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Epidemiological Data of Visual Impairment at Child Assessment Service from 2013-18

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Visual impairment (VI) has a significant impact on various aspects of a person's life. The causes of VI in childhood are rare and heterogeneous. This causes great challenges in epidemiological studies of VI in children, in addition to the different classifications of VI and age definitions of childhood in the literature.[1,2,3]

Classification of VI

According to the 10th Edition of the International Classification of Disease (ICD-10) (2016 version), visual acuity (VA) is measured with both eyes open with presenting correction, if any, and it categorises VI into mild, moderate or severe VI, or blindness.[4] The ICD-11 (2018) classifies VI into distance and near vision impairment.[5,6] In Hong Kong, according to Rehabilitation Programme Plan (RPP) published in 2007, VI was classified by VA of the better eye with correcting glasses into mild, moderate or severe low vision, or total blindness.[7] This definition is used to define children with visual impairment in CAS in the following analysis. However, RPP has recently updated the definition of VI with reference to ICD-10 in 2020,[8] the corresponding details are summarised in Table 1.

Table 1. Classification of VI

<table>
<tr><th colspan="2" rowspan="2">Visual Acuity</th><th colspan="2">VI definition of Rehabilitation Programme Plan</th><th rowspan="2">ICD -10 (2016)</th><th rowspan="2">ICD -11 (2018)</th></tr>
<tr><th>2007</th><th>2020</th></tr>
<tr><td>Worse than</td><td>Equal to or better than</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>6/12</td><td></td><td></td><td rowspan="2">Mild or no visual impairment</td><td>No vision impairment</td></tr>
<tr><td>6/12</td><td>6/18</td><td></td><td></td><td>Mild vision impairment</td></tr>
<tr><td>6/18</td><td>6/60</td><td>Mild low vision</td><td>Moderate visual impairment</td><td>Moderate visual impairment</td><td>Moderate vision impairment</td></tr>
<tr><td>6/60</td><td>3/60</td><td>Moderate low vision</td><td>Severe visual impairment</td><td>Severe visual impairment</td><td>Severe vision impairment</td></tr>
<tr><td>3/60</td><td>1/60</td><td rowspan="2">Severe low vision</td><td rowspan="3"></td><td rowspan="3">Blindness</td><td rowspan="3">Blindness</td></tr>
<tr><td>1/60</td><td>Light perception</td></tr>
<tr><td colspan="2">No light perception</td><td>Total blindness</td></tr>
</table>

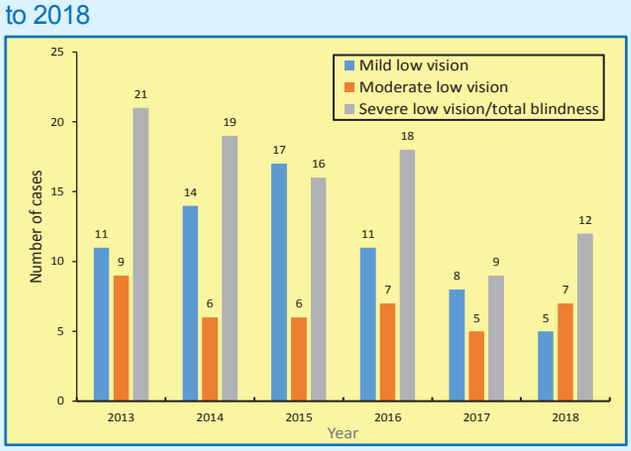
Incidence of VI at the Child Assessment Service

It is estimated that at least 2.2 billion people around the world have VI,[5] and 14 million of the world's children are blind.[1] In Hong Kong, according to data from the Census and Statistics Department, which is based on social data collected in the General Household Survey in 2013, 1,300 children under 15 years old had VI.[9] As at 30 September 2019, the Central Registry for Rehabilitation (CRR) in Hong Kong had 259 registrants with VI from 0 to 14 years old. Registration in the CRR is voluntary, so its figures may provide only a low estimate of the number of persons with selected types of disability.[10]

The Child Assessment Service (CAS) serves children under 12 years old. Children with VI are referred to the CAS by doctors from hospitals, maternal and child health centres, and the private sector. Our multidisciplinary assessment team provides comprehensive developmental assessments, recommendations on rehabilitation service referrals, interim support, and guidance for parents of children with VI.

