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Investigating the causal relationship between maltreatment and cognition in children: A systematic review

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ABSTRACT

Background: Cognitive impairment (i.e. lower IQ/cognitive development) in individuals who have experienced childhood maltreatment is well documented in the literature. It is not yet clear whether maltreatment itself causes cognitive impairment, or whether reduced cognitive functioning pre-dates maltreatment exposure and places children at risk of maltreatment.
Objective: This systematic review critically evaluated the evidence for a causal association between child maltreatment and impaired cognition in children under 12 years.
Methods: Following PRISMA guidelines, databases were searched and articles extracted according to inclusion criteria. Quality rating of articles was conducted independently by two reviewers and the evidence for a causal association was evaluated using guidelines based on the Hill criteria for causation in epidemiological and public health research.
Results: 31 articles were included in the review, with results that suggested lower IQ/cognitive development in maltreated children compared to controls, and a dose-response relationship between timing and duration of maltreatment and impaired cognition. Assessment of causality indicated strong evidence for a causal association between maltreatment and reduced overall cognitive performance in institutionalised children. Findings were less robust for non-institutionalised samples. Evidence regarding specific cognitive functions was mixed.
Conclusions: Extreme maltreatment may lead to reduced cognitive functioning in children under 12 years. More research is required to determine the impact of the nature and timing of maltreatment, as well as additional heritable and social factors, on specific profiles of cognition in this population.

1. Introduction

Child maltreatment, including emotional, physical or sexual abuse, or neglect, can be regarded as a form of "toxic stress" linked to dysregulation of the human stress response (Alink, Cicchetti, & Kim, 2012; Young-Southward, Svelnys, Gajwani, Bosquet Enlow, & Minnis, 2019) and to alterations in the brain (Pechtel & Pizzagalli, 2011). Several systematic reviews have documented impaired cognitive functioning (lower IQ/cognitive development) in adults (Irigary et al., 2013) and school-aged children (Maguire et al.,

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2015) who have experienced childhood maltreatment. One such review reported associations between duration, severity, type and timing of maltreatment and cognition in children and adolescents (Kavanaugh, Dupont-Frechette, Jerskey, & Holler, 2017).

Cognitive impairment in maltreated children is hypothesised to result from disruptions to normal brain development as a result of the experience of maltreatment. Chronic exposure to stress in early life may impact upon specific areas of the brain that undergo protracted postnatal development, such as the prefrontal cortex and superior temporal gyrus (Pechtel & Pizzagalli, 2011). These areas are responsible for higher-order functions, such as aspects of executive functioning, and insults to these areas may explain impairment in cognition observed in this population. Evidence from longitudinal studies of institutionalised children support this hypothesis: length of time spent in institutionalised care is positively associated with the extent of cognitive impairment (Beckett et al., 2006; Castle et al., 1999; Loman, Wiik, Frenn, Pollak, & Gunnar, 2009; O'Connor et al., 2000; Rutter, Kreppner, & O'Connor, 2001) and once removed from the depriving environment, cognitive catch-up, with group scores increasing, and some entering the normal range has been demonstrated (Rutter & the English & Romanian Adoptees Study Team, 1998; Beckett et al., 2006; Nelson et al., 2007).

An alternative hypothesis is that vulnerabilities in the brain are a consequence of heritable or social factors, such as poverty, that are present prior to maltreatment. In an assessment of causality of childhood victimisation on cognitive impairment among individuals involved in large longitudinal studies in the UK and New Zealand, Danese et al. (2016) demonstrated that cognitive impairment pre-dated experiences of victimisation. Furthermore, children with developmental disorders are at greater risk of maltreatment (Olson & Jacobson, 2013); this could explain the higher prevalence of maltreatment documented in this population.

Limitations within the current literature restrict the potential of establishing a causal relationship between child maltreatment and cognitive impairment, should one exist. Many studies assessing IQ in maltreated children do not control for heritable factors (Pechtel & Pizzagalli, 2011) and cross-sectional, rather than longitudinal, study designs are often used to examine brain functioning following maltreatment exposure (Danese et al., 2016). Yingying, D'Arcy, Shuai, and Xiangfei (2019) conducted a systematic review of 11 prospective studies evaluating cognition among children exposed to maltreatment. They concluded that childhood maltreatment was associated with cognitive functioning but they were unable to judge whether maltreatment *causes* cognitive impairment or vice versa.

1.1. Criteria for establishing causal relationships

The Hill criteria (1965) have long been used to evaluate causal relationships in epidemiology and public health research. Recent reappraisal of the Hill criteria (see Panel 1) suggests a careful focus on separating probabilistic (i.e likely) associations from causality, scrutiny of potential mechanistic processes, and replicability in more than one study (Howick, Glasziou, & Aronson, 2009). Examining existing studies using these guidelines may help to evaluate the evidence for causality in the association between child maltreatment and cognitive functioning.

Panel 1. Revised Hill criteria for causal relationships

- Size of effect not attributable to plausible confounding
- Appropriate temporal and/or spatial proximity
- Dose-responsiveness
- Reversibility (if the cause is removed then the effect should also disappear)
- Plausible mechanism of action
- Coherence
- Replicability
- Similarity

To this end, the purpose of this systematic review is to synthesise the evidence examining an association between child maltreatment and cognitive impairment, and to assess whether a causal relationship between child maltreatment and cognitive impairment can be established using the updated Hill criteria proposed by Howick et al. (2009). Because interventions to minimise possible long-term consequences of impairments in cognitive functioning rely on prompt identification of children with such difficulties (Maguire et al., 2014), this review focused on children under the age of 12 years. This systematic review aimed to address the following question: what is the evidence for a causal relationship between experiences of maltreatment and cognitive impairment in children under 12 years?

2. Method

Preferred Reporting Items for Systematic reviews and Meta analyses (PRISMA) guidelines were followed. PsycInfo (1981–2019), Embase (1996–2019) and Medline (1996–2019) were searched using the following terms:

1 Child* N4 (abus* OR neglect* OR maltreat* OR institutional* OR postinstitutional*)
2 (Cognit* OR intellectual* OR neurocognit*) N4 (impair* OR deficit* OR dysfunction OR function* OR performance OR outcome*)
3 1 and 2 were combined with AND.

The final search was conducted in July 2019. Reference sections of included articles were screened to ensure that no relevant articles were missed. Articles that were available in English were selected based on the following inclusion criteria:

- Children aged 0–12 years.
- Association between child maltreatment (verified by child protection agencies or equivalent) and performance-based cognition (including general intelligence, memory, executive functioning, processing speed, verbal comprehension, perceptual reasoning) assessed. Articles utilising parent/caregiver measures of cognition only were excluded because only weak and limited correlations between parent-rated and performance-based executive functioning have been found previously (e.g. Fay-Stammbach & Hawes, 2018).

