



Children Born Low Birth Weight And Preterm: Impacts to the Brain: Executive Function

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Learner Outcomes

Participants will a) identify and recognize executive function (EF) and its importance in early learning particularly for children born LBW and preterm.

Understand components of EF and ways to identify skills in the early years.

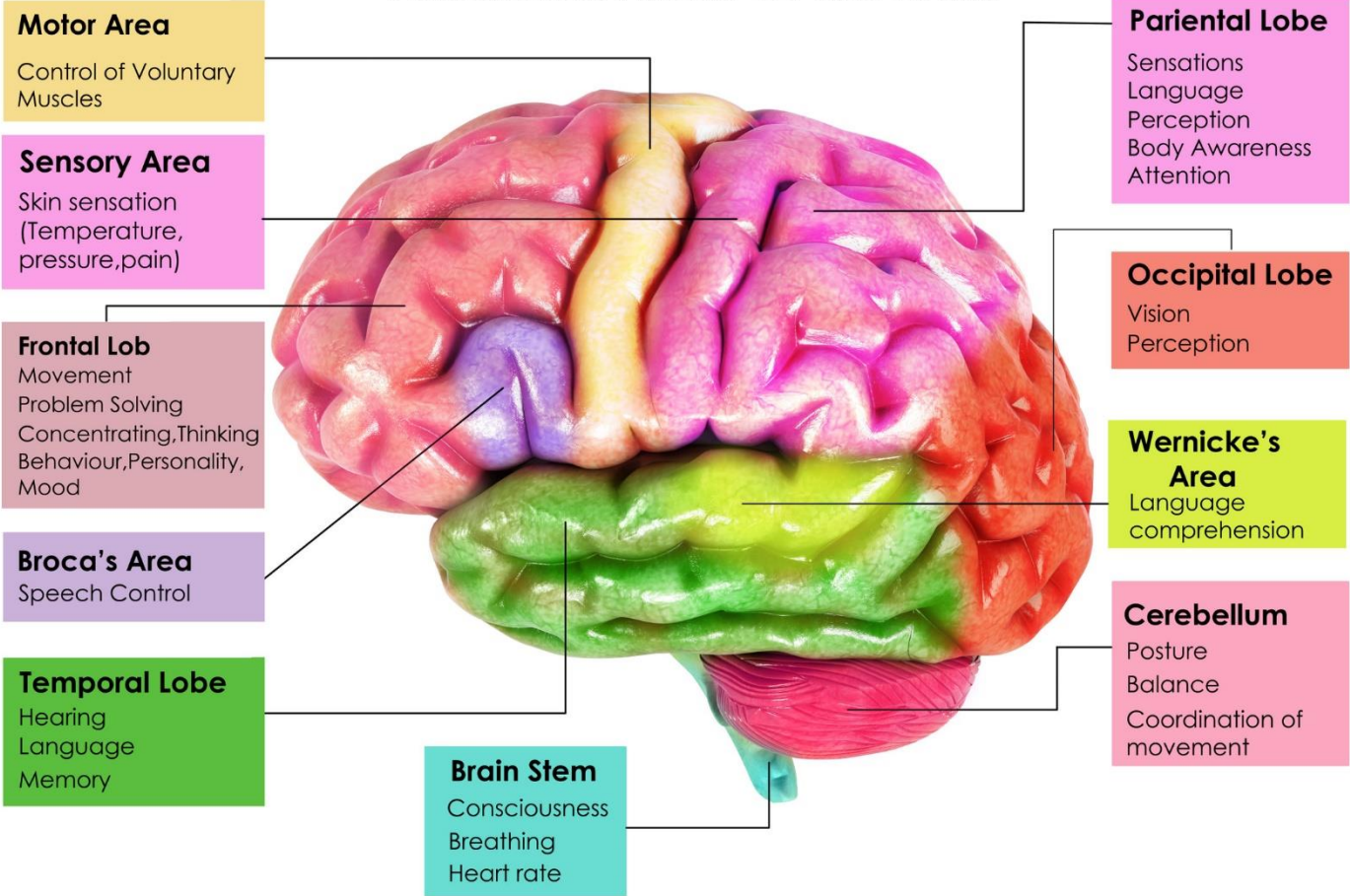
Discuss implications for practice/implementation of practice within early intervention.

