

Section B: Assessing neurodevelopmental impairment

Introduction

Exposure of the fetal brain to alcohol can cause a range of structural brain abnormalities, neurological problems and functional neurodevelopmental deficits. These can result from prenatal alcohol exposure (PAE) at *any* time during the pregnancy and may be present in the absence of facial dysmorphology, which is associated with first trimester exposure.

Domains of neurodevelopment (16)

In FASD, ten domains of neurodevelopment have been identified that reflect areas of brain function known to be affected by PAE, based on evidence from human and animal research and clinical experience. These are as follows and should be assessed as part of the diagnostic evaluation for FASD:

1. Brain Structure/Neurology
2. Motor skills
3. Cognition
4. Language
5. Academic Achievement
6. Memory
7. Attention
8. Executive Function, including impulse control and hyperactivity
9. Affect Regulation
10. Adaptive behaviour, Social Skills or Social Communication

A FASD diagnosis requires objective evidence of *severe impairment* of brain function in *at least 3* of these 10 specified neurodevelopmental domains. The rationale for this is that PAE may cause widespread fetal brain injury and result in pervasive brain dysfunction.

Patterns of neurodevelopmental impairment in individuals with PAE are complex and diverse. There is no typical pattern of impairment in FASD, most likely due to differences in the timing and level of PAE and genetic and environmental factors that influence maternal blood alcohol level and brain development.

Evidence of severe impairment in 3 or more domains should be attributed to prenatal alcohol exposure only when other possible aetiological factors have been considered.

Criteria for severe impairment in neurodevelopmental domains:

The 'clinical cut-off' for severe impairment is defined either as a *global score or a major subdomain* score on a standardised validated neurodevelopmental scale that is 2 or more standard deviations below the mean (≤ 2 SD) *or* less than the 3rd percentile ($< 3^{\text{rd}}$ PC). The specific criteria for impairment in each domain and examples of standardised tests that may be used in assessments are shown in Table 3.

Assessment process

Assessment of neurodevelopmental domains includes:

- Measurement of occipitofrontal head circumference (OFC)
- Neurological examination
- Developmental assessment, typically by a multidisciplinary team involving:
 - Clinical history taking which includes interviewing caregivers to identify the reasons for presentation, individual's strengths and weaknesses, and developmental, family, psychosocial and medical history
 - Review of maternal, birth, child medical and other e.g. child protection records
 - Clinical observation
 - Use of standardised rating scales and psychometric assessment tools and application of diagnostic criteria (Australian Diagnostic Criteria for FASD)
- Review results of relevant investigations – e.g. Brain MRI or genetic screening

Testing typically involves *direct* and *indirect* assessment

- **Direct assessment** uses standardised tests that *directly* measure brain structure or neurodevelopmental skills (e.g. verbal reasoning on cognitive assessment, expressive language skills on standardised language assessment). When available, standardised assessment tools should be used that are appropriate for the age, developmental or educational level of the child, and their cultural and linguistic background.
- **Indirect assessment** uses a combination of clinical observation or examination, and evidence from multiple sources and/or standardised observer or self-report rating scales to measure the *functional manifestations* of neurodevelopmental impairment (e.g. parent and teacher rating scales to measure inattention or adaptive behaviour, and observation to assess quality of social communication during play).
- Direct assessment is preferred; however, in assessing some domains (e.g. Attention) a combination of *direct* and *indirect* assessment can be used. Use of *indirect* assessment alone is indicated when standardised tests are not available (e.g. when using DSM-5 (30) diagnostic criteria to document depression and anxiety for the *Affect regulation* domain)
- The clinician should combine all available evidence, from both direct and indirect assessments, to determine whether or not an individual meets severe impairment for a specific domain. For example a low score on the Beery VMI (31) (direct assessment) and the Vineland motor scale (32) (indirect assessment of motor skills obtained during assessment of adaptive function) provide converging evidence for impairment in the domain of *Motor skills*.

Other considerations regarding FASD assessment

Ideally assessment is performed by a multidisciplinary team that includes a paediatrician or adolescent physician and psychologist with any combination of speech pathologist, occupational therapist, social worker and physiotherapist depending on availability of trained professionals. Referral to a psychiatrist, clinical geneticist or neurologist may be required if clinically indicated.

Few specialised diagnostic clinics for FASD exist in Australia and most children are diagnosed in child development clinics or by individual developmental, general and community paediatricians. Clinicians without access to a multi-disciplinary team play an important role in history taking, physical examination, and referral for allied health and psychological assessments, and in collating results, applying diagnostic criteria and coordinating ongoing care.

The diagnosis of FASD does *not* necessarily require assessment of all domains. Assessment should be prioritised according to the individual's functional difficulties, age and capacity for testing, given local resources. We recommend that adaptive function is assessed in all individuals (*Adaptive Behaviour, Social Skills or Social Communication* domain). (16) Even when three domains are found to be impaired, testing of other domains is encouraged when there are clinical concerns. This will assist clinicians to fully identify the individual's strengths and needs and to develop appropriate recommendations for management, referral and intervention.

