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Contact

Email : ro_cas@dh.gov.hk
Website : http://www.dhcas.gov.hk
Editorial Board : Epidemiology and Research Committee, Child Assessment Service, Department of Health
Address : 2/F, 147L Argyle Street, Kowloon, Hong Kong

Message from Subspecialty Division

Individuals with solid cognitive abilities who could not learn to read have been noted from the late 19th Century, when Dr. W. Pringle Morgan of England reported in 1896 a "bright boy with average intelligence in conversation and ... good eyesight but an inability to read". In the U.S., intensive government initiatives to study reading disabilities were launched in 1987. Through international efforts as these, the nature of developmental dyslexia, its prevalence, developmental course and outcome were studied in ensuing decades to culminate in today's scientific understanding of the condition. This includes dyslexia being first understood as a constitutional language-based disorder, focusing on underlying insufficient phonological processing skills that led to difficulties in single word decoding and the manifestation of problems with reading , spelling and writing,[1] and further elaborated by the International Dyslexia Association and the National Institute of Health in 2003 to explicitly state that secondary consequences, including problems in reading comprehension and reduced reading experience, can impede growth of vocabulary and background knowledge.[2]

In Hong Kong, the story of dyslexia began around the 1980's when acquired dyslexia in adult was further studied, and in the 1990's when debates over whether "dyslexia / specific learning disabilities (SLD)" existed in the Chinese language gathered momentum. Over the last two decades, local research and experience have demonstrated that dyslexia indeed existed in Chinese, and that the prevalence of reading disabilities in Hong Kong was no less than average rates quoted in the West – with an estimated prevalence of 9.7-12% and male to female ratio of around 1.6:1.[3]

By 2007, through combined efforts of many sectors, Hong Kong saw dyslexia (SLD) being admitted into Hong Kong's government policy as a formal category of disability, tools for its identification and intervention being developed, professional training on the subject receiving high priority, and basic scientific research into genetic, neurological, linguistic and educational aspects of the condition being intensively rolled out. Finally, public awareness and non-discrimination are actively being promoted in Hong Kong.

Dyslexia : Recent Advances

LAM CCC

In this paper, recent developments on different aspects of developmental dyslexia are presented, covering genetic etiology, neurobiological features, cognitive processes, manifest behaviour and response to intervention.

Genetic Route to Behavioural Phenotype[4]

Candidate dyslexia susceptibility genes DYX1C1, KIA0319, DCDC2 AND ROBO1 are involved in cortical development

Subtle cortical malformations involving neuronal migration and axon growth lead in turn to abnormal cortico-cortical and cortico-thalamic circuits and auditory processing abnormalities

These may resolve in some individuals, or contribute to phonological disorders in dyslexia and different phenotypes

Brain Differences and Neuroimaging[5]

fMRI evidence demonstrated disruption in the neural systems serving reading, providing evidence of dyslexia as a valid disorder

Brain imaging is not recommended as an assessment tool for the diagnosis of dyslexia in school-age children

It may be helpful in

- very young children with limited cooperation, using diffusion tensor imaging to show white-matter tracts connectivity
- bright, highly accomplished young adults who have compensated to some degree for their dyslexia and for whom current testing is often inadequate

Neuroimaging Studies in Chinese Reading[6]

Studies of Chinese orthography-to-phonology transformation (OPT) using event-related fMRI suggest that the left inferior frontal gyrus, left temporoparietal region and the left temporal-occipital junction are involved and constitute a distributed neural network

Both word frequency and visual-phonology-mapping consistency contribute to the distributed phonological representation

The regions involved in this study are the same as areas also critically involved in different writing systems

Common Cognitive Linguistic Factors in Dyslexia and Oral Language Impairment[7]

In analyzing underlying processes of dyslexia and SLI, a four quadrant model with (i) classic dyslexia (ii) classic SLI (iii) poor comprehension and (iv) no-impairment is proposed, noting that

- Phonological factors are regarded as characteristic of dyslexia
- Non-phonological factors including semantic and syntactic skills also play important roles in literacy development
- Classic SLI is treated as a case of double deficit with both phonological and non-phonological impairments
- Poor comprehenders show weak semantic processing and normal phonological skills

This model also relates coherently to both neurobiological and genetic findings

This conceptual framework should have implications in assessment, profiles, intervention and prediction of reading intervention outcomes.

