Heterogeneous Trajectories of Delayed Communicative Development From 12 to 36 Months: Predictors and Consequences

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ABSTRACT: *Objective:* The objective of the study was to identify distinct trajectories of delayed communicative development from 12 to 36 months and examine differences in risk factors and developmental outcomes for each trajectory. *Methods:* Participants were 2192 children drawn from a prospective longitudinal pregnancy cohort in a large Canadian city. Maternal pregnancy medical records were used to determine perinatal risk factors. The Ages and Stages Questionnaire Communication subscale was administered at 12, 24, and 36 months. At 36 months, mothers reported on the child's health, cognitive, and behavioral development. *Results:* Using growth mixture modeling, we identified 4 trajectories of communicative development. Most children (81.1%) were characterized by high and stable scores from 12 to 36 months. The remaining children fell into a low-increasing class (13.0%), a moderate-stable class (4.5%), and a low-decreasing class (1.4%). At 36 months, the low-increasing class had caught up to the high-stable group. However, by 36 months, the low-decreasing class fell under the recommended "referral" cutoff, and the moderate-stable class fell under the "monitoring" cutoff criteria. Children with continued communication problems at 36 months were more likely to have a congenital anomaly and lower family income than late-talking children who had caught up. *Conclusion:* Repeated assessments of a brief screening tool were able to differentiate patterns of communicative development over time, each with unique risk factors and developmental outcomes. Results highlight the potential for risk factors and repeated screenings to help identify children most at risk for persistent communication delays and in need of early support services.

(*J Dev Behav Pediatr* 40:335–343, 2019) **Index terms:** communication, language, development, screening tools.

Language and communication delays are estimated to affect as many as 20% of children by age 4 years.¹ Toddlers with delays in language development are often termed "late talkers," with the implicit assumption that these children will "catch up."² However, not all children recover from these early lags, and they continue to show language delays. Furthermore, for some children,

delayed communication skills can be an early indicator of other neurodevelopmental deficits that forecast developmental disorders, such as attention-deficit hyperactivity disorder (ADHD),³ as well as difficulties with executive functioning and academics.^{4,5} While individual pathways of child communicative growth are highly variable and heterogeneous,¹ most research has focused on identifying mean-level growth across samples of children. To our knowledge, no study has utilized growth mixture modeling (GMM) to examine *distinct* trajectories or patterns of growth in communicative abilities from infancy to the late toddler years. Using GMM, this study will establish heterogeneous trajectories of language delays within a large epidemiological sample and identify risk factors that differentiate children who recover from early delays from those who show persistent communication deficits.

The American Academy of Pediatrics suggests that developmental delays be identified by the age of 2 years in order for early intervention strategies to be implemented.⁶ Indeed, evidence suggests that interventions are most effective for children at risk of delays when services are implemented early, when development is rapidly unfolding.⁷ Unfortunately, the majority of children do not receive a developmental delay diagnosis until after age 4 years,⁸ with many diagnoses first identified in schools,

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when disparities in development become more apparent but also more difficult to attenuate.

Standardized developmental screening assessments are useful tools in accurately identifying children with developmental delays, with sensitivity and specificity in the range of 70% to 90%.^{9,10} The Ages and Stages Questionnaire (ASQ) Communication subscale is a 6-item parent report measure that is increasingly used in pediatric offices and clinics to screen for early child communication delays.¹¹ It is cost-effective, age-normed, and validated among infants born prematurely or with other biological risk factors and thus is an excellent candidate measure for providing insight into a child's communicative ability relative to their typically developing peers.¹² Identifying clinically significant delays in early communication, however, comes with an interesting paradox: early detection is key, but many children are considered to "grow out of it." Thus, both parents and pediatricians may wonder at what point they should become concerned.

