



ASSESSING FOR FETAL ALCOHOL SPECTRUM DISORDER: A SURVEY OF ASSESSMENT MEASURES USED IN ALBERTA, CANADA

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ABSTRACT

Background

The recommended “gold standard” for Fetal Alcohol Spectrum Disorder (FASD) assessment involves a multidisciplinary diagnostic team and comprehensive battery of neuropsychological tests to evaluate functioning across 10 brain domains. The current Canadian Guideline for diagnosis of FASD outlines a list of test measures for assessment; however, very little research exists to explore which specific tools are being used in clinical practice.

Objectives

The purpose of the current study was to gain a better understanding of the testing measures used by FASD clinicians in Alberta, Canada.

Methods

A survey was sent to coordinators of 23 Alberta FASD clinics requesting them to distribute the survey to their diagnostic team members, including physicians, psychologists, speech-language pathologists, and occupational therapists.

Results

A wide range of measures (both direct and indirect; $n = 173$) to assess brain domains were reported by clinics. Many tests were used to assess function across multiple brain domains. Most of the commonly used tests aligned with those suggested in the Canadian Guideline; however, there were many additional measures being used that were not listed in the Guideline.

Conclusions

This study revealed important information about the use of testing measures in FASD assessment and sheds light on the commonalities in practice across clinics in Alberta. Results demonstrate strong convergence of direct and indirect measures to assess brain function. Ultimately, identifying a comprehensive, reliable, and usable testing battery of measures for FASD assessment will improve the clarity and accuracy of the diagnostic process and facilitate advancements in the field, as well as enable comparisons across clinics.

Keywords: *fetal alcohol spectrum disorder; assessment; diagnosis; psychometric testing; clinical practice.*

Fetal Alcohol Spectrum Disorder (FASD) is a diagnostic term used to describe a continuum of effects associated with prenatal alcohol exposure (PAE), including impairment in physical, cognitive, social-emotional, and behavioural functioning.^{1,2} Unfortunately, these brain-based difficulties are life-long, and without adequate supports, individuals with FASD are at risk for a range of adverse outcomes, including problems with school and employment, independent living, inappropriate behaviours, mental health and substance use, and legal issues.³ Researchers have shown that early diagnosis of FASD is a significant protective factor that can mitigate some of these challenges.⁴ FASD diagnosis is critical for connecting individuals with appropriate services and resources, and ensuring that individuals and their families are well supported to manage difficulties associated with the disability.¹

FASD ASSESSMENT AND DIAGNOSIS

There have been several approaches to formalized FASD assessment and diagnosis, beginning in the United States in 1996 with the Institute of Medicine's (IOM) recommendations for the diagnosis of FASD.¹ Subsequently in 1999, Astley and Clarren developed another assessment method using a 4-Digit Diagnostic Code to classify the magnitude of expression for each feature across 4 key diagnostic areas: physical growth deficiency ("growth"), facial abnormality ("face"), damage to the central nervous system ("brain"), and likelihood of PAE ("exposure").^{6,7} Additional guidelines for diagnosing FASD and alcohol related

disorders have been proposed by other researchers,⁸ as well as the World Health Organization, Centres for Disease Control and Prevention, and the *Diagnostic and Statistical Manual of Mental Disorders – 5th Edition (DSM-V)*. The term "FASD" is generally not considered to be a diagnostic label in any of these approaches, but rather an umbrella term used to capture a range of specific diagnoses. These specific diagnostic labels include Fetal Alcohol Syndrome (FAS), partial Fetal Alcohol Syndrome (pFAS), Alcohol-Related Birth Defects (ARBD), and Alcohol Related Neurodevelopmental Disorder (ARND),^{5,6,8} Static Encephalopathy, Neurobehavioural Disorder, and specifiers related to sentinel physical findings and alcohol exposure.⁷

In Canada, guidelines for the diagnosis of FASD were originally published in 2005¹ and have been widely adopted by diagnostic clinics in Canada and other countries.⁹ These guidelines were a harmonization of previous approaches, combining the 4-Digit Code system and the IOM diagnostic nomenclature (i.e., FAS, pFASD, and ARND). An updated Canadian diagnostic guideline was published in December 2015, which took into consideration new research and data as well as clinical experience to improve clarity and consistency in FASD diagnosis across the lifespan, and to address the evolution within the field of FASD.² Key updates to the 2015 guideline included the adoption of the term FASD as a diagnostic label (with a specifier related to the presence or absence of sentinel facial features), and the addition of a non-diagnostic designation of "At-Risk for FASD and Neurodevelopmental

Disorder” to capture individuals who do not meet diagnostic criteria at the time of assessment, but are nonetheless at-risk and require future follow-up. Growth was excluded as a diagnostic criterion, and the neurodevelopmental domains were updated and clarified (i.e., the affect regulation domain was added) for assessment across the lifespan.

Neurodevelopmental Assessment

Although different FASD diagnostic systems vary slightly in approach and terminology, the fundamental criterion of significant and pervasive neurodevelopmental impairment remains consistent across all diagnostic systems. According to the 2015 Canadian guideline, neurodevelopment, or the “brain” domain, is assessed through the evaluation of 10 domains of functioning: motor skills; neuroanatomy/neurophysiology; cognition; language; academic achievement; memory; attention; executive functioning (EF), including impulsivity and hyperactivity; affect regulation; and adaptive behaviour, social skills, or social communication.² For an FASD diagnosis to be made, an individual must meet the criteria of pervasive neurodevelopmental dysfunction as demonstrated by severe impairment (i.e., clinical cutoff lower than the 3rd percentile) in 3 or more of the 10 brain domains specified. The majority of these areas of brain function should be assessed using *direct measures*, such as standardized tests and physical measurements. In some cases, it is not always possible to use direct measures, and in these situations, *indirect measures* (e.g., informant ratings/rating scales, historical assessment, clinical interview, formal file review, observation) may be used. When using indirect measures, information should be collected through multiple sources rather than a single informant and should also meet the criterion for significant impairment, defined as below the 3rd percentile.²

