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Standardized Screening Facilitates Timely Diagnosis of Autism Spectrum Disorders in a Diverse Sample of Low-Risk Toddlers

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Abstract

Objective—Routine, standardized screening for ASD has been hypothesized to reduce known racial/ethnic and socioeconomic status (SES) disparities in age of first diagnosis. This study explored demographic differences in toddlers' age and performance on developmental measures at the time of ASD assessment.

Method—Toddlers (16-39 months at evaluation) who screened at-risk for developmental delay on the Modified Checklist for Autism in Toddlers (M-CHAT) or M-CHAT-Revised (M-CHAT-R) and follow-up interview participated in a diagnostic assessment. Of these, 44.7% were racial/ethnic minorities and 53.5% were non-minorities. Child race/ethnicity, years of maternal education (MEd), and household yearly income (YI) were parent-reported.

Results—Small but significant correlations were observed between MEd or YI and evaluation age and adaptive communication, socialization, and motor scores. Controlling for MEd and YI, minority racial/ethnic group did not predict child's performance on most measures and did not predict likelihood of ASD diagnosis. Differences in age at evaluation and receptive language skills were small effects.

Conclusion—Significant but small effects emerged for SES and minority status on toddlers' age at evaluation and parent-reported adaptive skills, but these did not predict ASD diagnosis. The small magnitude of these effects suggests that routine, standardized screening for ASD in toddlers and timely access to diagnostic evaluation can reduce disparities in age at diagnosis and possibly reduce racial/ethnic disparities in access to services for ASD and other developmental delays.

Keywords

M-CHAT; autism screening; socioeconomic status

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Conflicts of Interest

Diana Robins is co-owner of M-CHAT LLC, which licenses use of the M-CHAT in electronic products. Data used in the current study were collected using the free version of the M-CHAT and no royalties are associated with this study. Marianne Barton and Deborah Fein are co-owners of the M-CHAT LLC, and donate their proceeds to the University Foundation and Psychological Services Clinic. For the remaining authors none were declared.

Autism spectrum disorders (ASD) are characterized by serious and pervasive impairments in communication and social interaction, and the presence of restricted interests and repetitive behaviors.[1] Current prevalence estimates indicate 1 in 88 children in the U.S. is identified with an ASD.[2] Substantial evidence suggests that ASD can be diagnosed around the second birthday, and that early diagnosis is stable.[3] Screening for ASD in toddlers leads to early identification and intensive intervention, and subsequently improved outcome.[4]

ASD occurs in all racial/ethnic and socioeconomic groups in the U.S.[5] However, reports of differences in prevalence of ASD by these demographic factors have been conflicting.[6] National surveys have found that the reported prevalence of ASD is comparable for African-American and White children, but significantly lower for Latinos than non-Latinos.[7-9] Prevalence of ASD was also lower among children whose backgrounds included lower socioeconomic status (SES), with prevalence steadily increasing along with SES. Barton and al[5] described factors that may contribute to disparities in screening, including inconsistent attendance at well-child care visits, barriers due to limited English language proficiency, and cultural differences in interpretation of early symptoms of ASD. Others have suggested that observed differences in ASD diagnosis rates may reflect cultural differences in the relative importance of developmental milestones, for example social or language skills,[10] or that clinician bias leads to dismissal of ASD symptoms in certain groups when using spontaneous clinical judgment alone.[11] It remains unclear whether lower rates are in fact due to limited access to screening and diagnosis, or to true differential prevalence of ASD. The CDC[2] recently reported that the largest increases in prevalence of ASD were among Latino (110% increase) and African-American (91% increase) children, perhaps demonstrating the positive effect of increased awareness, screening, and access to screening and diagnostic services in these populations.

