BRIEF REPORT

Child Maltreatment and Motor Coordination Deficits among Preschool Children

Terrance J. Wade¹ · Jennifer Bowden² · H. Jane Sites³

Published online: 11 August 2017
© Springer International Publishing AG 2017

Abstract Emotional, cognitive and social developmental deficits have been key concerns linking adverse childhood experiences (ACEs) to school-readiness. However, one domain for school readiness, physical development (i.e., motor coordination), has been overlooked. This study examines the prevalence of motor deficits among a sample of high-risk preschool children. The data come from 78 children between 2 and 5 years of age referred to the Therapeutic Interagency Preschool (TIP) of which 44 (54.6%) were reported by the caregiver to have experienced maltreatment. Motor development was assessed by Physical and Occupational Therapists using the Peabody Developmental Motor Scale (PDMS-2). Overall, children with maltreatment showed rates of impaired motoric development five to seven times higher than expected compared to PDMS-2 published norms with those exposed to sexual or physical abuse having the highest rates. This study indicates the need to consider physical developmental deficits among high risk preschool children for assessing school readiness.

Keywords Child maltreatment · Child abuse · Neglect · Developmental coordination disorder · Motor skills · Preschool children

✉ Terrance J. Wade
twade@brocku.ca

¹ Department of Health Sciences, Brock University, 1812 Sir Isaac Brock Way, St. Catharines, ON L2S 3A1, Canada

² Child and Adolescent Psychiatry, Helen Devos Children's Hospital, Grand Rapids, USA

³ Division of Child and Adolescent Psychiatry, Cincinnati Children's Hospital Medical Center, Cincinnati, USA

A toxic childhood environment including maltreatment, neglect, family dysfunction and family mental illness has been linked to many adult physical health issues and disease as well as other negative outcomes including poor school performance, mental disorder, criminality, substance use, and general life instability (Felitti 2009; Felitti et al. 1998). A life course perspective surmises that these childhood exposures result in cognitive, emotional and social developmental deficits placing these children on this negative life course trajectory through either biological changes (e.g., De Bellis and Zisk 2014) and/or through unhealthy lifestyle choices and mental health issues during adolescence (e.g., Dong et al. 2004; Lee et al. 2014).

Childhood developmental deficits resulting from growing up in a family prone to adverse childhood experiences (ACEs) are linked to poor school-readiness and scholastic performance (Boivin and Hertzman 2012). While deficits in emotional, cognitive, and social development have been key concerns linking school-readiness to ACEs, one domain for school readiness, specifically physical development (i.e., motor coordination), has been overlooked. Severe deficits in motor coordination, either fine and gross motor skills, have been labelled as developmental coordination disorder, or DCD. Children with deficits in motor coordination have been shown to do more poorly in school and manifest higher rates of emotional and behavioral problems in middle and high school (Cairney et al. 2010).

We are not aware of any published studies that assess physical developmental delays in young children in connection with ACEs and maltreatment. In this study, we examine whether preschool children exposed to maltreatment also manifest deficits in physical development. Second, we

examine whether any deficits in physical development differ across types of maltreatment.

Methods

The data come from a recent program evaluation of the Therapeutic Interagency Preschool (TIP) at the Cincinnati Children's Hospital Medical Center (CCHMC). The CCHMC ethics review board approved the use of these data for research and publication. TIP is an enhanced Head Start preschool program that incorporates a seamless integration with child welfare and mental health services (see Sites et al. 2007). Children are referred to TIP through Children Services or community providers due to concerns for development, behavior, and/or home placement instability. Upon referral, a complete family history and child assessment is taken and any information from the referring agencies is captured.

Of the total 78 children referred to TIP during the evaluation, 44 (54.6%) were reported by the caregiver to have experienced maltreatment. Maltreatment was measured using the Childhood Trauma Events Survey (CTES 2.0) Caregiver form, a 26-item inventory adapted from the Traumatic Stress Survey (Baker et al. 1998). It was completed by the caregiver at the time of intake along with a series of other assessments. Various items were collapsed to identify physical, sexual, and emotional/verbal abuse as well as domestic violence. While many other children referred to TIP likely experienced maltreatment, it was not identified by the current caregiver so they were not included in the final analysis.

