Review Article

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Effects of Occupational Therapy Intervention on Motor Cognitive Behavioural Development of Infant Born Pre-term: A Systematic Review

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Abstract

Aim: To synthesize the existing literature and determine the efficacy of occupational therapy intervention, starting in the neonatal intensive care unit (NICU), on the motor, cognitive, and behavioural outcomes of Indian infants born pre-term.

Method: Databases were searched for randomized controlled trials, quasi-randomized controlled trials, pre and post studies etc of occupational therapy early intervention for infants with a gestational age of less than 37 weeks, initiated in the NICU and delivered by a therapist or parent with therapist support. Quality was evaluated using the Cochrane standardized risk of bias assessment tool. Recommendations were made using the Grading of Recommendations, Assessment, Development and Evaluations approach.

Results: Ten studies met the inclusion criteria. Studies were categorized into four intervention categories: (1) nesting, positioning and diaper sizing; (2) multi-sensory stimulation; (3) KMC (skin to skin care) (4) oral-motor intervention. Risk of bias varied from low to high or was unclear.

Interpretation: Preliminary support indicates that occupational therapy improves motor and cognitive outcomes in the short-term and possibly long-term. Occupational therapy intervention programmes for pre-term infants have a positive influence on cognitive and motor outcomes during infancy. A great deal of heterogeneity between studies was due to the variety of early developmental intervention programmes tested and to gestational ages of included pre-term infants; thus, comparisons of intervention programmes were limited. Further research is needed to determine which early developmental interventions are most effective in improving cognitive and motor outcomes, and to discern the longer-term effects of these programmes.

Key words: occupational therapy, pre-term infant, NICU, multi-sensory stimulation, KMC, neonatal positioning, exclusive breast feeding, spoon feeding, paladai feeding, PIOMI)

Introduction

India has largest birth ratio (about 26 million per year) and experiencing dramatic improvement in infant and child survival, although neonatal and infant mortality rate is still high 30 to 41 per 1000 births [1.]

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Every year around 21 million low birth weight babies are born. They represent 16 percent of all new born, but large regional variations exist, where as in India constitute about 60%-70% of intra-uterine growth retardation and remaining 30%-40% pre-term infants born before 37 weeks of gestation[1].

Pre-term birth is a major public health challenge worldwide, contributing about 10% of all births[3]. Pre-term babies, those born before 37 weeks of pregnancy, have a higher risk of motor, cognitive, and behavioural impairments than those born full-term[2-5].

Occupational Therapists (OTs) in the NICU are responsible for recognising the interaction between the physical and social environments, educating caregivers on the NICU process, developing individualised intervention plans, and remaining competent, according to the American Occupational Therapy Association (AOTA, 2006b)[6].

Infants born preterm are also at risk of having developmental coordination disorder, language impairments, problems with social/emotional development, impaired executive functions, and a limited attention span[7]. The risk of developmental impairment in children born pre-term increases with decreasing gestational age[3].

The rationale for providing Occupational therapy to neonates is supported by three ideas:

1. Protection of the neonatal brain;
2. Optimization of the environment and intervention to promote better developmental outcomes;
3. Support for parents to cope with the challenges of preterm birth and prepare to support infants at risk for developmental delays.

Infants born pre-term are also at risk of having developmental co-ordination disorder, language impairments, problems with social/emotional development, impaired executive functions, and a limited attention span. The risk of developmental impairment in children born pre-term increases with decreasing gestational age.

There is much variability in occupational therapy, with models of intervention having a different focus, such as prevention, remediation, or treatment of a specific disability. Heterogeneity also exists in the dose and timing of intervention in addition to heterogeneity, a lack of clarity in neonatal therapy research makes synthesizing the findings difficult.

Thus, the purpose of this review was to identify and evaluate studies where occupational therapy in neonates was initiated in the NICU, as provided or designed by an occupational therapist, and report the effect of the intervention on the motor, cognitive and behavioural outcomes.

Methodology

- The protocol for this systematic review was developed according to the Preferred Reporting Items of Systematic Reviews and Meta-Analysis for Protocols (PRISMA-2020).

Study design

- Experimental studies such as randomized controlled/clinical trials (RCTs) and cluster RCTS and various study designs (randomized controlled trials, quasi-experimental, cross-over or single-group repeated measure studies, PDSA). All literature published in English language in last 10 year (2012-2022). Studies that report outcomes of behaviour, motor development, and/or cognitive development, physiological parameters using standardized assessments, on Indian participants and fitted the inclusion criteria based on population, type of intervention, and reported outcomes.