Phonological Representations in Reading Development

Cognitive frameworks for phonological development aree proposed to explain underlying brain representation[8]

- Semantic and phonological features are represented in the brain in the young child, and are augmented over time as the child grows
- Factors affecting the augmentation include vocabulary size and rate of expansions, word frequency and familiarity, linguistic factors and neighbourhood density of the words learned
- Implicit restructuring and segmental representation of words are therefore believed to emerge with spoken language experience, and affect phonological awareness and how easily the child will learn to read and write
- Dyslexic children take longer time to restructure segments to the phoneme level and is more problematic for those learning to read a non-transparent orthography

Measurement of implicit phonological representation are obtained though lexical gating, priming, and syllable similarity tasks[6]

- Children with dyslexia were shown to perform consistently worse than chronological age and reading age controls
- These were correlated with measures of speech perception, phoneme awareness and phonological short-term memory
- They accounted for unique variance in predicting reading ability

Review of Treatments for Dyslexia[9]

In evaluating different interventions, aspects to be considered include outcome measures which should be determined by what needs to be achieved at a specific stage of the child's development; intensity required; sustainability of gains attained; types of professional skills needed to deliver them and presence of rigorous scientific peer-reviewed studies.

Phonologically driven linguistic treatments

- The young child: explicit intervention
- The older child with severe impairment: intensive and longer in duration
- Aims: to increase reading accuracy and fluency, to increase vocabulary, and to improve text comprehension through strategies to help the child connect with and think about the text

Commercial linguistically based products are available, but need continued validation for efficacy

Non-linguistic interventions

- Auditory processing training: gains in auditory , phonologic and language processing noted, reading skills gain inconsistent
- Visual system training: based on hypothesis that abnormal magnocellular systems cause decreased visual motion sensitivity and inferior binocular convergence control. When given to children with dyslexia and unstable binocular vision, those who achieved binocular stability showed most reading gains
- Exercise-based approach to remediate dyslexia and in related disorders: based on hypothesis that cerebellum has a role in eye movement as well as phonologic processing. These have been inconsistent or ineffective in producing gains in reading abilities.

Also to be provided as indicated are training of attention, working memory and executive functions, training for sensorimotor deficits, monitoring and support for social emotional status, strengthening of resilience, and tracking of the child's dynamic language development and strengthening subtle weaknesses at each level. Compensatory accommodations must be considered in addition to remediation, including extra time, a quiet room, word processor, scribes, voice activated word processing programmes, and others.

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CAS Epidemiological Data on Dyslexia from 2003 to 2006

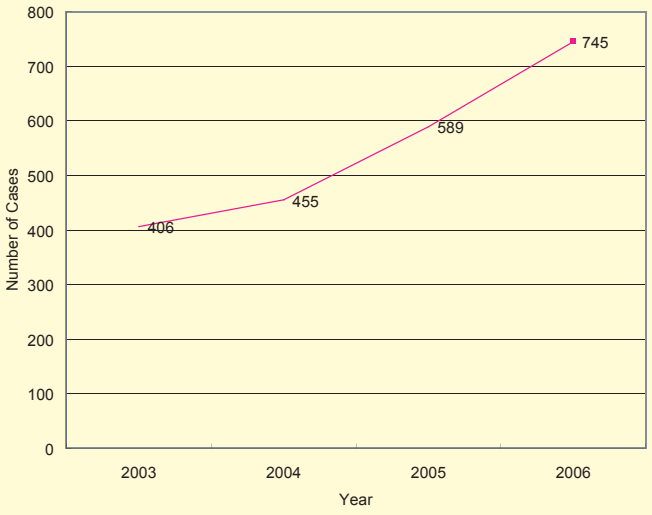
Tsang L, Chan B, Lam I

Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties are often unexpected in relation to age and other cognitive and academic abilities; they are not the result of generalized developmental disability or sensoryy impairment.[1] With increase in public education and awareness of the condition, CAS witnesses increasing referrals as more and more children suffering from this condition are brought for attention.

A Rising Incidence Rate

Figure 1 showed the number of cases diagnosed with dyslexia (including those who met the criteria of marginal dyslexia) from the year 2003 through 2006. A steady increase in new cases diagnosed with dyslexia was observed in CAS, with 406 cases diagnosed in 2003 increasing to 745 cases in 2006, an increase of 84% over 4 years. The increment is likely to be attributable to the increase in public awareness in the condition.

Figure 1. Number of children diagnosed with dyslexia and marginal dyslexia, 2003-2006



Sources of Referral

There were four major referral sources, namely from private practitioners, Maternal and Child Health Centres (MCHC) and Student Health Service of the Department of Health, and from the Hospital Authority (Table 1). The large percentage of referrals from private practitioners reflects the increased awareness of the children's learning difficulties by the parents, as it is quite common for the parents to actively approach general practitioners for the purpose of obtaining referrals to child assessment centres. Reportedly, it is not easy for parents to directly request for psychological assessments for the children at schools.