Executive Function (EF)



Refers to a group of neurocognitive processes in the brain that direct, connect, and organize information that is manifested in planned behavior.

Functional Areas Of The Brain



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Neurocognitive Processes

Self Regulation/Co-
regulation

Inhibition

Working Memory

Cognitive Flexibility

Goal Setting

Planning and Organization



Self-regulation



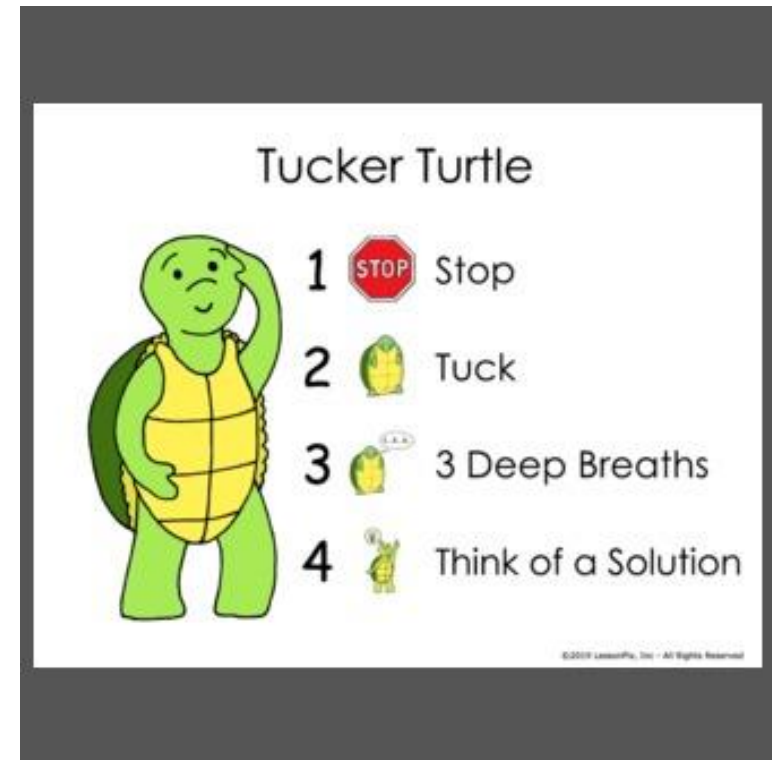
Self-regulation: Skills are developing during the first years of life and throughout a person's lifetime.

Co-Regulation: warm and responsive interactions that provide the support, coaching, and modeling children need to “understand, express, and modulate their thoughts, feelings, and behaviors” (Murray et al. 2015).

Inhibit

Ability to control behavior and impulses

- Redirect activity
- Stop, Think, Act
- Children who struggle with this
- may have challenging behaviors



Working Memory



Ability to hold and process “stored” information!

A not B tasks

Process that results in goal-directed behavior (attention)



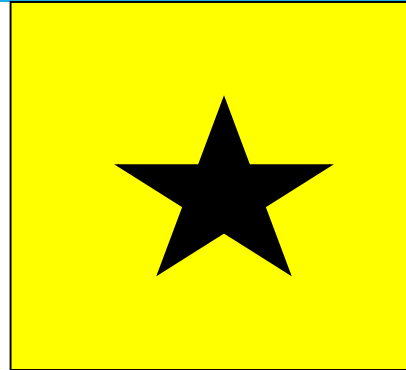
Cognitive Flexibility

Ability to shift between two different concepts or attributes

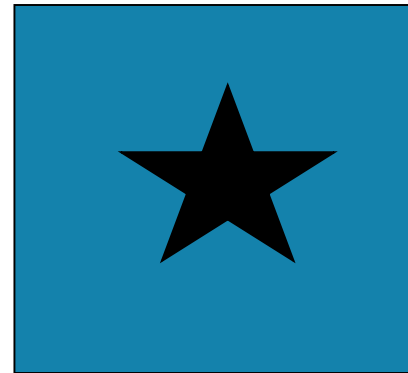
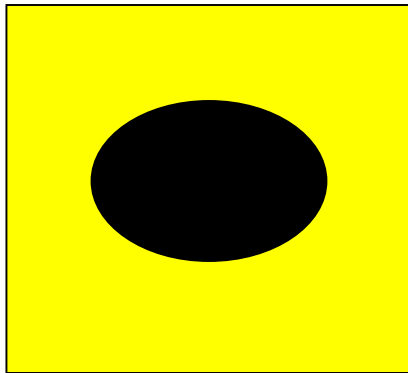


Dimensional Change Card Sort- Separated Task

Rule: Sort by Color



Rule: Sort by Shape



What About Children Born LBW And Preterm?