Case reports, reviews, conference proceedings and theses were excluded. Besides type of article, there were no other exclusion criteria. A sub-sample of 20 % of titles and abstracts were screened by a second reviewer. Any differences in agreement were solved via conference.

Relevant data were extracted from each included study, and the Crowe Critical Appraisal Tool (CCAT, v1.4) was used to assess the quality of each study. The tool creates a score out of 5 for each of the following domains: preliminaries, introduction, design, sampling, data collection, ethical matters, results, and discussion, resulting in a total score out of 40. A score of < 20 was considered low quality; $20-30$ moderate quality, and > 30 high quality. Quality assessment of each article was completed independently by two reviewers. Any differences in agreement (25 % of papers) were solved via conference.

Causality of the association between child maltreatment and cognition was assessed using the revised Hill (1965) guidelines for causation (Howick et al., 2009) (Panel 1).

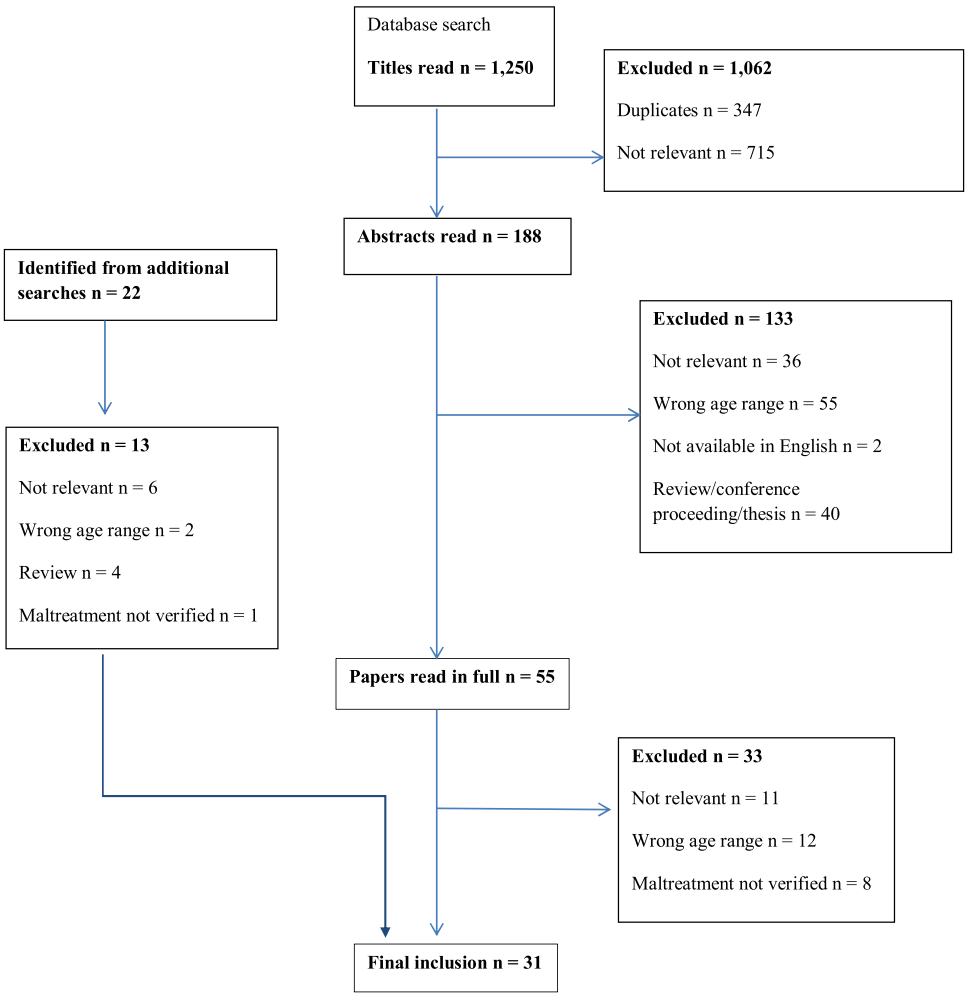

Fig. 1. Inclusion and exclusion of articles.

3. Results

The search yielded a total of 1250 articles. 347 duplicates were removed, along with 715 articles that were clearly not relevant (see Fig. 1). 188 abstracts were screened, and 55 articles were read in full. 22 articles met the inclusion criteria. The reference sections of included articles were screened, yielding an additional 9 articles for inclusion. 31 articles were included in the review. All articles were assessed as being of high or moderate quality (CCAT score > 20). Tables 1 and 2 describe the characteristics of the included studies. These were heterogeneous in samples, methodologies and outcomes; as such, it was not possible to conduct a meta-analysis. A narrative synthesis of the findings was therefore conducted. The following section will present the findings from community samples of maltreated children, followed by the findings from samples of institutionalised children.

3.1. Findings from community samples of maltreated children

Seventeen articles presented cross-sectional findings from samples of children abused and/or neglected in family settings (Table 1: 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21). Findings related to general cognition point to worse performance among maltreated children, although significant findings were not present across all areas of cognition. In a sample of physically abused preschool children and controls, Friedrich, Einbender, and Luecke (1983) found significant differences on the verbal and memory scales of the MCSA, with physically abused children performing worse than controls. Sandgrund, Gaines, and Green (1974) collected data on IQ in abused or neglected children and controls aged 5 – 12 years, finding that 25 % of the abused sample, 20 % of the neglected sample, and 3% of the control sample exhibited an IQ of below 70. Crozier and Barth (2005) used data from the National Study of Child and Adolescent Wellbeing to show that 32.6 % maltreated children aged 6 – 11 years scored one standard deviation below the mean or lower on a measure of cognitive functioning compared to national norms. Augusti and Melinder (2012) measured executive functioning in 8 – 12-year-old maltreated children and controls. Maltreated children performed significantly worse on a spatial working memory task compared to controls.

Hoffman-Plotkin and Twentyman (1984) found that abused or neglected children aged 3 – 6 years had lower cognitive functioning than controls. In a sample of physically abused children and controls aged 1 – 6 years, Prasad, Kramer, and Ewing-Cobbs (2005) found lower cognitive ability among those who were abused. Kerr, Black, and Krishnakumar (2000) examined cognitive performance in 6-year-old children with histories of failure to thrive and maltreatment, maltreatment alone, or neither risk factor. Children with both risk factors had lowest cognitive scores; with maltreatment only intermediate scores; and with neither highest scores. Kocovska et al. (2012) reported IQ data on 5 – 12-year-old children with symptoms of indiscriminate friendliness and maltreatment histories and controls. Mean IQ among maltreated children was an average of 15 points lower than the control group.