Table 1. Number of children with dyslexia by source of referral, 2003-2006

Source of referral	2003 N (%)	2004 N (%)	2005 N (%)	2006 N (%)	Total N (%)
Private Practitioner	144(35.5)	174(38.2)	223(37.9)	336(45.1)	877(40.0)
Department of Health					
MCHC	17(4.2)	53(11.7)	61(10.4)	128(17.2)	259(11.8)
Student Health Service	36(8.9)	34(7.5)	80(13.6)	66(8.9)	216(9.8)
Hospital Authority					
Paediatrics Department	25(6.2)	43(9.5)	89(15.1)	76(10.2)	233(10.6)

Reasons of Referral

Throughout these years, the majority of cases (65% in 2003; 72% in 2004; 63% in 2005, and 57% in 2006) were diagnosed between the ages of 6 to 8.11 years. The most common cause of referral was learning problems (52% in 2003 and 53% in 2006), with the second being emotional and behavioral difficulties (10% in 2003 to 25% in 2006). Maladaptive behavioral and emotional manifestations were commonly seen in children with underlying specific learning difficulties.

Gender Ratio

60% to 80% of individuals diagnosed with reading disorder were reported to be males.[2] This pattern was also observed in CAS. The male to female ratio was 2.7 to 1 across these years (Table 2).

Table 2. Number and ratio of female to male diagnosed with dyslexia, 2003-2006

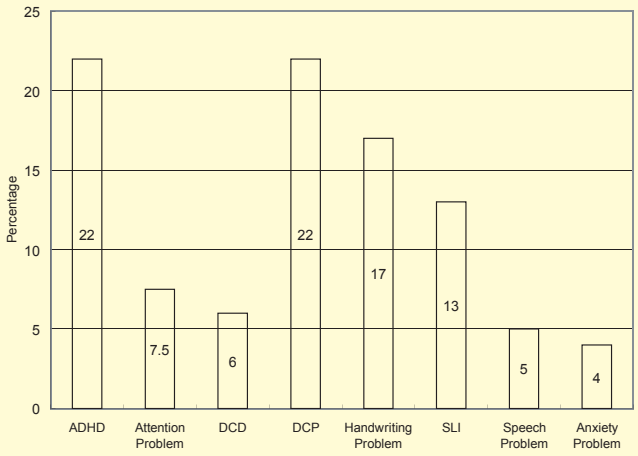
Source of referral	2003 N (%)	2004 N (%)	2005 N (%)	2006 N (%)	Total N (%)
Female	105(26.0)	116(25.7)	140(23.8)	234(31.4)	595(27.2)
Male	298(74.0)	336(74.3)	448(76.2)	511(68.6)	1593(72.8)

However, caution should be drawn to the fact that referral procedures may often be biased toward identifying males since they more frequently display disruptive behavior in association with dyslexia. Dyslexia has been found to occur at more equal rates in males and females when careful diagnostic ascertainment and stringent criteria are used.[2] Effort should be made to minimize girls being under-diagnosed.

Comorbid Conditions

A number of associated features were reported. Attention Deficit Hyperactivity Disorder (ADHD) was reported in 22% of the cases, and an extra 7.5 % was identified with attention problems; 6% with Developmental Coordination Disorder (DCD) and a further 22% with less severe developmental coordination problems, 17% with handwriting problems; 13% with Specific Language Impairment (SLI), 5% with speech problems. A small percentage also suffered from anxiety and mood disorders (4%) (Figure 2).

Figure 2. Comorbid conditions of children with dyslexia



Discussion

Diagnostic criteria

Much discussion has been going on recently on the diagnostic criteria of dyslexia, in terms of (1) the underlying level of intellectual functioning and (2) cases which do not fully meet the diagnostic criteria, as stipulated in the manual of the Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-SpLD).[3]

In performing assessment on this tool, it is proposed that children with either Verbal Scale IQ (VIQ) or Performance Scale IQ (PIQ) above the lower boundary of Low Average IQ (i.e. VIQ or PIQ ≥ 80) would meet the inclusion criteria. However, the cut off of IQ at 80 might include those with limited intellectual functioning or lower, given the confidence interval of ± 4 to ±6. Furthermore, the present tool used for intellectual assessment, the Hong Kong Wechsler Intelligence Scale for Children was normed during 1978-1981, and the Flynn Effect may well have taken effect by today, given the more than 20 years that have passed. Thirdly, should the discrepancy of VIQ versus PIQ be ignored, this inclusion criteria might even include children with VIQ falling within the range of mild grade mental retardation, which would impede the rate of word acquisition and recall. Therefore, instead of a hard-and-fast cut-off point of IQ ≥ 80 in either VIQ or PIQ, clinical judgment with sound justification in terms of the child's overall intellectual functioning has to be called for.