In 2013-18, the CAS assessed 201 children with VI, 135 of whom (67.2%) had moderate low vision (VA between 3/60 and 6/60), severe low vision (VA from light perception to 3/60) or total blindness (no light perception) (Figure 1). This group corresponded to the ICD-10 categorisation of severe VI (VA between 3/60 and 6/60) and blindness (VA from no light perception to 3/60). Cases with severe VI and blindness (SVI/Blind) were commonly grouped together for analysis in other epidemiological studies.[1,2] The number of new SVI/Blind cases at the CAS is 15 to 30 per year and has been stable over the past 10 years.[11] The majority (80.7%) of these children were referred to the CAS before the age of two.

Figure 1. The number of VI cases at the CAS from 2013 to 2018



Causes of VI

The causes of VI among children vary across countries. In low-income countries (e.g. in Africa), congenital cataract is a leading cause, while in high-income countries (e.g. in the North America), cerebral visual impairment (CVI), retinal disorders and optic nerve disorders are major causes.[1,5,12,13,14] In CAS, the major causes of VI in children assessed are CVI (63.7%) , retinal disorders (15.6%) and disorder of the whole globe and anterior segment (10.4%). This finding is similar to that in developed countries. Other less common causes of VI in children in CAS are disorders affecting cornea, lens, uvea and optic nerve, glaucoma and congenital nystagmus (Table 2).

Table 2. Causes of VI in children with severe visual impairment/blindness (SVI/Blind) in CAS

Sites affected	Disorders	Number (percentage)
Cerebral/visual pathway		86 (63.7%)
Retina	Retinopathy of prematurity, retinal detachment, maculopathy, hereditary retinal dystrophy, familial exudative vitreoretinopathy, atrophic retina and disc, Leber congenital amaurosis, retinoblastoma, albinism	21 (15.6%)
Whole globe and anterior segment	Coloboma, anterior segment dysgenesis, microphthalmos /anophthalmos, persistent hyperplastic primary vitreous	14 (10.4%)
Cornea	Sclerocornea, corneal scar	3 (2.2%)
Lens	Cataract, spherophakia	3 (2.2%)
Uvea	Coloboma, aniridia, WAGR syndrome	3 (2.2%)
Optic nerve		3 (2.2%)
	Glaucoma	1 (0.7%)
	Congenital nystagmus	1 (0.7%)
Total		135

Ninety-nine (73.3%) of the 135 children with SVI/Blind in CAS had one or more non-ophthalmological disorders or disabilities (Table 3). Children with VI can be divided into two main groups: one with isolated VI and the other with VI associated with other disabilities.[13,15,16] The developmental needs and thus the clinical management of these two groups are different in various respects. Those in the group with associated disabilities also face an increased risk of a poorer outcome.[16]

Table 3. Non-ophthalmic disorders or disabilities in children with severe visual impairment/blindness (SVI/Blind) in CAS

Type	With CVI	With other causes of VI	Total
Significant global developmental delay or intellectual disability	58	11	69
Epilepsy	39	1	40
Cerebral palsy	23	1	24
Genetic abnormality	10	0	10
Hearing impairment	8	0	8
Intracranial haemorrhage	7	0	7
Hydrocephalus	4	1	5
Microcephaly	4	0	4
Hypoxic ischaemic encephalopathy	3	0	3
Brain malformation	3	0	3
Inborn error of metabolism	3	0	3
Congenital cytomegalovirus infection	2	0	2
Mitochondrial disease	2	0	2

In summary, the incidence of VI in children assessed at the CAS has remained stable over the last decade. The main causes are CVI and retinal disorders. Most of these children also suffer from other non-ophthalmological disorders or disabilities in addition to VI. Children with VI required multidisciplinary team assessment and management, in view of their complex needs and heterogeneous conditions.

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Challenges in Assessing Preschool Children with Visual Impairment

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Introduction

Developmental assessment of children with visual impairment (VI) poses a lot of challenges to clinicians. As a major multidisciplinary team assessing children with VI in Hong Kong, we would like to share our experience and points to note when assessing these children.