Accordingly, the goals of this study were 3-fold. First, in a large epidemiological sample, we utilized GMM to examine whether distinct, qualitatively different trajectories of delayed communicative development could be established between the ages of 12 and 36 months using the ASQ Communication subscale. Prior research has examined single growth trajectories of communication or language abilities (e.g., vocabulary size) over time, which can establish the rate of change across an entire sample and identify factors associated with slower or faster growth.^{13,14} The underlying assumption of single growth curve models, however, is that the overall pattern of growth is homogeneous, and individual differences in growth are merely quantitative. In contrast, GMM is unique in that it can model multiple heterogeneous trajectories that reflect qualitative and quantitative differences in growth patterns across time, which is more in line with clinical assumptions of language and communication disorders. Using this technique, we sought to examine whether we could identify separate trajectories of early communication abilities that distinguish between children who show early delays but then catch up to their peers (e.g., "late bloomers") versus children who are at risk for more sustained language and communication deficits (e.g., developmental language disorder). Second, we tested whether these trajectories could be predicted by factors known to place children at risk of communicative delays and deficits.¹ Third, we examined whether these unique trajectories predicted differences in vocabulary size, developmental delay diagnoses, and speech-language pathology referrals at 36 months. Given the association between communication disorders and ADHD,¹⁵ we also examined whether trajectories evidenced differences in hyperactivity/inattention symptoms at 36 months.

METHODS

Participants

Participants were drawn from a large prospective pregnancy cohort in urban northwest Canada. Previous

reports have described the study characteristics and design.¹⁶ Briefly, pregnant women were recruited through local primary health care offices, community advertising, and the local Laboratory Services. Inclusion criteria included being at least 18 years of age, the ability to communicate in English, a current gestational age of less than 25 weeks, and receiving prenatal care within the greater metropolitan area. Between August 2008 and July 2011, 3387 women were enrolled in the study. Mothers were predominantly white (81.9%), with smaller percentages of women identifying as Asian (10.7%), Latin American (1.6%), black (1.2%), indigenous (0.5%), or mixed/other (4.1%). Participants were generally from middle- to high-socioeconomic backgrounds, with 79.6% of participants having a university, college, or trade school degree and 80.8% having an annual family income of \$70,000 CAD or more per year.

The original study was only funded through a 4-month postnatal assessment period. However, additional funding was subsequently acquired to continue assessments through early childhood. Due to the timing of funding acquisition and ethics approval, many participants had aged out of the follow-up assessment periods. Thus, sample sizes at 12, 24, and 36 months were notably smaller. Only participants who had completed the Ages and Stages Questionnaire (ASQ) Communication subscale¹⁷ during at least 1 of the 3 assessment periods at 12, 24, or 36 months and were within the age guidelines of the ASQ at the time of completion were included in the current study, resulting in a final sample size of 2192 (Supplemental Figure 1 for flow chart, <http://links.lww.com/JDBP/A212>). All procedures were approved by the last author's institutional review board.

Measures

Communicative Development

At the 12-, 24-, and 36-month assessment periods, mothers completed the ASQ Communicative Development subscale. Specific items are age-normed for each assessment period to reflect appropriate developmental milestones for 12 month olds (e.g., "Does your baby say 3 words?"), 24 month olds (e.g., "If you point to a picture of a ball (kitty, cup, hat, etc.) and ask your child, 'What is this?' does your child correctly name at least 1 picture?"), and 36 month olds (e.g., "Does your child make sentences that are 3 or 4 words long?"). The ASQ includes 6 items at each age, scored in intervals of 5 (0 = *never/rarely*; 5 = *sometimes*; 10 = *most of the time*). Thus, the range of possible scores is 0 to 60 at each age. The ASQ has been shown to have moderate to high sensitivity (0.70–0.90) and specificity (0.76–0.91), with good test-retest reliability (0.94–0.95) and interobserver reliabilities between parents and professionals (0.94–0.95).^{10,18} The ASQ Communication screening tool is moderately correlated (i.e., 0.30–0.40) with other assessments of language skills (e.g., Peabody Picture Vocabulary Test, Preschool Language Scale).¹⁹

Demographic Characteristics

At 25 weeks' gestation, maternal education was collected using a scale of 1 (some elementary or high school) to 6 (completed graduate school), while income was reported in increments of \$10,000 (1 indicates $\leq \$10,000$; 11 indicates $\geq \$100,000$). All mothers were capable of speaking, reading, and writing in English. However, approximately 10% of families were multilingual. Therefore, we controlled for multilingual households in the analyses.