Barrera, Calderon, and Bell (2013) compared neuropsychological performance in children who had experienced sexual abuse and had a diagnosis of PTSD; children who had experienced sexual abuse and did not have a diagnosis of PTSD; and controls. Regardless of PTSD, reduced attentional inhibition was associated with a history of sexual abuse, but most neuropsychological tests did not show a clear difference between groups. Spratt et al. (2012) found that children aged 3 – 10 years with a history of neglect or institutional rearing demonstrated lower cognitive scores compared to those with no history of neglect or adoption.

In contrast to other findings, Petrenko, Friend, Garrido, Taussig, and Culhane (2012) demonstrated that supervisory neglect was associated with higher verbal IQ scores in a sample of maltreated 9 – 11-year-olds. However, it must be noted that children in this group still scored on average half to a full standard deviation below the mean for normative samples on a measure of IQ. Pears, Kim, and Fisher (2008) examined cognitive functioning in association with profiles of maltreatment in maltreated foster children aged 3 – 6 years. Lower cognitive functioning was associated with profiles of neglect, physical abuse, or both. Nolin and Ethier (2007) attempted to differentiate 6 – 12-year-old children with neglect and/or physical abuse and comparison children using cognitive profiles. Physically abused neglected children demonstrated significantly lower scores than controls on measures of attention, visual-motor integration, mental calculation, and concept formation. Non-physically abused neglected children demonstrated significantly lower scores than controls on measures of auditory attention and visual-motor integration. Non-physically abused neglected children showed significantly higher scores than physically abused neglected children on measures of planning, control, self-regulation and problem-solving. Bucker et al. (2012) compared children aged 5 – 12 years with histories of maltreatment with controls on measures of IQ, working memory, attention, impulsivity and executive function. Maltreated children demonstrated worse performance than controls on tests of memory and attention, but no other significant differences were found. Further, maltreated children exhibited higher prevalence of subsyndromal symptoms than controls, which was associated with worse cognitive performance. DeBellis, Hooper, Spratt, and Woolley (2009) examined the cognitive impact of neglect on 3 – 12-year-old neglected children with and without PTSD, and controls. Neglected children showed significantly lower IQ, language, visual-spatial, learning/memory and attention/executive functions than controls. After controlling for IQ, all measures except visual-spatial remained significant.

Two studies provided evidence for dose-response relationships between maltreatment and cognition (10, 4). Pears and Fisher (2005) examined relationships among developmental delays and maltreatment and placement experiences in 3 – 6-year-old children in foster care. They found a moderate positive correlation between age at first foster care placement and executive functioning. Further, significant negative correlations were found between being placed into foster care due to neglect or emotional abuse and visuospatial processing, language, memory and executive functioning. Cowell, Cicchetti, Rogosch, and Toth (2015) looked at the impact of developmental timing of maltreatment on cognitive functioning in children aged 3 – 9 years compared to non-maltreated children. Maltreated children had significantly lower inhibitory control scores compared to controls but no significant differences between maltreated children and controls were found on memory or attention scores. Children who were maltreated in infancy had significantly worse performance than children who were maltreated later. Children who experienced maltreatment during a single

Table 1
Included studies of community samples, organised via CCAT score.

	Authors/date	Study design	Outcomes	Participants (n, age, country, recruitment)	Type of maltreatment	Cognitive domains and assessment	Confounders controlled for	Limitations	CCAT Score (Max = 40)	Bradford Hill Criteria (Max = 7)
1	Bosquet Enlow et al. (2012)	Longitudinal: assessments at 2, 5 and 8 years old.	Influence of timing of maltreatment exposure on the magnitude and persistence of cognitive impairment.	Data from the Minnesota Longitudinal Study of Parents and Children, USA. Children (n = 206) whose mothers were recruited during pregnancy from hospitals.	Physical abuse, emotional abuse or neglect, sexual abuse, witnessing maternal partner violence, identified via observations, interviews, and reviews of medical and child protection records.	General cognitive performance. Bayley, WPPSI, WISC.	Race, gender, SES, maternal IQ, birth complications, birth weight, cognitive stimulation in the home.	Small sample size	33	6
2	Strathearn et al. (2001)	Longitudinal: follow-up over 4 years.	Relationship between child maltreatment and cognitive development in extremely low birth weight infants.	Infants with low birth weight (n = 352) recruited from a hospital, Australia.	Physical abuse, sexual abuse, emotional abuse or neglect, identified via Families Youth and Community Care Queensland reports.	IQ GQ, GCI	Birth weight, gestation, small for gestational age status, gender, multiple births, requirement for home oxygen, grade 3–4 periventricular haemorrhage, moderate to severe ventricular dilation, necrotizing enterocolitis, retinopathy of prematurity, maternal age, race, marital status, maternal education, hospital insurance status.	No non low birth weight control group.	33	6
3	DeBellis et al. (2009)	Cross-sectional	Neurocognitive impact of neglect.	Children age 3 − 12 years. Neglected children with PTSD (n = 22), neglected children without PTSD (n = 39) recruited through Departments of Social Services, and controls (n = 45) recruited through schools and paediatric clinics, USA.	Neglect identified through the Department of Social Services.	IQ, fine motor skills, language, visual-spatial, memory/ learning, attention/ executive functions. NEPSY, CPT, PPVT-3, WISC-III/WPPSI-R, WJ-III, WASI.	IQ.	Small sample size.	32	4

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Table 1 (*continued*)

	Authors/date	Study design	Outcomes	Participants (n, age, country, recruitment)	Type of maltreatment	Cognitive domains and assessment	Confounders controlled for	Limitations	CCAT Score (Max = 40)	Bradford Hill Criteria (Max = 7)
4	Cowell et al. (2015)	Cross-sectional.	Effect of childhood maltreatment on neurocognitive functioning based on developmental timing of maltreatment (including onset, chronicity and recency).	Maltreated (n = 223) children age 3 – 9 years recruited from the Department of Human Services. Non-maltreated (n = 136) children aged 3 – 9 years matched for SES recruited from families receiving Temporary Assistance to Needy Families, USA.	Sexual abuse, physical abuse, emotional maltreatment or neglect, identified through child protection services records.	Inhibitory control, working memory, memory, attention. Day-night Stroop-like task, tapping task, three pegs task, Corsi-Milner test of temporal order and recognition memory, six boxes task, global-local spatial processing task, line bisection task.	Age.	Parental characteristics not controlled for.	31	6
5	Bucker et al. 2012)	Cross-sectional.	Comparison of cognitive function in children compared with age- and sex-matched controls.	Children with early trauma (n = 30), age 5 – 12 years, recruited from a child protection programme and a foster care home in Brazil. Age- and sex- matched children without early trauma (n = 30) recruited from community primary health care centres, a school, and a university paediatric clinic.	Sexual abuse, maltreatment or neglect identified via child protection services.	IQ, working memory, attention, impulsivity and executive function. Vocabulary, block design and digit-span subtests of the WISC-III, WCST, CPT.	Age, sex.	Small sample size.	31	4
6	Nolin and Ethier (2007)	Cross-sectional.	Differentiation of neglected children with or without physical abuse from comparison children using cognitive profiles.	Children age 6 – 12 years with histories of neglect and physical abuse (n = 56) and neglect without physical abuse (n = 28) recruited from child protection services. Comparison children (n = 53) recruited from schools, Canada.	Neglect with or without physical abuse, identified through child protection services.	Motor performance, attention, learning, visual-motor integration, language, executive function, intelligence. Purdue Pegboard, NEPSY, CVLT-C, VMI, WISC-III.	SES.	Only examined physical abuse and neglect.	31	4
7	Pears et al. (2008)	Cross-sectional.	Profiles of maltreatment and their association with cognitive functioning, internalising and externalising problems.	Maltreated foster children (n = 117) aged 3 – 6 years recruited from child welfare system, USA.	Physical abuse, sexual abuse, physical neglect, supervisory neglect, emotional maltreatment, identified through child welfare case records.	Cognitive functioning, neuropsychological functioning and language development. WPPSI-R, NEPSY, PLS-3.		Small sample size.	31	3