Disparities in access to ASD diagnosis are consistent with broader findings of disparities in access to healthcare overall for racial and ethnic minorities and low-income populations in the U. S.[12, 13] In both the U.S. and the Netherlands, ethnic minority children were less likely than White children to have ASD diagnosis documented in their records.[11] In Medicaid-eligible children with ASD, African-American children were 1.5 years older than White children when diagnosed with ASD, and had more contacts with providers prior to this diagnosis.[14] Early diagnosis of ASD has been associated with higher levels of parent education and income, but not with race/ethnicity in some studies, while others report that economically disadvantaged children and African-American children are the least likely to be diagnosed under age six.[8,14] Rosenberg and colleagues[15] found that even for high SES families, African-American and multiracial toddlers were diagnosed later than Asian-American and White toddlers. The authors suggested that parents from underrepresented populations may endorse initial concerns about their child's development at later ages. The current body of literature has yet to tease apart the relative influence of SES and racial/ethnic and related cultural background on observed disparities in ASD diagnosis.

Differences in age of diagnosis may reflect underlying differences in the child's development or symptom severity that would make diagnosis more likely. In a retrospective study, Cuccaro and al[16] found later onset of first words and phrase speech in African-American children ages 3-21 years with ASD compared to White children. However, there

were no significant differences in the children's overall level of ASD symptomatology. Also, Tek and Landa[17] recently reported that toddlers from underrepresented populations were more likely to receive scores at the time of diagnosis that indicated atypical or delayed communication, language, and gross motor development.

The aim of the current study was to build on this existing research on disparities in screening and diagnosis of children based on socio-demographic factors. This study used a sample of toddlers who received best-practice screening for ASD and timely referral for evaluation and diagnosis. We sought to investigate family demographic factors that might impact differences in the age at which a child presented for this evaluation and the child's developmental level and symptom presentation. Specifically, we hypothesized that children from underrepresented populations (minority racial/ethnic group and low SES) would be older at the time of evaluation due to existing disparities in access to screening and diagnosis in the broader population, but that these disparities would be relatively attenuated due to the screening methods used.

Method

Sample

Participants were drawn from an ongoing two-site (University of Connecticut [UConn], Georgia State University [GSU]) study evaluating the psychometric properties of an ASD-specific screening questionnaire called the Modified Checklist for Autism in Toddlers (M-CHAT)[18] and its revision (M-CHAT-R)[19] in a low-risk sample of toddlers screened during 18- and 24-month well-child care visits. Inclusion criteria required participants to complete evaluations based on M-CHAT(-R) risk for ASD and to provide at least one of the following variables: race/ethnicity, maternal education (Med), and family income.

The broader screening study included children screened with the M-CHAT (N= 18,989) and the M-CHAT-R (N= 16,215); toddlers were eligible for the screening study if they were 16-30 months old, attending a well-child care visit at M-CHAT-R completion. Of these, 2,899 in total screened positive and required phone follow-up. Non-participation at the level of M-CHAT(-R) screening at the pediatrician's office cannot be assessed because pediatricians do not consistently document refusals. Of those who completed initial screening, 301 participants were missing race/ethnicity data, 359 were minority race/ethnicity, and 202 were non-minority. Reasons for non-participation included experimenter error (n_{minority}= 10, $n_{\text{non-minority}}$= 5), unable to contact via phone/letter (n_{minority}= 208, $n_{\text{non-minority}}$= 76), parent refusal (n_{minority}= 19, $n_{\text{non-minority}}$=3), and other/unknown (n_{minority}= 119, $n_{\text{non-minority}}$= 101). Three hundred forty-six children who screened positive did not participate in the free developmental evaluation offered; 138 of these were missing race/ethnicity data, 109 were minority race/ethnicity, and 99 were non-minority. Reasons for non-participation in the evaluation included experimenter error (n_{minority}= 1, $n_{\text{non-minority}}$= 0), unable to contact via phone/letter (n_{minority}= 21, $n_{\text{non-minority}}$= 15), parent refusal/no-show/canceled (n_{minority}= 82, $n_{\text{non-minority}}$=76), and other/unknown (n_{minority}= 5, $n_{\text{non-minority}}$= 8). The current investigation focused on the subsample of at-risk toddlers who completed a full diagnostic evaluation (N = 349) as a part of the broader screening study (UConn n = 170, GSU n = 179; 7 evaluations were conducted in Spanish by bilingual

clinicians). Participants who were missing both race/ethnicity and SES indicators were excluded.