The assessment describes an individual profile of current neurodevelopmental function and thus ideally most domains should be assessed concurrently. However, according to the psychometric properties of each standardised assessment tool, *previous* assessments may be valid for inclusion and may not require repetition. For example, most measures of intellectual functioning such as the Wechsler scales (33-35) have valid test-retest reliability for a period of up to 2 years and should not be re-administered within this time frame due to the influence of the "learning effect" on subject responses and scores. As a general rule, any direct or indirect assessment including clinical diagnoses can be considered "current" if it has been made *within the last 2 years* (depending on test properties). Clinical judgement is required to ensure that past assessments or diagnoses are valid and meet criteria for impairment.

Apart from PAE, a range of prenatal or postnatal exposures and existing genetic, medical or mental health conditions may contribute to neurodevelopmental impairment and should always be considered in the diagnostic formulation. These include intrauterine infection, extreme prematurity (prenatal), hearing or visual impairment, head injury, early life trauma and CNS infection (postnatal).

FASD may be associated with a wide range of co-morbidities. (36) These include:

- Developmental and behavioural conditions e.g. Language disorders, ADHD, anxiety disorders, Autism Spectrum Disorder
- Genetic (chromosomal) abnormalities
- Congenital malformations

These factors may co-exist with FASD, thus FASD is not necessarily a diagnosis of exclusion. From a clinical perspective, pre-existing diagnoses such as ADHD should be reviewed and documented as part of the FASD diagnostic assessment as they may contribute to impairment. This includes obtaining *current* observations, reports and information from rating scales.

Cultural and linguistic considerations

Assessment of neurodevelopmental impairment must take into consideration the *linguistic and cultural background* of the child, adolescent or adult being assessed, as well as their educational experience within the schooling system. This includes ensuring *cultural safety* in the assessment process and a process of seeking *informed consent* that is culturally and linguistically appropriate. This may be achieved using verbal or written communication and may require an interpreter or cultural consultant or liaison officer. The process and implications of the assessment, the regard for confidentiality and restricted access to the results, and the way results will be used should be discussed with families. This is critical for all individuals undergoing assessment for FASD, but requires additional consideration when patients have diverse cultural or linguistic backgrounds.

Ideally, clinicians will have had *cultural awareness* training and have achieved a level of *competency* relevant to the family's background prior to the FASD assessment process. This will help maximise rapport and ensure awareness of relevant *familial, historical, social and legal factors* that may affect individual and family engagement with and performance during the assessment. This is particularly important for Australians who identify as Aboriginal and Torres Strait Islander because their current or prior experience with health care practitioners and researchers may impact on their willingness to engage in FASD assessment. Furthermore, intergenerational and current trauma, high rates of chronic stress, mental health disorders, social disadvantage and marginalisation and contact with legal system or incarceration affect many Indigenous communities. These factors may impact on both neurodevelopment and interaction with the healthcare system. Clinicians should also be aware of ways in which their own cultural and linguistic backgrounds, beliefs and experiences may influence how they engage with individuals and families and conduct assessments.

Assessment strategies for people of diverse linguistic or cultural backgrounds might include use of:

- Appropriately trained interpreters during direct assessments to enable use of the individual's first or preferred language if possible.
- Psychometric tests that are untimed, non-verbal, do not rely on acquired knowledge, involve spatial processing and are not influenced by culture, particularly if they provide a practical context (e.g. use pictures). One example is the Universal Non-Verbal Intelligence Test (UNIT). (37)
- Observer reports or rating scales that are contextualised within the cultural or learning environment of both the patient and the observer.

- Specific professional guidelines regarding cross-cultural assessment, e.g. The Australian Psychological Society's *Guidelines for the provision of psychological services for Aboriginal and Torres Strait Islander people of Australia* (2003). (38)

Key definitions:

The '**clinical cut-off**' for **severe impairment** is defined either as a *global score or a major subdomain* score on a standardised validated neurodevelopmental scale that is:

- **2 or more standard deviations below the mean (≤ 2 SD) or**
- **less than 3rd percentile ($< 3^{\text{rd}}$ PC)**

Considerations

- There should be appropriate allowance for test error.
- The 2 standard deviations cut-off is the usual standard for defining a severe level of impairment. For example, using DSM-5 (30) a diagnosis of Intellectual Disability requires scores of ≤ 2 SD on tests of intelligence and adaptive functioning such as the Wechsler Intelligence Scale for Children-5th edition (WISC-V A&NZ) (35) and Vineland Adaptive Behaviour Scales - 2nd Edition (Vineland-2) (32) respectively.
- Some tests e.g. the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) (39), which is used for assessing motor skills, consider a score of less than 1 standard deviation from the mean to be indicative of *clinically significant* impairment, though this would not qualify as a child as having *severe* impairment in this domain. In such situations, where significant functional impairment is evident although FASD criteria for severe impairment (≤ 2 SD or $< 3^{\text{rd}}$ PC) are not met, *it is critical to ensure adequate therapeutic supports are in place.*

