DEVELOPING A DECISION TREE FOR CLINICAL IDENTIFICATION OF CHILDREN PRENATALLY EXPOSED TO ALCOHOL II: MODEL VALIDATION

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BACKGROUND

- Recent studies have focused on developing a clinically relevant and feasible diagnostic screening tool that accurately identifies children affected by heavy prenatal alcohol exposure (AE).
- Using data from phase two of the Collaborative Initiative on Fetal Alcohol Spectrum Disorders (CIFASD II), we created a decision tree model with high classification accuracy (>80%) to identify children with heavy prenatal AE.
- The current study aimed to validate this model in two age groups from an independent sample from CIFASD III.

METHOD

Subjects

Children aged 5-7y (C; *M*=6.6) and adolescents aged 10-16y (A; *M*=13.4) were recruited for a multisite study investigating the effects of prenatal alcohol exposure. Subjects (N=454) comprised two groups at each age: children with histories of prenatal AE (the AE-3 group) and non-exposed controls (the Non-AE-3 group). The Non-AE-3 group included typically developing controls and children with other clinical concerns (e.g., ADHD, learning or behavior disorders; **Table 1**).

Measures

Differential Ability Scales – Second Edition (DAS-II):
General Cognitive Ability (GCA; *Standard score*)
Child Behavior Checklist (CBCL):
Somatic Complaints, Social Problems, Thought Problems, Attention Problems, Rule Breaking Behavior, Aggressive Behavior (*T scores*)
Vineland Adaptive Behavior Scales – Second Edition (VABS-II):
Socialization, Communication, Daily Living Skills (*Standard scores*)
Dysmorphology:
Palpebral fissure length <11th percentile, vermillion border lipometer score >3, philtrum lipometer score >3, ptosis, incomplete extension of >0 digits (*measures coded dichotomously indicating presence/absence of feature*)

Statistical Analyses

Demographic data were analyzed using analysis of variance (ANOVA) and Chi-square techniques. Accuracy of the previously developed model (Goh et al.), which included two entry points, was tested. Logistic regression analyses were conducted at each node of the tree to obtain odds ratio (OR) values. Positive (PPV) and negative (NPV) predictive values and classification accuracies were calculated. Z-test analyses were used to determine whether classifications, PPVs, and NPVs were statistically different from chance, based upon the decision to classify subjects into two groups (i.e., AE or Non-AE).

Demographic Data

In the younger age range, groups significantly differed on GCA and ADHD diagnosis rate. In the older age range, groups significantly differed on GCA, age, and ADHD diagnosis rate. Groups did not significantly differ on any other demographic variables (**Table 1**).

Table 1. Demographic Information by Group

Variable	Child (*n* = 165)		Adolescent (*n* = 289)	
	AE-3 (*n* = 55)	Non-AE-3 (*n* = 110)	AE-3 (*n* = 98)	Non-AE-3 (*n* = 191)
Sex [*n* (% Females)]	32 (58)	48 (44)	43 (44)	90 (47)
Age [*Mean* (SD)]	6.8 (0.12)	6.6 (0.09)	13.0 (0.21)*	13.7 (0.15)*
Race [*n* (% White)]	24 (44)	59 (54)	53 (54)	103 (54)
Ethnicity [*n* (% Hispanic)]	6 (11)	14 (13)	16 (16)	42 (22)
Handedness [*n* (% Right)]	44 (80)	99 (90)	86 (88)	162 (85)
GCA [*Mean* (SD)]*	86.8 (1.82)	99.1 (1.28)	88.1 (1.54)	101.2 (1.10)
ADHD [*n* (%)]*	38 (69)	33 (30)	68 (69)	38 (20)
FAS [*n* (%)]	7 (13)	0 (0.0)	11 (11)	0 (0.0)
CIFASD Site [*n* (%)]				
Atlanta	22 (40)	34 (31)	21 (21)	55 (29)
Los Angeles	0 (0)	1 (<1)	13 (13)	20 (10)
Minnesota	22 (40)	44 (40)	32 (33)	50 (26)
San Diego	11 (20)	31 (28)	32 (33)	66 (35)

*Significant at $p < .05$ level.

RESULTS

The final decision tree is shown in **Figure 1**. All classification accuracies, PPVs, NPVs, and OR values are shown in **Table 2**. Overall classification accuracies from model development and validation within child and adolescent age ranges are shown in **Figure 2.**