Demographic information is reported in Table 1. For analyses two groups were created: non-minority (White participants; *n*=187) and minority (collapsing the remaining categories *n*=156); six children missing race/ethnicity were excluded from these analyses. Participants were classified as ASD (*n*=155) including: Pervasive Developmental Disorder-Not Otherwise Specified (*n*=82) and Autistic Disorder (*n*= 73), or non-ASD (*n*=194), including: Developmental Delay (*n*=79), Developmental Language Disorder (*n*=45), Other Diagnosis (*n*=8), and No Diagnosis/Typical Development (*n*=62).

T-tests compared the UConn and GSU sample characteristics (see Table 2). Significant differences were found for MEd, Vineland Communication, Daily Living Skills, and Socialization SS, and Childhood Autism Rating Scale (CARS) score. Additionally, χ^2 tests returned significant differences between sites in the number of children who had ASD diagnoses versus non-ASD diagnoses ($\chi^2_{(1)}$=5.12, p=.024) and the number of minority versus non-minority children ($\chi^2_{(1)}$=9.77, p=.002). GSU had greater numbers of minority children and children with ASD. Based on the Fisher z-transformation there were no significant differences between the UConn and GSU subsamples on regression coefficients for age at evaluation (r_{UConn}=.256, r_{GSU}=.193, z=.544, p=.586) and Mullen Receptive Language T-score (r_{UConn}=.320, r_{GSU}=.221, z=.870, p=.384). These differences did not preclude combining the groups, and the combined sample was used for the remaining analyses.

Measures

The M-CHAT is a 23-item parent report questionnaire in a yes/no format designed to screen for behaviors seen in toddlers with ASD.[18,20] Children who screen positive on 3 of 23 items total or 2 of 6 “critical items” on the M-CHAT are considered to be at elevated risk for ASD diagnosis. The M-CHAT is currently in revision (M-CHAT-R[19]). Screening positive on the M-CHAT-R requires 3 of 20 items total or 2 of 7 “best items” failed. The M-CHAT and M-CHAT-R Follow-up Interviews (FUI)[19,21] verify answers on each questionnaire. M-CHAT sensitivity was estimated to be 0.97, specificity 0.95, and negative predictive value (NPV), 0.99.[20,22] Sensitivity, specificity, and NPV of the M-CHAT-R were estimated to be 0.91, 0.95, and 0.99 respectively. Including the FUI sensitivity was 0.72, specificity 0.99, and NPV 0.99.[20, 23] In low-risk samples, the M-CHAT yielded a positive predictive value (PPV) of .11 without the FUI, and a PPV of .65 when the FUI was included.[23]

The CARS[24] is a behavior rating scale designed to differentiate ASD from other developmental delays. At age 2, the CARS has good inter-rater reliability of (ICC=.71), and internal consistency (α=.94); test-retest reliability was .88. Total scores on the CARS and independent behavior ratings were highly correlated at r=.80.[24]

The Mullen Scales of Early Learning[25] is a standardized test of cognitive abilities used with children from birth to age 68 months. The Mullen has an internal consistency ranging from α=.75-.83 within each scale, test-retest reliability from .75-.96, and inter-rater reliability from .91-.99.[25]

The Vineland Adaptive Behavior Scales[26] is a standardized parent-report interview designed to address adaptive skills including Communication, Daily Living, Socialization, and Motor domains. Both the Vineland and its revised edition, the Vineland-II[27] were used. The Vineland's overall reliability and validity have been well-established.[26] Split-half reliability for the four domains ranges from .83-.97. Correlations between each subdomain for the Vineland-II are moderate ($r \geq .75$ for 75% of domain comparison), but are higher for young children. Split-half reliability within each domain ranges from .91-.95. The average test-retest reliability was .85 and average inter-rater reliability was .75.[27]

Additional measures collected in the larger screening study but not used in the current study include the Autism Diagnostic Observation Schedule[28] (ADOS) and either the Autism Diagnostic Interview- Revised[29] (ADI-R) or a symptom interview designed by the authors specifically for this study. The ADOS is a play-based measure designed to elicit social, communication, and play skills. The ADI-R is a parent interview that assesses deficits in social relatedness, communication, and restricted/repetitive/stereotyped behaviors. These are widely used in ASD research to classify children with and without ASD.