The neurodevelopmental deficits associated with FASD are known to be heterogeneous and complex¹⁰ and there is no single pattern that applies to all individuals with FASD.² To determine an individual’s profile of functioning and confirm an FASD diagnosis, a multidisciplinary approach is recommended to gather information about the client’s history, including reliable PAE history, and to implement a comprehensive

battery of tests. The suggested clinical team composition varies depending on the client’s age; however, an example of a full team for a school-aged client would include a clinic coordinator, pediatrician, psychologist, speech-language pathologist (SLP), occupational therapist (OT), and other members such as a social worker, mental health professional, or probation officer where relevant.²

Suggestions for clinical tools used to assess neurodevelopment in FASD are provided in the 2015 guideline. However, the choice of measures used in clinical practice may vary depending on client demographics and characteristics (e.g., age, communication abilities, etc.), testing circumstances, clinician preference and experience, as well as client compliance. To date, there are very few studies to examine the use of assessment measures in the FASD population, and the existing research is focused on preschool-aged children.¹¹ This gap in the literature is important, as information about the use of testing measures in FASD assessment may shed light on any inconsistencies between clinics or areas where adequate tools are lacking, as well as promote conversation and collaboration between clinics to identify useful, current, and reliable measures that may not have been identified in previous guidelines. Ultimately, identifying a comprehensive, reliable, and usable testing battery of measures for FASD assessment will improve the clarity and accuracy of the diagnostic process and facilitate advancements in the field.

CURRENT STUDY

The province of Alberta, Canada is a world-leader in FASD research and practice. For the last decade, FASD has been a major priority for the Alberta government, with its 10-year strategic plan to coordinate, plan, and deliver FASD services and research initiatives across the province.¹ As a result of this provincial strategy, 12 FASD Service Networks have been established, as well as more than 20 FASD assessment and diagnostic clinics for individuals across the lifespan. These clinics have been very well supported with a specific training program since 2011, and through the Lakeland Centre for FASD, clinic training is inherent. With the release of the 2015 Canadian guideline for FASD diagnosis, all Alberta FASD clinics transitioned away from using

the 2005 guidelines and the 4-Digit Code system and adopted the updated guideline.²

The purpose of the current study was to gain a better understanding of the testing measures used in FASD assessment. Survey data was gathered on the different measures used at FASD clinics across Alberta. Specifically, we sought to: (1) ascertain the range of measures that Alberta clinics are using to evaluate brain domains in FASD assessment across the lifespan; (2) examine the commonalities between the measures used by different clinics; (3) explore the extent to which clinics are using the measures suggested in the 2015 Canadian guideline; and (4) identify additional measures that are commonly used beyond those suggested in the guideline.

METHODS

A survey was developed, modeled after the *Examples of Neurodevelopmental Tests* (Appendix F) in the 2015 Canadian guideline.² For a comprehensive understanding of which tools were used for FASD assessment across the lifespan, respondents were asked to list the measures they administered in each brain domain for clients in various age groups at the time of the study. The survey was sent via e-mail to clinic coordinators of all Alberta FASD clinics that were active at the time of the study ($N = 23$). Clinic coordinators were asked to distribute the survey to their clinicians and diagnostic team members, including physicians, psychologists, SLPs, and OTs. Participants had the option to either type or hand-write their responses and return the survey via e-mail or post. Data collection occurred between October 2016 and January 2017, and the study team followed up with clinics with delayed responses or wherever there was a lack of clarity in responses. All survey data was analyzed using descriptive information and frequencies.

RESULTS

Survey responses were obtained from 19 of the 23 clinics contacted (83% response rate), including pediatric ($n = 6$), adult ($n = 3$), and combined pediatric/adult clinics ($n = 10$). Individual respondents ($n = 36$) comprised of 16 psychologists, 10 SLPs, 9 OTs, and 1 clinic coordinator who responded on behalf of the clinicians at their clinic. Five clinicians

(3 psychologists, one OT, and one SLP) were employed at more than one clinic. For 6 clinics, only one individual responded, which was always a psychologist. For the remaining 13 clinics, 2 or more respondents provided data, which included, for instance, 2 psychologists or 2 SLPs from the same clinic, or a psychologist, SLP, and OT from the same clinic. Wherever there were repeat responses at a clinic (e.g., 2 clinicians from the same clinic reporting the same measure in the same domain), only one response was counted.

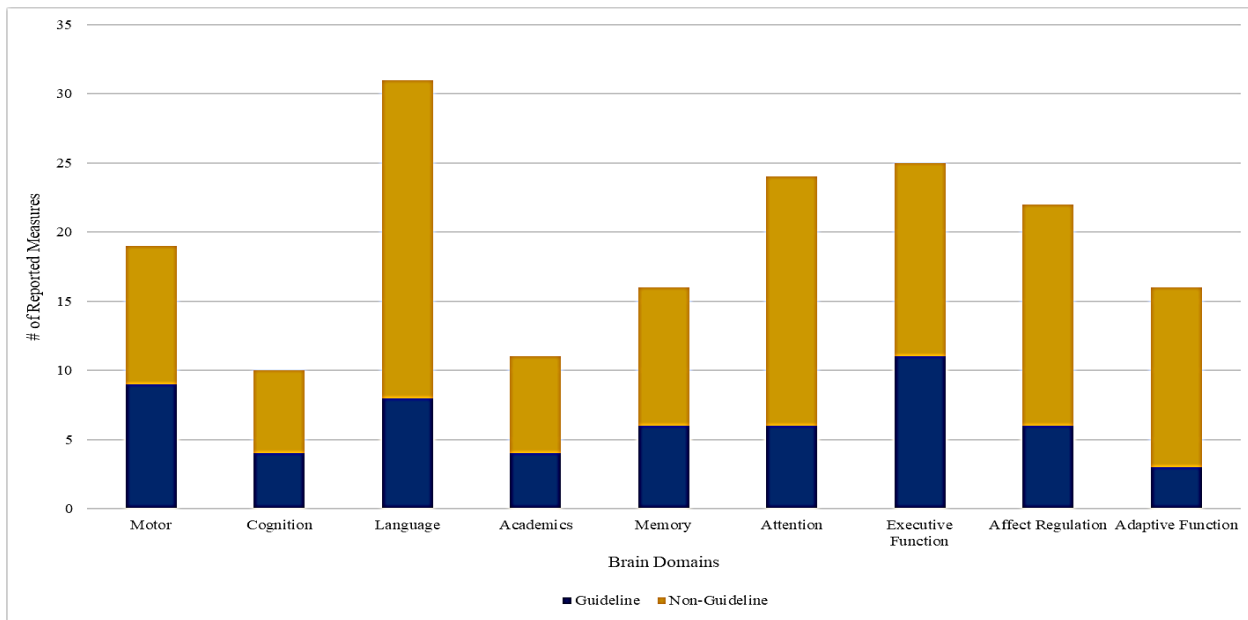
Results of the 2016 Alberta waitlist study indicate that waitlists and factors that contribute to these lists vary by clinic. For example, 8 clinics had no waitlist and 15 clinics had waitlists which ranged in number from 7 individuals to 216 individuals waiting for an FASD assessment.¹³ Province wide, a total of 544 children and 589 adults were on waitlists for diagnosis, though it is important to note that these numbers are never static. Consequently, it is important to note that individual clinic capacity may also influence the measures that clinics report here, as well as the number of responses per clinic.