Conversely, during daily clinical assessment, there are children with test results not meeting the full diagnostic criteria for this tool. The HKT-SpLD does not yet cover salient learning components such as reading comprehension and cognitive abilities such as morphological awareness. Therefore, clinical judgment collating detailed learning history, learning style and the extent of learning support, motivation, etc. should be considered. Without a formal diagnosis of dyslexia, these children may not be granted the necessary remediation and accommodation that are pertinent to their learning and coping with the curriculum.

Under-diagnosis of the condition

The re are as yet no population based statistics on dyslexia either from the Hong Kong's Census & Statistical Department or the Central Registry for Rehabilitation (CRR). Data reported by the HK-SpLD Research Team[4] indicated that, based on a study at 27 schools in Hong Kong, Kowloon and the New Territories with the use of the HKT-SpLD, the prevalence rate of specific learning difficulties in reading and writing (dyslexia) in Hong Kong is 9.7% to 12.6% with 6.2% to 8.7% mild cases, 2.2% to 2.3% moderate cases and 1.3% to 1.6% severe cases.

Figures on SLD cases reported by the Education Bureau (EDB) are 461 in 2000-2001, 948 in 2001-2002, 980 in 2002-2003, 922 in 2003-2004 and 1,065 in 2004-2005 respectively. A total of 4,376 students with SLD in all primary and secondary schools were identified within these past five years. It is felt that whilst these

figures may reflect workload presented to EDB, they do not reflect the serious situation in Hong Kong. The distribution of these cases within schools of different levels of academic achievement also varies significantly.[5]

Cases diagnosed with dyslexia by CAS and the Education Bureau together are far lower than the prevalence rate as indicated by the HK-SpLD Research Team, implying that a large number of children with dyslexia have not been identified, and that necessary remediation and accommodation have not been rendered. Concerted effort should be made to devise a well-planned system from early identification of children at-risk of dyslexia to formal diagnosis, plus not missing out those children who might be working extra hard to compensate for and masking their dyslexic problems.

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Children with Dyslexia: Can They Be Identified at Pre-school Assessment at Child Assessment Service?

Lam I, Chan B, Tsang L

It is generally accepted that children with dyslexia need to be identified at an early age to facilitate the development of individual education plans and to optimize the effectiveness of intervention. Failure to identify such difficulties early can result in the manifestation of a range of problems, not only academic but also emotional and behavioral.

Many pre-school children are referred to the Child Assessment Service (CAS) for developmental problems disabilities by medical doctors and psychologists. Our pediatricians and clinical psychologists are key disciplines responsible for identifying pre-school children suspected to be at risk for dyslexia.

The current study is comprised of a retrospective review of clinical files of all pre-school children identified to be at risk of dyslexia at the CAS from the year 2002 to 2005. We have the following questions in mind:

1. Can children with dyslexia be identified in pre-school assessment at the CAS? What is our rate of successful early identification?
2. What are the tools currently used by our pediatricians and clinical psychologists for early identification?
3. What are the demographic characteristics and cognitive profiles of children found to be dyslexic in subsequent re-assessments?
4. What are the implications for future service?

Background Information

In the present study, files of 141 children identified during the period 2002-2005 to be at risk for dyslexia in pre-school years, and who have completed follow up diagnostic assessment before August 2007 were reviewed. There were 94 boys and 47 girls. The mean age was 5.75 years (S.D. = 6.23 months). The youngest child being identified to be at risk was 4.16 years old, while the oldest one was 6.83 years old.

Screening Professionals and Tools

Of these 141 children, clinical psychologists identified about 68%, while developmental pediatricians identified the remaining 32%. Children were assessed and considered to be at risk for dyslexia based on reports of parents and teachers as well as their performance on a number of screening tools. Measures commonly used include Chinese word reading (93.6%), Chinese word dictation (63.1%), and reading and dictation of English alphabets (69.5%). Other screening tools adopted by clinical psychologists and pediatricians include the Gardner Reversal Frequency Test, English word reading, and rapid automatized naming (RAN).