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Table 1 (*continued*)

	Authors/date	Study design	Outcomes	Participants (n, age, country, recruitment)	Type of maltreatment	Cognitive domains and assessment	Confounders controlled for	Limitations	CCAT Score (Max = 40)	Bradford Hill Criteria (Max = 7)
8	Scarborough et al. (2009)	Longitudinal: assessments at 18- and 36-months following investigation of maltreatment.	Relationship among child, caregiver and maltreatment characteristics and low scores on developmental measures.	Data from the National Survey of Child and Adolescent Wellbeing, USA. Maltreated children age 0 – 3 years (n = 997).	Physical, sexual or emotional abuse, neglect identified through child protection services.	Global development. BDI, VABS, KBIT, PLS.		No non-maltreated comparison group.	30	5
9	Petrenko et al. (2012)	Cross-sectional.	Effects of maltreatment subtypes on cognitive, academic and mental health functioning.	Children age 9 – 11 years (n = 334) recruited to an RCT for the Fostering Healthy Futures programme.	Physical abuse, sexual abuse, physical neglect, supervisory neglect identified from child welfare records.	IQ K-BIT.		No non-maltreated comparison group	30	1
10	Pears and Fisher (2005)	Cross-sectional.	Types of developmental delays observed in young children in foster care and how placement and maltreatment experiences are associated with these delays	Children age 3 – 6 years in foster care (n = 99) recruited through the child welfare system. Comparison children (n = 54) recruited via advertisements in supermarkets, day care centres, Head Start classrooms and newspapers/ newsletters, USA.	Physical abuse, sexual abuse, emotional abuse, neglect, identified through child protection services.	Language, attention/ executive function, visuospatial processing, sensorimotor function, memory, learning, general cognitive function. NEPSY, block design and vocabulary sub-tests of the WPPSI-R, PLS-3, stroop task, card sort task	Whether the child was new to foster care.	Parental characteristics not controlled for.	29	4
11	Spratt et al. (2012)	Cross-sectional.	Impact of neglect on children's cognition, language, behaviour and parenting stress.	Children age 3 – 10 years with history of physical or emotional neglect (n = 17), adopted from international institutions (n = 15), and with no history of neglect or adoption (n = 28) recruited through medical/ mental health practitioners or through flyers, USA.	Physical or medical neglect, physical abuse, sexual abuse or emotional abuse identified through child protection services.	Cognitive functioning, language. DAS, TELD or TOLD.	Annual household income.	Small sample size.	28	3

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Table 1 (*continued*)

	Authors/date	Study design	Outcomes	Participants (n, age, country, recruitment)	Type of maltreatment	Cognitive domains and assessment	Confounders controlled for	Limitations	CCAT Score (Max = 40)	Bradford Hill Criteria (Max = 7)
12	Barrera et al. (2013)	Cross-sectional.	Neuropsychological functioning in abused children compared to controls.	Children age 8 – 12 years (n with sexual abuse histories and PTSD symptoms = 13; n with sexual abuse history and no PTSD symptoms = 26) recruited from an organisation supporting children affected by sexual abuse who were involved in legal action against their alleged abusers. Controls (n = 37) recruited from a school, Colombia.	Sexual abuse identified via recruitment organisation.	Neuropsychological functioning. MINI, TMT, CVLT, Ray-Osterrieth Complex Figure Task, Stroop Test, WCST.		Small sample size.	27	3
13	Kocovska et al. (2012)	Cross-sectional.	Neurodevelopmental difficulties in maltreated adopted children.	Children age 5 – 12 years. Children with history of severe maltreatment and symptoms of indiscriminate friendliness (n = 34) recruited via Adoption UK charity. Comparison children (n = 32) recruited via medical practices, UK.	Physical abuse, sexual abuse, emotional neglect or physical neglect identified via social work records.	IQ WASI.		Small sample which may be skewed due to recruitment via adoption charity.	27	3
14	Kerr et al. (2000)	Cross-sectional.	Relationship between failure to thrive, maltreatment cognitive performance, adaptive functioning at school, classroom behaviour and home behaviour.	6-year-old children (n = 193; n with maltreatment only = 21; n with maltreatment and failure to thrive = 28) recruited from paediatric clinics, USA.	Neglect, physical abuse or sexual abuse, identified through child protection services.	Cognitive performance. Vocabulary and block design subtests of WPPSI-R.	Age, gender, SES.	No examination of mechanisms underlying associations	26	4
15	Prasad et al. (2005)	Cross-sectional.	Cognitive, motor and language skills of physically abused pre-schoolers.	Physically abused children age 1 – 6 years (n = 19) recruited from hospitals. Comparison children (n = 19) recruited from hospitals, subsidised clinics, and community notices, USA.	Physical abuse identified through child protection services and child protection committee at hospitals.	General cognitive ability, language, motor skills. Bayley-II or Stanford-Binet Intelligence Scales-IV, MSCA, SICD or CELF (Preschool or Third Edition).		Small sample size.	26	3

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Table 1 (*continued*)