What Tests are FASD Clinics Using to Assess Brain Function?

There was a wide range ($n = 173$) of measures reported by FASD clinics to assess brain domains. Figure 1 illustrates the number of measures reported in each domain, with the highest number in the language domain ($n = 31$) and the lowest in cognition ($n = 10$). As shown in Figure 1, clinics overall reported more measures not listed in the Canadian guideline (shown in red) compared to measures suggested in the guideline (shown in blue). Note that the neuroanatomy/neurophysiology domain was not included in any of the figures or tables below. This domain was assessed by a physician who conducted a medical assessment, measured head circumference, reviewed and evaluated medical history for evidence of a seizure disorder (due to unknown etiology), or reviewed any medical imaging reports (MRI, CT or PET scans of the brain) to determine impairment.

Numerous measures (14 direct and 10 indirect) were used to assess functioning across multiple brain domains, as shown in Table 1. The direct measures used most comprehensively to assess multiple brain

Assessing for Fetal Alcohol Spectrum Disorder: A Survey of Assessment Measures Used in Alberta, Canada
FIG 1. Total Number of Measures Reported to Assess Brain Domains by FASD Clinics in Alberta, Canada.



domains were the Wechsler intelligence scales (cognition, language, memory, attention, EF), and the indirect measures were observation (motor skills, language, attention, affect regulation, adaptive behaviour) and history/record review (motor skills, academic achievement, attention, affect regulation, adaptive behaviour). Domains with the highest number of overlapping measures were attention (6 direct, 7 indirect), EF (8 direct, 4 indirect), and adaptive behaviour (5 direct, 7 indirect).

In most domains, the majority of measures reported by clinics were direct measures (shown in bold in Tables 2 through to Table 10). However, some domains had much higher proportions of indirect measures. The domains with the highest proportion of direct versus indirect measures were cognition and memory (both 100%), and the lowest proportion of direct measures was reported in the affect regulation domain (11%).

Notably, a number of clinics reported the use of outdated assessment measures. This was especially true for the academic achievement domain, with 6 clinics reporting the use of the older Woodcock Johnson Test of Achievement – 3rd Edition, and for attention, adaptive behaviour, EF, and affect regulation, with 5 clinics reporting older versions of tests in these domains (Adaptive Behaviour Assessment System – 2nd Edition, Behavior Assessment System for Children – 2nd Edition, Behavior Rating Inventory of Executive Function, and Conners Continuous Performance Test – 2nd Edition). An abbreviated measure (the Wechsler

Abbreviated Scale of Intelligence – 2nd Edition) was reported by 2 clinics to assess the cognition domain.

Which Tests Are Most Commonly Used Across Clinics?

There was substantial overlap of measures reported across clinics (see Figure 2 and Tables 2 through 10). The domains with the most consistency in measures reported across clinics were cognition (WAIS by 95% and WISC by 85% of clinics), adaptive behaviour (ABAS by 95% of clinics), and EF (BRIEF by 84% of clinics). Motor skills was the domain with the least consistency in reported measures, with the top measure (BOT-2) reported by 42% of clinics.

To what extent are clinics using tests suggested in the 2015 Canadian guideline?

As seen in Table 2 through to Table 10, many of the most commonly reported tests align with those explicitly suggested in the 2015 guideline (denoted with an asterisk). There was particularly strong alignment with suggested measures in the language and adaptive behaviour domains, where *all* suggested measures were reported by at least one clinic. There was also strong alignment in the motor skills, cognition, academic achievement, and EF domains, where all but one suggested measure was reported by at least one clinic.

There are several tests suggested in the 2015 guideline that were not reported by any clinics including: the Differential Ability Scales – 2nd Edition

Table 1. Tests Used to Assess Functioning across Multiple Brain Domains.

	Motor Skills	Cognition	Language	Academic Achievement	Memory	Attention	Executive Function	Affect Regulation	Adaptive Behaviour
Direct Measures									
CCC			✓						✓
CELF			✓						✓
COWAT			✓				✓		
ILS					✓	✓	✓		✓
NAB			✓		✓	✓			✓
NEPSY					✓	✓	✓	✓	
RBANS					✓	✓			
RCFT/ROCF					✓		✓		
SLDT			✓				✓ ✓		✓
SP	✓							✓	
TOPS			✓				✓		
Verbal Fluency Test			✓				✓		
Wechsler IQ Subtests		✓	✓		✓	✓	✓		
WRAML					✓	✓			
Indirect Measures									
BASC						✓	✓	✓	✓
BRIEF						✓	✓	✓	✓
CMOP-E								✓	✓
Conners Rating Scales						✓	✓		
VABS						✓	✓		✓
Interview	✓							✓	✓
Observation	✓		✓			✓		✓	✓
History/ Record Review	✓			✓		✓		✓	✓
Parent/ Teacher Report						✓		✓	
Previous diagnosis						✓		✓	

BASC = Behaviour Assessment System for Children, BREIF = Behavior Rating Inventory of Executive Function, CCC = Children's Communication Checklist, CELF = Clinical Evaluation of Language Fundamentals, CMOP-E = Canadian Model of Occupational Performance and Engagement, COWAT = Controlled Oral Word Association Test, ILS = Independent Living Scale, NAB = Neuropsychological Assessment Battery, RBANS = Repeatable Battery for the Assessment of Neuropsychological Status, RCFT = Rey Complex Figure Test and Recognition Trial, ROCF = Rey-Osterreich Complex Figure, SLDT = Social Language Development Test, SP = Sensory Profile, TOPS = Test of Problem Solving, VABS = Vineland Adaptive Behavior Scales, WRAML = Wide Range Assessment of Memory and Learning.