Dyslexia Diagnostic Criteria

These 141 children were subsequently re-assessed by our clinical psychologists or outside psychologists during primary school years. The assessment process involved an intellectual assessment using the Hong Kong Wechsler Intelligence Scale for Children (HK-WISC) as well as dyslexia assessment using the Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-SpLD). The tests of the HKT-SpLD are grouped under five domains: Literacy, Digit Rapid Naming, Phonological Awareness, Phonological Memory, and Orthographic Knowledge.

In the current study, children scoring below 80 on IQ as assessed by HK-WISC or HK-WISC Short Form were excluded. We adopted the diagnostic criteria as specified in the manual of HKT - SpLD for classifying dyslexic and marginally dyslexic children.[1]

Rate of Successful Identification

In these subsequent re-assessments, 78 children were diagnosed to have dyslexia while another 28 met the criteria for marginal dyslexia. The rate for successful preschool identification at the CAS was 75.2%. This high prediction rate is encouraging in that future reading and writing difficulties can be identified in the majority of at risk children during pre-school years.

Demographic Characteristics and Cognitive Profile of Dyslexic Children

The demographic characteristics, co-morbid conditions, data on intellectual capacity as well as performance on the HKT-SpLD of the 78 children diagnosed with dyslexia were further obtained from the medical files.

The mean age at re-assessment was 7.06 years (S.D. = 10.37 months). There were 53 boys and 25 girls, yielding a gender ratio of 2.1 to 1. Their mean Full Scale IQ score or Short Form Estimated Full Scale IQ score was 98.55 (S.D. = 10.87), which falls into the Average Intelligence range.

Consistent with the findings of Chan, Lau & Tsang,[2] these children often demonstrated co-morbid conditions including Attention Deficit and Hyperactivity Disorder (ADHD) or Attention Deficit Disorder (ADD) (33.3%), inattention and/or hyperactivity problems (20.5%), Specific Language Impairment (SLI) (10.3%), Developmental Coordination Disorder (DCD) (6.4%), gross motor and/or fine motor problems (28.2%), and mood problems (3.8%) (Figure 1).

Figure 1. Comorbid conditions of dyslexia children

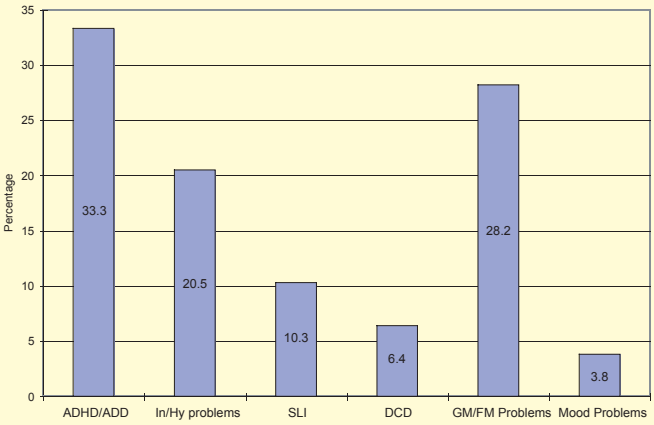

Table 1 presents the partial correlations among the composite scores of various HKT-SpLD domains for dyslexic children, controlling for their age and IQ score. Results indicated that the Literacy score was significantly correlated with Digit Rapid Naming score ($r = 0.47$, $p<0.001$) in a positive direction. However, significant correlations were not found between literacy performance and scores of other cognitive domains including Phonological Awareness, Phonological Memory or Orthographic Knowledge.

Table 1. Partial correlations among composite scores of the HKT-SpLD domains

	Literacy	DR	PA	PM	OK
Literacy	-				
DR	.4688***	-			
PA	-0.0209	0.1448	-		
PM	-0.0485	-0.219	-0.0861	-	
OK	0.2201	0.1095	0.2368	0.0129	-

Note: * p<0.05; **p<0.01; ***p<0.001
DR = Digit Rapid Naming; PA = Phonological Awareness;
PM = Phonological Memory; OK = Orthographic Knowledge

For comparison with the previous findings of Ho et al[3] on Chinese children with dyslexia in Hong Kong, multiple linear regression analyses were conducted using the composite scores of cognitive domain tests as predictors for the dependent variable of literacy composite score. The age and IQ score were controlled by entering in the first step of the regression analyses.

Table 2 summarizes the results of regression analyses. It demonstrates that children's age and IQ scores had no significant contribution towards the prediction of literacy performance. Digit Rapid Naming score emerged as a significant predictor of literacy score. It accounted for 21.5% of the variance on the dependent variable ($p<0.001$). On the other hand, the composite scores of Phonological Awareness, Phonological Memory as well as Orthographic Knowledge domains failed to make significant contribution to the prediction of literacy performance.