Neonatal Characteristics

Maternal medical records provided the following information: maternal age at discharge, neonate gestational age, and presence of congenital anomaly (e.g., vascular skull malformation, cleft palate, spastic diplegia). Neonatal birth weight and gestational age were used to create a "small for gestational age" variable, which was defined as falling in the bottom 10th percentile of weight according to gestational age.²⁰

Family History of Language Delay

At the 36-month assessment, mothers reported on whether the following family members had experienced either a language delay or late talking: mother, father, grandparent, or older sibling. Consistent with previous research,¹ we dichotomized this information into a family history variable (0 = no family history; 1 = 1 or more relatives with a history of language delays).

Child Outcomes

Four maternal-reported child outcomes were assessed at 36 months: (1) a modified, 6-item version of the Child Behavior Checklist Hyperactivity/Inattention subscale,²¹ which has been utilized in several large longitudinal studies.²² Items were assessed on a 3-point Likert scale, ranging from 0 (*not true*) to 2 (*very or often true*), and summed, resulting in a score ranging from 0 to 12 ($\alpha = 0.80$); (2) the MacArthur-Bates Communicative Development Inventory-III Vocabulary scale,²³ a widely used and validated parent-report measure of words a child says from a checklist of 100 words; (3) whether the child has been diagnosed with any developmental delay; and (4) whether a medical professional ever recommended the child see a speech-language pathologist.

Analytic Strategy

In order to examine trajectories of communicative development from 12 to 36 months, we conducted growth mixture modeling (GMM) in Mplus Version 8.0.²⁴ GMM identifies latent groups of individuals who evidence qualitatively different growth trajectories (i.e., classes). We examined unconditional latent growth trajectories in which both the slope (i.e., average rate of linear change) and the intercept (i.e., average starting point) were allowed to vary across classes while the variance around the intercept was estimated to be equal across classes. In order to determine the appropriate number of classes, an increasing number of classes is specified until the model fit no longer significantly improves with the inclusion of the additional class.²⁵

Results of the Missing Completely At Random (MCAR) test described by Little²⁶ suggested that data were MCAR, $\chi^2 = 253.52$, $df = 245$, $p = 0.34$. Thus, to retain the full sample size of 2192, all analyses used full information maximum likelihood (FIML) estimation to handle missing data. FIML is a widely accepted technique and is considered superior to listwise and pairwise deletion procedures because it optimally maintains the original structural association between variables in the model.²⁷

RESULTS

Descriptive statistics for all study variables are included in Table 1. Scores on the Ages and Stages Questionnaire (ASQ) Communication subscale were significantly correlated over time ($rs = 0.22$ – 0.53) and were associated with all 4 of the outcome measures at 36 months, most notably vocabulary size ($rs = 0.25$ – 0.54). The ASQ Communication scores were normally distributed at 12 and 24 months (i.e., absolute skewness < 2.0) and slightly negatively skewed at 36 months (i.e., skewness = -2.36), likely reflecting a ceiling effect of the ASQ as the majority of children showed scores in the upper range of the scale. However, we utilized an estimator in MPlus that is robust to small departures from normality, and growth mixture modeling is also able to adequately deal with issues of non-normality.²⁸