Advancements in medical technology and practice have led to increasing survival rates among infants born preterm.

- Decreased mortality, particularly with ELBW, may lead to impaired cognitive and social outcomes at later ages
- Immature brain equals higher risk for brain injury.



Centers For Disease Control Definitions

Preterm: <37 weeks gestation

- In United States: 10.1% in 2020; CDC

Birthweight

- Low birthweight (LBW): <2500 grams
- Very low birthweight (VLBW): <1500 grams
- Extremely low birthweight (ELBW): <1000 grams

Social Determinants And Disparities In Health

Outcomes can be highly variable in the preterm group.

Some children born preterm demonstrate significant delays in early and later childhood.

Others seem indistinguishable from their peers who were born full term.



RESEARCH ON EF AND LBW/PRETERM

VLBW and very preterm children (<1500 g, <33 weeks gestation) scored lower on tasks of executive functioning than full-term peers at school-age.

Outcomes include poor cognitive function, learning difficulties, and behavior problems. Von Houdt et al., 2019

PROJECT EF: EXECUTIVE FUNCTION (EF) IN INFANTS AND TODDLERS BORN LBW AND PRETERM



To examine whether traditional infant toddler assessments that have components of EF in their structure can discern early indicators of EF.

Measures

Bayley Scales of Infants and Toddler Development- III (BSID III)

- Bayley, 2005

Dimensions of Mastery Questionnaire (DMQ 18)

- Morgan et al., 2019

Child Behavior Checklist (CBC)

- Achenbach & Rescorla, 2001

Behavior Rating Inventory of Executive Function – Preschool (BRIEF-P)

- Gioia & Isquith, 2003

DATA COLLECTION POINTS

6-8 months
corrected age

- BSID III
- DMQ 18

18-20 months
corrected age

- BSID III
- DMQ18
- CBC

36-40 months

- BSID III
- DMQ 18
- CBC
- BRIEF-P

SAMPLE DEMOGRAPHICS

	Full Term (N = 41)	LBW (N = 100)
<i>Sex</i>		
Male	53.7	52.0
Female	46.3	48.0
<i>Race</i>		
American Indian/Alaska Native	--	2.1
Asian	7.5	6.3
Black	--	4.2
Latino	15.0	16.8
White	70.0	55.8
Other	7.5	14.7

SAMPLE DEMOGRAPHICS

	Full Term (N = 41)	LBW (N = 100)
<i>Mother's Education</i>		
Less than college	7.3	33.0
Some college	17.1	24.5
College grad+	75.6	42.5
<i>Father's Education</i>		
Less than college	10.0	45.1
Some college	32.5	17.6
College grad+	57.5	37.3

LBW/PRETERM SAMPLE DEMOGRAPHICS

	Mean	Ranges
Corrected Age (months)	6.6	5.7 – 8.9
Gestational Age (weeks)	32.9	25.0 – 37.0
Birth Weight (grams)	1813.7	620 - 2,466



6 TO 8 MONTHS

Project EF

BSID III SCALES- AVERAGE SCORES

No significant differences for children born preterm/LBW and full term

Concern for item density at 6 months on BSID III

Correcting for age often inflates standard scores for children who are LBW

	Full Term (N = 41)	Pre/LBW (N = 100)
Cognitive Scaled	10.10	10.54
Cognitive Composite	100.49	102.55
Receptive Scaled	9.02	8.93
Expressive Scaled	9.90	9.07
Language Composite	96.95	94.27
Fine Motor Scaled	11.22	10.66
Gross Motor Scaled	10.76	9.87
Motor Composite	105.95	101.61

DMQ SCALES- AVERAGE SCORES

Full term and preterm/LBW children did not differ significantly on six DMQ scales with two exceptions:

Parents of children who were full term rated the child significantly higher on:

Gross Motor Persistence ($F(1) = 5.62, p = .019$)

General Competence ($F(1) = 16.48, p = .000$) than parents of children with LBW.