Table 2. Predictions of literacy composite score by the predictors using regression analyses

	Dependent variable (Literacy composite score)		
	Predictors	R^2 Change	F change
Set 1	Age, IQ score	0.076	2.715
Set 2	Digit Rapid Naming	0.215	19.748***
Set 3	Orthographic Knowledge	0.022	2.012
Set 4	Phonological Awareness, Phonological Memory	0.016	0.742

Note: * $p<0.05$; ** $p<0.01$; *** $p<0.001$

Ho et al[3] found that both rapid naming and orthographic knowledge showed significant unique contribution to literacy. Yet the current study has only identified rapid naming as a significant predictor of literacy performance.

Conclusions & Future Implications

To conclude, the present study demonstrated that there is high possibility of identifying preschool children who are at risk for dyslexia through measures currently employed by CAS disciplines. However, the lack of standardized tools for pre-school screening is a commonly cited obstacle. It is thus valuable to examine which cognitive skills might be predictors and early indicators of children's later literacy performance, as well as to work towards a standardized screening tool for assessing pre-school children at risk for dyslexia.

In the present study, demographic characteristics and cognitive profiles of children with dyslexia, and who were identified during pre-school years, were comparable to those in other local studies. Rapid naming was found to be a powerful predictor of literacy performance, and thus its inclusion in the battery of assessment tools for pre-school children can be considered.

As for all developmental disabilities, early identification and intervention is critical to ultimate success in remediation and habilitation. It is beneficial not only to parents who are given specific advice for promoting reading and preventing reading difficulties at an early stage, but more importantly for setting these children on the right path to literacy through timely intervention. The CAS is in a good position to identify at risk pre - school children andto ensure that necessary support is being engaged.[4] With close liaison and communication between the CAS and Education Bureau, it is hoped that appropriate remediation and accommodation services can be arranged for these children once their specific needs are identified.

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Towards Early Identification of Dyslexia in Chinese Preschool Children: A Collaborative Project with Department of Psychology, CUHK

Lam FWF

Introduction

Dyslexia, or specific reading disability, is a common developmental condition characterized by discrepant difficulties in word recognition and reading, in the context of normal general intelligence, adequate motivation and effective education. Without intervention it often results in serious consequences in learning and adverse psychosocial outcomes for affected individuals. Through evidence from methodologically rigorous studies, favorable outcome of remediation of dyslexia and of prevention of at - risk cases developing reading failure was demonstrated.[1] In view of the potentially profound negative effects of dyslexia[2,3] and positive outcomes of prevention and early intervention, young children at risk of dyslexia should be identified early and offered evidence-based training. Its high prevalence also justifies careful surveillance of at-risk cases from a public health economy perspective.

However, apart from "The Hong Kong Learninng Behaviour Checklist for Preschool Children",[4] which is a questionnaire for parents and teachers, there is no individually administered psychometric test that assesses preschool children who are at-risk of dyslexia in Hong Kong. This situation can be attributed to limited understanding of cognitive profiles and developmental characteristics of Chinese preschool children at risk of dyslexia. To date, deficits of phonological awareness and automaticity are considered the most significant cognitive deficits underlying dyslexia in alphabetical scripts.[5] On the other hand, Chinese characters are comprised of a script that is morphosyllabic, with each character representing both a syllable and a basic unit of meaning, the morpheme. It is also described as logographic given its complex visual form.

Do our Chinese dyslexic children exemplify the same cognitive deficits as their peers who are learning alphabetic languages? Recent cross-linguistic studies using cognitive tasks evaluations and functional MRI studies concluded that phonological processing is the basic cognitive skill in reading Chinese despite its logographic nature.[6-8] However morphological awareness (defined as the consciousness of the morphemic structure of words and the ability to reflect on and manipulate that structure) was found to be a core cognitive construct for explaining variability in reading Chinese in preschool and school age children,[9,10] as in other alphabetical languages. Moreover, visual skills were also implicated in learning to read or write Chinese words given the complexity of its visual form.[11] In fact, functional MRI findings consistently demonstrated that the left middle frontal gyrus and right parietal areas are activated during experimental tasks related to reading Chinese character, implicating visuospatial processes to be particularly involve[12-14]

In this paper, I describe our collaborative study with Department of Psychology, The Chinese University of Hong Kong. The objective of our study is to identify the cognitive measures that can best discriminate young Chinese children who are at risk of dyslexia from their typically developing peers and study their correlation with Chinese word recognition.