The main predictor variables in the current study were child race/ethnicity and 2 proxy indicators of family SES: maternal education (MEd) and yearly household income (YI). These were collected via parent report on a history questionnaire. At GSU, parents indicated child race/ethnicity by responding to an open-ended question. At UConn, parents indicated one or more selections from a list of categories. At GSU, a parent also reported MEd by responding to an open-ended question asking how far the child's mother went in school. At UConn a parent indicated 1 of 8 categories corresponding to years of education. In either case, the parent's response was converted to the number of years of education completed (i.e. H.S. diploma or GED= 12 years).

Parents reported household YI in categories ranging from below $10,000 to greater than $100,000, in $10,000 increments (e.g., $10,000-$20,000). When YI data were missing, parents' reported monthly income was converted to yearly income estimates. When both yearly and monthly income data were missing, these data were often available from a second, follow-up evaluation that the child received at age 4 (n=42). No significant change in household yearly income was observed in a random sample of families who provided income at both time points (M_{Time1}= $75,181 ($SD$= $31,651), $M_{\text{Time 2}}$= $76,818 ($SD$= $31,215); $t(55) = -1.384$, $p = .172$). Age 4 data were therefore used when data were unavailable at age 2. If age 4 data was not available, these participants were excluded from analyses involving YI. YI was then re-coded to each category's median dollar amount. For example, below $10,000 per year was re-coded as $5,000 and the final category, greater than $100,000, was re-coded as $105,000. The YI variable was not normally distributed; as expected for household income in the U.S., YI was negatively skewed overall, with a greater number of participants at the higher end of the range. The mean of this distribution was $59,912 ($SD$=36,227) and the median was $55,000. Minority parents had lower mean YI (M_{minority}= $45,420 ($SD$=35,890), $M_{\text{non-minority}}$= $71,012 ($SD$=32,423); $t(280)=6.26$, $p<.001$) and MEd (M_{minority}= 14.40 years (SD=2.88), $M_{\text{non-minority}}$= 15.24 (SD=2.53); $t(289.22)=2.74$, $p=.006$) compared to non-minority parents. Therefore, these variables were controlled for in any comparisons by race/ethnicity.

Procedures

Parents completed the M-CHAT(-R) at the pediatrician's office. Parents whose children screened positive received the M-CHAT(-R) FUI over the phone, and if the child continued to screen positive, the family was offered a free developmental evaluation. The current sample consists of children who screened positive on both the M-CHAT(-R) and FUI; negative screens were not evaluated. Overall, 4.62 months (*SD*=3.24; range .44-18.15 months) elapsed on average between screening and evaluation, with UConn participants at 4.25 months (*SD*= 3.05) and GSU participants at 4.96 months (*SD*= 3.39) elapsed time. Participants without transportation were provided with free taxi service, or the evaluation was completed in their home or pediatrician's office. The evaluation, conducted by a licensed psychologist or a licensed developmental-behavioral pediatrician and a doctoral student in psychology, included a battery of developmental, adaptive skills, and ASD-specific measures. Informed consent was obtained from participating parents according to the Institutional Review Board policies at UConn and GSU. Children were administered the Mullen and the ADOS while parents were administered the Vineland(-II) and either the ADI-R or a symptom interview designed by the screening study investigators. The clinician completed the CARS using parent-reported information and direct observation. ASD diagnoses were made using standardized DSM-IV TR[1] criteria and were based on clinical judgment taking all standardized measures into account. Criteria for other diagnoses such as Developmental Delay and Developmental Language Delay were made specifically for the current study. Children were excluded from the larger screening study if they had major motor or sensory impairments that would preclude use of the study measures, or if the family's native language was not English or Spanish.