There are some general principles when assessing children with VI as described below. As these children have poor vision, when they come to a new environment for the assessment, they will be more at ease if additional manual guidance and a verbal description of the room layout are given. Simple verbal instructions can be used, such as “There is a low table five steps in front of you with a chair in front; please pull out the chair and sit down”. The environment must be free of danger for them to move around easily. The floor must be clear of objects, and there must be no sharp edges. Additional support, such as a wall or a familiar adult will improve the child’s sense of security to be ready for the assessment. A quiet testing room is preferred. The assessor can let the children know what they are expected to do by giving manual guidance and verbal cues. It will be better if the children are addressed by name when being talked to. Simple sentences are used to describe the assessment tasks and activities in the immediate surroundings. If possible, familiar objects or favourite textures or activities can be introduced first, as children with significant VI quite often have tactile defensiveness. Instead of moving immediately to the history taking, the assessor better first allows time for free parent-child interaction to help the child adapt to the new surroundings. This also provides hints about the child and parent’s communication style, the child’s communication ability, and the parent’s language facilitation skills. The assessment has to be conducted at slower pace, since they will need time to become familiar with the new surroundings.

For children with total blindness, they are guided to explore and touch the assessment items before starting the test. When the children become more comfortable and relaxed, the assessor can then gradually introduce more items for the assessment. Music is pleasurable for blind children, so it is useful to use music to help them relax, especially if they appear nervous during the assessment.

For children with moderate to severe low vision, their visual efficiency is affected by lighting, contrast, familiarity with materials and surroundings, and visual fatigue. The assessor should control the lighting when assessing them. It is important to illuminate objects while ensuring that there is no glare, especially for those who are photophobic. Their position while performing table tasks is also important. It will be more desirable if no shadow is cast over an activity or book. Contrast also affects visual performance. Children with VI need activities that have clear outlines and colours that provide a good contrast. Therefore, we have to prepare a suitable background when doing the assessment, such as using a black cloth to cover a light blue table for building a tower with yellow cubes. It is also better to use cubes with different colours instead of the same colour when performing cube-design copying so that the child can see the outline clearly.

A multi-disciplinary approach is preferred when assessing children with VI. Functional vision may vary a lot for children with the same cause of VI. An optometrist can provide more detailed information about their functional visual ability.

Following are some general principles for assessment of different aspects of children with VI.

Sensory and fine motor function assessment

Children with blindness cannot see people or objects approaching them and may exhibit hypersensitivity to touch and even tactile defensiveness. A firm touch is generally better than a light touch. In addition, it is less defensive when a verbal cue accompanies or precedes a tactile cue.[1] Therefore, we can use our voice to let children with blindness know where we are before touching them. Vision provides considerable information before direct contact with new materials, allowing children with normal development to prepare for the experience. Children with blindness, however, do not have this kind of preparation owing to their lack of visual input. Therefore, we help them touch and explore novel textures at their own pace and provide adequate guidance and support. We try to describe the texture first when introducing it to them and then encourage them to touch it gradually. The use of firm

texture, such as dry sand, is introduced before soft texture, such as shaving cream. Although children with blindness need a great deal of sensory stimulation, it is important not to over-stimulate them, as this may cause confusion, and they may eventually stop the activities. Therefore, the assessment environment needs to be kept quiet and less crowded.

Body awareness, spatial awareness, and spatial orientation are crucial for their exploration of space and their environment and have to be assessed when they are young. Some may exhibit weak postural control and fear of movement, which will hinder their learning and exploration of their environment. Therefore, assessment of these areas is important.

When assessing fine motor skills of children with blindness, it is important to assess their tactile discrimination skills, grip strength (especially finger grip strength), bilateral coordination and finger dexterity, since all these skills are essential for learning Braille. In addition, hand-over-hand guidance may be needed at the beginning to help them understand what is expected and how to manipulate an object. However, it is important to reduce the prompts so that they become more active.[2] They need to control their own hands, which serve as their "eyes" as well as "tools" for interacting with people and objects. Frequent manipulation of their hands is to be avoided, and sufficient time has to be provided for them to respond and interact.

