 5 studies applied the Gesell Developmental Assessment scale, which is a neuromotor assessment method for neonates and has been widely recognized in the diagnosis of brain injury. In the early rehabilitation group, infants underwent visual and auditory stimulation, hand-eye coordination training, touch massages, passive exercise, vestibular exercise training, and active guidance activities. This resulted in significantly improved adaptability, gross and fine motor skills, language ability, and personal-social scores compared to patients in the control group, suggesting that early rehabilitation treatment exerted a positive effect on nerve development.

In this meta-analysis, 7 studies examined the intellectual development index and the motor development index of patients in the two groups. The results showed that the

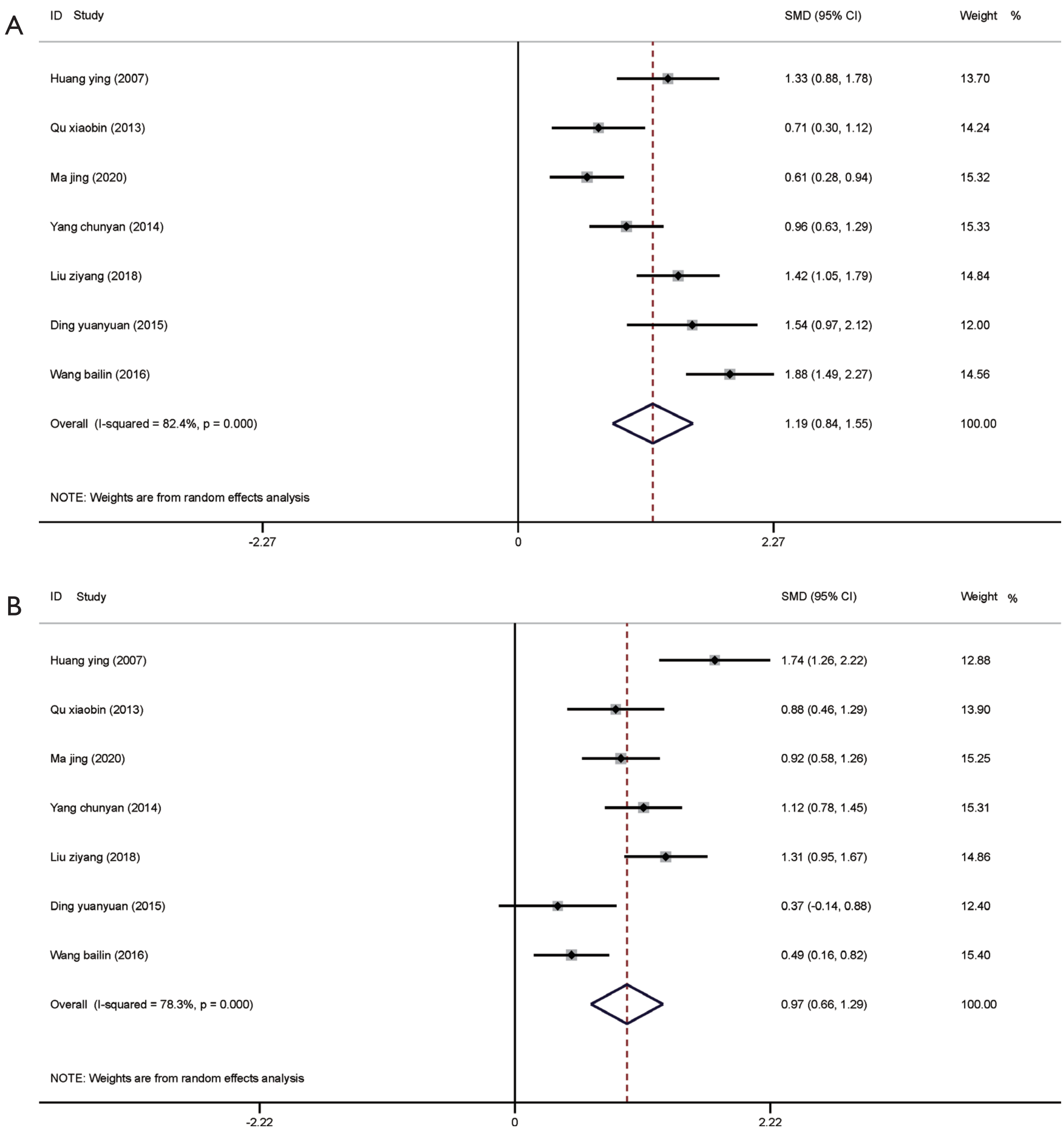


Figure 4 Forest maps of two score. (A) The MDI score; (B) the PDI score. MDI, mental development index; PDI, psychomotor development index.