Statistical Analyses

The overall sample size for the current study (N = 349) provided sufficient power (power = .80, alpha = .05) to detect medium effects (Cohen's $d > .5$, $r < .3$) for multiple regression and simple correlation.[30] Due to the existence of subgroups within this sample, Fisher's z-test (FZT) was used to determine whether there were significant differences between them on the hierarchical regressions of interest.[31] Hierarchical multiple regression analyses were performed to predict child age at evaluation and scores on measures of symptom severity (M-CHAT score, CARS), adaptive functioning (Vineland-II), and developmental level (Mullen) from demographic variables using SPSS software (IBM, Armonk, NY). Discriminant function analysis was used to predict the likelihood that a child of minority background would be diagnosed with ASD versus a non-ASD diagnosis, controlling for MEd and YI.

Results

Children were evaluated at 25.72 months (*SD*=4.48; 16.77-39.67 months). At UConn, mean age at evaluation was 25.52 months (*SD*= 4.55; 16.80-39.67 months) and at GSU mean age at evaluation was 25.91 months (*SD*= 4.42; 16.77-38.73 months; see Table 2). Minority children presented for evaluation one month later than non-minority children (M_{minority}=26.28 months (*SD*=4.43), $M_{\text{non-minority}}$=25.20 months (*SD*=4.48); $t_{(341)}$=-2.26, p=.025;see Table 3).

Correlations are presented in Table 4; effect sizes (R^2 values) indicated small effects. As anticipated, MEd and YI were highly correlated (r=.60, p<.001). YI was negatively correlated with child's age at evaluation (r=-.14, p=.019). YI was positively correlated with Vineland Communication (r=.17, p=.005), Social (r=.14, p=.020), and Motor domain standard scores (SS; r=.19, p=.002). Correlations with MEd were similar and also represented small effects. MEd was negatively correlated with child's age at evaluation (r=-.14, p=.014). MEd was positively correlated with Vineland Communication (r=.14, p=.011), Socialization (r=.11, p=.046), and Motor (r=.16, p=.005) domain SS. CARS score was not significantly correlated with either variable.

To test the hypothesis that minority status would predict a child's age at evaluation and performance on evaluation measures (dependent variables), hierarchical multiple regressions were conducted, controlling for YI and MEd. In each hierarchical multiple regression, in step 1, YI and MEd were the independent variables; in step 2, minority status was entered into the step 1 equation. Minority status was found to be a significant predictor of child age at evaluation (R^2= .045, ΔR^2= .017, $F_{(3, 273)}$= 4.26, p = .006) and Mullen Receptive Language T-score (R^2= .050, ΔR^2= .033, $F_{(3, 269)}$ = 4.71, p = .003), above and beyond the contribution of SES indicators to the variance. While these findings of the change in variance accounted for (ΔR^2) were significant, minority status represented small effects and explained very small portions of the variance.

Finally, Discriminant Function Analysis was used to test the hypothesis that group differences by minority status exist in the likelihood that a child will be diagnosed with ASD versus non-ASD, controlling for MEd and YI. There were no significant differences in the covariance matrices among the two groups (Box's M test; p= .660). Wilks' lambda was not significant (Λ = .993, $\chi^2(3, N = 277) = 1.828$, p= .609), indicating that there was no difference in the rate of diagnosis.

Discussion

The aim of the current study was to investigate the impact of family demographic factors on the age at which a child received an ASD evaluation, as well as the child's developmental level and symptom presentation. In accord with previous studies,[6,8,9,14,15] it was hypothesized that children from underrepresented populations (minority and low SES) would be evaluated at a later age and would be more severe in their symptom presentation and developmental delays at the time of evaluation.