Trajectories of Communicative Development

Comparison of statistical indices suggested that a 4-class model was the best fitting model (Supplemental Table 1, <http://links.lww.com/JDBP/A213> online). As shown in Figure 1, class 1 represented the majority of children (high-stable class; 81.1% of the sample) and was characterized by high scores at 12 months (intercept = 52.65, standard error (SE) = 0.34) and slight increases over time (slope = 0.79, SE = 0.19, $p < 0.001$). Class 2 (moderate-stable class; 4.5%) showed moderate scores on the ASQ Communication subscale at 12 months (intercept = 39.93, SE = 3.23) and did not demonstrate significant change over time (slope = -0.48 , SE = 1.50, $p = 0.75$). Class 3 (low-increasing; 13.0%) started off with relatively low Communication scores (intercept = 30.85, SE = 1.23), followed by rapid increases at 24 and 36 months (slope = 11.22, SE = 0.56, $p < 0.001$). Finally, class 4 (low-decreasing; 1.4%) also showed low initial scores on the ASQ Communication subscale (intercept = 29.12, SE = 4.79) but instead demonstrated decreased scores over time (slope = -7.66 , SE = 2.94, $p = 0.009$).

Also included in Figure 1 are the recommended cutoff ranges for monitoring and referral.²⁹ The low-decreasing class was the only group to have an average score below the recommended cutoff value of 29.43 for monitoring at 12 months. By 36 months, the moderate-stable class was also in the monitoring range.

Predictors of Trajectory Class Membership

Next, we examined predictors of the 4 latent trajectory classes using the manual 3-step method described by

Table 1. Mean Values, SDs, and Bivariate Correlations

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ASQ Communication subscale scores																	
12 mo	48.72	10.74															
24 mo	51.26	12.45	0.31 ^a														
36 mo	52.94	7.03	0.22 ^a	0.53 ^a													
Predictors																	
Maternal education	3.96	1.07	−0.06	0.06 ^a	0.08 ^a												
Income	9.30	2.42	−0.02	0.09 ^a	0.13 ^a	0.30 ^a											
Multilingual	0.10	—	0.00	−0.09 ^a	−0.08 ^a	0.02	−0.29 ^a										
Maternal age	31.29	4.44	−0.03	0.01	−0.01	0.28 ^a	0.26 ^a	0.05									
Family history	0.18	—	−0.12 ^a	−0.10 ^a	−0.09 ^a	−0.02	−0.03	−0.02	0.04								
Male sex	0.47	—	−0.13 ^a	−0.16 ^a	−0.11 ^a	0.00	−0.01	0.03	−0.03	−0.03							
Congenital anomaly	0.09	—	−0.02	−0.02	−0.06	−0.02	−0.04	0.00	−0.04	−0.02	0.04						
GA	38.89	1.76	0.12 ^a	0.07	0.07 ^a	0.05	0.07 ^a	−0.06	−0.02	−0.12 ^a	−0.02	−0.07 ^a					
SGA	0.10	—	−0.08 ^a	−0.01	−0.02	−0.01	−0.02	0.04	−0.02	−0.05	0.02	0.03	0.00				
Outcomes at 36 mo																	
CDI	68.51	23.33	0.25 ^a	0.54 ^a	0.52 ^a	0.01	0.13 ^a	−0.24 ^a	−0.10 ^a	−0.05	−0.11 ^a	−0.09 ^a	0.06	−0.02			
Developmental delay	0.03	—	−0.12 ^a	−0.34 ^a	−0.29 ^a	−0.01	0.01	−0.02	0.04	0.04	0.03	0.04	−0.11 ^a	0.02	−0.27 ^a		
S-LP referral	0.08	—	−0.10 ^a	−0.47 ^a	−0.28 ^a	−0.02	−0.02	−0.01	0.00	0.06	0.09 ^a	0.04	−0.13 ^a	0.03	−0.30 ^a	0.51 ^a	
Inattention/hyperactivity	3.17	2.34	−0.13 ^a	−0.12 ^a	−0.12 ^a	−0.04	−0.03	0.01	−0.07 ^a	−0.01	0.10 ^a	−0.02	−0.03	0.04	−0.10 ^a	0.04	0.03

^a*p* < 0.01. ASQ, Ages and Stages Questionnaire; CDI, communicative development inventory; CI, confidence interval; GA, gestational age; SGA, small for gestational age; S-LP, speech-language pathologist.