MDI and PDI scores of the experimental group were higher than those of the control group. Due to various reasons, the development of the central nervous system and the motor nervous system in high-risk children is abnormal, resulting in mental and motor retardation in children. Early rehabilitation treatment can promote the recovery and regeneration of the injured nervous system, improve the rehabilitation and compensation ability, and reduce long-term nerve damage. Early rehabilitation therapy promotes the intellectual and motor development of children. Furthermore, environmental stimulation and functional training are beneficial to the development of brain cells and the formation of myelin, which may improve the ability of children to respond to the surrounding environment. Early rehabilitation therapy encourages the transmission of motor sensory stimulation to the cerebral cortex, inhibits the

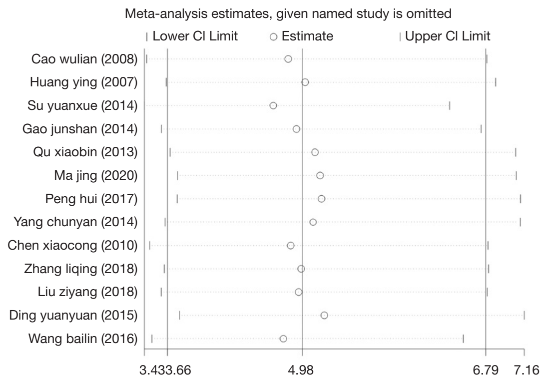


Figure 5 Sensitivity analysis of the effective rate.