Inclusion criteria

Population

Very pre-term infants (born > 32 weeks gestation) with very low birth weight(1-1.5kg) and low birth weight (1.5-2.5 kg) Who were hospitalized in the NICU and had occupational therapy intervention

Interventions

Intervention was either delivered directly by an occupational therapist, or designed by a therapist and delivered by the parent under the supervision of a therapist in the NICU or initiated just before discharge and continued at home.

Comparator

All types of comparator groups, such as non-exposed control group or a group exposed to different intervention

Outcome

Studies reporting pre-term infants 'outcomes of behaviour, motor development, and/or cognitive development using standardized assessments.

Exclusion criteria

Populations with mean or median gestational age greater than 35 weeks, with a purposeful sample of healthy infants (defined as 3 or more of the following factors: never on oxygen, never on medications, no intraventricular haemorrhage or other perinatal brain injury, or if Apgar scores were >7 at 1 or 5 min)

Search strategy

A systematic search for studies published from year 2012 to 2022, on electronic databases was searched with MeSH/ Thesaurus terms to screen for relevant studies for this systematic review: CINAHL, MEDLINE, PubMed, EMBASE (OVID), Cochrane Database of Systematic Reviews, Cochrane (CENTRAL), Web of Science, The Scopus database, Google scholar, etc

Study quality

Assessment of study quality was independently performed by two reviewers, and dis-agreements regarding study quality were resolved by discussion among the two reviewers until consensus was achieved.

The Cochrane's risks of bias assessment tool were used by two reviewers independently to screen the studies risk of bias which was classified as low, high, or unclear risk of bias. The tool screens for sequence generation, allocation concealment, blinding, incomplete outcome data, and selective outcome reporting.

We used the GRADE Guideline Development Tool to create a 'Summary of findings' table to report the quality of the evidence.

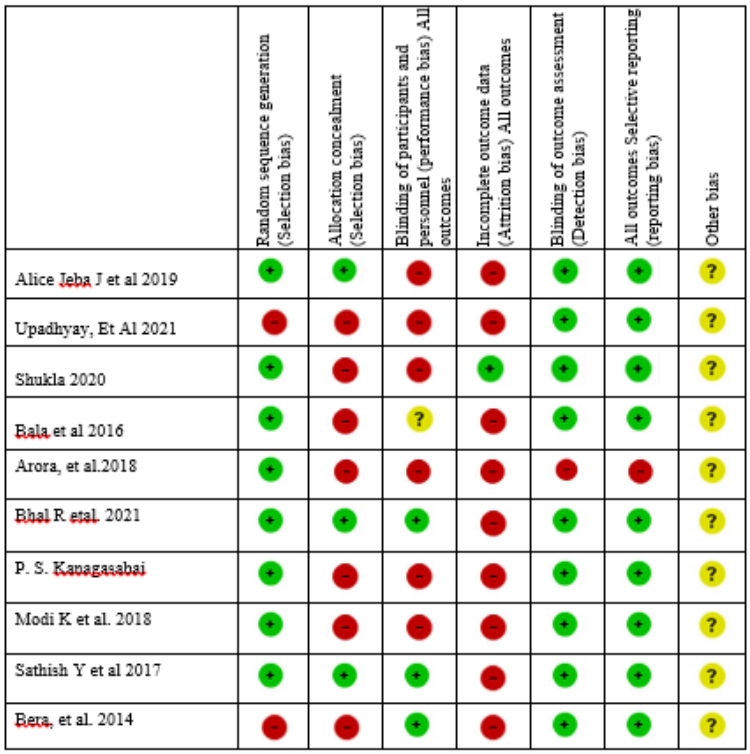


Fig. 1: Risk of bias summary: review authors' judgements about each risk of bias item for each included study