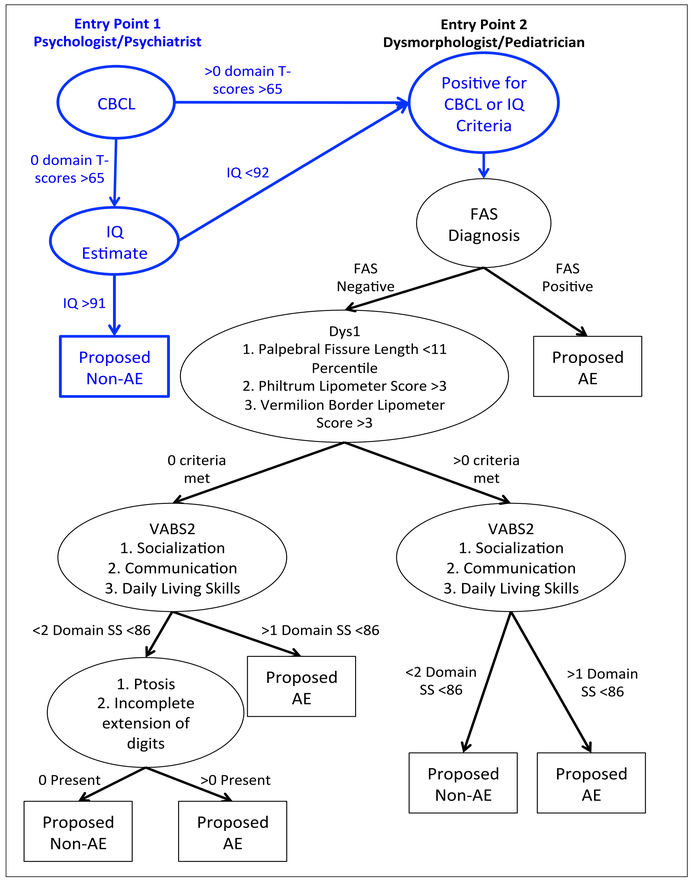

Figure 1. Final Decision Tree Showing Entry Points 1 and 2

Table 2. Classification Accuracies, PPVs, NPVs, OR values

	Child		Adolescent	
	Entry Point 1	Entry Point 2	Entry Point 1	Entry Point 2
Overall Accuracy (%)	84.5	82.1	80.0	79.5
Sensitivity (%)	70.7	63.8	79.3	81.3
Specificity (%)	93.5	93.4	87.6	78.3
PPV (%)	87.9	85.7	77.4	71.4
NPV (%)	82.9	80.7	88.7	86.2
Significant OR values	7.19 - 32.72		2.17 - 31.78	

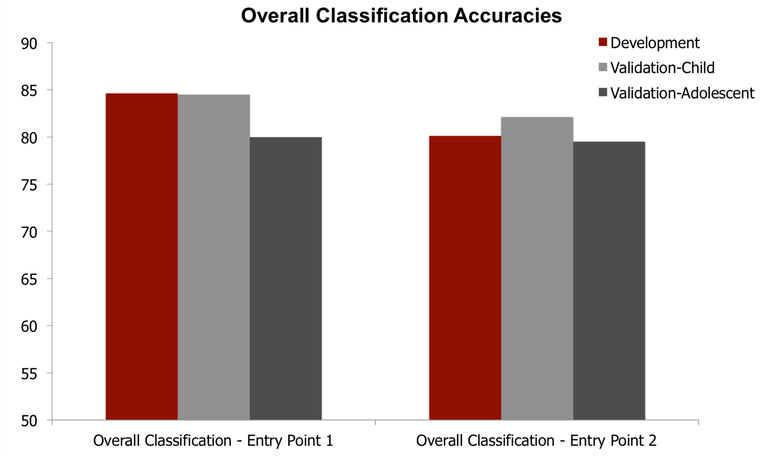

Figure 2. Comparison of Overall Classification Accuracies from Development and Validation within Child and Adolescent

- All values were significantly higher than chance (*p*s<.001), except sensitivity using the second entry point in the child age range (*p*=.058). Each node of the decision tree significantly differentiated between AE-3 and Non-AE-3 groups (*p*s<.05) except at the node employing an IQ estimate in both adolescent (*p*=.101) and child (*p*=.143) age ranges. OR values at the node employing an IQ estimate were not significant in either the child (OR=2.67, *p*=.143) or adolescent (OR=2.23, *p*=.075) age ranges.
- In the younger age range, misclassified AE-3 subjects generally were younger. Misclassified Non-AE-3 subjects generally were older, more likely to be left-handed, had lower GCA scores, and higher rates of ADHD diagnosis.
- In the older age range, misclassified AE-3 subjects generally were younger and had lower rates of ADHD diagnosis. Misclassified Non-AE-3 subjects generally were older, were less likely to be white, and had lower GCA scores.

DISCUSSION

- Results validate use of this decision tree (Goh et al.) in discriminating alcohol-exposed youth from non-exposed youth, including those with behavioral problems.
- While use of the DAS-II GCA provided comparable accuracy rates in CIFASD III as use of the WISC-IV FISIQ in CIFASD II, it did not significantly discriminate between alcohol-exposed and non-exposed groups.
- High specificity rates using the DAS-II suggest non-exposed children were correctly identified, and we hypothesize that incorrectly classified children were correctly identified by subsequent measures in the tree.
- Inclusion of a heterogeneous comparison group makes results more generalizable and clinically relevant, as behavioral presentation of AE is similar to other clinical disorders.
- Future research should identify additional neuropsychological variables that reliably identify adolescents and children with heavy AE in order to increase clinical utility and flexibility of the tree.

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