Diagnostic And Cultural Considerations to Improve The Identification Of Autism Spectrum Disorder Among Han Chinese Children

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Research note

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Abstract

Objective: The trajectory and norm of children's development is needed to understand the idea of spectrum in autism spectrum disorder (ASD) diagnosis. The children's developmental growth trajectory from six to 66 months in the developmental dimensions of growth motor, fine motor, language, and social communication is investigated in the Taiwan Birth Cohort Study dataset (N=11,145).

Results: The growth trajectory showed children's language development began to incline at 18 months, and peaked at 36 months. On the other hand, children's social development showed a steady growth from 18 to 66 months. Furthermore, the increase in the trajectory of children's language development prior to age three, compared to other developmental dimensions, may also increase the difficulty of diagnosis. The two-stage window screening method can be used in settings where the screening sample is larger in size, such as the community or primary care settings, and has found to be more time and cost efficient. Better understanding of the children's developmental trajectory can enhance autism spectrum disorder detection and intervention.

Introduction

With the development of the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), many issues have been raised that are affected by our conceptualization of each psychiatric diagnosis, and each decision made can greatly influence the field of psychiatry. To find universal criteria that can be used in all cultures is difficult; however, it effects each diagnosis.

A complex model of a single autism spectrum disorder (ASD) category superimposed on two primary symptom dimensions is presented in the DSM-5. With an increased prevalence of one in 54, compared to an earlier prevalence rate of 6.7 per 1000, the diagnosis of ASD has attracted increased attention and concern. ASD screening tools have also been developed to promote early identification and intervention. However, the median age of diagnosis is still past the age of three, and even later for children from disadvantaged backgrounds.

Main Text

Clinical vs. community sample

For earlier detection and diagnosis, the American Academy of Pediatrics guidelines recommend routine ASD-specific and standardized developmental screening surveillance of every child. However, a nationwide community screening of the association between parental stress and children with ASD and developmental delay showed that mothers who had perceived better physical health and quality of life had increased concern that their children had ASD. This is inconsistent with clinical findings showing that taking care of children with ASD increases the stress of both parents, and mothers of children with ASD, developmental delay and intellectual disability also suffer greater stress and depression than mothers of
healthy children.\textsuperscript{8,9} This community study showed different results from previous studies; however, using the Resiliency Model of Family Stress, Adjustment, and Adaptation,\textsuperscript{10} Twoy, Connolly and Novak investigated the coping strategies of parents of children with ASD, and found that Asian-Americans were more readily able to hold an optimistic view when facing the stresses of ASD, due to their religion and philosophical beliefs, and to find solutions to problems and see the stressor simply as a fact of life.\textsuperscript{11} Another study also found that mothers of adults with intellectual disability were able to adapt, and thus had better self-perceived health than the controls.\textsuperscript{12} We can also hypothesize that in clinical cases, parents may have sought help because those children were exhibiting more disruptive behaviors or symptoms, thus causing greater distress to the mothers; this would result in a biased health-worker effect, wherein all mothers of children with ASD would be observed as having greater distress.

Therefore, ASD screening tools that can be used in primary care and community settings are vital. In the community, instruments that can be completed without professional training and that are short and easily comprehensible are needed. Community screening instruments are not only helpful to the public in heightening understanding of their children's developmental condition, they may also aid doctors in their decision-making process. Furthermore, for clinicians to interpret positive predict values (PPV) and negative predictive values (NPV) appropriately, they have to comprehend the estimated prevalence of the condition in their particular population.\textsuperscript{13} Hence, to understand the idea of spectrum in the ASD diagnosis in the \textit{DSM-5}, we not only need to understand the etiology of ASD, but also the trajectory and norm of children's development.