Children in this study were 25.72 months when evaluated, approximately two years younger than the national average,[6] and they received ASD-specific assessment because they screened positive on the M-CHAT and it's revision, the M-CHAT(-R). Although not all of these children went on to receive ASD diagnoses, the vast majority required Early Intervention (EI) services and received a diagnosis indicating developmental delay. Significant but small associations, explaining small proportions of variance, emerged between SES indicators and child age at evaluation and parent-reported child developmental level such that lower SES predicted later age at evaluation and more severe delays. Additionally, minority race/ethnicity, above and beyond the contribution of SES factors,

predicted age at evaluation and receptive language skills, such that racial/ethnic minority toddlers were a month older at the time of evaluation, and had less-developed receptive language skills on the Mullen than non-minority toddlers. However, these effects were very small, and likely do not represent clinically meaningful differences.

Both maternal education and household yearly income predicted child adaptive functioning in the communication, social, and motor domains, according to parent report. In our large sample of toddlers diagnosed with ASD or developmental delays, young children whose mothers are more educated or whose families have higher yearly income tended to have better language and cognitive abilities. This is in contrast to findings of Tek and Landa[17] that scores on the ADOS and age equivalents on the Mullen were not associated with SES and may be due to measurement differences for both SES (e.g., Tek and Landa used Hollingshead index) and developmental level (e.g. Mullen age equivalents versus Mullen T scores). The authors also found that in their sample of upper-middle class families, minority toddlers with ASD had less-developed performance on the Gross Motor and Receptive Language domains.[17] This finding was partially replicated; child minority status, controlling for family SES, predicted Mullen Receptive Language score in the current study, such that minority toddlers had lower skills in this area on average compared to non-minority toddlers. This finding represented a small effect and is likely not a clinically significant discrepancy.

Finally, minority status, controlling for SES factors, did not predict the likelihood that a child would receive an ASD diagnosis versus a non-ASD diagnosis, similar to the results of a recent retrospective study by Cuccaro and al.[16] This is in contrast to previous studies that have found minority children to be more likely to be diagnosed with another disorder prior to ASD diagnosis, and that African-Americans are less likely than Whites to receive certain psychiatric diagnoses such as anxiety and depression in general.[13]

These findings indicate that it is crucial to control for indicators of SES when looking for racial/ethnic disparities in the age at which a child receives evaluation and diagnosis. The presence of a subgroup of Spanish-speaking participants within this minority group and the limited number of personnel to conduct phone calls and evaluations in Spanish may have contributed to this group's overall delay in evaluation. However, our findings persisted when this subgroup of participants was excluded from analyses. However, it is notable that in this study, evaluations were free and significant effort was made to ensure access for the participating families. In this study, the delay in evaluation for racial/ethnic minority children was small (one month) and may not be clinically meaningful. This is in stark contrast to previous studies that found minority children and children from low-income families were diagnosed with ASD several years later than their non-minority or higher income counterparts.[5,8-11,14-16] Whereas most studies have looked retrospectively at the number of children reported to have ASD diagnoses, the current study used a large, prospective sample of children drawn population-based screening. These data may also reflect changes in awareness about ASD and the need for timely evaluation and intervention that have occurred over the past decade. Further research is therefore needed to examine in detail the barriers to accessing and attending ASD-specific evaluations that may be experienced in underrepresented populations.

Although the current study is the first to examine disparities in diagnosis of ASD in a large sample of toddlers who participated in routine, standardized screening in pediatric practice, some limitations should be acknowledged. First, the current study is not a population-based epidemiologic study. Participating families agreed to participate in routine developmental screening offered by their pediatrician, and were therefore highly motivated to continue participation in follow-up screening and evaluation. Additionally, the level of family income and maternal education was relatively high at our GSU and UConn screening sites compared to the national averages. The structured nature of the screening, referral, and evaluation practices used as part of this study limit the generalizability of these findings to the broader population of the U.S. in areas with dissimilar infrastructure for evaluation. Whereas minority participation overall was excellent, representation of distinct racial/ethnic groups was not sufficient to make more meaningful comparisons than minority versus non-minority and necessitated the creation of a heterogeneous “minority” group. Also, participants were only excluded if both SES and racial/ethnic background data were unavailable. Future studies should oversample individuals from various racial/ethnic backgrounds across SES groupings, in order to examine potential differences in barriers to identification in specific groups and subgroups. It also is important to note that as expected from U.S. Census data, the representation of different racial and ethnic groups across sites was varied; this may be a limitation, but also may increase the generalizability of the current study by applying screening in two geographically diverse regions. The generalizability of the results is also limited to families whose primary language are English or Spanish, as speakers of other languages were excluded. Additionally, differences in the collection of primary predictor variables (maternal education, child race/ethnicity) across the two sites, including the use of both forced-choice and open-ended formats, may have lead to discrepancies that influenced these results.