Study Design

Approval for research was obtained from the Ethics Committee of Department of Health and written parental consent was obtained in all participants. This is a longitudinal cohort study: the first stage when participants just complete the second year of kindergarten (screening for at-risk cases) and the second stage during the first year of primary school (diagnosis). Inclusion criteria of our participants were preschool children with either family history of dyslexia in elder siblings (who were diagnosed at Child Assessment Service) or with reported difficulties in word recognition by parents or teachers. The latter group was ascertained by clinical evaluation of developmental paediatricians to have age-appropriate nonverbal development but delayed language development. The latter group also showed variable impairments in one or more key areas of effective reading, including phonological awareness, lexical skills, receptive and exressive oral language or letter identification.[15] Children with significant behavioural problems such as autism or hyperactivity were excluded. Control participants were matched for age, nonverbal IQ and parental education to the at-risk group and they were typically developing children who were selected from participants in an on-going study of language and literacy development under the initiatives of Department of Psychology, CUHK.

Table 1. Estimated mean scores and standard deviations of various tasks controlling for children's age, nonverbal IQ and parents' education of three groups of participants (language delayed, normally-achieving and at familial risk of dyslexia) and the F values for univariate test of group differences

Group/Task	Language delayed (n=36) Mean (S.D.)	Familial risk (n=36) Mean (S.D.)	Normally Achieving (n=36) Mean (S.D.)	F-value F (2, 102)	Pairwise comparisons by LSD
Literacy task					
Chinese word recognition (max = 211)	22.22 (3.09)	33.22 (3.15)	51.49 (3.10)	22.96***	NA>LD; NA>FR; LD<FR
Cognitive tasks					
Visual-Spatial Relationships (max = 16)	7.95 (0.60)	9.73 (0.61)	10.49 (0.60)	4.71*	NA>LD; NA=FR; LD<FR
Syllable deletion (max = 13)	8.42 (0.55)	10.24 (0.56)	11.75 (0.55)	9.27***	NA>LD; NA=FR+; LD<FR
Tone detection (max = 36)	21.99 (0.73)	22.36 (0.74)	24.51 (0.73)	3.53*	NA>LD; NA>FR; LD=FR
Rapid number naming (seconds)	29.73 (1.51)	23.29 (1.53)	19.86 (1.51)	11.10***	NA<LD; NA=FR; LD>FR
Morphological awareness (max = 15)	6.26 (0.54)	6.87 (0.54)	8.91 (0.54)	6.43**	NA>LD; NA>FR; LD=FR

Note: NA= normally achieving group; LD = language delayed group; FR = familial risk group
*p < .05; **p < .01; ***p < .001
+ p = .06

At kindergarten level, the three groups were tested on *Chinese word recognition* (The word list comprises of 27 one-character and 34 two-character simple words designed for Hong Kong kindergartners and words from the reading subtest of the *Hong Kong Test of Specific Learning Difficulties in Reading and Writing;*[16] and a battery of tasks encompassing *Syllable deletion, Tone detection, Rapid Number Naming, Visual-spatial relationships and Morphological awareness. Nonverbal intelligence was measured by using the Coloured Progressive Matrices*.[17] Testing for the at-risk participants was performed individually by trained psychology major students of the CUHK Department of Psychology, in the presence of a developmental paediatrician at seven Child Assessment Centres in Hong Kong. Controls were tested on the same set of measures, in which all tasks were administered by using standard booklets, oral instructions and recordings from MP3.

When the cohorts reach the end of primary one academic year two years later, they will be tested with the Literacy test domain of *Hong Kong Test of Specific Learning Difficulties in Reading and Writing*,[16] which is the core diagnostic criterion of dyslexia. With these results, individual cognitive tasks performed earlier at preschool will be re-examined for correlation with the outcome diagnoses, and those with significant correlation will be considered as candidate items in the construction of a screening tool for Chinese preschool children at-risk of dyslexia in Hong Kong.

Preliminary Results

We recruited 72 at risk children, in which 36 (21 boys, 15 girls, mean age= 61.06 months, SD=3.37 months) were in the familial risk group and another 36 (24 boys, 12 girls, mean age= 60.83 months, SD=3.82 months) were in the language delay group. Analysis of covariance (ANCOVA) using SSPS version 13, controlling for the effects of age, nonverbal IQ and parents' education demonstrated that the at-risk groups with language delay and family history scored significantly lower in Chinese word recognition (CWR) and there was significant across group difference in all cognitive tasks (Table 1).