	Full Term (N = 41)	Pre/LBW (N = 100)
Object Oriented Persistence	3.29	3.25
Social Persistence with Adults	2.93	2.79
Social Persistence with Children	2.37	2.57
Gross Motor Persistence*	3.80	3.41
Mastery Pleasure	4.05	3.86
Negative Reaction to Failure	2.53	2.63
<i>General Competence*</i>	<i>3.35</i>	<i>2.59</i>

BSID III Item Components Of EF

Emotional Control

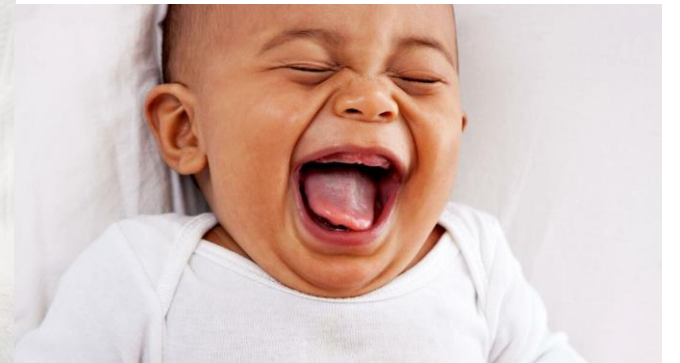
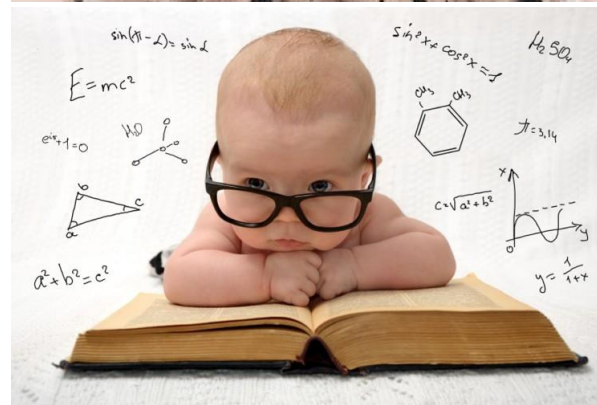
Attention

Working Memory

Inhibit

Shift

Plan/Organize



BSID III AND EF SCALES- AVERAGE SCORES

Full term children score significantly higher on two scales

- Attention $F(1) = 24.16, p < .001$
- Plan/Organize $F(1) = 9.09, p = .003$

	Full Term (N = 41)	Pre/LBW (N = 100)
<i>Attention*</i>	<i>.90</i>	<i>.82</i>
Working Memory	.32	.31
Inhibit	.38	.42
Plan/Organize*	.60	.54
Shift	-	-
Emotional Control	1.00	.99



18 to 20 Months



BSID III SCALES

Children in the full-term group scored significantly higher on seven scales

Average Scores 18 Months	Full Term (N = 37)	Pre/LBW (N = 78)
Cognitive Scaled	11.27	10.8
Cognitive Composite*	106.35	97.88
Receptive Scaled*	10.70	8.33
Expressive Scaled*	11.54	8.63
Language Composite*	106.70	91.32
Fine Motor Scaled*	11.14	9.81
Gross Motor Scaled*	9.68	8.54
Motor Composite*	102.32	95.17

BSID III AND EF COMPONENTS – AVERAGE SCORES – 18 MONTHS

Children born full term score significantly higher on two scales:

Attention $F(1) = 4.76, p = .031$

Inhibit $F(1) = 9.04, p = .031$

	Full Term (N = 37)	Pre/LBW (N = 78)
<i>Attention*</i>	.58	.52
Working Memory	.56	.55
Inhibit*	.64	.45
Plan/Organize	.61	.58
Shift	.41	.50
Emotional Control	1.00	.93