Physical development assessments were conducted by trained OTs and PTs on 77 children to assess delays in fine motor skills and 52 to assess gross motor skills using the Peabody Developmental Motor Scale (PDMS-2) (Folio and Fewell 2000). The Peabody is a standardized screening assessment used for children from birth through five years of age providing standardized scores and percentile ranks based on a large normative sample of typically developing children at the same age and is a discriminative measure demonstrating excellent validity and reliability (Tieman et al. 2005). It assesses numerous dimensions and provides two summative scores including fine motor and gross motor development. Gross motor development is based on four categories including reflexes, stationary and locomotion motor skills, and object manipulation. Fine motor development is based on grasping and visual-motor integration (Folio and Fewell 2000).

Additional demographic data include sex, age, and number of home placements prior to referral to TIP. These data were

collected from various sources including the CCHMC intake database and the community referral agencies.

Results

Table 1 presents a profile of children referred to TIP ($N = 78$) and those with caregiver-reported maltreatment ($N = 44$). Almost 60% of the maltreated children were male and over 60% were 3 years of age. In both groups, the majority had at least one home placement prior to TIP while many had 3 or more indicating a highly unstable home environment. The prevalence of caregiver-reported maltreatment of the children overall was 56.4%. Among those children with caregiver-reported maltreatment, 13.6% experienced sexual abuse, 43.2% experienced physical abuse, 40.9% experienced verbal and/or emotional abuse and 81.8% experienced domestic violence.

Overall, children reported to have been exposed to maltreatment showed high rates of impaired motoric

Table 1 Demographic profile and prevalence of exposure among children referred to TIP for preschool services and those with caregiver-reported maltreatment

	Total TIP referrals ($N = 78$)	Maltreated group ($N = 44$)
Sex		
Male	59%	56.8%
Female	41%	43.2%
Age		
2	2.5%	2.3%
3	63.7%	63.6%
4	31.3%	31.8%
5	2.5%	2.3%
Race		
Caucasian	41.3%	47.7%
African american	51.2%	45.5%
Biracial	7.5%	6.8%
Placements prior to TIP		
0	7.5%	4.5%
1	43.8%	50.0%
2	25.0%	29.5%
3 or more	23.9%	15.9%
Child maltreatment		
Any maltreatment	56.4%	100%
Sexual abuse	-	13.6%
Physical abuse	-	43.2%
Verbal and emotional abuse	-	40.9%
Domestic violence	-	81.8%

Table 2 Motor coordination profile of children referred to tip with caregiver-reported maltreatment

Motor coordination domains	Average standard score	Percent scoring below clinical threshold (5th percentile)	Percent scoring below subclinical threshold (15th percentile)
Fine Motor (<i>N</i> = 43)	Mean = −0.89; Mode = −1.40	20.9%	44.2%
Gross Motor (<i>N</i> = 27)	Mean = −0.83; Mode = −1.00	14.8%	25.9%
Overall motoric assessment (<i>N</i> = 43)	n/a	35.7%	65.6%

development compared to the published norms of the PDMS-2 (Table 2). The mean score for both fine and gross motor skills was about −0.80 standard deviation below published norms while the modal average was −1.40 for fine motor skills and −1.00 for gross motor skills. In addition, the number of children scoring in the clinical range (below 5th percentile) for fine and gross motor coordination were between 3 and 4 times higher than expected. Examining the subclinical threshold (below 15th percentile), 44.2% and 25.6% maltreated children had scores below the threshold for fine and gross motor skills respectively. Overall, there were more children scoring in the clinical and subclinical range for fine motor skills than gross motor skills. Combining fine and gross motor skills to assess any motoric delay among maltreated preschool children, 35.7% scored in the clinical range while 65.6% scored in the combined clinical and subclinical range indicating a high level of motoric deficits.

In Table 3, there is a higher percentage of children for each type of maltreatment scoring in the clinical and subclinical range for fine motor coordination compared to gross motor coordination. Moreover, those exposed to either sexual or physical abuse were more likely to be in the clinical range manifesting deficits in both fine and gross motor coordination and overall motoric development. Cumulative exposure to maltreatment shows similar differences across fine and gross motor coordination but does not reveal a notable pattern based on increases in the types of exposure.