Table 2. Measures Used To Assess Motor Skills (Direct Measures Are In **Bold**).

Tool	% of clinics (n)
*Bruininks-Oseretsky Test of Motor Proficiency – 2nd Ed.	42 (8)
*Beery-Buktenica Developmental Test of Visual-Motor Integration – 6th Ed.	37 (7)
*Grooved Pegboard/Purdue Pegboard Test	37 (7)
*Finger Tapping/Oscillation Test	32 (6)
*Hand Dynamometer/Hand Grip Strength Test	32 (6)
*Peabody Developmental Motor Scales – 2nd Ed.	21 (4)
Observation	16 (3)
Quick Neurological Screening Test – 3rd Ed.	16 (3)
Sensory Profile – 2nd Ed.	16 (3)
Caregiver Interview	11 (2)
*Miller Function & Participation Scales	11 (2)
*Movement Assessment Battery for Children – 2nd Ed.	11 (2)
Shore Handwriting Screening	11 (2)

**Denotes measures suggested in the 2015 FASD diagnostic guideline.*

*Measures reported by only one clinic included the *Abnormal Involuntary Movement Scale, Developmental Test of Visual Perception, McMaster Handwriting Assessment Protocol, and Sensory Profile Measure, as well as physician neurological exam, and record review.*

Table 3. Measures Used to Assess Cognition (Direct Measures Are In **Bold**).

Tool	% of clinics (n)
*Wechsler Adult Intelligence Scale – 3rd and 4th Eds.	95 (18)
*Wechsler Intelligence Scale for Children – 4th and 5th Eds.	85 (16)
*Wechsler Preschool and Primary Scale of Intelligence – 2nd through 4th Eds.	48 (9)
Wechsler Abbreviated Scale of Intelligence – 2nd Ed.	11 (2)

**Denotes measures suggested in the 2015 Canadian FASD diagnostic guideline.*

*Measures reported by only one clinic included the *Bayley Scales of Infant and Toddler Development – 3rd Ed., Developmental Assessment of Young Children – 2nd Ed., Detroit Test of Learning Aptitude – 2nd Ed., Mullen Scale of Early Learning, Stanford-Binet Intelligence Scales – 5th Ed., and the Wechsler Nonverbal Scale of Ability.*

for cognition, academic achievement, and memory; the Kaufman Assessment Battery for Children – 2nd Edition for memory; the Test of Everyday Attention for Children for attention; the Behavioral Assessment of the Dysexecutive Syndrome for EF; and the Carey Temperament Scales, Infant Toddler Social Emotional Assessment, Multidimensional Anxiety Scale for Children – 2nd Edition, and

Children’s Depression Inventory – 2nd Edition for affect regulation.

As noted above, there were very few standardized tools reported in the neuroanatomy/neurophysiology domain. In fact, only 3 clinics provided responses in this domain. Reported tests included consultation with a psychiatrist/physician to assess for microcephaly, head circumference, physical/medical anomalies

Table 4. Measures Used to Assess Language (Direct Measures Are In Bold).

Tool	% of clinics (n)
*Peabody Picture Vocabulary Test – 4th Ed.	58 (11)
*Clinical Evaluation of Language Fundamentals – 4th and 5th Eds.	48 (9)
*Test of Narrative Language – 1st and 2nd Eds.	26 (5)
*Expressive Vocabulary Test – 1st and 2nd Eds.	26 (5)
Boston Naming Test – 2nd Ed.	26 (5)
Receptive One-Word Picture Vocabulary Test – 4th Ed.	16 (3)
Controlled Oral Word Association Test	11 (2)
Expressive One-Word Picture Vocabulary Test – 4th Ed.	11 (2)
Oral and Written Language Scales – 2nd Ed.	11 (2)
*Preschool Language Scales – 5th Ed.	11 (2)
*Receptive-Expressive Emergent Language Test – 3rd Ed.	11 (2)
*Renfrew Bus Story	11 (2)
Test of Problem Solving – 2nd (Adolescent) and 3rd (Elementary) Eds	11 (2)
Verbal Fluency Test	11 (2)
*Language samples	11 (2)
Past assessments	11 (2)

*Denotes measures suggested in the 2015 Canadian FASD diagnostic guideline.

Measures reported by only one clinic included the Comprehensive Assessment of Spoken Language, Children’s Communication Checklist – 2nd Ed., Communication Matrix, Comprehensive Receptive and Expressive Vocabulary Test – 3rd Ed., Listening Comprehension Test, Neuropsychological Assessment Battery, Preschool Language Assessment Instrument – 2nd Ed., Rosetti Infant Toddler Scale, Social Language Development Test (Elementary and Adolescent), Test of Word Knowledge, and WPPSI General Language Composite, as well as informal narrative probes, narrative assessment, observation, and self-made informal screening.

Table 5. Measures Used to Assess Academic Achievement (Direct Measures Are In **Bold**).

Tool	% of clinics (n)
*Wechsler Individual Achievement Test – 3rd Ed.	79 (15)
*Woodcock Johnson Tests of Achievement – 3rd and 4th Eds.	52 (10)
*Wide Range Achievement Test – 4th Ed.	21 (4)
History/record review	11 (2)

*Denotes measures suggested in the 2015 Canadian FASD diagnostic guideline.