Figure 1. Heterogeneous trajectories of communicative development from 12 to 36 months. ASQ, Ages and Stages Questionnaire.

Asparouhov and Muthén.³⁰ All predictors were regressed on class membership simultaneously in a single model, thereby allowing for the estimation of independent effect sizes controlling for all other predictors in the model. Results of the multinomial logistical regression are provided in Table 2.

In comparison to the high-stable class, children in the moderate-stable class were almost 4 times as likely to be male (odds ratio [OR] = 3.94; 95% confidence interval [CI], 1.53–10.18) and were more than 3 times as likely to have a family history of language delays (OR = 3.48; 95% CI, 1.42–8.53). In addition, the moderate-stable class had lower family incomes than any of the other 3 classes (ORs = 0.77–0.85). In comparison to the high-stable class, the low-increasing class was almost twice as likely to be male (OR = 1.95; 95% CI, 1.22–3.11) and about twice as likely to have a family history of language delays (OR = 2.26; 95% CI, 1.24–4.12). In comparison to the high-stable class, both the low-increasing and low-decreasing classes had lower gestational ages (ORs = 0.82–0.87). The low-decreasing class was differentiated from the low-increasing class by lower maternal education (OR = 0.56; 95% CI, 0.35–0.92). In addition, the low-decreasing class was almost 4 times as likely to have a congenital anomaly than both the high-stable class (OR = 3.71; 95% CI, 1.39–9.95) and the low-increasing class (OR = 4.03; 95% CI, 1.17–13.90). Maternal age, multilingual households, and small-for-gestational-age status did not significantly differentiate between class membership.

Outcomes of Trajectory Class Membership

Next, we examined whether class membership predicted differences in expressive vocabulary, developmental delay diagnoses, speech-language pathologist (SLP) referrals, and inattention-hyperactivity symptoms at 36 months of age, while controlling for the effects of the predictors from the previous step on both class membership and child outcomes. Results are shown in Table 3.

At 36 months, the high-stable class evidenced the largest number of words produced on the Communicative Development Inventory-III Vocabulary scale 100-word checklist (mean = 75.62), followed by the low-increasing (mean = 52.34), moderate-stable (mean = 28.11), and low-decreasing classes (mean = 2.08). All classes were significantly different from one another, p values < 0.001. All at-risk groups were significantly more likely to have received a developmental delay diagnosis by 36 months than the high-stable class. In addition, both the moderate-stable (25%) and low-decreasing (65%) classes had higher likelihoods of having a developmental delay diagnosis than the low-increasing class (4%). The moderate-stable (36%) and low-decreasing (84%) classes were also more likely to have been referred to an SLP by 36 months than the high-stable (4%) and low-increasing (8%) classes. The low-increasing class did not show significantly more SLP referrals than the high-stable class. Finally, both the low-increasing (mean = 4.35) and the low-decreasing (mean = 4.72) classes evidenced greater symptoms of hyperactivity and inattention at 36 months than the high-stable class (mean = 2.92), p values < 0.05.

One might wonder if individuals who made use of speech and language services might be more likely to belong to the class of children who showed improving communication skills over time (i.e., the low-increasing trajectory). In order to answer this question, we conducted follow-up analyses to determine whether classes differed in their utilization of SLP referrals. Of the 147 participants in the study who were issued referrals, 110 (75%) reported visiting an SLP. A χ^2 test revealed that there were no differences between classes in their utilization of speech or language services following a referral, $\chi^2(3, 147) = 1.65, p = 0.65$.