Discussion

Aware of no other published study examining maltreatment and motor coordination, this study provides preliminary evidence of a high prevalence of motoric deficits among maltreated preschool children. Albeit limited due to its small sample size and its focus on an extremely high-risk population, this study is novel in that it identifies the need to consider physical developmental deficits in addition to cognitive, emotional, and social deficits in assessing school readiness. Moreover, as there is some evidence linking motoric deficits to later cognitive, social, and emotional issues (Cairney et al. 2010), the interaction between physical development and other developmental domains is an important area for further study. As well, to confirm the present findings, it is necessary to expand this work by examining child maltreatment, ACEs, and physical development in larger, community-level populations.

To conclude, deficits in any developmental domain including motor development can have a detrimental effect on school readiness and success for maltreated children further cementing their likelihood of a negative life-course trajectory as described above. Assessing physical development as an element of school readiness and implementing interventions that address these deficits in addition to other developmental deficits can increase the likelihood of school success for these children, an important phase to alter their life-course toward more positive longer-term outcomes (Boivin and Hertzman 2012).

Table 3 Percentage of children exposed to maltreatment scoring below clinical and subclinical thresholds for motoric developmental delay by type of maltreatment

Maltreatment	Fine motor coordination		Gross motor coordination		Overall motoric development	
	Clinical threshold (5th percentile)	Subclinical threshold (15th percentile)	Clinical threshold (5th percentile)	Subclinical threshold (15th percentile)	Clinical threshold (5th percentile)	Subclinical threshold (15th percentile)
Sexual abuse ^a	33.3%	66.7%	33.3%	33.3%	66.7%	80.0%
Physical abuse	31.6%	42.1%	18.2%	18.2%	46.2%	57.1%
Verbal/ emotional abuse	22.2%	22.2%	9.1%	18.2%	30.8%	38.5%
Domestic violence	20.0%	42.9%	13.0%	21.7%	34.8%	61.5%

^a The motor coordination data for child victims of sexual abuse should be interpreted with caution due to small cell sizes

Compliance with Ethical Standards

Conflicts of Interest Terrance J. Wade has received financial compensation as a statistical and program evaluation consultant with the Therapeutic Interagency Preschool (TIP) Program and Cincinnati Children's Hospital. All other authors have no declared conflict of interest.

References

- Baker, D. B., Boat, B. W., Grinvalsky, H. T., & Geraciotti, T. D. (1998). Interpersonal trauma and animal-related experiences in female and male veterans: Implications for program development. *Military Medicine*, 163(1), 20–25.
- Boivin, M., & Hertzman, C. (Eds.). (2012). *Early childhood development: Adverse experiences and developmental health*. Royal Society of Canada - Canadian academy of health sciences expert panel. Ottawa: Royal Society of Canada.
- Cairney, J., Veldhuizen, S., & Szatmari, P. (2010). Motor coordination and emotional-behavioral problems in children. *Current Opinion in Psychiatry*, 23, 324–329.
- De Bellis, M. D., & Zisk, A. (2014). The biological effects of childhood trauma. *Child and Adolescent Psychiatric Clinics of North America*, 23(2), 185–222.
- Dong, M., Giles, W. H., Felitti, V. J., Dube, S. R., Williams, J. E., Chapman, D. P., & Anda, R. F. (2004). Insights into causal pathways for ischemic heart disease: Adverse childhood experiences study. *Circulation*, 110(13), 1761–1766.
- Felitti, V. J. (2009). Adverse childhood experiences and adult health. *Academic Pediatrics*, 9(3), 131–132.
- Felitti, V. J., Anda, R. F., Nordenberg, M. D., Williamson, D. F., Spitz, A. M., Edwards, B. A., et al. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The adverse childhood experiences (ACE) study. *American Journal of Preventive Medicine*, 14(4), 245–258.
- Folio, M. R., & Fewell, R. R. (2000). *Peabody developmental motor scales*. Chicago: Riverside Publisher.
- Lee, C., Tsenkova, V., & Carr, D. (2014). Childhood trauma and metabolic syndrome in men and women. *Social Science and Medicine*, 105, 122–130.
- Sites, H. J., Wade, T. J., & Putnam, F. (2007). Integrating mental health, education, and child welfare interventions for preschoolers with severe maltreatment histories: Ohio's therapeutic interagency preschool (TIP) model. *The American Professional Society on the Abuse of Children (APSAC) Advisor*, 19(1), 6–12.
- Tieman, B. L., Palisano, R. J., & Sutlive, A. C. (2005). Assessment of motor development and function in preschool children. *Mental Retardation and Developmental Disabilities Research Reviews*, 11, 189–196.