Significant discrepancy

In some domains, severe impairment may be considered when there is a **large discrepancy between subdomain scores**, even if the global (overall) score is within 2 standard deviations of the mean. In this situation the clinical cut-off for severe impairment is defined by:

1. A **statistically significant discrepancy between subdomain scores** (i.e. a discrepancy seen in less than 3% of the population). This is calculated by the relevant clinician using scoring software provided with standardised neurodevelopmental tools.
2. The lower of the two discrepant scores is **at least one standard deviation below the mean.**

Note - This assumes that a discrepancy is both *clinically* and *statistically* significant according to the particular standardised scales being used. Each has their own cut-offs for what is considered a significant difference between scale scores (e.g. For WISC IV this is an Index score difference of 23). (38)

Clinical judgement

Clinical judgment should be used to determine whether severe impairment is present in the following situations:

- a. When test data is inconsistent within a domain.
- b. When a global score or major subdomain score is in the borderline range and/or within the standard error of measurement for cut-off.
- c. When there is discrepancy between indirect and direct assessment measures or between observers (e.g. two clinicians, parents and teachers).

In these situations, the decision should be supported by clinical observation and history, preferably evidenced from two or more sources.

- A domain should not be considered impaired on the basis of a *single subtest score* from one assessment measure.
- Domains should be assessed as though they were *separate entities* and clinicians should not use a single test score as evidence of deficits in two domains, even when those domains are theoretically related (e.g. Verbal IQ cannot be used as evidence of impairment in domains of both language and cognition).

Inconclusive assessment

In some circumstances, a clinician may identify individuals who, despite having undergone assessment, fail to fulfil criteria for diagnosis for FASD at the current time, but may nevertheless potentially have FASD. Some example situations include:

- Neurodevelopmental assessment is incomplete or inconclusive.
- Despite confirmed PAE, neurodevelopmental impairment is present in fewer than three domains.
- Neurodevelopmental impairment is present in three or more domains, but impairment is not sufficiently severe to meet criteria.
- Comprehensive, age-appropriate neurodevelopmental assessment is impossible or unavailable e.g. in infants and young children.

These individuals may be considered '**at risk of FASD**' and **require follow-up and reassessment**. In the diagnostic formulation the clinician should explain why the child is considered at risk but indicate that they do not currently meet diagnostic criteria.

Special considerations

Infants and Children under 6 years of age

Infants and children under 6 years of age represent a special group when being assessed for FASD. This is because:

- The developing brain has the capacity for change, related to brain plasticity and ongoing development of neural connections, in response to environmental and other factors (e.g. an adverse or stable caring environment).

- Assessment is more difficult and limited in scope compared to that available for older children e.g. assessment of executive function.
- Some functional manifestations of FASD may not become apparent until later in childhood e.g. problems with academic achievement or developmentally inappropriate behaviours that become progressively problematic in the school setting.

A diagnosis of FASD can be made in an infant or young child under the age of 6 years using the diagnostic algorithm (Figure 1) with the following considerations:

Neurodevelopmental Assessment

- Assessment of neurodevelopment should be made using age-appropriate standardised assessment tools, not just clinical assessment or observation. This will enable confirmation that neurodevelopmental skills are severely impaired at clinical cut-off level (≤ 2 SD or $< 3^{\text{rd}}$ pc).
- By definition, Global Developmental Delay constitutes impairment in 3 or more domains of neurodevelopment. For a FASD diagnosis, Global Developmental Delay must be *severe* as indicated on a standardised assessment (e.g. Bayley Scale of Infant and Toddler Development Third Ed (Bayley III) (40) or Griffiths Mental Development Scales – Extended Revised (GMDS-ER) (41).

Microcephaly

- In an infant or young child *with microcephaly and all 3 sentinel facial features, a diagnosis of FASD with 3 sentinel facial features can be made, whether PAE is confirmed or unknown, even without evidence of severe neurodevelopmental impairment in 3 domains based on standardized assessment (42, 43). Nonetheless, in these children, concerns about neurodevelopmental impairment are likely to be present and should be documented accordingly. Children with microcephaly are at high risk of subsequent neurodevelopmental disorder: they should be monitored, and genetic testing should be considered.*
- Infants and children under 6 years of age *without microcephaly* and with all three sentinel facial features who do not meet criteria for neurodevelopmental impairment are considered '*at risk of FASD*', whether PAE is confirmed or unknown. These children do not fulfil FASD diagnostic criteria and require follow-up and reassessment.

Older adolescents and adults

Special considerations in the assessment for FASD in adolescents and adults include:

- Changes in physical characteristics occur with age e.g. facial features.
- Obtaining information about the pregnancy (including prenatal alcohol exposure) and early childhood may be difficult.
- Adolescents/adults may require different types of assessment than children.

- Functional manifestations of FASD may differ in adolescents/adults e.g. problems with sexual behaviour, psychological and mental health, substance misuse, vocational training and employment, risk taking behaviour, independent living, and contact with the legal system.
- Social and family situation such e.g. living independently, in supervised residential care or detention, may impact on validity of testing using observer reports.