	Authors/date	Study design	Outcomes	Participants (n, age, country, recruitment)	Type of maltreatment	Cognitive domains and assessment	Confounders controlled for	Limitations	CCAT Score (Max = 40)	Bradford Hill Criteria (Max = 7)
16	Hoffman-Plotkin and Twentyman (1984)	Cross-sectional.	Behavioural and cognitive functioning in abused and neglected children compared to controls.	Children age 3 − 6 years with a history of child abuse or neglect (n = 28) recruited via social services or no history of maltreatment (n = 14) recruited through local day care centres, Canada.	Physical abuse, neglect, identified through social services.	Cognitive functioning. PPVT, Stanford-Binet Intelligence Scale, Merrill-Palmer Scale of Mental Tests.		Small sample size.	26	3
17	Augusti and Melinder (2013)	Cross-sectional.	Executive functioning in maltreated children compared to non-maltreated peers.	Children age 8 − 12 years. Maltreated children (n = 21) recruited through child protection services and domestic violence shelters. Non-maltreated children (n = 22) recruited from schools, Norway.	Physical abuse, witnessing violence, neglect identified via child protection services.	Executive function. WASI, CANTAB, D-KEFS colour-word interference test.		Small sample size.	26	4
18	Crozier and Barth (2005)	Cross-sectional.	Cognitive functioning and academic achievement in maltreated children.	Data from the National Survey of Child and Adolescent Wellbeing. Maltreated children aged 6 − 11 years (n = 814), USA.	Physical abuse, sexual abuse, neglect, 'other' identified through child welfare services.	IQ. K-BIT.	Age, gender, race, ethnicity, maltreatment type, poverty, prior history of child welfare services involvement, caregiver mental health problems, clinical behaviour problems.	No non-maltreated comparison group.	26	4
19	McNichol and Tash (2001)	Longitudinal: assessments 18 months apart.	Impact of parental substance abuse on cognition and behaviour in children.	Children age 5 − 7 years (n = 268) recruited via a family foster care agency, USA.	Physical abuse, neglect, prenatal exposure to illegal drugs, parental substance abuse, parental mental illness, sexual abuse, domestic violence, identified via social work.	IQ. WISC, McCarthy scales, KABC.		No non-maltreated comparison group.	22	6

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Table 1 (*continued*)

	Authors/date	Study design	Outcomes	Participants (n, age, country, recruitment)	Type of maltreatment	Cognitive domains and assessment	Confounders controlled for	Limitations	CCAT Score (Max = 40)	Bradford Hill Criteria (Max = 7)
20	Sandgrund et al. (1974)	Cross-sectional.	Impact of child abuse and neglect on cognitive development.	Children age 5 − 12 years (abused n = 60; neglected n = 30) recruited from families receiving public assistance. Non-maltreated children (n = 30) recruited from a paediatric hospital, USA.	Abuse, neglect identified via child protection agencies.	IQ WPPSI, WISC.		Small sample size.	21	4
21	Friedrich et al. (1983)	Cross-sectional.	Cognitive differences among abused and non-abused preschool children.	Children aged 3 − 5 years. Physically abused children (n = 11) recruited via a day programme for abused children. Controls (n = 10) recruited via a Head Start programme, USA.	Physical abuse identified via child protection services.	Cognition. MSCA, WRAT.		Small sample size.	20	3

Abbreviations: Bayley Bayley scales of infant development; BDI Battelle screening test; CANTAB Cambridge neuropsychological test automated battery; ; CAPI Child Abuse Potential Inventory; ; CELF Clinical evaluation of language fundamentals; CPT Continuous performance task; CVLT-C California verbal learning test for children; DAS Differential abilities scale for children; DCCS Dimensional change card sort; DDS Denver Developmental Scales; D-KEFS Delis-Kaplan executive function system; GCI McCarthy general cognitive index; GQ Griffiths general quotient; IQ intelligence quotient; KABC Kaufman assessment battery for children; K-BIT Kaufman brief intelligence test; MCA Minnesota comprehensive assessment; MSCA McCarthy scale of children's abilities; NEPSY Developmental neuropsychological assessment; PCCTS Parent Child Conflict Tactics Scale; PLS Preschool language scale; PPVT Peabody picture vocabulary test; PTSD Post traumatic stress disorder; SES socioeconomic status; SICD sequenced inventory of communication development; TELD Test of early language development; TOLD Test of language development; USA United States of America; VABS Vineland adaptive behaviour scale; VMI Beery Buktenica developmental test of visual-motor integration; WASI Wechsler abbreviated scale of intelligence; WCST Wisconsin card sorting task; WISC-III Wechsler intelligence scale for children-III; WJ-III Woodcock-Johnson tests of cognitive abilities-III; WPPSI-R Wechsler preschool and primary scale of intelligence-revised; WRAT Wide Range Achievement Test.

Table 2
Included studies of institutionalised samples, organised via CCAT score.

	Authors/ date	Study design	Outcomes	Participants (n, age, country, recruitment)	Cognitive domains and assessment	Confounders controlled for	Limitations	CCAT Score (Max = 40)	Hill Criteria (Max = 7)
22	Nelson et al. (2007)	Longitudinal: assessments took place at 4 time points.	Cognitive development in post-institutionalised children.	Data from the BEIP. Institutionalised children (n = 136), half of whom remained in institutions and half of whom were allocated to foster care. Never institutionalised controls (n = 72) recruited from community paediatric clinics. Cognitive assessments took place at baseline, 30 months, 42 months and 54 months.	Cognitive development. Bayley-II or WPPSI-R.	Birth weight, gender.	No data on characteristics of institutionalised children's birth families.	31	N/A
23	O'Connor et al. (2000)	Longitudinal: assessments took place at age 4 and 6 years.	Cognitive development and catch-up in neglected children.	Data from the ERAS. Romanian adoptees (n = 165; placed before 24 months = 117, placed after 24 months n = 48) and UK adoptees (n = 52) age 4−6 years recruited through adoption agencies and social services departments.	Cognitive development. MSCA.	Gender.	No data on characteristics of institutionalised children's birth families.	31	6
24	Beckett et al. (2006)	Longitudinal assessments at age 6 and 11 years old.	Cognitive outcomes in post- institutionalised children.	Data from the ERAS. Romanian adoptees (n = 131). UK adoptees (n = 50) recruited via adoption agencies.	General cognitive performance. MSCA, WISC.	Year of adoption, parental motivation to adopt, age at placement.	No data on Romanian adoptees' experiences prior to UK entry.	30	6
25	Bauer et al. (2009)	Cross-sectional.	Role of early deprivation in maturation of the cerebellum and aspects of cognitive development.	Children age 9−12. Post-institutionalised children (n = 31) recruited from Wisconsin International Adoption Project registry. Controls (n = 30) recruited from community advertisements, USA.	Memory, executive function, attention. CANTAB.	Duration of institutionalisationheight/weight at adoption, country of origin, condition of orphanage setting.	Small sample size.	30	4
26	Loman et al. (2009)	Cross-sectional.	Developmental outcomes of post-institutionalised children.	Children age 8−11 years (post-institutionalised n = 91; internationally adopted early from foster care n = 109; non-adopted n = 69). Adopted children recruited from the Minnesota International Adoption Registry. Non-adopted children recruited from university registry of community families, USA.	IQ. Block design and vocabulary subtests of the WISC-III or Leiter International Performance Scale-Revised.		Lack of data on pre-adoption experiences.	29	4
27	Rutter et al. (2001)	Longitudinal: assessments took place at age 4 years and age 6 years.	Behavioural patterns associated with early deprivation.	Data from the ERAS. Romanian adoptees who came to the UK before age 3.5 years (n = 156) and UK adoptees placed before age 6 months (n = 50).	General cognitive ability MCSA		No data on characteristics of institutionalised children's birth families.	28	5