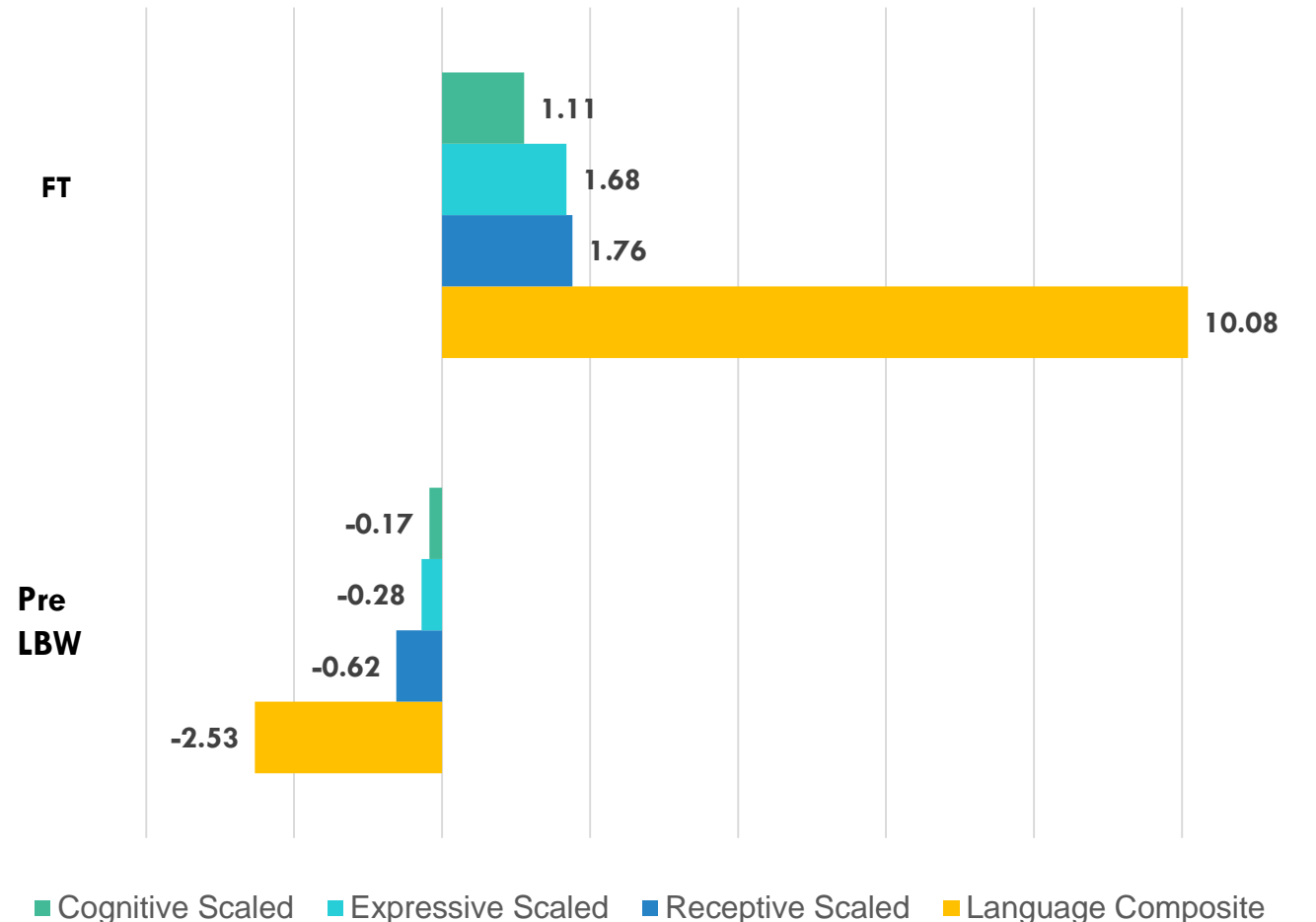
AVERAGE DIFFERENCE IN BSID-III SCORES BETWEEN 6 AND 18 MONTHS

FT, N = 37
Pre/LBW, N = 78

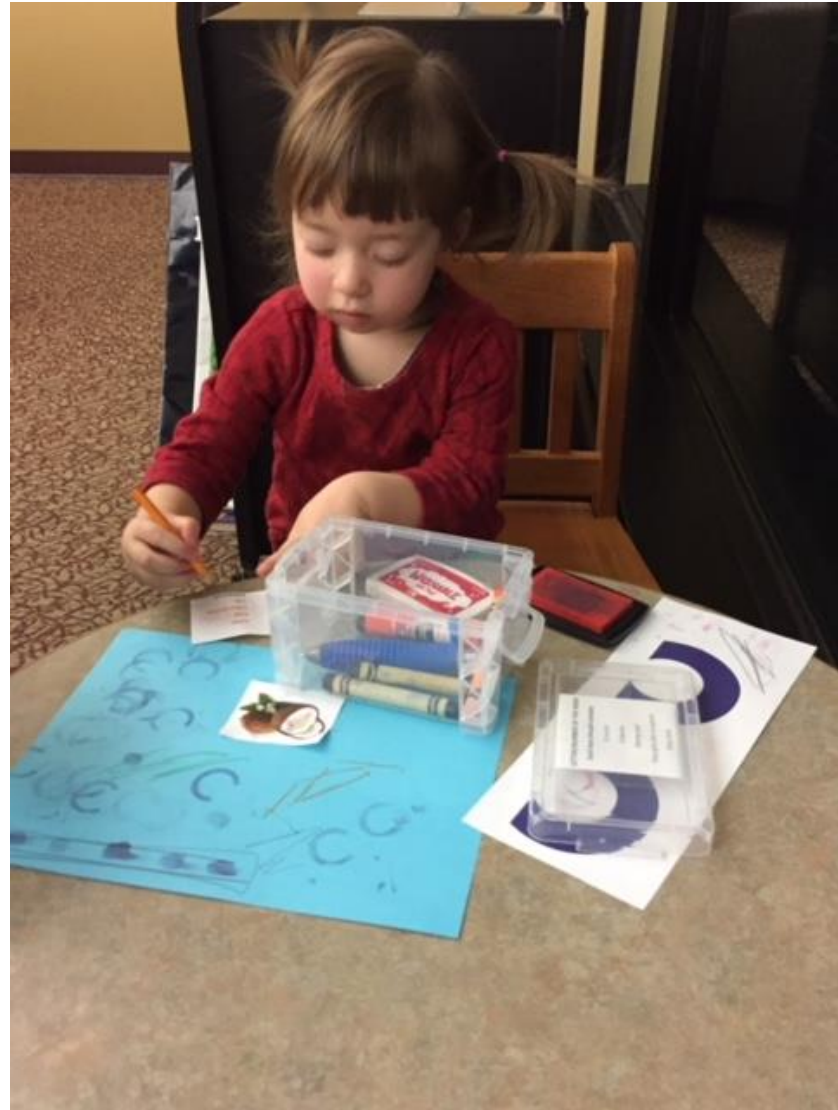
Multivariate analyses found significant differences in language composite scores, cognitive, expressive, and receptive scaled scores

Children born full-term, showed a significantly larger, positive average difference score compared to children born with LBW

Average change scores decreased slightly for those in the LBW group



36 TO 40
MONTHS



BSID III SCALES –

Children in the full term group scored significantly higher on all 8 scales.

Average Scores 3 years	Full Term (N = 31)	Pre/LBW (N = 43)
Cognitive Scaled*	11.74	9.86
Cognitive Composite*	108.71	99.30
Receptive Scaled*	12.77	10.05
<i>Expressive Scaled*</i>	<i>12.00</i>	<i>9.74</i>
Language Composite*	114.29	99.53
Fine Motor Scaled*	11.10	9.09
Gross Motor Scaled*	10.45	8.26
Motor Composite*	104.94	92.07

BSID III AND EF COMPONENTS – AVERAGE SCORES – 3 YEARS

Full Term children score significantly higher on three scales:

Attention $F(1) = 7.56, p = .008$

Working Memory $F(1) = 20.25, p < .001$

Plan/Organize $F(1) = 9.72, p = .003$

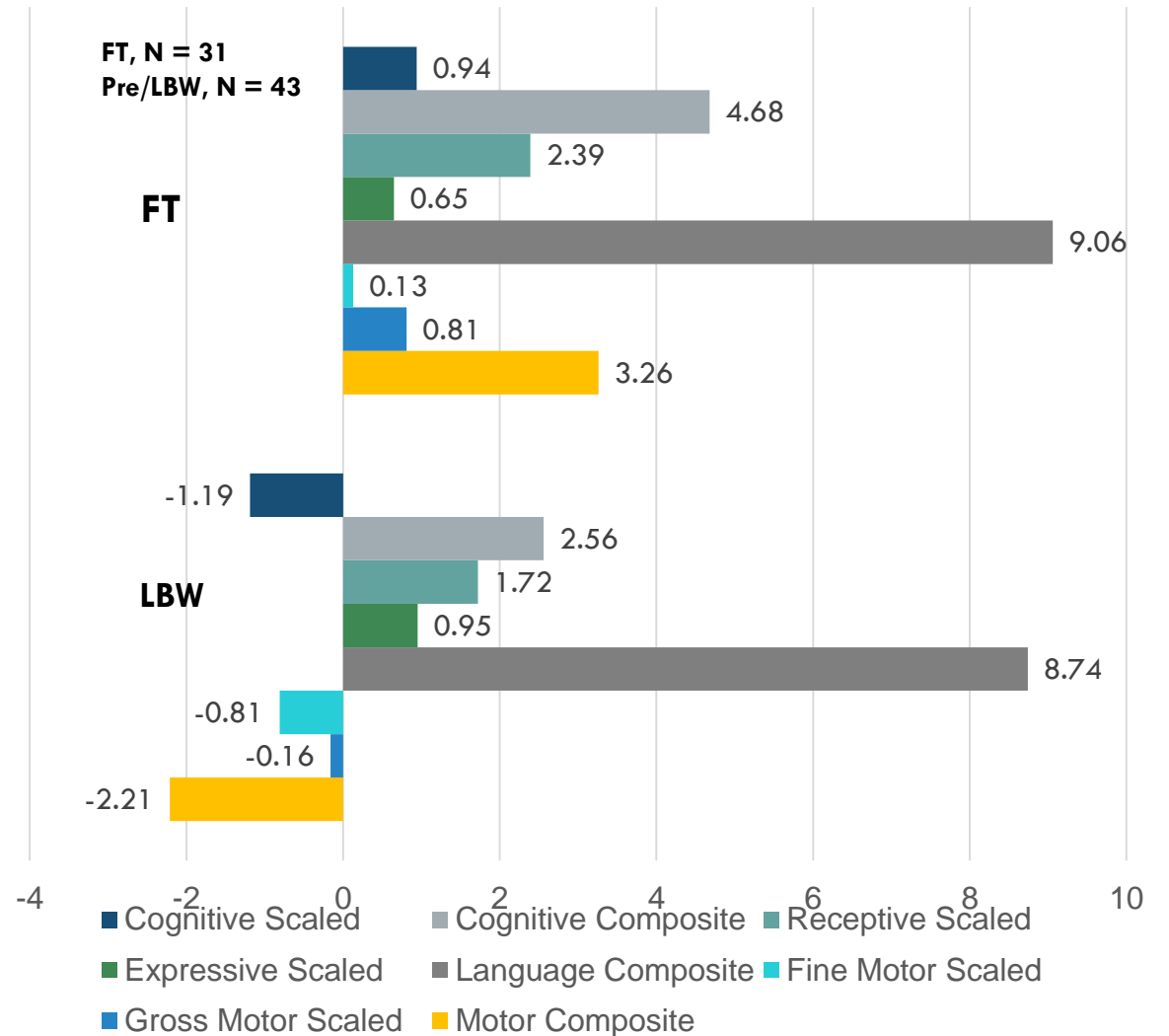
	Full Term (N = 31)	Pre/LBW (N = 43)
<i>Attention*</i>	.63	.49
Working Memory*	.70	.50
Inhibit	.85	.76
Plan/Organize*	.58	.47
Shift	.43	.36

AVERAGE DIFFERENCE SCORES ON THE BSID III BETWEEN 18 MONTHS AND 3 YEARS

Multivariate analysis found no significant differences

Children born full-term, showed an overall positive trend compared to children born with LBW

Average change scores decreased slightly for those in the LBW group on four scales