\textbf{Application of two-stage window screening in the community}

For early detection and large-scale screening in the community, two-stage screening methods are often used. A two-stage screening process involves using a more inexpensive, less invasive test at the first stage (e.g., Modified Checklist of Autism in Toddlers [M-CHAT]), and a more expensive or more invasive, but more sensitive and specific test at the second stage (e.g., Autism Diagnostic Inventory - Revised [ADI-R]).\textsuperscript{14} Chien, Huang and Lung proposed the two-stage window screening method, a more efficient screening method.\textsuperscript{15} This screening method can be used in settings where the screening sample is larger in size, such as the community or primary care settings.\textsuperscript{16} Two cutoff points are needed in the first stage of the two-stage window screening, yielding three groups. Those in the first (highest scoring) group are normal (assuming higher scores are better), and those in the third (lowest) group have the highest risk for the disorder; therefore, they can be directly scheduled for diagnostic assessment (e.g., ADI-R). Participants in the middle group, between the two cutoff points, have the highest probability of being misclassified and need to be screened further using a more specific screening instrument (e.g., M-CHAT). A lower number of people need to be screened in the second stage using this method, decreasing the cost of testing.\textsuperscript{15,16} Lung and colleagues used the eight-item Parental Concern Checklist (PCC) as the first-stage screening instrument in a two-stage window screening method. With the cutoff points of 2/3 and 6/7, the PCC can differentiate three distinctively different developmental groups.\textsuperscript{16} Participants in the borderline
The group (scores from three to six on the PCC) would be administered a more specific screening instrument (such as the M-CHAT) at the second stage to decide if they need a more invasive assessment. Participants with the greatest risk (scores seven and eight on the PCC) should be directly scheduled for a more invasive and detailed diagnostic assessment.\textsuperscript{16} After four years, when the children were 66 months old, the NPV of the PCC remained high at 99.67\% (Table 1), showing that those that were not screened out at 18 months were not likely to be diagnosed at 66 months. In the traditional method of positive or negative two-stage screening, all those scoring higher than the cutoff point need to be tested at the second stage. Fewer people need to be assessed in the second stage using the two-stage window screening, which decreases the cost of testing\textsuperscript{15} and the number of false positives.\textsuperscript{16}

|          | ASD | Not diagnosed | Total | PPV: |
|----------|-----|---------------|-------|------|
| PCC 3–6  | 25  | 2615          | 2640  |      |
| others   | 63  | 18960         | 19023 |      |
| Total    | 88  | 21575         | 21663 |      |

Table 1

The application of the two-stage window screening method in screening of children using Parental Concern Checklist (PCC) at 18-months and rate of diagnosis with autism spectrum disorder at 5.5 years old

|          | Sensitivity | Specificity |
|----------|-------------|-------------|
|          | 25/88=      | 18960/21575=|
|          | 28.41\%     | 87.87\%     |

PPV: positive predictive value; NPV: negative predictive value

The two-stage window screening method was applied in another study using the Taiwan Birth Cohort Study Developmental Instrument (TBCS-DI) as the first-stage screening instrument and the M-CHAT as the lead criteria for screening of ASD at six, 18, and 36 months.\textsuperscript{17} Eighteen percent of the children were screened out as being at high risk for ASD, and the cutoff points of 65/66, 42/43, and 51/52, were found for the TBCS-DI six-, 18-, and 36-month scales, respectively, with NPVs of 83.44\%, 84.21\%, and 85.35\%, showing that the TBCS-DI can be used as a broadband screening instrument for ASD in a community-based setting.\textsuperscript{17} Although the NPVs of the TBCS-DI were found to be high (above 80\%), the PPVs were low (19\%, 21\%, 25\% for six, 18, and 36 months respectively).\textsuperscript{17}

In addition, when the children were 66 months old (four years later), the NPV of the TBCS-DI was still at 99.81\% (Table 2). It should be noted that both the TBCS-DI and PCC involve parental reports of their children's development. However, the PCC deals with parental concerns and the TBCS-DI with the
Although they are both first-stage screening instruments, they carry the risk of over-referral\textsuperscript{18} and may increase the apparent prevalence of disorders, with a high possibility of false positives. This may be especially true in the case of the PCC, because the questions relate to concerns that a parent might have regarding their child's development. Unlike clinical research, low PPVs are accepted in community research because the threshold for failing the screening was set low to prevent as many misses as possible at the expense of the PPVs. For clinical research, the prevalence is set at 50\% (control vs. clinical groups), and is not reflective of the real prevalence of the disorder. Therefore, even though low PPVs may bring about a high rate of false positives, causing over-referrals in the community, a study showed that those who screen out as false positives in developmental screening perform substantially worse than the true-negatives in standardized testing, and show greater psychosocial risks.\textsuperscript{19} For that reason, early intervention for those screened out as false positives as a preventive strategy is still needed when permitted, since it can ameliorate later stigmatization.

|                   | ASD | Not diagnosed | Total |
|-------------------|-----|---------------|-------|
| TBCS-DI           | 54  | 3763          | 3817  |
| PPV:              |     |               | 54/3817 = 1.41\% |
| others            | 34  | 17812         | 17846 |
| NPV:              |     |               | 17812/17846 = 99.81\% |
| Total             | 88  | 21575         | 21663 |