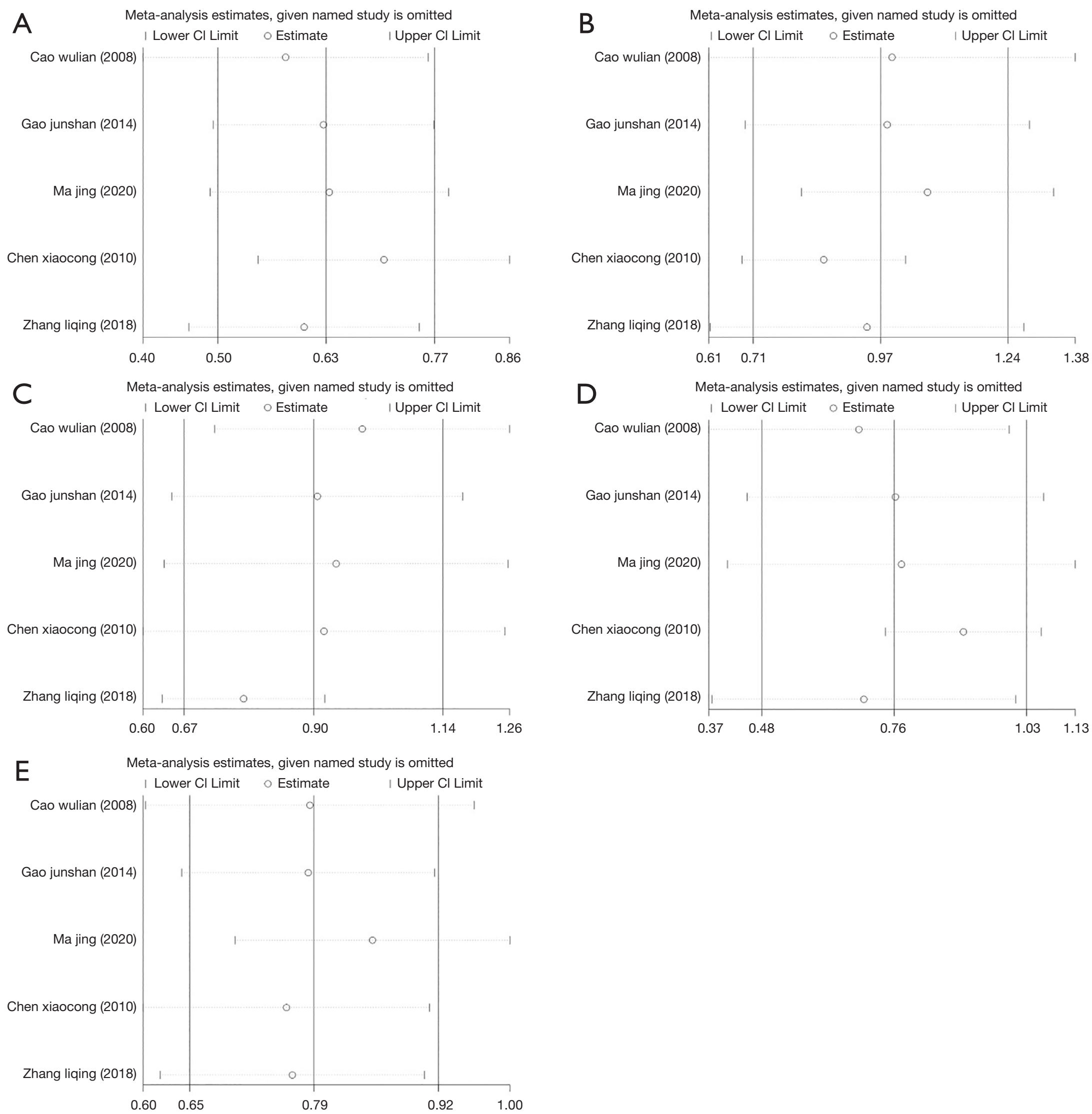


Figure 6 Sensitivity analysis of the neurodevelopmental indicators. (A) Adaptive score; (B) gross motor score; (C) fine motor score; (D) language score; (E) personal-social score.

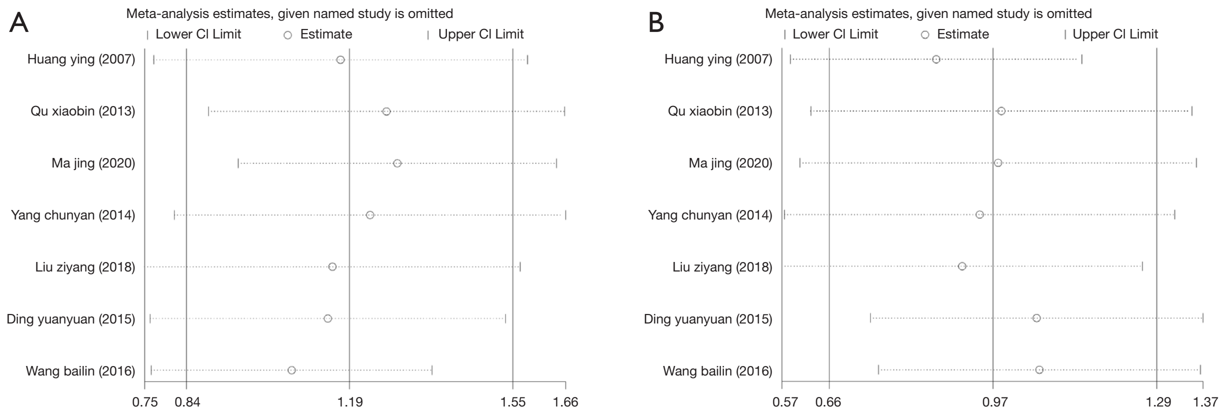


Figure 7 Sensitivity analysis of two score. (A) The MDI score; (B) the PDI score. MDI, mental development index; PDI, psychomotor development index.

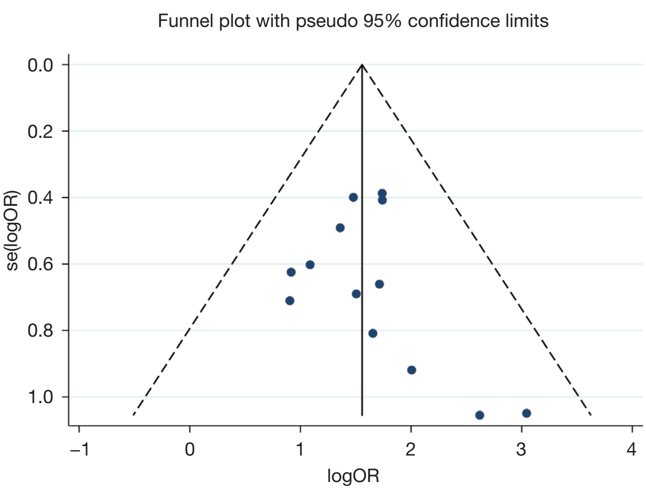


Figure 8 Funnel plot for effective treatment.

transmission of abnormal signals, reduces the generation of abnormal movements, and restores normal motor function (26).

There are some limitations in this meta-analysis. First, the sample size of the included studies is small, the overall population range in the study is limited, and the included studies are mostly in the Chinese literature, and these factors may result in certain selection bias and affect the external authenticity of the conclusions. Second, the included trials did not follow the principle of random grouping, and no blinding method nor allocation concealment schemes were used to control information bias, which may affect the internal authenticity of the results.

In summary, early detection, early intervention, and active rehabilitation of high-risk infants with brain injury is conducive to preventing the onset of neurodevelopmental disorders, and motor and mental retardation. Early rehabilitation therapy can improve the neuromotor and intellectual development in high-risk infants with brain injury.