DISCUSSION

This is the first study to identify distinct, heterogeneous trajectories of at-risk or delayed communicative

Table 2. Multinomial Logistic Regression Analyses Predicting Latent Class Membership

Comparison Class vs Reference Class	Moderate Stable vs High Stable			Low Increasing vs High Stable			Low Decreasing vs High Stable			Moderate Stable vs Low Increasing			Low Decreasing vs Low Increasing			Moderate Stable vs Low Decreasing		
	OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
Family factors																		
Maternal education	0.96	0.71–1.29	1.16	0.94–1.43	0.65*		0.42–1.01	0.84		0.59–1.19	0.56**		0.35–0.92	1.47		0.86–2.50		
Family income	0.82***	0.72–0.92	0.96	0.87–1.05	1.07		0.86–1.32	0.85**		0.74–0.99	1.12		0.89–1.42	0.77**		0.60–0.98		
Multilingual	1.41	0.61–3.27	1.02	0.50–2.06	2.97*		0.93–9.48	1.39		0.47–4.08	2.92		0.74–11.46	0.48		0.12–1.98		
Maternal age	1.01	0.95–1.08	1.01	0.95–1.07	1.02		0.89–1.16	1.00		0.92–1.09	1.01		0.87–1.16	1.00		0.86–1.16		
Family history	3.48***	1.42–8.53	2.26***	1.24–4.12	1.86		0.37–9.23	1.64		0.55–4.86	0.81		0.15–4.46	1.89		0.30–11.83		
Child factors																		
Male sex	3.94***	1.53–10.18	1.95***	1.22–3.11	3.15*		0.99–10.05	2.05		0.71–5.92	1.30		0.38–4.47	1.56		0.33–7.33		
Congenital anomaly	1.17	0.47–2.90	0.91	0.41–2.04	3.71***		1.39–9.95	1.32		0.41–4.29	4.03**		1.17–13.90	0.32*		0.08–1.19		
Gestational age	1.08	0.84–1.38	0.87**	0.76–0.99	0.82**		0.71–0.96	1.23		0.93–1.63	0.95		0.81–1.11	1.31		0.98–1.74		
SGA	1.29	0.44–3.78	0.85	0.39–1.85	1.47		0.44–4.87	1.50		0.40–5.58	1.74		0.42–7.19	0.88		0.18–4.32		

Bolded values represent significant differences between comparison classes. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. CI, confidence interval; OR, odds ratio; SGA, small for gestational age.

development from 12 to 36 months, a period of development that is under constant scrutiny from parents and practitioners. The majority of children fell into a typically developing group characterized by high-stable Ages and Stages Questionnaire (ASQ) Communication scores over time (81%). Three trajectories of delayed communication also emerged: 4.5% of the sample showed moderate communication scores that did not improve or decline over time, 13% showed low initial communication abilities followed by a catch-up period during the toddler years, and finally, 1.4% of children showed low and decreasing communication scores over time.

Although previous research has found that neonatal and sociodemographic risk factors predict slower growth in language,^{1,31,32} identifying heterogeneous trajectories of delayed communicative development offers insight into whether there are distinct risk factors for children who show initial delays and then improve versus those who show persistent lags. In this study, both the moderate-stable and the low-decreasing groups, which accounted for about 6% of children in our sample, had failed to “catch up” to the high-stable group by 36 months. Each trajectory was associated with a unique pattern of demographic and neonatal risk factors that, if present, may alert health practitioners to risks for potential delays in communication.

While both the moderate-stable and the low-increasing classes were more likely to be born male and have a family history of late talking and language delays, children who failed to improve over time (i.e., the moderate-stable class) were also more likely to have a lower family income than any of the other classes. Both the low-increasing and low-decreasing classes had lower gestational ages than the high-stable class, suggesting that early birth may increase the risk for delayed communication at 12 months. However, the low-decreasing class was also differentiated by a number of other medical and sociodemographic risk factors, including lower maternal education and higher congenital anomalies than both the high-stable and the low-increasing classes. Together, these results suggest that boys, premature infants, and children with a family history of language delay are at increased risk for early communication deficits, but that congenital anomalies and lower family socioeconomic status differentiate children who show persistent deficits in communication (i.e., the low-decreasing and moderate-stable classes) from those who catch up (i.e., the low-increasing group) by 36 months.