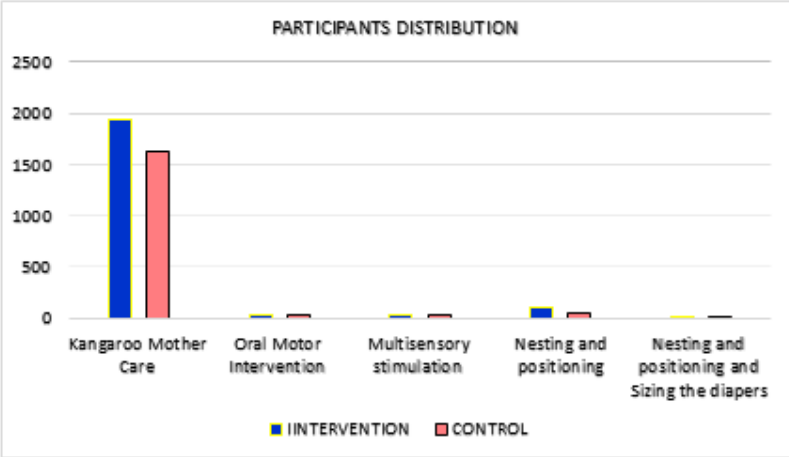
Inference -Green, moderate-to-large effect in a low/unclear risk of bias study; yellow, small effect and low risk of bias or moderate/large effect with high risk of bias; red, no effect.

Results

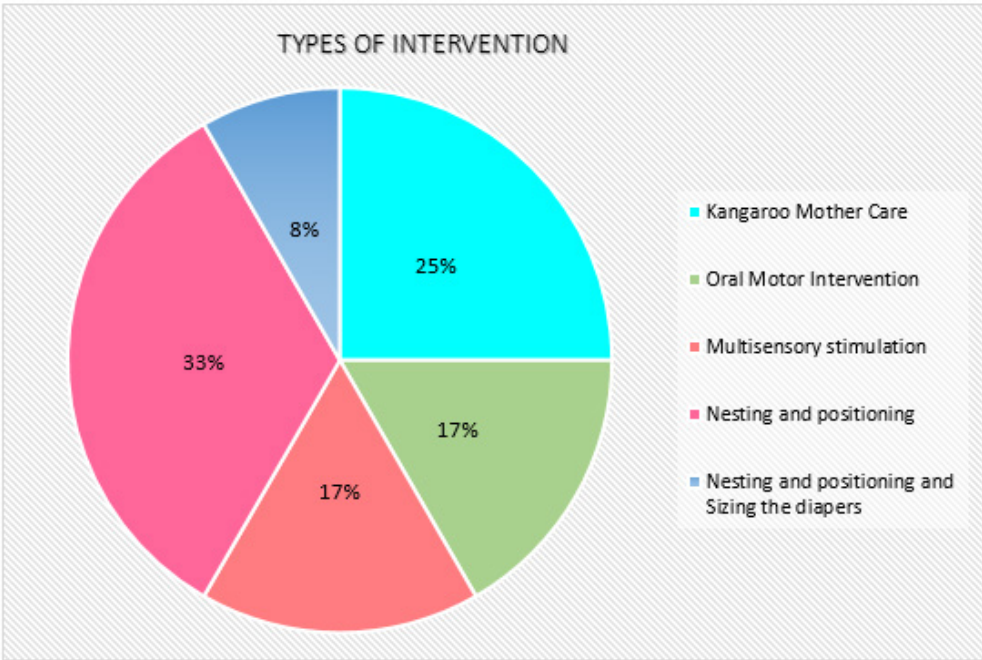
Description of studies

The search yielded 1005 studies after duplicates were excluded. Screening of titles resulted in 57 trials for further scrutiny. Review authors determined that 13 studies were potentially eligible for inclusion in the review. On further inspection at data extraction, we had to exclude the stage 3 study, as data could not be extracted in relation to infants under 37 weeks' PMA. Therefore, a total of 10 studies were eligible for full data extraction.

The included studies enrolled between 16 and 1600 participants, for a total of 3898 participants, which reported feeding intervention, multi-sensory stimulation, therapeutic positioning, skin to skin contact (kangaroo mother care) nesting protocols.



Graph 1: Showing Distribution of No. of Participants (intervention and control group) and Intervention in Included Studies



Graph 2: Types of Intervention in Included Studies

Discussion

To our knowledge, this is the first systematic review to evaluate the efficacy of early interventions therapy implemented in Indian population. The findings of the systematic review suggest that occupational therapy may improve motor and cognitive outcomes in infants born pre-term. Therapist-delivered postural control intervention (TDPCI) was found to have a short-term effect on motor development. Developmental care and Oral-motor interventions also showed a positive effect on behavioural motor and cognitive development. The results of are discussed in detail in the following sections.