The current study informs clinical practice for toddlers referred for developmental delays and specifically for children with ASD. First, family SES was a contributing factor to child age at evaluation and performance on measures such as the Vineland. This may reflect true differences in development, especially of language ability, but may also reflect differences in parents’ perception of the study measures and of their child’s development. Therefore, attention should be paid during both screening and evaluation to a parent’s reading level, understanding of interview questions, and frame of reference for comparing their child’s skills to other toddlers. Specific recommendations for language development in particular should be provided, as language areas in this study and in others have been noted to be the most disparate between impoverished children and those raised with more financial resources, and maternal education has been closely associated with child language development.[32] With standardized screening and support for such screening as provided in this study, and readily available evaluation including transportation as needed, disparities by socio-demographic factors were minimized and nearly eliminated. Future attempts to adapt screening practices based on community needs (e.g., offering in home evaluations, completing evaluations at the pediatrician’s office) should be explored. It is possible that families to whom free transportation was provided would have otherwise been unable to access evaluation for ASD. Therefore, policies aimed at reducing these barriers, such as the universal, standardized screening for ASD in toddlers as employed in the current study, and

creative solutions to transportation barriers, must continue to be a priority. Lastly, it is important for primary care providers to understand the cultural perspectives of parents as related to development, behavior, and the identification of disorders at young ages as they may be important factors in the likelihood that parents will fully participate in the screening and diagnostic activities crucial to the early identification of ASD and other developmental disorders.

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Table 1

Demographic Characteristics

Characteristic	UConn (n=170) No.(%)	GSU (n=179) No.(%)
Sex		
Female	48 (28.2)	57 (31.8)
Male	122 (71.8)	122 (68.2)
Diagnosis		
No Diagnosis/Typical	32 (18.8)	30 (16.8)
Language Delay	25 (14.7)	20 (11.2)
Developmental Delay	43 (25.3)	36 (20.1)
Other Diagnosis	5 (2.9)	3 (1.7)
PDD-NOS[a]	28 (16.5)	54 (30.2)
Autistic Disorder	37 (21.7)	36 (20.1)
Child Race/Ethnicity		
White	106 (62.3)	81 (45.3)
African-American	14 (8.2)	61 (34.1)
Latino/Hispanic	29 (17.1)	10 (5.6)
Asian-American	8 (4.7)	6 (3.4)
Other/Biracial	11 (6.5)	17 (9.5)
Missing Ethnicity	2(1.2)	4 (2.2)

[a]PDD-NOS- Pervasive Developmental Disorder-Not Otherwise Specified

Table 2

t-Tests Comparing UConn and GSU Subsamples on Demographics and Evaluation Scores

	UConn Mean(SD)	GSU Mean(SD)	*t*	*df*
Yearly Income($)	59,527 (34,549)	60,328 (38,079)	ns	--
Maternal Education, yr	14.44 (2.60)	15.28 (2.79)	−2.81[b]	323
Age, mo	25.52 (4.54)	25.91 (4.42)	ns	--
M-CHAT[c]	6.51 (4.60)	6.26 (3.47)	ns	--
Mullen VR[d]	35.21 (12.97)	33.82 (13.16)	ns	--
Mullen FM[e]	33.86 (11.99)	31.44 (11.79)	ns	--
Mullen RL[f]	31.34 (13.35)	29.04 (11.91)	ns	--
Mullen EL[g]	29.95 (11.65)	29.15 (9.79)	ns	--
Vineland Communication SS[h]	76.83 (12.50)	81.30 (13.40)	−3.21[b]	346
Vineland DLS[i] SS	80.93 (15.11)	84.26 (13.59)	−2.16[a]	346
Vineland Socialization SS	80.63 (11.85)	84.83 (10.87)	−3.45[b]	346
Vineland Motor SS	85.53 (12.47)	87.06 (12.48)	ns	--
CARS[j]	24.59 (6.34)	26.73 (6.43)	−3.11[b]	344

[a] $p<0.05$.