Since children with moderate to severe low vision have residual visual ability, we need to emphasise assessing their visual motor control and eye-hand coordination skills, since these are the areas most affected. In addition, the testing materials have to be presented with good contrast and a clear outline. For example, most children with VI find it difficult to do scissoring tasks in the Bruininks-Oseretsky Test of Motor Proficiency since the background is too complex. Therefore, we can conduct extra informal tasks by asking them to cut along a clearly presented outline free of distracting lines to document their fine motor ability more accurately. When asking them to perform form-board puzzle tasks, we must ensure that the puzzle insets have contrasting colours so that the outline of the shape is clearly presented.

Self care and play assessment

It is important to help children with blindness use other senses, such as their auditory, olfactory, tactile and kinaesthetic senses, to access their environment and optimise their performance in self care and play. We can observe their response to various sensory inputs in different situations carefully to see how they respond and what they seem to understand.

When they perform self-care activities, we talk to them before touching their lips with a spoon or food, helping them put clothes on, wiping their face, changing their position, and so forth. The underlying foundations and specific skills needed to perform self-care tasks without vision are also addressed. For some children with blindness, recommending adaptation or modification to the environment, such as adding tactile cues in their clothing to distinguish front and back; seating and use of equipment, such as using a bowl with suction or a heavy plate to help them avoid knocking over a bowl or plate while eating; and other strategies that support independence are to be addressed during assessment. The living space of children with blindness has to be organised so that there is fixed place for everything. The importance of putting everything in its place after use (e.g., on a certain shelf in the bathroom and in certain drawer in the bedroom) is stressed. The home environment is better to be free of clutter.

When assessing the self-care skills of children with moderate to severe low vision, tools with high colour contrast are provided, such as a coloured towel in a white bathroom, or a blue cup for white milk. Organised scanning techniques (e.g., left to right, top to bottom) can be used when functioning in a stationary environment. Visual clutter of the tools is to be avoided.[3]

For play skills, active reaching out and exploration of toys is limited for young children with blindness. Many toys are simply too large, too small, too fragile, or too abstract for them to explore using either their tactile or auditory sense. Thus, adaptation of assessment materials to elicit their play skills may be needed, such as adding some beans inside the stacking rings to increase auditory and proprioceptive feedback, modifying on/off buttons of

some electronic toys by enlarging them, or adding tactile cues to them so that child with blindness can locate them easily, and adding tactile cues and even daily objects in modified homemade books.[4]

Handwriting assessment

When assessing their handwriting skills, a pen or pencil with strong colour contrast to that of the paper is provided, especially for children with severe low vision. Avoid crowding of all visual stimuli in writing tasks.

For children with nystagmus, it is important to find their comfort zone/point, especially in reading and writing tasks. For example, if children show less nystagmus when they look at the right side, they better sit on the left side of the classroom with the blackboard on their right side.

Be aware that some children with VI need to move their eyes close to the paper when writing because of visual limitations. Avoid always asking them to 'sit upright'. However, there is a lot of stress on their back and neck due to their poor sitting posture. We have to help them to reduce this stress by encouraging them to take frequent breaks, use a tilting table or book stand, do neck and back stretching exercises, use low vision aids, and so forth.

When conducting handwriting assessments, it is essential to conduct both near-copying and distance-copying test for these children. In addition, we have to recommend the appropriate font size for them to help them with their school work, especially for reading and handwriting tasks.

For children who are studying in mainstream schools, school recommendations on seating position, lighting, working position, handwriting demands, enlargement of test and exam papers, and so forth, are very important.