Evaluation of general and sexual health, substance use, protective factors and risk taking behaviour is important to assess the individual's overall health and wellbeing, and may provide supporting indirect evidence for impairment in FASD domains. For example, poor judgement and limited experiential learning may suggest impairment in executive functioning.

There are also some specific considerations when assessing the domain of *Adaptive behaviour, social skills or social communication* in older adolescents and adults. Please refer to Table 3.



Table 3: Neurodevelopmental domains: criteria for severe impairment

1. Brain Structure / neurology	Definition	<p>Brain structure and neurology includes:</p> <ul style="list-style-type: none"> ▪ Abnormal occipitofrontal head circumference ▪ Structural brain abnormalities ▪ Seizure disorder not due to known postnatal causes ▪ Significant neurological diagnoses otherwise unexplained
	Direct/indirect assessment	<p>Severe impairment is present when one or more of the following are identified:</p> <ul style="list-style-type: none"> ▪ Occipitofrontal head circumference is <3rd PC or ≤2 SD <ul style="list-style-type: none"> ○ For premature infants OFC should be corrected for gestational age until 2 years of age ▪ Structural brain abnormalities known to be associated with prenatal alcohol exposure are shown on brain imagingⁱ <p>Examples include:</p> <ul style="list-style-type: none"> ○ Reduction in overall brain size ○ Corpus callosum (agenesis, hypoplasia) ○ Cerebral cortex (reduced gyrification or anterior cingulate cortex surface area) ○ Reduction in volume in specific areas: cerebellum, hippocampus, basal ganglia – caudate ▪ Seizure disorder in which other aetiologies have been excluded. ▪ Significant neurological diagnoses otherwise unexplained are identified e.g. cerebral palsy, visual impairment, sensorineural hearing loss <i>when other aetiologies have been excluded</i>
	Considerations	<p>Microcephaly</p> <p>There are many other causes of microcephaly which should be excluded, including familial microcephaly, chromosomal abnormalities, intrauterine infection or exposure to teratogens other than alcohol. These causative factors may be identified in addition to PAE. When possible, parental head circumference should be measured. Investigate as clinically indicated.</p> <p>In some circumstances a child may have reliable past documentation of an OFC <3rd percentile, but at the time of assessment the OFC is >3rd percentile. In this situation, clinical judgement should be</p>

		<p>used to judge whether this discrepancy reflects persistent microcephaly or may reflect measurement error.</p> <p>Neuroimaging</p> <p>Brain imaging such as MRI is not required for a diagnosis of FASD but is recommended when clinically indicated e.g. by the presence of microcephaly or macrocephaly that is not familial; localising neurological signs; focal seizure disorder; or signs of neurodegenerative disorder.</p>
2. Motor Skills	Definition	<p>Motor skills include fine motor skills (manual dexterity, precision), gross motor skills (balance, strength, co-ordination, ball skills and agility), graphomotor skills (handwriting) and visuo-motor integration (VMI). (44, 45)</p>
	Direct assessment	<p>Severe impairment in motor skills is present <i>when</i> on a validated test of motor skills:</p> <ul style="list-style-type: none"> ▪ <i>a composite score is below the clinical cut-off; or</i> ▪ <i>1 or more major subdomain scores (gross motor skills; fine motor skills; graphomotor skills; and visuo-motor integration) is/are below the clinical cut-off (e.g. gross motor and fine motor skills can be scored separately using the BOT-2). (39)</i> <p>Examples of standardised tests:</p> <ul style="list-style-type: none"> ○ Bruininks-Oseretsky Test of Motor Proficiency (BOT-2); (40) (gross motor and fine motor); 4y-6y. ○ Berry-Buktenica Development Test of Visual-Motor Integration (VMI); (32) (visual motor integration); 2y - adult. ○ BOT-2 (40) (gross motor and fine motor); 6y- 21y. ○ Movement Assessment Battery for Children 2nd Ed (Movement-ABC 2) (45) 3y- 16y 11m
	Indirect assessment	<p>Clinical assessment may provide supporting evidence of severe impairment: e.g. report of problems with balance, coordination.</p> <p>Abnormal tone, reflexes, strength, soft neurological signs (46) and other findings on the neurological examination may be considered in combination with direct assessment of motor skills using a standardised assessment tool.</p> <p>Clinical evidence of impairment in speech articulation or oral-motor function may be considered in combination with direct assessment of motor skills.</p>