Summary of main results

The investigators reported a range of interventions that appear beneficial for pre-term infants in terms of reduced length of hospital stay and earlier transition to oral feeding, with reduced length of time on parenteral nutrition neuro-muscular maturity, weight gain, pain reduction, improvement in vital signs.

Kangaroo Mother Care

World Health Organization (WHO) guidelines currently recommend initiation of short in-termittent Kangaroo Mother Care sessions when the infant's condition begins to stabilize, and continuous Kangaroo Mother Care when fully stable. In this review out of 3898 participants 3575 participants received (intervention 1941 contol-1634) skin to skin care (kangaroo mother care)[14,19,21] KMC showed modest but statistically significant improvement in vital physiological parameters18 and improve survival rate of LBW neonates by 25%[19].

Nesting And Positioning and Sizing the Diapers

The use of positioning aids for pre-term infants is recommended to facilitate their growth and clinical outcome. A study conducted in New Delhi investigated the effect of nesting on posture discomfort and physiological parameters of low-birth-weight infants. There was a significant reduction in the discomfort in experimental group compared to the control group (t=10.65)[21], one study was on positioning nesting and dipper sizing, introduction of nesting rolls and appropriate size diapers had significantly improved mean IPAT score[13].

Oral Motor Intervention

Oral motor intervention trial[15,16] showed that pre-feeding intervention with PIOMI is effective in improving the oral-motor function of the pre-term infants Gaebler and Hanzlikhad10 demonstrated that infants receiving a peri- and intra-oral stimulation just before oral feedings scored better on the NOMAS which was also consistent with results of these studies.

Multisensory intervention

Multi-sensory stimulation appears to have a beneficial effect on the tonal maturation in pre-term infants, the response of the infants to stimulation was within the physiological limits, hence ATVV stimulations are safe to administer in stable pre-term infants[19,18]. The present observations are consistent with Nelson[11], who also showed no clinically significant difference in the HR, RR and SpO2 between the control group and the ATVV stimulated group in preterm infants of 33–35-week post conceptional age.

Variations in sample, inclusion, exclusion criteria and control conditions

There is significantly variability among studies in terms of sample characteristics. Statistical significance; There is wide variation in gestational ages of pre-term babies on whom OT intervention was applied leading to limited generalizability of study findings. Most of the studies excluded the vulnerable pre-term as their condition might interfere with study. Inconsistencies are found across studies as in most of the studies the control group received developmentally supportive routine care. Some studies have used sham intervention[9], swaddling[3], wrapping in cloths[3] (to blind the unit staff and primary care providers) which includes standing by the bedside for the exact same duration and while putting a curtain.

Quality of the evidence

Trends in the data appear to indicate that providing an occupational therapy intervention protocol reduces length of hospital stay, time taken to achieve oral feeding and time spent on parenteral

nutrition, cognitive and neuromuscular maturity but all of the analyses are based on studies of limited methodological quality. Results of the data analysis are encouraging but must be interpreted with caution, given the high risk of bias encountered across virtually all of the included studies. the quality of the evidence ranged from low (parenteral nutrition, breast feeding, sensory stimulation) to very low (vital signs, weight gain, cognitive development)

Potential biases in the review process

We strove to decrease biases in the review process authors (MS, RB) individually examined studies using screening tool. Our deviations from the protocol consisted of re-definition of interventions, re-scoping of the review focus and application of the GRADE method in assessing the quality of evidence and were unlikely to introduce bias into the review process.

Limitations of included studies

There is a possibility of publication bias, where only studies reporting positive outcomes were published and included in this review. In addition, most studies included multiple outcome measures, many of which did not reach statistical significance. Many outcomes that did have statistical significance were challenging to interpret and many may not have been clinically significant. We included multiple research designs in an effort to capture all appropriate literature related to OT in NICU, so lower quality non-randomized designs could have biased the review findings, the studies that were randomized, did not specify their methods clearly or report allocation concealment. Completeness of treatment and follow-up was also difficult to ascertain, as studies infrequently reported the number of infants by group with complete outcomes data and reasons for loss to follow-up. Most interventions were very short and were not conducted across the hospitalization period and did not give clear descriptions of inclusion criteria. Finally, generalizability of many of the studies is limited.

Ethical Clearances: Ethical clearance was taken from institutional ethical committee to conduct the study.

Conflict of Interest: Authors report no conflict of interest.

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