(*continued on next page*)

Table 2 (*continued*)

	Authors/ date	Study design	Outcomes	Participants (n, age, country, recruitment)	Cognitive domains and assessment	Confounders controlled for	Limitations	CCAT Score (Max = 40)	Hill Criteria (Max = 7)
28	Pollak et al. (2010)	Cross-sectional.	Impact of early deprivation on cognitive processes.	Children age 8 – 9 years. Post-institutionalised children (n = 48) and early adopted children (n = 40) recruited through the Minnesota and the Wisconsin International Adoption Project registries. Non-adopted children (n = 44) recruited from advertisements and the Institute of Child Development Participant Pool, USA.	Memory, attention, executive control, learning. CANTAB, NEPSY, WISC.	Sex.	No data on characteristics of institutionalised children's birth families.	28	4
29	Rutter et al. (1998)	Longitudinal measures taken at entry to UK and age 4 years.	Developmental impairment and catch-up following adoption after early deprivation.	Data from the ERAS. Children age 4 years. Romanian adoptees who came to the UK before age 2 years (n = 111). UK adoptees placed before age 6 months (n = 52).	General cognitive ability. DDS, MCSA.		Measure of developmental level at entry to UK relied on parent's retrospective accounts.	27	5
30	Castle et al. (1999)	Longitudinal: assessments took place at age 4 years and age 6 years.	Impact of variations in quality of depriving environment and duration of institutional care on intellectual functioning.	Data from the ERAS. Romanian adoptees (n = 129), UK adoptees (n = 52).	IQ. MSCA.	Age at entry to UK, weight at entry to UK, quality of food in institution.	Quality of institutional care identified via parent report.	26	5
31	Hostinar et al. (2012)	Cross-sectional.	Executive functioning in post- institutionalised children.	Children age 2 – 4 years (n who had experienced institutional care = 60; n who had not experienced institutional care = 30).	Executive functioning. DCCS, spin the pots task, delay of gratification task.	IQ.	No data on characteristics of institutionalised children's birth families.	25	5

Abbreviations: Bayley – Bayley scales of infant development; BEIP – Bucharest Early Intervention Project; CANTAB – Cambridge neuropsychological test automated battery; DCCS – Dimensional change card sort; DDS – Denver Developmental Scales; ERAS – English and Romanian Adoptees Study; IQ – intelligence quotient; MSCA – McCarthy scale of children's abilities; NEPSY – Developmental neuropsychological assessment; UK – United Kingdom; USA – United States of America; WISC-III – Wechsler intelligence scale for children-III; WPPSI-R – Wechsler preschool and primary scale of intelligence-revised.

period of development performed as well as non-maltreated children, while children who experienced maltreatment during three or more developmental periods performed significantly worse than other children.

Four articles reported findings from longitudinal studies carried out in populations of children abused and/or neglected in a family setting (1, 2, 8, 19). Two studies examined factors associated with cognitive impairment in this population. Scarborough, Lloyd and Barth (2012) examined data on global development gathered at 18 and 36 months following an investigation of child maltreatment in 0 – 3-year-old children who took part in the National Survey of Child and Adolescent Wellbeing to identify factors associated with low scores on developmental measures at one or both time points. While case worker reports of special needs at the time of maltreatment investigation, living in poverty, caregiver cognitive impairment and caregiver lack of high school education were all associated with low scores, neglect and sexual abuse were more highly associated with low scores. Bosquet Enlow, Egeland, Blood, Wright, and Wright (2012) used data from the Minnesota Longitudinal Study of Parents and Children to examine the influence of maltreatment timing on cognitive outcomes, assessing children at 2, 5 and 8 years. Maltreatment in infancy, but not in preschool, was significantly associated with poor cognitive outcomes; those who were maltreated in infancy demonstrated cognitive scores 7.25 points lower on average than those without exposure during this period.

Two prospective longitudinal studies examined the impact of maltreatment on cognition over time. McNichol and Tash (2001) assessed IQ in children aged 5 – 7 years in family foster care twice over a period of 18 months, finding that they scored in the low range of cognitive functioning overall but demonstrated significant improvement in cognitive functioning over time. Strathearn, Gray, O'Callaghan, and Wood (2001) followed children referred for low birth weight over 4 years to show that cognition at 4 years was significantly reduced in infants who were referred for neglect, and that those with substantiated neglect showed progressive decline in cognitive function over time compared with non-neglected children, suggesting an association between neglect and reduced cognitive functioning.

In summary, cross-sectional studies of community samples of maltreated children demonstrate largely consistent findings of reduced cognitive performance generally in maltreated children compared to controls, with some discrepancies in findings related to specific cognitive functions. Additionally, data on dose-response relationships between maltreatment and cognition, as well as prospective longitudinal data demonstrating associations between maltreatment and impaired cognition are found in these samples.

3.2. Findings from samples of institutionalised children

Several cross-sectional studies have demonstrated associations between institutionalisation and cognitive functioning (Table 2: 25, 26, 28, 31). In a sample of 2 – 4-year-old post-institutionalised children, Hostinar, Stellern, Schaefer, Carlson, and Gunnar (2012) found that these children showed reductions in executive functioning compared to controls; effects which remained significant after controlling for child IQ. Pollak et al. (2010) examined the impact of early deprivation on cognition among post-institutionalised, early-adopted, and non-adopted children aged 8 – 9 years. Post-institutionalised children showed deficits in visual memory and attention and visually mediated learning and inhibitory control, but these same children performed at developmentally appropriate levels on tests involving auditory processing and executive processes. Loman et al. (2009) considered IQ in post-institutionalised children; children internationally adopted early from foster care, and non-adopted controls aged 8 – 11 years. Means for estimated IQ were in the average range for all groups. However, post-institutionalised children performed more poorly on cognitive measures compared to children adopted from foster care and non-adopted children. Moreover, increased time in an institution was related to lower performance. Bauer, Hanson, Pierson, Davidson, and Pollak (2009) measured cerebellar volume and performance across memory, attention and executive functioning in post-institutionalised children aged 9–12 years and controls. Post-institutionalised children had smaller superior-posterior cerebellar lobe volume, which mediated test performance between groups, with larger volumes yielding better results on tests of memory and planning.