Measures reported by only one clinic included the Alberta Diagnostic Reading Passages, *Bracken Basic Concepts Scale – 3rd Ed. Receptive, Graded Word List, Jerry Johnson Informal Reading Inventory, Process Assessment of the Learner – 2nd Ed., and Wechsler Fundamentals: Academic Skills, as well as modified transactional play-based assessment.

Table 6. Measures Used to Assess Memory (Direct Measures Are In **Bold**).

Tool	% of clinics (n)
*California Verbal Learning Test – 2nd Ed. and Children’s version	68 (13)
*Rey Complex Figure Test and Recognition Trial	42 (8)
Wechsler subtests (WAIS, WISC, WPPSI)	32 (6)
*Wide Range Assessment of Memory and Learning – 2nd Ed.	32 (6)
*NEPSY-II Subtests	21 (4)
Rey Auditory Verbal Learning Test	21 (4)
*Wechsler Memory Scale –Revised, 3rd, and 4th Eds.	21 (4)
Benton Visual Retention Test	16 (3)
*Children’s Memory Scale	11 (2)

**Denotes measures suggested in the 2015 Canadian FASD diagnostic guideline.*

Measures reported by only one clinic included the Brief Visuospatial Memory Test – Revised, Child and Adolescent Memory Profile, Independent Living Scales, Neuropsychological Assessment Battery Memory Module, Repeatable Battery for the Assessment of Neuropsychological Status, Rivermead Behavioural Memory Test, and Test of Memory and Learning – 2nd Ed.

Table 7. Measures Used to Assess Attention (Direct Measures Are In **Bold**).

Tool	% of clinics (n)
**Conners – 3rd Ed. and Adult ADHD Rating Scales	58 (11)
**Behavior Assessment System for Children – 2nd and 3rd Eds.	52 (10)
*Conners Continuous Performance Test – 2nd and 3rd Eds.	37 (7)
Brief Test of Attention	32 (6)
**Anecdotal evidence/parent and teacher report	26 (5)
**Observation	26 (5)
NEPSY-II	16 (3)
Attention Process Training Test	11 (2)
Digital Vigilance Test	11 (2)
Integrated Visual and Auditory Continuous Performance Test – Plus	11 (2)

**Denotes measures suggested in the 2015 Canadian FASD diagnostic guideline. **Suggested along with other clinical evidence/observation when used with children.*

*Measures reported by only one clinic included the Allen Cognitive Level Screen, Behavior Rating Inventory of Executive Function, Conners Continuous Auditory Test of Attention, Independent Living Scales, Neuropsychological Assessment Battery, Repeatable Battery for the Assessment of Neuropsychological Status, **Swanson Nolan and Pelham Questionnaire – 4th Ed., Spatial Span test, Vineland Adaptive Behavior Scales – 2nd Ed., Visual Search and Attention Test, WISC and WRAML subtests, as well as physician diagnosis and record review.*

Table 8. Measures Used to Assess Executive Function (Direct Measures Are In **Bold**)

Tool	% of clinics (n)
**Behavior Rating Inventory of Executive Function – 1st and 2nd Eds., and Adult version	84 (16)
*NEPSY-II	42 (8)
Trail Making Test/Comprehensive Trail Making Test	42 (8)
*Delis-Kaplan Executive Function System	37 (7)
Category Test	32 (6)
*Test of Problem Solving – 2nd (Adolescent) and 3rd (Elementary) Eds.	32 (6)
*Wechsler Working Memory Scales	21 (4)
*Wisconsin Card Sort Task	21 (4)
**Behavior Assessment System for Children – 2nd and 3rd Eds.	16 (3)
*Rey Complex Figure Test/Rey-Osterreich Complex Figure	16 (3)
Stroop Test	16 (3)
Iowa Gambling Task	11 (2)
Verbal Fluency Test	11 (2)

**Denotes measures suggested in the 2015 Canadian FASD diagnostic guideline. **Suggested along with other clinical evidence/observation when used with children.*

*Measures reported by only one clinic included the Brixton Spatial Anticipation Test, Calendar Task, *Comprehensive Executive Function Inventory, Conners – 3rd and Early Childhood editions, Controlled Oral Word Association Test, Functional Assessment of Verbal Reasoning and Executive Strategies, Independent Living Scales (Integrated Problem Solving), Symbol Digit Modalities Test, *Social Language Development Test (Elementary and Adolescent versions), and Vineland Adaptive Behavior Scales – 2nd Ed., as well as **record review, and self-made checklists.*

Table 9. Measures Used to Assess Affect Regulation (Direct Measures Are In **Bold**)

Tool	% of clinics (n)
*Behavior Assessment System for Children – 2nd and 3rd Eds.	68 (13)
Personality Assessment Inventory – Original and Adolescent versions	47 (9)
Anecdotal evidence/*clinical interview/parent and teacher report	42 (8)
*Beck Depression Inventory – 2nd Ed.	32 (6)
Observation	32 (6)
Behavior Rating Inventory of Executive Function – Original and Adult versions	21 (4)
History/review of collateral information	16 (3)
Millon Inventories (MACI and MCMI – 4th Ed.)	16 (3)
*Beck Anxiety Inventory	11 (2)
Beck Youth Inventories – 2nd Ed.	11 (2)
*Previous or current diagnosis	11 (2)
Symptom Checklist-90-Revised	11 (2)
Trauma Symptom Inventory	11 (2)

**Denotes measures suggested in the 2015 Canadian FASD diagnostic guideline.*

*Measures reported by only one clinic included the Behavior Dimensions Scale – 2nd Ed., *Child Behavior Checklist, Canadian Model of Occupational Performance and Engagement, Mini International Personality Item Pool, Minnesota Multiphasic Personality Inventory – 2nd Ed. and Adolescent version, NEPSY-II, Screen for Child Anxiety Related Disorders, and Sensory Profile – 1st Ed.*

Table 10. Measures Used to Assess Adaptive Behaviour, Social Skills, Or Social Communication (Direct Measures Are In **Bold**)