These findings are in line with recent research investigating heterogeneous trajectories of language development from 4 to 11 years old.³³ McKean et al. found evidence for 3 language trajectory groups: stable (94%), low-decreasing (4%), and low-improving (2%). The low-improving class was associated with greater environmental risks, including socioeconomic disadvantage, while the low-decreasing trajectory had a higher likelihood of biological risk factors. Notably, this study did not

Table 3. Adjusted Mean Values and Probabilities for Child Outcomes by Latent Class

Outcome	High Stable	Moderate Stable	Low Increasing	Low Decreasing
CDI total vocab	75.62 _a	28.11 _b	52.34 _c	2.08 _d
Developmental delay diagnosis (%)	0 _a	25 _b	4 _c	65 _d
Speech pathologist referral (%)	4 _a	36 _b	8 _a	84 _c
Inattention/hyperactivity	2.92 _a	3.61 _{a,b}	4.35 _b	4.72 _b

Scores reflect adjusted statistics for outcomes after controlling for all predictor variables. Within each row, mean values with different subscripts are significantly different from each other; $p \leq 0.05$. CDI, communicative development inventory.

find evidence for a moderate-stable group, and proportions of children in each class differed from the current study. These differences are likely the result of the different developmental periods under study, as language is highly variable during infancy and the early toddler years.³²

Also of note in the present study is that the outcomes at age 3 years generally fell into a pattern whereby poorer outcomes (i.e., lower vocabulary, more developmental delay diagnoses, and speech-language pathologist referrals) were associated in a descending fashion with membership in the low-decreasing, moderate-stable, low-increasing, and high-stable classes. However, this pattern did not hold for inattention/hyperactivity symptoms. Instead, the low-increasing class displayed the second highest level of inattention/hyperactivity symptoms, which were not significantly different from the low-decreasing class. Inattention and hyperactivity are hallmark symptoms of attention-deficit hyperactivity disorder (ADHD), which is presumed to have neurological and genetic underpinnings.^{34,35} Therefore, it is possible that there is a shared biological or neurological issue that results in both early delays in communication skills and heightened inattention and hyperactivity symptoms. These early deficits in communication might eventually ameliorate, as is the case for the low-increasing class, even as they continue to show heightened inattention and hyperactivity symptoms. However, a small proportion of children who show additional risk factors (e.g., low maternal education and congenital anomalies) might show confounding issues with both communication problems and ADHD symptoms. Another possibility is that a shared environmental factor (e.g., exposure to lead or other toxins, prenatal stress, and screen time) could also account for some of the overlap between early communication problems and ADHD symptoms. Additional research is warranted, but this suggests that early language delays could be an early warning sign for heightened risk of ADHD.

Clinical Implications

Results suggest that approximately 81% of infants score highly on the ASQ Communication subscale at 12 months and will continue to meet developmental milestones related to communication in early childhood and likely beyond. However, for those 19% who show early lags in communication abilities, repeated assessments are likely to be beneficial. Children in the low-decreasing

and moderate-stable groups were the most at risk for poor developmental outcomes at 36 months, suggesting that even children who fall above the recommended cutoff criteria but show relatively low scores on the ASQ Communication scale at 12 or 24 months (i.e., <40 points) and then fail to improve at subsequent time points may benefit from intervention services. Notably, the combined percentage of children who fell into these 2 groups was 5.9%, similar to the estimated 6% to 8% of children who will eventually be diagnosed with a developmental language disorder.^{36,37}