Gross motor assessment

The gross motor assessment environment must be free of danger and obstacles, such as small rugs on the floor or anything that is slippery or can be tripped over, half-opened doors, unfamiliar objects, sharp or protruding objects, and interfering sensory disturbances, especially noise.[5,6,7]

The children are provided with adequate details about the assessment environment, where they are, and what activities they are expected to perform, by giving manual guidance and verbal cues for any movement and posture that will be assessed.[8]

Vision is important for developing balance,[9] and motivating and monitoring movement.[10] To compensate for the loss of visual input, children have to be provided with adequate sensory clues, such as toys that produce sound, vibration, tactile sensation (rough, smooth, soft, slippery, sticky, spiky), proprioception (heavy and light, level and inclined), temperature (hot and cold), and smell to guide their movement.[6]

To help children explore their environment, the assessor's voice or sound-making toys can be used as cues to inform the children where the assessor is standing, in terms of distance and direction. The assessor describes the environment or distance and direction of the children's target, with reference to children's position and body parts. Children are encouraged to reach out with their hands to feel the texture of the surrounding surface, and use their feet to feel the texture and slope of the supporting surface. Children are reminded to solicit sensory clues in their surroundings, such as sound, smell, temperature, and air flow, to distinguish different surroundings.[6]

When assessing stair climbing, children are allowed to hold onto a rail. They need to feel the depth and height of the step by hand or foot before going up the staircase, and they are reminded verbally when they reach the top. Similarly, children need to feel the depth and height of the steps by hand or foot before going down a staircase, and they are reminded verbally when they reach the bottom of a staircase. Some tactile cues at both ends of a rail will also help the children identify the top and bottom of the staircase.

When assessing dynamic balance when walking along balance beam, the children need to feel the height and width of the beam before they start walking on it. Then they need to feel the beam by gliding their feet slowly along its top surface, before they lift a foot off the beam surface to take a step forward. They must be told when they are coming to the end of the beam.

Before running speed and agility are assessed, the children can be led along the running track at a walking pace to help them become familiar with the track. Assessors may use their own voice, clap their hands, or use a sound-making toy to indicate the direction and distance the children have to run.[7,11]

For the jumping test, the assessor can ask the children to practise basic jumping first, such as jumping on the spot and jumping forward, while holding their hands. Then they are allowed to feel the height of the step before they attempt to jump down from the step unaided. They have to feel the height or size of a hurdle or obstacle before they attempt to jump over it.[12]

When assessing hopping, the assessors can practise a few hops with them while holding their hands and tap their leg to tell them which foot to raise. The assessors then use their voice, clap their hands, or use sound-making toy to indicate the direction and distance to hop.

When assessing climbing activities, the assessors provide a detailed description of the climbing facility and help the children explore it with their hands and feet before climbing unaided. The assessors can provide verbal cues throughout the climbing process.

Ball handling is challenging for children with significant VI, especially those with total blindness. Assessors can use a ball that makes sound when in motion when assessing ball skills. This is done by inserting a bell or small beads inside the ball. The children start by rolling the ball back and forth on the floor while sitting. For those with some residual vision, the next step can be throwing and catching ball while standing. Progression is to be from short to long distance, starting with passing the ball from hand to hand. The target can also give out a sound when hit by the ball for target-aiming throwing or kicking activities.[7]

Language and communication assessment

Communication assessment refers to complicated procedures that involve information collection, evaluation, description and interpretation.[13] Speech therapists must acquire knowledge of the differences in speech and language development of sighted and VI children to provide an accurate assessment with effective adaptations for children with VI.

According to guidelines from the New York State Department of Health,[14] children with pure VI are likely to develop babbling and early speech sounds at approximately the same age as typically developing children. Language acquisition follows the same pattern as for sighted children, but a slower progression is evident. However, their acquisition of visually related words and the development of pragmatic skills is usually different.

A. Standardised tests

Despite the importance of speech and language assessment for children with suspected low language functioning, standardised tests for children with VI are limited.[15] It is common for clinicians working with VI children to use available speech and language standardised tests or select subtests from these tests. Most of the speech and language standardised tests are developed based on the developmental sequence of typically developed children. Therefore, when these standardised assessment tools are used, they have to be adapted to the special needs of children with VI to help them achieve their best performance.