Six high quality prospective longitudinal studies have demonstrated a dose-response relationship between length of time in the institution and degree of cognitive impairment as well as "cognitive catch-up", i.e. increase in group cognitive scores, in some cases entering the normal range, for some children. Five studies provided evidence from the ERAS (23, 24, 27, 29, 30) (Romanian adoptees n = 165; UK adoptees n = 52), demonstrating poor cognition in institutionalised Romanian children, with worse outcomes for those who spent more time in institutions, and some evidence of cognitive catch-up following placement in family homes. Castle et al. (1999) assessed IQ in adoptees at age 4 and 6 years, finding evidence for a strong dose-response relationship between age at entry to the UK and cognitive scores at age 6 years among Romanian adoptees that was a function of institutional care rather than time in the adoptive home. Rutter and the English and Romanian Adoptees Study Team (1998) showed that, within this sample, Romanian adoptees who came to the UK before age 2 years showed developmental delay, with over half functioning in the intellectually disabled range. Developmental catch-up by age 4 years among Romanian children placed before age 6 months was comparable with UK adoptees. Age of entry to the UK was the best predictor of cognitive ability at age 4 years. In Romanian adoptees who came to the UK before age 3.5 years, 14 % demonstrated cognitive impairment, compared with 2% of UK adoptees placed before age 6 months (Rutter et al., 2001). Furthermore, there was a significant association between cognitive impairment and age of entry to the UK, with greater impairment among those who were older at entry.

Adding to these findings, with the same sample, Beckett et al. (2006) found that Romanian children who entered the UK aged 6 months or above had an IQ that was 15 points on average below that of children who entered the UK before the age of 6 months, or within-UK adoptees. There was strong continuity in IQ overall across the follow up period, but the degree of impairment at age 6 years predicted cognitive catch-up, with only the most severely impaired showing significant catch-up by age 11. Furthermore, O'Connor et al. (2000) found evidence for a dose-response association between duration of deprivation during institutionalisation and lower cognitive scores at age 6 in this sample.

One unique randomised controlled trial (RCT) of foster care has shown that institutionalised care causes cognitive impairment, and placement in foster care is an effective intervention to reduce such difficulties (22). Nelson et al. (2007) report on data from cognitive assessments administered to children in the BEIP comprising (n = 136) institutionalised children, half of whom were allocated to foster care and half who remained in institutions, and (n = 72) never-institutionalised controls. Assessments took place at baseline, then 2.5 years, 3.5 years, and 4.5 years later. Institutionalised children showed lower intellectual performance than never-institutionalised children who had been raised within their birth families. Children randomly assigned to foster care experienced significant gains in cognitive functioning, with better outcomes for children who were placed at a younger age. Indeed, regression analysis revealed that the cost of remaining in an institution was 0.59 IQ points per month at age 4.5 years.

3.3. Causality assessment

Table 3 details the results of the causality assessment across included articles. Nelson et al. (2007) was excluded from the causality assessment as its randomised controlled design eliminates confounding. Articles most commonly met criteria for similarity, replicability and coherence. The least commonly met criteria related to confounding variables; while six articles included measures of birth parent IQ (or a proxy variable, such as household income) (1, 2, 6, 11, 14, 18), the remaining articles did not. Effects could therefore be attributable to differences between groups in heritable factors rather than maltreatment experiences. Ten studies (1, 2, 8, 19, 22, 23, 24, 27, 29, 30) were longitudinal in design, facilitating the measurement of change in cognition following maltreatment over time, and 11 (2, 4, 6, 19, 23, 24, 26, 27, 29, 30, 31) provided evidence for a dose-response relationship between maltreatment and cognition, finding that more neglectful institutional experiences, longer duration of maltreatment experiences and the occurrence of maltreatment within specific developmental periods or multiple periods were associated with poorer cognition. Fourteen studies (1, 2, 3, 4, 6, 10, 17, 19, 20, 23, 24, 25, 30, 31) discussed a plausible mechanism of action for the relationship between maltreatment and cognition, such as the deleterious impact of stress on the developing brain and consequent impacts on cognition. Overall, support for a causal relationship between maltreatment and cognition was found among institutional samples, as well as two high quality longitudinal studies of community samples of maltreated children.

4. Discussion

This systematic review sought to critically evaluate the evidence for an association between maltreatment and cognition in children under 12 years. Evidence for poor cognition in maltreated children compared to controls, and a dose-response relationship between timing and duration of maltreatment, as well as the quality of the neglectful environment was found. Findings in relation to specific areas of cognition were mixed; while evidence was found for worse performance across measures of executive functioning, attention, language and memory in maltreated children compared to controls, these findings were not consistently replicated across all the included studies.

Following the Howick et al. (2009) guidelines for assessing causality, this review found direct, mechanistic and parallel evidence that maltreatment causes cognitive impairment in children. Evidence for an association was demonstrated in cross-sectional studies, with worse general cognitive performance in maltreated children compared to controls established, but with mixed findings in relation to specific areas of cognition. Notably, when considering causality, the evidence from cross-sectional studies is weak, as the direction of causality could be from maltreatment to cognitive problems or vice versa. However, direct evidence for causality was also demonstrated in longitudinal studies, which by their design provide higher quality evidence with regards to causality. Firstly, longitudinal studies of children maltreated in a family setting and those raised in institutional environments demonstrate that abuse and/or neglect is associated with poor cognitive performance over time. Notably, causality should not be assumed on temporal order alone, and the findings from Danese et al. (2016) would suggest that cognitive dysfunction can precede maltreatment. However, studies of both institutionalised children and community samples also provide evidence for a dose-response relationship between timing and duration of maltreatment and cognitive outcomes, as well as evidence for cognitive catch-up once children were removed from maltreating environments. Finally, one randomised controlled trial, representing the highest quality evidence in assessing causality, has shown that institutionalised care causes cognitive impairment and placement in family foster care is effective in reducing difficulties. Notably, Glowinski (2011) cautions against generalising evidence from the BEIP and ERAS populations to maltreated children in community samples as the former represent populations who experienced extreme depriving conditions.

An important study that did not meet the inclusion criteria for this review is relevant to consider. Danese and colleagues (2016) used the UK E-Risk study (n = 2232) and the New Zealand Dunedin study (n = 1037) to examine the association between childhood violence victimisation and cognitive functioning in childhood, adolescence and adulthood. Although the authors found impairment in cognitive functioning among those exposed to childhood victimisation, this impairment was largely explained by cognitive difficulties that pre-dated victimisation exposure and confounding genetic and environmental factors. Indeed, among the studies in this review, Scarborough, Lloyd, and Barth (2009) demonstrated that parent cognition was one of several variables that was associated with child cognition, and a significant limitation of most studies was that such heritable factors were not controlled for. However, the results of studies that did control for this confounding variable in analysis (1), or a proxy variable such as family household income (2, 6, 11, 14, 18) echo those of studies that did not, offering tentative support to the hypothesis that maltreatment itself impacts upon cognition over and above genetic factors. Nevertheless, future research should aim to further explicate the relationships among genetic factors, maltreatment experiences, and cognition.