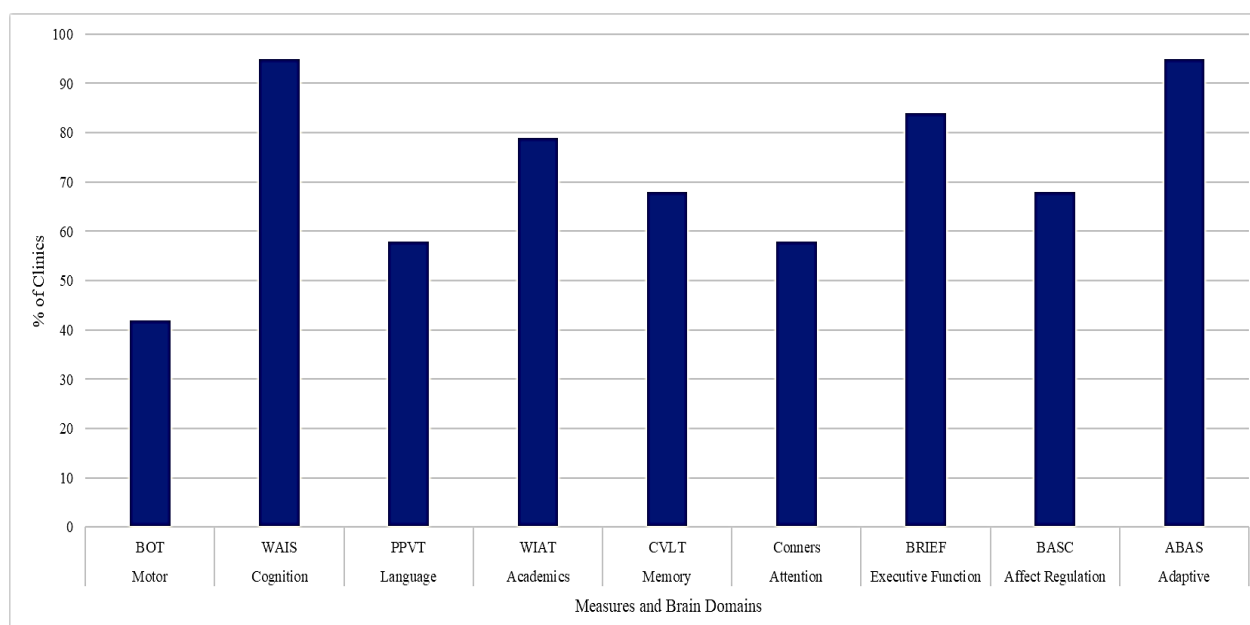
Tool	% of clinics (n)
*Adaptive Behavior Assessment System – 2nd and 3rd Eds.	95 (18)
*Social Language Development Test (Elementary and Adolescent Versions)	42 (8)
*Vineland Adaptive Behavior Scales – 2nd and 3rd Eds.	21 (4)
Behavior Assessment System for Children – 2nd and 3rd Eds.	16 (3)
Observation	16 (3)
Clinical Evaluation of Language Fundamentals – 4th Ed. Pragmatics Profile	11 (2)
Clinical interview	11 (2)
Independent Living Scale	11 (2)
Record review/review of collateral information	11 (2)
The Awareness of Social Interference Test	11 (2)

*Denotes measures suggested in the 2015 Canadian FASD diagnostic guideline.

Direct measures

Measures reported by only one clinic included the Advanced Clinical Solutions – Social Cognition, Behavior Rating Inventory of Executive Function, Children’s Communication Checklist – 2nd Ed., Canadian Model of Occupational Performance and Engagement, Scales of Independent Behavior – Revised, and Texas Functioning Living Scales.

FIG 2. Assessment Measures Most Commonly Reported to Assess Brain Domains by FASD Clinics in Alberta, Canada.



Note. BOT = Bruininks-Oseretsky Test of Motor Proficiency, WAIS = Wechsler Adult Intelligence Scale, PPVT = Peabody Picture Vocabulary Test, WIAT = Wechsler Individual Achievement Test, CVLT = California Verbal Learning Test, Conners = Conners Rating Scales, BRIEF = Behaviour Rating Inventory of Executive Function, BASC = Behavior Assessment System for Children, ABAS = Adaptive Behavior Assessment System.

associated with FAS, or history of seizures; review of existing neuroimaging reports (e.g., CT, MRI, EEG); and assessment of facial features using physical measurements and photographic analysis software. These align closely with the 2015 guideline suggested tests, which include assessing for microcephaly, structural abnormalities via brain imaging, and seizure disorders.

Which Tools Are Being Used Beyond Those Recommended in the 2015 Guideline?

Although most of the tests commonly used by clinics align with the 2015 guideline suggestions, many additional tools were reported. Twenty tests were reported by 3 or more clinics outside of those suggested in the guideline, as seen in Tables 2 through 10 and summarized in Table 11. Of these measures, the most commonly reported were the PAI and observations for affect regulation; TMT/CTMT and Category Test for EF; Wechsler subtests for memory; and BTA for attention.

DISCUSSION

In the context of constantly evolving FASD diagnostic approaches, there is an ongoing need to

understand current clinical practice. An important part of diagnostic decision-making. This knowledge helps us to examine consistencies and differences between diagnostic clinic practices, uncover any specific areas where adequate clinical measures may be lacking, and identify tools that may not be suggested by the current Canadian guideline, but may nonetheless aid in the diagnostic process.

MEASURES USED IN ALBERTA

In the current study, we surveyed 19 FASD assessment and diagnostic clinics across Alberta, Canada on their use of assessment measures to evaluate brain function. Responses were obtained from a variety of professionals, including psychologists, SLPs, OTs, and a clinic coordinator. Obtaining responses from multiple professionals increased the chances that testing measures were accurately and comprehensively captured. Results showed that there was a wide variety of measures being used

Table 11. Tests Reported By Clinics Beyond Those Suggested in the 2015 Canadian Guideline.