Special testing considerations and suggestions for assessing children with special needs can be found in the examiner's manuals of some standardised tests, like Clinical Evaluation of Language Fundamentals (5th edition) (CELF-5),[16] Clinical Evaluation of Language Fundamentals–Preschool–Second (CELF-P2),[17] and Preschool Language Scales (5th edition) (PLS-5).[18] Normative test scores can be used if adjustments do not alter the administration procedure or test stimuli. In addition to the environmental adjustments that were mentioned earlier, sufficient time for a response is to be allowed for the child to scan the visual materials and touch the manipulatives before and during the assessment.[16,18] Extra trial items can be used to help familiarise the children with the tasks.[16,17] Clinicians can also provide verbal stimuli according to the repetition rules of each subtest, if required.[16,17]

Alternative modifications may be needed if the adjustments listed cannot elicit the children's best performance.[16,17] However, it is inappropriate to translate the raw scores into normative data for results interpretation. Examiners have to clearly report the accommodations used and focus on describing the children's responses with specific modifications in the assessment documentation.[16,17] A cautionary statement for results interpretation is to be included.[19]

Normative data should not be used when the following accommodations are used. When selecting items, clinicians can skip those that are not helpful in assessing children with VI.[16] Real objects are preferred to miniatures or pretend objects for test items.[20,21] Additional tactile, smell and descriptive verbal cues, and other auditory formats of information can be provided. For example, clinicians may have to draw the children's attention to the details of the visual stimuli of the tests.[16] At times, clinicians will have to repeat test stimuli, although repetition is not normally allowed in some subtests of standardised tests.[16] To further investigate the children's actual ability, further action for incorrect answers can be taken. For instance, clinicians can clarify incorrect responses with the children and ask for an explanation.[16] They can also rephrase the instructions or items and present them to the children again. Besides, transferring test materials to Braille materials can be useful for working with children who can read Braille.[20]

B. Informal assessment

1. Natural interaction with the significant caregivers

Early social interaction development depends mostly on vision.[22] Parents of children with significant VI have to make use of other modalities to communicate with their children. These include simultaneous verbal description of activities in which the child with VI is engaged, and appropriate tactile and verbal cues or a hand-to-hand approach to encourage the child to interact and respond. During the assessment of young children with VI, observing their social play involving touch with their caregivers is useful to see how they respond. The clinician can also talk to the parents about providing an appropriate learning environment, with appropriate toys and exploration of the physical world.

2. Symbolic play

Children with VI spend much less time on play than their sighted peers, particularly at the preschool stage.[23] They are inclined to inspect or manipulate objects rather than using them symbolically. They may be self-contained in their own play rather than relating to other children. Young children with significant VI enjoy playing routines with music and movement. Assessment of their play skills provides hints to understanding their cognitive skills (e.g., object permanence, cause-effect and object function) and language skills (e.g., requests, asking for information, and imagination). Communicating with specialists in other disciplines can help speech therapists choose appropriate toys for assessments. Real objects are better for children with blindness, as they provide rich sensory information. For older preschoolers, the clinician can assess experience-based pretend play. It is important that the representative toys look and feel like real objects. They may require considerable time to explore the components, texture and structure of the toys.

3. Speech

Object-naming test in response to tactile or verbal cues can be used to collect speech samples of children with significant VI. The examiner can apply tactile cues to check their stimulability of misarticulated sounds. (Stimulability refers to a child's ability to imitate a sound after auditory and visual models with and without instructions.)

4. Language

Children with significant VI seem to be at a disadvantage regarding concept development and subsequent semantic development, particularly for words with multiple meanings, such as "fly".[15,24] They may take a longer time to develop comprehension of pronouns, comparison words, and words related to spatial relationships and activities.[14] Research indicates that blind children have no delay in syntactic development.[25] Any early delays in acquiring syntactic structures are made up over time.[24] Speech therapists have to know their language characteristics before assessment. It is important that they communicate with specialists in other disciplines to find out appropriate test stimuli (such as simplified line drawings vs. pictures with contrasting colours). A particular concept may need to be tested in different

contexts, starting with the ones the children are most familiar with, as they may have problems generalising.[14] Free language samples can give more information about their language competence. The sampling can be obtained through interviews, observation of parent-child interaction, and structured tasks like story retelling with objects or movement as cues.

5. Pragmatics

Significant VI clearly affects the development of non-verbal communication. These children may also stay in the echolalic stage longer than their sighted peers.[14] Young blind children use a relatively high proportion of calls or vocatives as a way of getting information about their surroundings.[24] They produce a smaller proportion of verbal expressions to offer, show or draw attention from others than sighted children do. When speech therapists review their functional and conversational pragmatics, reports from a significant person is important. Extra time is usually required for the therapist to establish rapport with the child in a clinical setting before the examiner can elicit certain pragmatic functions.