Importantly, consistent differentiation between the low-decreasing, low-increasing, and moderate-stable groups was not evident until 36 months. At 12 months, the low-increasing and low-decreasing groups were almost equivalent, while at 24 months, the low-increasing and moderate-stable groups were comparable. Thus, a single assessment at either 12 or 24 months may not be sufficient to differentiate children likely to improve versus those at risk for persistent problems. Screening at 2 different time points for children showing early delays allows practitioners to track the rate of change in communication abilities over time, thereby increasing the early detection of persistent communication problems. Indeed, recent research suggests that the combination of both developmental screening and monitoring over time increases the likelihood of at-risk children receiving early intervention services.³⁸ Furthermore, repeated screenings may increase early detection but are unlikely to result in many “false positives,” given recent data that suggest that the sensitivity of the ASQ Communication scale in a sample of high-risk infants is 4% at 12 months and 65% at 24 months and the specificity is much higher at 89% to 99%.³⁹ In addition, children who receive “false positives” on developmental screenings have poorer performance in measures of language, adaptive functioning, and academic achievement than children with true-negative scores, suggesting that “over-referral” may actually provide beneficial services to at-risk but subclinical children.⁴⁰

While the average score of the moderate-stable group was above the recommended monitoring cutoff score for communication abilities until 36 months, these children showed significantly lower vocabularies and higher risk of developmental delays than the high-stable class at 36 months. Because of their relatively higher ASQ scores and lower income, children showing moderate communication abilities that fail to improve over time may fall

under the radar and not receive additional services and support. It is also important to note that even though the low-increasing class appeared to “catch up” by 36 months in terms of performance on the ASQ, they still evidenced lower vocabularies, greater developmental delay diagnoses, and heightened inattention/hyperactivity symptoms at age 3 years compared to the high-stable class. Thus, these children would also likely benefit from early services during the critical toddler years that could have long-term benefits.

Study Limitations

Several limitations merit discussion. First, consistent with the sociodemographic nature of the region, participants in our study were highly educated and relatively advantaged, which may limit the generalizability of study findings (e.g., prevalence rates for delayed trajectories might be higher in high-risk samples). Second, because most children do not receive developmental delay diagnoses until after age 4 years,⁸ we were unable to test for specificity of developmental delay diagnosis at age 3 years. Third, although the multimethod, multi-informant nature of the predictors is a strength of the current study, both the ASQ and the developmental outcomes at age 3 years were derived from parental reports, which could produce biased estimates. Fourth, caregivers completed the ASQ at 3 time points, which meant that only linear trajectories could be examined. However, it is possible that growth would be quadratic if measures had been extended to after age 3 years (e.g., rapid increases in toddler years, followed by slower growth). Fourth, only 1.4% of children in our sample fell into the low-decreasing class, which may have obscured our ability to detect significant differences between this trajectory and the other 3 trajectories. However, it is notable that even with this small class size, we still detected significant differences in key predictors and outcomes, including those with relatively rare occurrences (e.g., congenital anomalies, developmental delay diagnoses).

Finally, the use of a development screening tool means that our analyses are focused on identifying trajectories of *delayed* communicative development as opposed to trajectories of language skills and abilities. In other words, the screening tool could establish a “typically developing” trajectory (i.e., the high-stable group), but it is unlikely to differentiate children who simply meet developmental language milestones versus those who show above-average skills (e.g., precocious or gifted children). While this is fitting with the goals of the current study, researchers interested in examining above-average as well as delayed children should make use of a more continuous measure of language abilities (e.g., the MacArthur-Bates Communicative Development Inventories).

CONCLUSIONS

This study provides critical insight into the developmental trajectories of children with delayed communication abilities. Although many children with

delayed communication abilities appear to catch up, about 6% of children in our sample continued to show persistent deficits in communication abilities, which further predicted lower vocabularies and increased developmental delays at age 36 months. However, even children who initially fell behind and showed improvements in general communication abilities, as measured by the Ages and Stages Questionnaire, showed deficits in vocabulary size and increased hyperactivity and inattention symptoms at 36 months, suggesting they continue to display developmental concerns. Early identification is a prerequisite for early intervention, which can shrink disparities in developmental outcomes between children with typically developing and delayed communication abilities. Our results suggest that repeated assessments of communication abilities with a brief, cost-effective measure during late infancy and early toddlerhood, in combination with awareness of associated risk factors, can help identify children most at risk for persistent communication problems.

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