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Footnote

Reporting Checklist: The authors have completed the PRISMA reporting checklist. Available at https://dx.doi.org/10.21037/tp-21-380

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://dx.doi.org/10.21037/tp-21-380). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Ni Y, Chen J, Ding X, et al. Nantong City, 403 cases of basic referral high-risk infants risk factors statistics and screening method analysis. Maternal & Child Health Care of China 2012;27:5501-3.
2. Oskoui M, Coutinho F, Dykeman J, et al. An update on the prevalence of cerebral palsy: a systematic review and meta-analysis. Dev Med Child Neurol 2013;55:509-19.
3. Reid SM, Meehan E, McIntyre S, et al. Temporal trends in cerebral palsy by impairment severity and birth gestation. Dev Med Child Neurol 2016;58 Suppl 2:25-35.
4. Wu X, Sun R, Li C. Research progress of early rehabilitation therapy for stroke. Medical Journal of Qilu 2005;20:371-2, 374.
5. Inguaggiato E, Sgandurra G, Cioni G. Brain plasticity and early development: implications for early intervention in neurodevelopmental disorders. Neuropsychiatr Enfance Adolesc 2017;65:299-306.
6. Sgandurra G, Beani E, Giampietri M, et al. Early intervention at home in infants with congenital brain lesion with CareToy revised: a RCT protocol. BMC Pediatr 2018;18:295.
7. Higgins JPT, Green S. Cochrane handbook for systematic reviews of interventions, version 5.0.2. 2008. Available online: http://handbook-5-1.cochrane.org/v5.0.2/
8. Cao W, Li J, Qin Q. Early intervention method on high-risk neonates with brain damage. Practical Preventive Medicine 2008;15:337-9.
9. Huang Y, Li R, Que L. Clinical observation on the results of early intervention of high risk infants and prognosis. China Tropical Medicine 2007;7:1034-5.
10. Su Y. Clinical observation on early rehabilitation of high-risk infants with brain injury. Yiayao Qianyan 2014;4:57-8.
11. Gao J. Clinical observation of cerebral palsy high-risk infants with early rehabilitation treatment. Chinese and Foreign Medical Research 2014;(11):17-8.
12. Qu X. Clinical observation of early nursing intervention for perinatal brain injury high-risk infants. Jiankang Bidu 2013;(5):225.
13. Ma J, Wu Z, Zeng L, et al. Application of systematic intervention management in early rehabilitation nursing of high-risk infants with brain injury. Journal of Qilu Nursing 2020;26:85-7.
14. Peng H. To investigate the best therapy program of rehabilition in high-risk infants with cerebral injury. Chinese Journal of Trauma and Disability Medicine 2017;25:23-4.
15. Yang C, Xu P. Prognosis research of early rehabilitation on premature infant with risk factors. Chinese Journal of Child Health Care 2014;22:735-8.
16. Chen X, Gao C. Case-control study on the effect of early intervention on high-risk infants of cerebral palsy. Chinese Journal of Child Health Care 2010;18:694-7.
17. Zhang L, He R. clinical observation of early rehabilitation in the treatment of perinatal brain injury in high-risk infants. Yiayao Qianyan 2018;8:68-9.
18. Liu Z. The application effect of early rehabilitation therapy in high-risk children with brain injury. China Reflexology 2018;27:93-4.
19. Ding Y, Bai L, Wang D. Clinical observation on the effect of early experimental rehabilitation therapy on motor function of high-risk infants. Journal of Qiqihar University of Medicine 2015;(14):2094-5.
20. Wang B, Jiang X. Effects of early comprehensive rehabilitation treatment for high-risk children's intelligence and psychomotor development. The Medical Forum 2016;20:2185-6.
21. Xiao J, Zheng J, Li X. High-risk children 188 cases of early intervention effect analysis. Chinese Journal of Child Health Care 2011;19:864-5.
22. Zhang Y, Guo J. The theoretical basis and research progress of early intervention strategies for high-risk infants. Chinese Journal of Rehabilitation 2019;34:101-4.
23. Yu Z, Kong M. The effect of early intervention on the development of high-risk infants with brain injury and the research progress of integrated traditional Chinese and western medicine treatment. Journal of Modern Clinical Medicine 2020;46:225-6, 230.
24. The Subspecialty Group of Rehabilitation, the Society of Pediatrics, Chinese Medical Association. Interpretation of early, accurate diagnosis and early intervention in cerebral palsy: advances in diagnosis and treatment published by JAMA Pediatrics in 2017. Chinese Journal of Practical

Pediatrics 2018;33:743-9.
25. Zhang Q, Ren R. Research progress in neuropsychological development of high-risk newborns. Medical Recapitulate 2015;(4):648-9.
26. Yuan Y, Zhou R, Deng J, et al. Investgation of super early rehabilitation intervention on neural psychological development of high-risk infants. Progress in Modern Biomedicine 2017;17:1530-3.

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