	Considerations	<p>For motor skills, significant functional impairment may be evident in learning and play when motor skill levels are at 1 standard deviation below the mean ($\leq 16^{\text{th}}$ centile). If this is documented during assessment it is important to ensure adequate therapeutic supports are in place, even if criteria for severe impairment ($\leq 2\text{SD}$ or $< 3^{\text{rd}}$ PC) are not met.</p> <p>As therapeutic approaches differ significantly for different components of the motor domain (e.g. gross motor versus fine motor) it is preferential to use a motor assessment (e.g. BOT-2) (39) which provides separate composite scores for gross and fine motor function to inform therapy. An overall motor composite score may hide an individual's relative strengths and weaknesses.</p> <p>Musculoskeletal based structural defects may also need to be considered for their impact on the motor domain e.g. lack of complete extension of one or more digits, decreased supination/pronation at the elbows, other joint contractures including inability to completely extend and/or contract at the hips, knees, and ankles. (47)</p>
3. Cognition	Definition	Cognition includes IQ, verbal and non-verbal reasoning skills, processing speed, and working memory.
	Direct assessment	<p>Severe impairment is present when standardised tests of cognition or intelligence show:</p> <ul style="list-style-type: none"> ▪ a <i>composite score below the clinical cut-off</i> - e.g. full scale IQ < 70; or ▪ a <i>major subdomain score below the clinical cut-off</i> e.g. for the WISC (34) this includes Verbal Comprehension, Visual Spatial, Fluid Reasoning, and Processing Speed or ▪ there is a <i>significant discrepancy</i> among major subdomain scores. <p>Examples of standardised tests:</p> <ul style="list-style-type: none"> ▪ < 6 years <ul style="list-style-type: none"> ○ Wechsler Preschool and Primary Scale of Intelligence (WPPSI-IV) (34); 2y 6m - 7y 7m ○ Stanford-Binet Intelligence Scales (SB-5); (48) 2y - 85 y ○ Differential Abilities Scales (DAS-II) (49); 2y 6m - 17y 11m ○ Wechsler Non-Verbal Scale of Ability-II (WNV-II); (50) up to 21 y ▪ > 6 years <ul style="list-style-type: none"> ○ Wechsler Intelligence Scales for Children (WISC-V ANZ)(35); 6y - 16y 11m ○ Stanford-Binet Intelligence Scales (SB-5); (48); up to 85 y ○ Wechsler Adult Intelligence Scale (WAIS-IV) (35); 16 - 90 y ○ Differential Abilities Scales (DAS-II); (49); up to 17 y

		<ul style="list-style-type: none"> ○ Universal Nonverbal Intelligence Test (non-verbal test) (37); 5 - 21y 11m ○ Wechsler Non-Verbal Scale of Ability (WNV); (50) 4 -21y ○ Naglieri Nonverbal Ability Test - Second Edition (NNAT-2) (51) 4 - 18 y
	Considerations	<p>Individuals who fulfil criteria for an Intellectual Disability, by definition, typically will have impairment in 3 domains of neurodevelopment as defined for FASD criteria (e.g. Cognition, Adaptive behaviour, Language, Motor skills).</p> <p>If working memory alone is severely impaired (below the clinical cut-off), this should be considered evidence of impairment in the <i>Executive functioning</i> domain rather than in the <i>Cognition</i> domain.</p> <p>A test that is independent of language and culture may be appropriate for certain populations (see Cultural and Linguistic Considerations, Section B).</p>
4. Language	Definition	Language includes expressive and receptive language skills.
	Direct assessment	<p>Severe impairment is present when:</p> <ul style="list-style-type: none"> ▪ a <i>composite score</i> assessing core language, receptive language, and/or expressive language is <i>below the clinical cut-off</i>; <i>or</i> ▪ there is a <i>significant discrepancy</i> between receptive and expressive composite scores; <i>or</i> ▪ there are <i>2 or more scores below the clinical cut-off</i> on subtests assessing higher-level language skills (i.e. the integrative aspects of language such as narrative and complex comprehension abilities) <p>Examples of standardised tests:</p> <ul style="list-style-type: none"> ○ Clinical evaluation of language fundamentals (CELF-4);(52) 5y - 21y 11m ○ Pre-School Language Scales, 5th Ed (PLS-5); (53) birth - 7y 11m
	Considerations	<p>This domain should be assessed as if it is a single entity.. It is inappropriate to use scores on verbal IQ sub-tests as a measure of <i>both</i> language and cognition.</p> <p>When possible, testing should be done in the individual’s first language. Specific tests may be available e.g. for some Indigenous languages.</p> <p>Clinical judgment regarding severity of impairment is required if:</p> <ul style="list-style-type: none"> ▪ testing is not standardised ▪ testing is not in an individual’s first language ▪ direct assessment is not possible.