Not all included studies explored the mechanisms by which maltreatment and cognition may be associated. Those that did focused on the impact of chronic stress on the developing brain, in line with discussions in previous reviews on this topic (e.g. Pechtel &

Table 3
Causality Assessment.

	Article	Size of effect not attributable to plausible confounding	Appropriate spatial and/or temporal proximity	Dose-responsiveness and reversibility	Plausible mechanism of action	Coherence	Replicability	Similarity
1	Bosquet Enlow et al. (2012)	✓	✓		✓	✓	✓	✓
2	Strathearn et al. (2001)		✓	✓	✓	✓	✓	✓
3	DeBellis et al. (2009)				✓	✓	✓	✓
4	Cowell et al. (2015)	✓		✓	✓	✓	✓	✓
5	Bucker et al. (2012)	✓				✓	✓	✓
6	Nolin and Ethier (2007)	✓		✓	✓		✓	
7	Pears et al. (2008)					✓	✓	✓
8	Scarborough et al. (2009)	✓	✓			✓	✓	✓
9	Petrenko et al. (2012)						✓	
10	Pears and Fisher (2005)				✓	✓	✓	✓
11	Spratt et al. (2012)					✓	✓	✓
12	Barrera et al. (2013)					✓	✓	✓
13	Kocovska et al. (2012)					✓	✓	✓
14	Kerr et al. (2000)	✓				✓	✓	✓
15	Prasad et al. (2005)					✓	✓	✓
16	Hoffman-Plotkin and Twentyman (1984)					✓	✓	✓
17	Augusti and Melinder (2013)				✓	✓	✓	✓
18	Crozier and Barth (2005)	✓				✓	✓	✓
19	McNichol and Tash (2001)		✓	✓	✓	✓	✓	✓
20	Sandgrund et al. (1974)				✓	✓	✓	✓
21	Friedrich et al. (1983)					✓	✓	✓
22	Nelson et al. (2007)							
23	O'Connor et al. (2000)		✓	✓	✓	✓	✓	✓
24	Beckett et al. (2006)		✓	✓	✓	✓	✓	✓
25	Bauer et al. (2009)				✓	✓	✓	✓
26	Loman et al. (2009)			✓		✓	✓	✓
27	Rutter et al. (2001)		✓	✓		✓	✓	✓
28	Pollak et al. (2010)				✓	✓	✓	✓
29	Rutter and the English and Romanian Adoptees Study Team (1998)		✓	✓		✓	✓	✓
30	Castle et al. (1999)		✓	✓		✓	✓	✓
31	Hostinar et al. (2012)			✓	✓	✓	✓	✓

Pizzagalli, 2011; Kavanaugh et al., 2017). Evidence from this review lends further support to this argument; Bosquet Enlow et al. (2012) demonstrated that maltreatment occurrence in infancy but not preschool was significantly associated with cognitive impairment, and Cowell et al. (2015) found that those who were maltreated in infancy exhibited worse cognitive outcomes than those who were maltreated later. These results suggest that maltreatment during periods when the brain may be more sensitive to stress may lead to cognitive impairment. Moreover, Bosquet Enlow et al. (2012) reflect that the nature of maltreating parent-child relationships may also impact upon child cognition. Maltreatment at an earlier stage of development might result in greater exposure to such pathological social experiences; further, such experiences might occur both within a maltreating environment but also as a result of social, behavioural and affective difficulties demonstrated in this population (e.g. Maguire et al., 2014) possibly arising both due to and in combination with cognitive impairment. These experiences could result in a 'vicious cycle' of negative experiences and difficulties accessing education (e.g. Romano, Babchishin, Marquis, & Frechette, 2014), with further deleterious consequences for cognition.

Research in institutionalised populations has shown that iron deficiency as well as duration of institutional care is independently associated with cognitive outcomes in children (e.g. Doom et al., 2014) and that malnutrition status impacts upon rate of cognitive improvement (e.g. Park et al., 2011). The developmental catch-up observed in the ERAS can hence be compared with studies of community maltreated populations where similar results are not observed; for example, analysis of cognitive development among maltreated children (n = 32) aged 1 − 6 years recruited from the community to an intervention for children in foster care demonstrated only slight improvements over 30 months (personal communication of unpublished data). It is possible that several heritable and environmental factors interact in the relationship between maltreatment and cognition, with data from community and institutionalised samples reflecting a spectrum of experiences and outcomes.

Parallel evidence for an association between maltreatment and overall cognitive development/IQ in children was found, with

results consistently suggesting poorer outcomes in maltreated children compared to controls. The evidence in relation to specific areas of cognition is less coherent, with results not consistently replicated across studies. Such differences in findings may be related to differences across samples and study methodologies e.g. tasks used to measure cognitive outcomes. More work examining specific profiles of abuse and neglect as well as the timing and chronicity of maltreatment in relation to specific profiles of cognition is indicated.

4.1. Limitations

The assessment of causality used in this review comprises guidelines and does not suggest unequivocal evidence for causation between child maltreatment and cognition; caution must be used when evaluating such evidence (Howick et al., 2009). Furthermore, this review examined evidence only in children under 12 years of age; longitudinal studies reporting follow-up findings beyond this age were excluded. Such findings nevertheless have important implications for our understanding of the ways in which child maltreatment impacts upon cognition and related variables into adulthood. Finally, due to the heterogeneity of included articles, it was not possible to conduct a meta-analysis. Standardising methodologies in this area (e.g. with regards to measurement of cognition) would facilitate the conduction of a meta-analysis in order to determine effect sizes and spur research to address existing gaps.

4.2. Conclusions and implications

In accordance with previous reviews in this area, this review demonstrates that maltreated children under 12 years demonstrate significantly poorer cognitive outcomes than their non-maltreated counterparts. This review shows some evidence that maltreatment causes cognitive impairment in the general population, and strong evidence that the extreme deprivation of institutionalisation causes cognitive impairment. More research teasing apart the complex relationships between heritable and environmental factors and specific cognitive outcomes in this population should be conducted. Standardising approaches to studying this area with regards to data collection methodologies would facilitate the conduction of meta-analyses and help to further advance the field. Regardless of the aetiology of difficulties, the wealth of evidence demonstrating that maltreated children experience cognitive difficulties, and the problem this poses for accessing education and peer relationships, highlights the need for a comprehensive cognitive assessment of young children who have been exposed to maltreatment. Identifying an individual profile of strengths and weaknesses as early as possible – and continuing to monitor outcomes – could help to support children to access educational and social environments in order to mitigate against further difficulties throughout the lifespan.

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