AVERAGE DIFFERENCE SCORES ON THE BSID III EF COMPONENTS BETWEEN 18 MONTHS AND 3 YEARS

Multivariate analysis found significant differences in four of the five components of EF

Children born full term showed a significantly larger, positive average difference score compared to children born with LBW/preterm

Average change scores decreased for children in the LBW/preterm group

FT, N = 31
Pre/LBW, N = 43



FINDINGS AT 18 MONTHS AND 3 YEARS PARENT REPORTS

*BRIEF-P Working Memory	Full Term	Preterm
	49.20 (54.96)	7.76 (12.16)*
BRIEF-P Plan/Organize	46.49 (52.90)	9.70 (11.59)*
BRIEF-P GEC	46.66 (51.84)	8.67 (11.45)*
CBC Withdrawn	51.68 (54.70)	2.94 (7.06)*
CBC Autism	51.80 (54.79)	3.50 (7.01)*
CBC Oppositional Defiant	51.74 (53.79)	2.50 (4.85)*



where

do we go

from

here?

Improvement Of Neurodevelopmental Outcomes

Improved methods for assessing and intervening at an early age for young children born LBW and preterm as well as other groups with EF deficits before school-age.

Findings emphasizes the need to identify strategies to improve long-term cognitive outcomes for children born extremely preterm and very preterm.

Twilhaar, 2018 (JAMA Pediatr, 172 (4): 361-367)

Provision Of Early Intervention (EI) Services

EI describes the services and supports that are available to babies and young children with developmental delays and disabilities and their families.

Eligibility for early intervention services is based on an evaluation of the child's skills and abilities.

Centers For Disease Control

DIVISION FOR EARLY CHILDHOOD POSITION STATEMENT ON LBW, PREMATURITY AND EI

Children born LBW and preterm are at high risk for neurodevelopmental concerns including language, cognitive/executive function, social-emotional, and motor delays.

There are marked inconsistencies in terms of practices and policies regarding services for children born LBW and preterm that vary widely from state to state, leading to complications in identification and referral of these children.

DIVISION FOR EARLY CHILDHOOD POSITION STATEMENT ON LBW, PREMATURITY AND EI

Family involvement and low risk environments were important contributors to positive outcomes starting in the Neonatal Intensive Care Unit (NICU).

DEC recommends that LBW of less than or equal to (\leq) 1500 grams (3.3 lbs.) and less than ($<$) 37 weeks of gestational age should be considered a diagnosed physical or mental condition that makes an infant eligible to receive EI services.

Increase Awareness And Training Of Early Childhood Providers

Efforts include websites that offer parents and professionals easy access to EF activities:

Free APP for Parents:

Your child's brain grows the fastest from birth through age 5! Helping them learn now gets them ready for school, friends, and life.

Vroom – Bezo Family Foundation

It is important to remember that EF skills last a lifetime.

Resources

1. Center on the Developing Child - <https://developingchild.harvard.edu/>
2. Vroom - <https://www.vroom.org>
3. Penguin and COPE studies at OHSU - <https://www.ohsu.edu/school-of-medicine/inspire-lab/participate>
4. Division for Early Childhood (DEC) Position Statement and Executive Summary on Early Intervention, Low Birthweight and Prematurity - <https://www.dec-sped.org/position-statements>



Publications

Blasco, P.M., Acar, S., Guy, S., Saxton, S., Duvall, S., & Morgan, G. (2020). Executive function in infants born low birth weight and preterm. *Journal of Early Intervention, 42* (4), 321-337. DOI: 10.1177/1053815120921946.

Blasco, P. M., & Acar, S. (2020). Assessment of executive function in everyday environments. In McLean, M., Hebbeler, K., Squires, J., & Banerjee, R. (Eds.), *DEC Recommended Practices Monograph Series No. 7: Assessment (95-110)*. Washington DC, United States: Division of Early Childhood.
<https://www.dec-sped.org/product-page/dec-recommended-practices-monograph-series-no-7-assessment>

Atkins, K. L., Dolata, J. K., Blasco, P. M., Saxton, S. N., & Duvall, S. W. (2019). Early intervention referral outcomes for children at increased risk of experiencing developmental delays. *Maternal and Child Health Journal, 1-9*.

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The End!
Thank You