		Problems with phonological awareness may impact on language and if present may contribute to impairment in this domain.
5. Academic Achievement	Definition	Academic achievement includes skills in reading, mathematics, and/or literacy (including written expression and spelling).
	Direct assessment	Severe impairment is present when standardised measures of reading, mathematics, and/or literacy show: <ul style="list-style-type: none"> ▪ a <i>composite score</i> below the <i>clinical cut-off</i>; or ▪ a <i>significant discrepancy</i> between cognition and either reading, mathematics, and/or written expression. <p>Examples of standardised tests:</p> <ul style="list-style-type: none"> ○ Wechsler Individual Achievement Test (WIAT II) (54) 4y- adult ○ Woodcock–Johnson Achievement Test (WJAT-III) (55) 4y- adult
	Indirect assessment	The following information can be used as supporting evidence for severe impairment: <ul style="list-style-type: none"> ▪ The National Assessment Program Literacy and Numeracy (NAPLAN) test results (54) ▪ School semester reports with achievement levels
	Considerations	The clinical team must determine whether the individual has had adequate access to and attendance at school or alternative instruction and/or remedial intervention before a deficit can be recorded. Consideration must also be given to the individual’s educational placement i.e. mainstream versus educational support class and opportunity e.g. remote location, multi-lingual setting, new immigrant. Even if the Full Scale IQ is below 70 (indicating impairment of <i>Cognition</i>), impairment can also be given in the domain of <i>Academic Achievement</i> as cognitive and academic skills do not necessarily directly correlate (e.g. some individuals with mild intellectual disability perform in the low average range academically). Both domains should be tested and considered separately. <p>If an individual has a Specific Learning Disorder according to DSM-5 (30) they fulfil criteria for severe impairment in academic achievement, providing testing shows evidence of impairment at clinical cut-off of at or below 2SD.</p> <p>Problems with phonological awareness may impact on academic achievement and if present may contribute to impairment in this domain.</p>



6. Memory	Definition	Memory includes overall memory, verbal memory, and visual memory
	Direct assessment	Severe impairment in memory is present when: <ul style="list-style-type: none"> ▪ a <i>composite score</i> for overall memory and/or verbal memory, and/or visual memory score is below the clinical cut-off;=or ▪ there is a <i>significant discrepancy</i> between verbal and nonverbal memory Examples of standardised tests: <ul style="list-style-type: none"> ○ Developmental Neuropsychological Assessment (NEPSY-II) (55), Memory and Learning sub-tests; 3 - 16 years ○ Wide Range Assessment of Memory and Learning, 2nd Edition (WRAML-II); (56) 5 - 90 years ○ Children’s Memory Scale (CMS), (57) 5 - 16 years
	Considerations	A deficit in <i>working memory</i> should be considered in the <i>Executive Function, including impulse control and hyperactivity</i> rather than <i>Memory</i> domain.
7. Attention	Definition	Attention has several components: <ul style="list-style-type: none"> i) <i>selective</i> attention (i.e. focusing on a particular stimuli) ii) <i>divided</i> attention (i.e. attending to 2 or more stimuli at the same time) iii) <i>alternating</i> attention (i.e. switching focus from one stimuli to another) iv) <i>sustained</i> attention (i.e. attending for a long period of time and resistance to distractions). Attention deficits usually manifest as problems with concentration, task focus and work organisation. In many definitions and theories of brain function, attention overlaps with some of the executive functions. In order to distinguish these domains for diagnostic purposes in FASD, attention has been defined separately. Deficits in inhibition, impulse control or hyperactivity should be considered in the domain of <i>Executive function, Impulse control and Hyperactivity</i> rather than <i>Attention</i> .
	Direct assessment	Severe impairment in attention is present on <i>direct</i> assessment when <i>two or more subtest scores are below the clinical cut-off</i> on continuous performance tests or other neuropsychological measures of selective, divided, alternating or sustained attention.

		<p>Examples of standardised tests:</p> <ul style="list-style-type: none"> ○ Conner’s Continuous Performance Test: 3rd Ed (58); 8 - 60+ y ○ Test of Everyday Attention for Children (Tea-CH) (59); 6 - 16 y ○ Delis-Kaplan Executive Function System (DKEFS) (60) i.e. Trail Making Test, Colour/Word Interference; 8 - 89 y ○ Developmental Neuropsychological Assessment (NEPSY-II)(55), Attention sub-tests; 3 - 16 y ○ Children’s Colour Trails Test (61) ; 8 - 16 y ○ Adult Colour Trails Test; (62) 18 - 89 y
	Indirect assessment	<p>Severe impairment in attention by <i>indirect</i> assessment is present when <i>two or more assessments provide converging evidence of impairment</i> e.g.:</p> <ul style="list-style-type: none"> ▪ clinical interview by different professionals ▪ scores at or below the clinical cut-off on standardised observer rating scales e.g. Conners 3 (parent, teacher or self-report) (58) ▪ file review ▪ direct clinical observation during neurodevelopmental testing <p>Examples of standardised rating scales:</p> <ul style="list-style-type: none"> ○ Conners 3rd Edition (Conners 3) (58); 6 - 18y ○ Conners Adult ADHD Rating Scales (CAARS) (63); 18 - 50+ y ○ Achenbach school-age scales - Child Behaviour Check List (CBCL), Teacher Report Form (TRF), Youth-Self Report (YSR) (64); 6-18y ○ Conners Comprehensive Behaviour Rating Scales (CBRS) (65); 6 - 17y 11m
	Considerations	<p>A diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) based on DSM-5 criteria (30) – either <i>inattentive</i> or <i>combined</i> presentation - fulfils criteria for severe impairment in the domain of <i>Attention</i>. Valid direct or indirect assessment methods and cut-offs should be used to make this diagnosis. ADHD hyperactive-impulsive presentation contributes to impairment in the <i>Executive function, including impulse control and hyperactivity</i> domain.</p> <p>Direct tests of attention which are part of testing in other domains (e.g. WISC, memory testing) can be used as evidence of impairment.</p>