Domain	Reported Measures	% of clinics
Motor Skills	Observation	16
	Quick Neurological Screening Test – 3rd Ed.	16
	Sensory Profile – 2nd Ed.	16
Language	Boston Naming Test – 2nd Ed.	26
	Receptive One-Word Picture Vocabulary Test – 4th Ed.	16
Memory	Wechsler subtests (WAIS, WISC, WPPSI)	32
		21
		16
Attention	Brief Test of Attention	32
	NEPSY-II	16
Executive Function	Category Test	32
	Stroop Test	16
	Trail Making Test (TMT)/Comprehensive Trail Making Test (CTMT)	42
Affect Regulation	Behavior Rating Inventory of Executive Function	21
	History/review of collateral information	16
	Millon Inventories (MACI and MCMI – 4th Ed.)	16
	Observation	32
	Personality Assessment Inventory (PAI)	47
Adaptive Behaviour	Behavior Assessment System for Children	16
	Observation	16

across the province but also, that there was substantial overlap across clinics and alignment with the measures recommended in the 2015 Canadian FASD diagnostic guideline, which all clinics were using at the time of the survey.

To that end, a significant finding of this study was that participating clinics were not only using the recommended neurodevelopmental tests, but also that their responses provided evidence that all clinics had adopted the new Canadian recommendations. This transition would have required additional training and changes to their diagnostic methodology to reflect these key changes. A dedicated and targeted training plan was developed by the Clinic Training Services program at the Lakeland Centre for FASD throughout 2015 and 2016. This initiative resulted in numerous face-to-face training sessions on the new guideline recommendations, a webinar delivered by a presenter with expertise on the new guideline, taped sessions which were accessible to clinic teams, as well as training that included live clinics and case studies. Additionally, the Canada FASD Research Network developed the *Multidisciplinary Team Training for Diagnosis of FASD: An Online Training Curriculum*.¹⁴ This online module-based curriculum is designed for clinicians who work in FASD clinics and is based on the 2015 guideline.² FASD assessment and diagnostic clinician and team training, mentorship for new and emerging FASD clinics, and Community of Practice meetings for clinicians are a constant part of the Clinic Training Services Program, both in Alberta and throughout Canada. Therefore, it was not surprising that all 19 clinics who were participating in this study were using the 2015 guideline, as the province of Alberta continues to be a Canadian leader in the field of FASD. The province of Alberta leads Canada in terms of the number of diagnostic clinics, who are well supported by Alberta's cross-ministry committee and 10-year strategic plan.¹⁵

A total of 173 distinct tests were reported by participating clinics, with the highest number in the language domain and the lowest in cognition. Many of these tests were used to assess functioning across multiple domains, especially in the areas of attention, EF, and adaptive behaviour. Complex cognitive and behavioural skills such as these involve multiple layers of functioning, thus the finding that measures

were used to assess function across multiple domains was not surprising. In fact, very few psychometric testing measures exist to assess “pure” brain function (i.e., impairments in only one specific domain), and are multifactorial and multipurpose in design. For example, this cross over is indicated by the overlap of tests and disciplines (i.e., psychology, speech and language pathology, occupational therapy) as demonstrated by the responses in this study. Indeed, several of the tests listed in the 2015 guideline were suggested to assess brain function across several domains.

However, caution needs to be taken when using tests to evaluate domains for which they were not necessarily designed. For example, a number of clinics reported using the Wechsler intelligence scales to evaluate language and memory, which was not recommended in the 2015 guideline. In fact, the guideline stipulated that the Wechsler working memory scale should be used to assess EF only. Several clinics also reported using the BASC to evaluate adaptive behaviour, and although some insight into adaptive behaviour may be gained from this test, using the BASC on its own to evaluate adaptive behaviour should be avoided given its subjective parent-, teacher-, and self-report data. While the BASC has been noted as a clinically appropriate alternative to longer, more intensive assessments in the PAE population in other countries,¹⁶ studies with other populations (e.g., individuals with high functioning autism spectrum disorder) have cautioned about assuming that all measures of adaptive behaviour are comparable and demonstrated that different measures of adaptive behaviour, including the BASC and VABS, may be discrepant.¹⁷ These findings highlight the need for continued diagnostic team training, which is an important part of maintaining diagnostic consistency. Considering that clinician turnover may be common in some FASD clinics, ongoing training and education are critical to ensuring that clinicians are practicing within their scope of profession, skill level, and expertise in order to best meet the needs of their clients.

We also found that there was considerable overlap in measures used across FASD clinics. In particular, the most consistent test selection was reported in the cognition, adaptive behaviour, and EF domains. The overlap in assessment measures across clinics in this

study speaks to the consistency and rigour of FASD diagnostic services and the cohesiveness of FASD clinical practice across the province. This precision in FASD assessment data collection also creates the potential for identifying patterns of brain function to better understand the profile of individuals with FASD in Alberta.

DIRECT VERSUS INDIRECT MEASURES

It is emphasized in the 2015 Canadian guideline that FASD clinicians should use *direct* assessment measures wherever possible, which include standardized tests and objective physical measurements. This recommendation was suggested for the majority of brain domains evaluated as part of the diagnostic process, but it was also understood that this was not always possible. In these cases, indirect measures such as rating scales and chart review were deemed acceptable, so long as information was collected from multiple sources, and supported by clinical judgment and other evidence. The intent of this recommendation was to reduce the risk of subjective interpretation or observer bias.²

The results of our study demonstrated the convergence of direct and indirect measures to assess brain functioning in individuals with FASD. In the majority of brain domains, clinicians in this study primarily reported the use of direct measures. For instance, in the cognition and memory domains, 100% of the measures reported were direct. An exception to this finding was noted in the affect regulation domain, in which only 2 direct measures out of 21 (11%) were reported. These results illustrate the scenario for using indirect measures, such as clinical observation and interviews, to supplement direct measures whenever possible and appropriate. This is particularly true for brain domains where direct measures do not exist or would not produce meaningful results. In general, FASD diagnostic clinicians should be encouraged to employ a variety of testing measures, including direct, standardized measures, supplemented by indirect measures to best characterize the profile of the individual being assessed and gain a comprehensive understanding of their needs. For instance, researchers have shown although direct measures (i.e., objective performance-based tests) and indirect behavioural

measures (i.e., rating scales) of EF are intended to assess the same underlying constructs, they do not correlate highly with one another in the general population¹⁸ or for individuals with FASD.^{19,20} However, using both types of measures in clinical assessment allows for the evaluation of underlying cognitive abilities, as well as day-to-day functioning. These findings indicate that clinicians should consider the use of ecologically valid tools along with performance-based measures to ensure that assessment results are objective, but also readily translatable into practical recommendations for individuals with FASD and their families. This merging of assessment measures will help to ensure that results are linked to meaningful interventions that are relevant to the client's real-world context.