[b] $p<0.01$.

[c] M-CHAT: Modified Checklist for Autism in Toddlers.

[d] VR: Visual Reception.

[e] FM: Fine Motor.

[f] RL: Receptive Language.

[g] EL: Expressive Language.

[h] SS: Standard Score.

[i] DLS: Daily Living Skills.

[j] CARS: Childhood Autism Rating Scale.

Table 3

Mean Scores for Minority and Non-Minority Groups

	Minority Mean(SD)	Non-minority Mean(SD)	*t*	*df*
Age, mo	26.28 (4.42)	25.20 (4.48)	−2.26[a]	341
M-CHAT[c]	6.32 (3.74)	6.46 (4.27)	ns	180
Mullen VR[d]	32.76 (12.94)	35.75 (12.66)	2.15[a]	338
Mullen FM[e]	31.31 (11.74)	33.62 (11.90)	ns	337
Mullen RL[f]	27.07 (10.07)	32.71 (14.01)	4.30[b]	330.27
Mullen EL[g]	28.37 (9.34)	30.63 (11.78)	1.98[a]	337.01
Vineland Communication SS[h]	77.81 (13.29)	80.13 (13.03)	ns	340
Vineland DLS[i] SS	84.01 (15.81)	81.68 (13.10)	ns	340
Vineland Socialization SS	82.83 (12.29)	82.80 (10.98)	ns	340
Vineland Motor SS	85.64 (12.42)	87.01 (12.47)	ns	340
CARS[j]	26.32 (6.74)	25.22 (6.66)	ns	338

[a] $p<0.05$.

[b] $p<0.01$.

[c] M-CHAT: Modified Checklist for Autism in Toddlers.

[d] VR: Visual Reception.

[e] FM: Fine Motor.

[f] RL: Receptive Language.

[g] EL: Expressive Language.

[h] SS: Standard Score.

[i] DLS: Daily Living Skills.

[j] CARS: Childhood Autism Rating Scale.

Table 4

Correlation Matrix and Effect Sizes for Demographic Variables of Interest

	Yearly Income		Maternal Education	
	r	R^2 $F(df_{Between}\ df_{Within})$	*r*	R^2 $F(df_{Between}\ df_{Within})$
Maternal Education, yr	.60[b]	--	--	--
Age, mo	-.14[a]	.019[a] 5.49 (1, 283)	-.14[a]	.018[a] 6.05 (1, 323)
M-CHAT	ns	--	ns	--
Mullen VR[d]	ns	--	ns	--
Mullen FM[e]	ns	--	ns	--
Mullen RL[f]	ns	--	ns	--
Mullen EL[g]	ns	--	ns	--
Vineland Communication SS[h]	.17[b]	.028[b] 8.00 (1, 282)	.14[a]	.020[a] 6.49 (1, 322)
Vineland DLS[i] SS	ns	--	ns	--
Vineland Socialization SS	.14[a]	.019[a] 5.57 (1, 282)	.11[a]	.012[a] 4.00 (1, 322)
Vineland Motor SS	.19[b]	.034[b] 10.05 (1, 282)	.16[b]	.025[b] 8.17 (1, 322)
CARS[j]	ns	--	ns	--

[a] $p<0.05$.

[b] $p<0.01$.

[c] M-CHAT: Modified Checklist for Autism in Toddlers.

[d] VR: Visual Reception.

[e] FM: Fine Motor.

[f] RL: Receptive Language.

[g] EL: Expressive Language.

[h] SS: Standard Score.

[i] DLS: Daily Living Skills.

[j] CARS: Childhood Autism Rating Scale.