		When indirect and direct tests of attention do not concur, clinical judgment is required to determine whether severe impairment exists. Consideration that <i>indirect</i> assessment may better reflect attention deficits in real life situations (e.g. at work or in school) may be pertinent.
8. Executive Function, including impulse control and hyperactivity	Definition	<p>Executive function refers to a set of higher-level skills involved in organising and controlling one’s own thoughts and behaviours in order to fulfil a goal with maximum efficiency.</p> <p>For the purposes of FASD diagnostic criteria, the domain of <i>Executive Function</i> includes impulse control and inhibition response, hyperactivity, working memory, planning and problem solving, shifting and cognitive flexibility. While in many definitions and theories of brain function attention overlaps with some of the executive functions, they have been defined separately for diagnostic purposes in FASD.</p> <p>Impulse control deficits are characterised by actions without forethought, which often have potential for harm to self or others.</p> <p>Hyperactivity is characterised by inappropriate and excessive levels of motor activity or speech.</p>
	Direct assessment	<p>Severe impairment in executive function and/or impulse control by <i>direct</i> assessment is present <i>when at least two or more subtest scores below the clinical cut-off</i> are obtained on neuropsychological measures of executive function (which often assess impulse control).</p> <p>Examples of standardised assessment tools:</p> <ul style="list-style-type: none"> ○ Developmental Neuropsychological Assessment (NEPSY-II) (55) Executive Functioning sub-tests – from 3 - 16 y ○ Delis-Kaplan Executive Function System (DKEFS) (60) – from 8 - 89 y ○ Rey-Osterrieth Complex Figure (ROCF) (66)
	Indirect assessment	<p>Severe impairment in executive function and/or impulse control by <i>indirect</i> assessment is present <i>when a clinical assessment provides converging evidence of impairment from multiple sources</i>, including scores at or below the clinical cut-off on standardised rating scales and supporting evidence from clinical interview, file review and direct clinical observation during neurodevelopmental testing.</p> <p>Examples of standardised rating scales:</p> <ul style="list-style-type: none"> ○ Behavior Rating Inventory of Executive Function (BRIEF-II) (67); 5 – 18y ○ Comprehensive Executive Function Inventory (CEFI) (68); 5 - 18y



		<ul style="list-style-type: none"> ○ Frontal Systems Behaviour Scale (FrsBe) (69);18 - 95 y <p><i>Hyperactivity</i> is measured on rating scales which also measure attention problems, as listed for <i>indirect assessment</i> in the <i>Attention</i> domain (e.g. Conners 3) (58).</p>
	Considerations	<p>A diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) – either combined or hyperactive-impulsive presentation - based on DSM-5 criteria (30), does <u>not</u> fulfil criteria for severe impairment in the domain of <i>Executive function, including impulse Control and hyperactivity Domain</i>. Additional evidence is required from other indirect and direct assessments to fulfil criteria for severe impairment.</p> <p>Assessment may show a discrepancy between <i>direct</i> and <i>indirect</i> tests in this domain due to the varying conceptualisations of executive function and related tests. In the situation where <i>indirect</i> tests show impaired scores but <i>direct</i> tests scores are normal, significant weight should be given to the <i>indirect</i> assessments, as they are a more valid measure of functional brain impairment in this domain. Hence, if two or more standardised rating scales (e.g. observer and self-report or two observers) are below clinical cut-off, then the <i>Executive Function, Impulse Control and Hyperactivity</i> domain is considered severely impaired.</p>
9. Affect Regulation	Definition	Affect regulation includes mood and anxiety disorders.
	Direct assessment	Not possible
	Indirect assessment	<p>Severe impairment in affect regulation by <i>indirect</i> assessment is present <i>when an individual meets the DSM-5 (30) criteria for:</i></p> <ul style="list-style-type: none"> ▪ Major Depressive Disorder (with recurrent episodes) ▪ Persistent Depressive Disorder ▪ Disruptive Mood Dysregulation Disorder (DMDD) ▪ Separation Anxiety Disorder Selective Mutism, Social Anxiety Disorder, Panic Disorder, Agoraphobia, or Generalised Anxiety Disorder. <p>Clinicians should formally ascertain that the individual meets criteria rather than assign a diagnosis on the basis of clinical impression or data from rating scales alone.</p> <p>Standardised rating scales which may assist diagnosis include:</p> <ul style="list-style-type: none"> ○ Spence Children’s Anxiety Scales (SCAS); (70) 8-15y ○ Behaviour Assessment System for Children-III (71); 2 - 21y ○ Beck Youth Inventories, 2nd Edition (BYI-II) (72)