OUTDATED AND ABBREVIATED TESTS

Another noteworthy finding in this study was that some clinics reported the use of outdated and abbreviated versions of tests, particularly in the areas of academic achievement, attention, EF, affect regulation, and adaptive behaviour. Important changes occur when a psychological test is revised, including updated norms, improved psychometric properties, administrative modifications, and more relevant testing stimuli.^{21,22} These changes can have significant implications for test interpretation and the subsequent conclusions that are drawn from the data. However, the decision to transition to an updated test is not always straightforward, particularly for clinicians in highly specialized areas, where for instance, population-specific standardized norms may not be available when the new test is published.²¹ Therefore, as always, clinicians are encouraged to use their professional judgment in test selection to best meet the needs of the client in their current context, which may include the use of abbreviated tests. A multitude of factors need to be considered when choosing the most appropriate assessment measures for an FASD assessment, and professionals should be encouraged to use their clinical judgment when determining if, and when, to employ an abbreviated version of a test, that fits with their unique testing circumstances and clinic resources. While clinical judgment is warranted, an important implication of this study is the opportunity for follow-up training with clinics who report using

outdated or abbreviated tests. As a result of this data, clinic training in Alberta has already been revised to incorporate the results of this study and to discuss assessment challenges across the provinces.

ALIGNMENT WITH 2015 CANADIAN GUIDELINE

Finally, we examined the alignment between tests reported by clinics and those suggested in the 2015 Canadian guideline, and found considerable adherence to the guideline. In all domains except for memory, EF, and affect regulation, the 3 most commonly reported measures matched those suggested in the guideline. There were also many tests that clinics used outside of those suggested in the guideline, especially in the adaptive behaviour, affect regulation, attention, and language domains. In terms of specific tools, the most commonly reported measures outside of those suggested in the guideline were the PAI and observation for affect regulation, the Trail Making Test/Comprehensive Trail Making Test and Category Test for EF, Wechsler subtests for memory, and the Brief Test of Attention for attention. Some of these measures have been used in previous studies including individuals with FASD, such as the Trail Making Test.²² A future direction of this work is the potential for the list of suggested measures in the Canadian guideline to be expanded to include other measures that may be clinically useful. Based on the clinical experience of some of the authors included here, tests such as the Rey Auditory Verbal Learning Test, the Category Test, and the Comprehensive Trail Making test may be potential tests for consideration in the future. It is important to note that some of the tests identified by clinics may pose certain challenges, such as the MCMI and PAI (e.g., minimal reading level) or the Wechsler subtests (e.g., do not fall under memory). Additional measures, such as the Stroop Test, may also be worthy of consideration and have previously been identified in the FASD literature.^{22,23} These findings shed light on additional measures that may be particularly useful for FASD assessment and diagnosis, and may be considered by clinics delivering FASD services in Canada. However, the choice of testing measures is best left to the individual clinicians, as we expect them to have the proper background and training that

provides confidence in their choice of tests and best clinical practice. It is critical to consider the overall picture of brain impairment in each domain as a whole, rather than focus specifically on the individual assessment measures. It is likely that clinician preference of particular tests adequately assesses the particular brain domain but may also include measures not yet recommended in the guideline.

LIMITATIONS AND FUTURE RESEARCH

This study is one of the first of its kind to capture the measures used for FASD assessment and diagnosis in Canada; however, there are nonetheless several limitations with this research. First, although the 83% response rate from invited clinics was relatively high, 4 of the 23 invited clinics declined participation in this study which may have biased the results. Two of the 4 clinics who declined to participate do not restrict referrals solely on FASD potential risk and see a range of complex needs. As well, although this study provides an overview of the assessment measures used in Alberta, it is a snapshot of only one province which may not be representative of other parts of the country. Larger scale research that includes FASD clinics from across the country would provide ongoing insight into the most up-to-date assessment measures used by FASD clinicians and would allow researchers to gain a more comprehensive picture of FASD diagnostic practices in Canada. To that end, future research that explores how clinics across Canada differ in terms of their assessment and diagnostic practices is warranted. Currently, an updated version of this study is being conducted with FASD clinics across Canada which will allow for a broader understanding of FASD diagnostic practices nationally.

Additionally, there was noted variability in the scope of clinicians who responded from each clinic, where some clinics had one only professional who provided feedback. Consequently, it is possible that some measures may have been missed and may not have fully reflected the multidisciplinary diagnostic team approach. As well, although physicians were invited to participate, none responded to our survey, which means that an important perspective from the clinical team was missed. It is important to consider

that responses are dependent on clinic type and on composition of the multidisciplinary team.

Similarly, it is discussed in the 2015 guideline that FASD diagnostic teams may involve additional members where appropriate, such as social workers, mental health professionals, nurses, and probation officers. Although these individuals generally do not participate in the assessment of brain function directly, their contribution to FASD assessment is critical and thus their perspectives should be incorporated into future research to more fully understand the complexities of the FASD diagnostic process.

CONCLUSION

This study provided key insights into FASD assessment in Alberta, and critical implications for the evolution of FASD diagnostic practice in Canada. The results presented here speak to the great variety of measures that FASD diagnostic teams are drawing upon to inform their assessments to garner a comprehensive understanding of each individual they assess. Findings also highlight the importance of using the most current and reliable measures relevant to their testing population, and the potential need for ongoing training for clinicians to ensure diagnostic consistency and adherence to evolving best practice. With the profound importance of early diagnosis for individuals with FASD, clinicians are tasked with the vital role of accurately capturing the strengths, challenges, and needs of their clients to connect them with individualized and meaningful support.

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