Discriminative cognitive measures were then analysed for correlation with CWR and results was shown in Table 2. CWR was significantly ($p<0.001$) and moderately (absolute value of correlation coefficient (0.37-0.46) correlated with all cognitive measures. Subsequent multiple regression analysis found that *Visual-spatial relationships*, *Morphological awareness*, and *Tone detection* were uniquely associated with CWR, and they also contributed unique variance in CWR in hierarchical regression analysis with all other variables statistically controlled(Table3).

Table 2. Partial correlations among different measures partialing for children's age, nonverbal IQ and parents' education

Variable	1	2	3	4	5
1. Chinese word recognition	--				
2. Syllable deletion	.43***	--			
3. Tone detection	.38***	.34**	--		
4. Rapid number naming	-.39***	- .46***	-.20*	--	
5. Visual-Spatial Relationships	.37***	.27**	.16	-.41***	--
6. Morphological awareness	.46***	.42***	.27**	-.32**	.21*

*p< .05; **p < .01; ***p < .001

Table 3. Hierarchical regression explaining Chinese word recognition from unique variables

Step	Variable	R	R^2 change	F change
1	Variables controlled	0.26	0.26	7.02***
2	Visual-Spatial Relationships	0.30	0.04	5.86*
3	Tone detection	0.35	0.05	7.69**
4	Morphological awareness	0.40	0.05	8.94**
1	Variables controlled	0.26	0.26	7.02***
2	Morphological awareness	0.33	0.07	11.37**
3	Visual-Spatial Relationships	0.37	0.04	5.46*
4	Tone detection	0.40	0.03	5.82*
1	Variables controlled	0.26	0.26	7.02***
2	Tone detection	0.31	0.05	8.13**
3	Morphological awareness	0.37	0.06	9.28**
4	Visual-Spatial Relationships	0.40	0.03	5.15*

Note: Variables controlled were children's age, nonverbal IQ and parents' education, syllable deletion and rapid number naming.

*p < .05; **p < .01; ***p < .001

Discussion

Selection of our at-risk cohorts was based on critically reviewed evidence from studies on early identification of dyslexia. First, the Jyväskylä Longitudinal Study of Dyslexia (JLD) had successfully identified preschool children who went on to develop reading difficulties by looking at Finnish children with familial risk,[18] based on longitudinal data on electrophysiological study, assessment of auditory-phonic and linguistic skills, neurocognitive development from birth through early childhood and letter identification at preschool age. Second, Bishop and Snowling reviewed the significant overlap between observed behavioural phenotype of specific language impairment and dyslexia; and children at genetic risk of dyslexia who subsequently developed dyslexia often showed compromised early language development.[19] Therefore in this study we focused on preschool children at risk of dyslexia by virtue of family history and early language delay.

This study draws on the combined strengths from clinical developmental paediatrics and theoretical framework of developmental psychology. The preliminary results have provided intriguing evidence that Chinese children at risk of reading impairment demonstrated significant difference in literacy skills and in reading related cognitive measures as early as preschool stage. A broad range of cognitive processes are involved in reading Chinese. Linguistic-related skills including phonological awareness (measured by syllable deletion and tone detection here), automaticity (measured by rapid number naming here), morphological awareness, as well as visual-spatial skills, are well correlated with Chinese word recognition. However, only tone detection, morphological awareness and visual spatial relationships contributed in unique ways to predict reading Chinese. These cognitive factors should be considered to be constructs of the preschool screening tool.

Finally, there are several limitations to the study. First, performance in Chinese word recognition and development of cognitive skills are affected by the heterogeneity of Hong Kong's pre-school curriculum and intensity of parental coaching. This kind of background information should be obtained and controlled. Second, our group of at risk children may be a heterogenous group with the potential of later showing co-morbid conditions including attention deficit hyperactive disorder. We may consider to administer standardized questionnaire for evaluation of attention and control for this variable in future studies. Last but not the least, interpretation of this set of cross-sectional data alone, obtained from participants who were only five year olds when tested and who have had limited experience in reading, must be done with caution. The longitudinal data obtained when these children have completed primary one will be crucial to correlate the predictive value of the individual cognitive task to the diagnosis of dyslexia.

Conclusion

Our study provided pertinent information for following early developmental trajectories in the acquisition of reading in young Chinese children at risk of dyslexia, in the context of the unique logographic and morphosyllabic nature of the script. We are encouraged that screening for young Chinese children at-risk of dyslexia appears to be feasible. Future studies will enable validation of the discriminative cognitive measures in the screening tool as more empirical data emerges.

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Next Issue

The next issue of CASER will be released in June 2008. The featured topic is on Specific Language Impairment.