		<ul style="list-style-type: none"> ○ Children’s Depression Inventory 2 (CDI-2), (73)7 – 17y ○ Multidimensional Anxiety Scale for Children 2nd Edition (MASC 2) (74)
	Considerations	<p>Care should be taken to document longstanding dysregulation rather than a short-term response to unfavourable life events or environmental conditions (e.g. multiple foster placements).</p> <p>For the purpose of FASD diagnoses, children who meet criteria A to F for the Disruptive Mood Dysregulation Disorder may be considered to have impairment in this domain. This diagnosis cannot be formally made until children are >6 and <18 years of age and the onset of symptoms must occur before the age of 10 years.</p>
10. Adaptive Behaviour, Social Skills, or Social Communication	Definition	<p>Adaptive behaviour is defined as the life skills which enable an individual to live independently in a safe and socially responsible manner, and how well they cope with everyday tasks.</p> <p>These include: (30)</p> <ul style="list-style-type: none"> ▪ <i>Conceptual</i> skills - language, reading, writing, math, reasoning, knowledge, and memory ▪ <i>Social</i> skills - empathy, social judgment, interpersonal communication skills, the ability to make and retain friendships ▪ <i>Practical</i> skills - self-management in areas such as personal care and daily living skills, job responsibilities, money management, recreation, and organising school and work tasks. <p>Social communication is a critical component of adaptive function but can be assessed separately.</p>
	Direct assessment	<p>Severe impairment in social communication by <i>direct</i> assessment is present when a <i>composite score measuring social language, social communication skills or pragmatic language skills is below the clinical cut-off</i>.</p> <p>Examples of standardised assessment tools for individuals >6 years of age:</p> <ul style="list-style-type: none"> ○ The Social Language Development Test – Elementary (SLDT-E) (75); 6y - 11y11m ○ The Social Language Development Test – Adolescent (SLDT-A) (76); 12y - 17y11m
	Indirect assessment	<p>Severe impairment in adaptive behaviour, social skills or social communication by <i>indirect</i> assessment is present when, according to a standardised interview or rating scale completed by a key informant a:</p> <ul style="list-style-type: none"> ▪ <i>Composite score</i> is below the clinical cut-off <i>or</i> ▪ <i>a major subdomain score</i> is below the clinical cut-off



		<p><i>For children and most adolescents</i>, standardised observer rating scales for adaptive function (typically for caregiver and/or teacher) should be used, although this may not be possible e.g. for a child in detention.</p> <p>Examples include:</p> <ul style="list-style-type: none"> ○ Vineland Adaptive Behaviour Scales, 2nd Ed (32) (VABS-II); birth - 90 y ○ Adaptive Behaviour Assessment System (ABAS-III); (77) birth - 89y ○ Behaviour Assessment System for Children – 3 (BASC-3) (77); 2 - 21 y ○ Pragmatic Language Observation Scale (PLOS) (78); 8 – 17y 11m ○ Children’s Communication Checklist, 2nd Edition (79); child and adult versions available. ○ Clinical Evaluation of Language Fundamentals (CELF-4 Australian) (52) Pragmatics Profile; 5 - 21y 11m <p>Observation by a speech pathologist of the individual interacting with their peers in institutional, school or family settings may also provide supporting evidence of impairment.</p>
	Special considerations	<p>Severe impairment in social skills and social communication is present when <i>on formal testing an individual meets the DSM-5 (30) criteria</i> for:</p> <ul style="list-style-type: none"> ▪ Autism Spectrum Disorder ▪ Social (Pragmatic) Communication Disorder <p>When individuals individual meet DSM-5 criteria for Conduct Disorder and/or severe Oppositional Defiant Disorder, this provides supporting evidence for impairment in the <i>Adaptive behaviour, Social skills or Social communication</i> domain however the individual still needs to meet other criteria demonstrating severe impairments in multiple aspects of social, practical and conceptual function (e.g. on Vineland Rating Scales). In some older adolescents and adults, indirect assessment can be complicated and additional considerations apply (see below).</p> <p>Older adolescents and adults</p> <p>For older adolescents or adults, a standardised, indirect rating scale for adaptive behaviour is preferred wherever possible and may be required for eligibility for some services and financial support.</p>

		<p>Alternative assessment methods may be required for people living alone or in an institutional setting who have not had a consistent caregiver or partner within the last two years who can act as an informant.</p> <p>For example, assessment of <i>adaptive function</i> may involve structured interview, observation of self-care and living skills, or use of historical records. Severe impairment is based on clinical judgement that deficits are sufficiently severe to fall below clinical cut-off. This might include:</p> <ul style="list-style-type: none">• Documented inability to function in key aspects on independent living (e.g. inability to manage money, maintain a household of reasonable safety and cleanliness, obtain/maintain a job, uphold personal hygiene, exhibit socialisation/coping strategies, care for children).• Documented difficulty in social competence (e.g. being financially victimised or unintentionally involved in criminal behaviour due to social gullibility; chronic inability to participate successfully in group treatments and/or group home placements). <p>For <i>social communication</i> assessment, a direct, age-appropriate measure should be used with the client, in combination with reports and historical information. Cultural and linguistic considerations should be applied if relevant, and testing and interpretation altered accordingly. (see Cultural and Linguistic Considerations in Section B).</p>
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