Sensitivity = 54/88 = 61.36\%
Specificity = 17822/21575 = 82.60\%

**Children's developmental trajectory**

The Taiwan Birth Cohort Study (TBCS) aimed to develop a nationally representative cohort database to establish national norms. Using national household probability sampling method with no exclusion criteria, all babies born in Taiwan in 2005 were eligible for inclusion in the TBCS. A total of 21,248 families (11.7\% selection rate) participated when the children were 6 months old; 20,172 families agreed to be followed up (95\%) at 18 months; 19,910 (94\%) at 36 months; 19,721 (93\%) at 66 months; and finally, 19,516 (92\%) families were followed up when the children were eight years old.\textsuperscript{20} Using a dataset of the development of 11,145 babies from six to 66 months selected nationwide as a basis, the
developmental trajectory of the children in the four dimensions of gross motor, fine motor, language, and social dimensions can be illustrated (Fig. 1). The procedures of the study have been approved by a teaching hospital in Taiwan. The growth trajectory showed children's language development began to incline at 18 months, and peaked at 36 months. On the other hand, children's social development showed a steady growth from 18 to 66 months. This is congruent with previous studies that showed at an early age, when children's language development is increasing, the pathological language patterns of children with ASD are categorized into the stereotyped behavior dimension, and as children grow older, and compared to the social development of normally developing children, their language dysfunction is reflected in the social-communication category. Furthermore, the increase in the trajectory of children's language development prior to age three, compared to other developmental dimensions, may also increase the difficulty of diagnosis.

Furthermore, due to the Chinese cultural context of collectivism and vertical hierarchical family structure, social harmony is emphasized and greater restraint is exerted over emotional displays than those in individualistic cultures. As a consequence, the TBCS-DI intended to separate emotion dimension from the gross motor, fine motor, language and social dimensions at when children were 3 years old but failed. The emotion dimension was only able to be distinguished from other dimensions at when the children were 8-year-old. Although the emotion dimension was unable to be distinguished prior to the age of eight, the predictive validity model shows the emotion dimension was a suppressor within the social dimension in earlier scales, supporting the importance of social communication in Asian collectivist culture.

Differences in emotional development of children in the Chinese culture may also influence the ability to diagnose atypical empathic responses in children with ASD, which has been shown to be contributed by epigenetics and the interaction between environmental factors and genetic susceptibilities.

**Conclusion**

With the launching of the *DSM-5*, studies have shown the new autism dyad has greater validity, with the core impairments of ASD being the expression of separable social communication and restricted and repetitive behavior and interests dimensions, decreasing false positive diagnoses and simultaneously maintaining or improving identification of ASD cases. Our national birth cohort follow-up developmental trajectory from 6- to 66-months also shows language development to be unstable prior to 36-months. Social development is more homogeneous, showing a steady growth from 18 to 66 months, thus being more reliable factor for diagnosis.

Enhancement of ASD detection can provide earlier and more appropriate intervention. To be able to appropriately screen for and identify children with ASD from diverse backgrounds, we need to understand the normal trajectory of development across different. Application of diagnostic criteria without understanding of cultural norms in development may contribute to delays in identification. Since cultural differences in normative social and emotional development may contribute to cultural differences in ASD
symptom presentation, and disparities in outcomes for children with ASD from diverse backgrounds. Future follow-up of the TBCS will hopefully provide us with more information regarding the application of the *DSM-5* and the etiology of factors which may affect the development of children in the Chinese community.

**Limitation**

A limitation of our study is the clinical diagnosis of ASD was based on parental report. Although it should be noted that parental nationally representative surveys have shown ASD-prevalence compatible with estimates from population-based studies that relied on medical and special education records.27

**Abbreviations**

ADI-R: Autism Diagnostic Inventory - Revised; ASD: autism spectrum disorder; DSM-5: Diagnostic and Statistical Manual of Mental Disorders; M-CHAT: Modified Checklist of Autism in Toddlers; NPV: negative predictive values; PCC: Parental Concern Checklist; PPV: positive predict values; TBCS: Taiwan Birth Cohort Study; TBCS-DI: Taiwan Birth Cohort Study Developmental Instrument

**Declarations**

**Ethics approval and consent to participate:** The protocol of this study was approved by the institutional review board of Health Promotion Administration, Taiwan. Written informed consent was obtained at each stage of the study from the main caregiver after a detailed explanation of the study.

**Consent to publish:** Not applicable.

**Availability of data and material:** Taiwan Birth Cohort Study datasets can be applied from the Taiwan Ministry of Health and Welfare, Bureau of Health Promotion, Taiwan. [https://dep.mohw.gov.tw/DOS/np-2500-113.html](https://dep.mohw.gov.tw/DOS/np-2500-113.html)

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**Authors’ contributions:** Both authors designed the study. B.C. Shu overlooked the sampling and experimental procedures. F.W. Lung undertook the statistical analysis and interpreted the analysis. F.W. Lung wrote the first draft of the manuscript. Both authors contributed to and have approved the final manuscript.

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Figures
Figure 1

Latent growth curve of children's developmental trajectory from 6 to 66 months in the gross motor, fine motor, language, and social communication dimensions.