Cognition assessment

Although intelligence, often defined as the ability to perceive, analyse and adapt to environmental changes, has been examined by researchers for decades, it still remains challenging to measure. An even greater challenge is measuring intelligence in people with blindness.[26] Some people argue that blind and partially sighted individuals are potentially disadvantaged when taking psychometric or standardised tests. One disadvantage to congenitally blind individuals is the lack of visual learning in their early life. How congenitally blind individuals may be shut off from certain experiences that sighted children have has been explained.[27] The age of onset of blindness can have an invisible effect on a child's performance on aptitude tests, particularly if unfamiliar or abstract objects are displayed or described.

Despite this, there are tests developed for sighted people but are commonly used with blind and partially sighted people, such as:

- Wechsler Intelligence Test for Children (WISC)
- Wechsler Preschool and Primary Scales of Intelligence (WPPSI)
- Woodcock-Johnson Psychoeducational Battery (W-J)
- Cognitive Ability Test (CAT)

There are a range of reasons tests developed for the sighted population which are used with blind or partially sighted individuals. The application of verbal subscales was found to be used more than three times as frequently as non-verbal subscales by assessors working with students with VI, and tests that were not developed or adapted for use with persons with visual impairment dominated (78%).[28] It was reasoned that Wechsler scales are widely used with children who are blind or partially sighted because of their flexibility, familiarity, availability, favourable psychometrics and cost effectiveness.[28] For examinees with mild impairment, the non-verbal subscales are thought to be appropriate and superior to the less well-known tests. It was also suggested that using the same test with sighted, blind and partially sighted children allows educators to compare results both in the class and against a baseline of normalised scores.[29]

However, tests developed for sighted individuals are not always appropriate to use with blind and partially sighted people. Non-verbal reasoning tests often use pictures and images, which are inaccessible to blind and partially sighted people. If they are converted to audio, the skills being assessed for a blind or partially sighted person may differ from those being assessed for a sighted person. For example, sighted people can use visual cues when looking for patterns, but blind or partially sighted people may need to rely on short term memory to answer the same question.[30]

An alternative may be to display images as tactile graphics or as a haptic test. Haptic (touch based) representations can be used to administer the questions, but logistical and administrative issues often make them an unsuitable alternative. If a picture is abstract, understanding it can be extremely difficult even to experienced tactile users.[31] Whilst the use of tactile or haptic representation may allow the use of the same questions, there is still the issue of validity. The replacement of visual understanding with understanding via touch means the sense used has changed, so the way the information is processed is different. Furthermore, the introduction of haptic alternatives on a large scale is

unlikely because they require different equipment and administration, and would lack comparability to other standardised tests.[30]

There are a few psychometric tests developed for, and standardised on, blind and partially sighted people, but some of them are dated, and none have gone through local validation. Examples are:

> Cognitive Test for the Blind (CTB), developed in the US in 1990
> Blind Learning Aptitude Test (BLAT), developed in the US in 1969
> Williams Intelligence Test for Children with Defective Vision, developed in the UK in 1956
> Interim Hayes-Binet Intelligence Scale, developed in the US in 1942

Whilst a collection of psychometric tests has been developed for blind and partially sighted people, standardisation is often an issue. The low incidence of blindness, particularly among children, and the geographical spread mean accessing a large sample for standardisation can be difficult.[32] Also, persons with VI differ in aetiologies of vision loss, age at onset, level of VI and the nature of vision loss. These factors significantly interact to determine not only residual functional vision, but also performance on tests assessing major higher cortical functions. Heterogeneity is further increased by the presence of comorbidities or secondary disabilities that may be associated with, or completely independent from, the aetiology of vision loss. All of these impact the norming and test interpretation for the blind and partially sighted population.[33]

Having discussed various challenges of, and solutions to, assessing blind and visually impaired individuals, here is what we are currently doing:

> For totally blind children, we administer just the verbal subscales of the Wechsler intelligence test: e.g. WISC-4, WPPSI-4. The disadvantage of using WPPSI-4 on children with blindness is that the verbal subscales for preschool children use pictures, and there are not enough subscales at this level that tap verbal ability. Therefore, if possible, we postpone the assessment until the child reaches the age of six and use WISC-4 instead. Alternatively, HK-WISC may be considered despite its dated norms.
> The William Intelligence Test for VI Children (psychometric tests developed for, and standardised on, blind and partially sighted people, but with dated norms and no local validation) can be used, but it provides only a qualitative description.
> For partially sighted children, we administer the non-verbal subscales of the Wechsler intelligence test as well. However, since many of the verbal subscales of the Wechsler intelligence test can be used successfully with blind and partially sighted people without adaptation, they are viewed as a more reliable estimate of the child's ability, especially for children with moderate low vision or worse, and when there is a significant discrepancy between their verbal and non-verbal ability.
> For image-based tests to be accessible for partially sighted children, we use large print or a magnifier to allow a better image for the child to see (while paying attention to the contrast of a picture from its background). We check what the child sees in the pictures and give corrective feedback: e.g., for the Picture Concept of WISC-4. We replace visual stimuli with tactile stimuli if appropriate; e.g., for Arithmetic of WISC-4, in which objects are substituted for printed pictures in counting activities. It is crucial to avoid modifications that might give additional cues to the child and invalidate the use of the test.
> In general, felt-tip pens are preferred to pencils if writing instruments are necessary, and breaks are allowed whenever the examinee feels tired.
> We always interpret the results with caution, and carefully note any modifications done in the report.

Summary

The assessment findings of audiologists, occupational therapists and physiotherapists document the effectiveness of the children's auditory, tactile and motor modes, and proprioception. This helps the assessor set up a secure assessment environment for the children and to present the various test tasks and materials in appropriate pacing and order. For children with low communicative ability, a joint assessment among therapists from different disciplines is recommended.

Despite the challenges in assessing the development and functioning of children with VI, with a multidisciplinary approach, an understanding of the limitations of standardised tests and the need to adapt them, and the dedicated effort of the assessment team, an objective and meaningful assessment can be achieved. The development of valid and reliable assessment tools for children with VI should be the way forward.

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Recent Publications and Scientific Presentations

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Leung C, Pin T, Siu A, Au A, To C, Lo SK, Chan B, Lau K, Ng T, Chan C, Lam C, Lee F. Development and pilot evaluation of the Cognition domain of the Hong Kong Comprehensive Assessment Scales for Toddlers. Dev Neurorehabil 2021;24(4):244-55. doi: 10.1080/17518423.2020.1858459. Epub 2020 Dec 23.

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Scientific Presentations

Children with genetic causes of hearing impairment: developmental profile of children with non-syndromic hearting impairment on 19 August 2021 at The Hong Kong Society of Child Neurology and Developmental Paediatrics-Neurodevelopmental Conference by Dr CHAN Wai-man.

Online evening seminar: Fine Motor Test for the School-Aged (FMTS) on 21 May 2021 at Hong Kong Occupational Therapy Association by CHUI Mun-yee.

Children with dual diagnosis of hearing impairment and autism spectrum disorder: Clinical characteristics and audiological profile on 4 March 2021 at The Hong Kong Society of Child Neurology and Developmental Paediatrics-Neurodevelopmental Conference by Dr HUNG Ching-ngar.

Understanding typical and disordered development in speech sound system (phonology) in children. How can teachers identify and support children with speech sound system problems in schools? on 15 January 2021 at Thematic Course on Supporting Students with SEN – Sensory, Communication and Physical Needs, The Education University of Hong Kong by CHEUNG Sau-ping, Pamela.

Understanding the aim, scope, and procedures on screening and assessment of oral language functions in pre-school and school-age children. How can teachers identify children with oral language difficulties in schools? on 7 January 2021; **How to enhance the oral language skills of school-age children with language impairment** on 8 January 2021 at Thematic Course on Supporting Students with SEN – Sensory, Communication and Physical Needs, The Education University of Hong Kong by CHAN Wai-ki, Amy.

Understanding typical and disordered development in speech sound system (phonology) in children. How can teachers identify and support children with speech sound system problems in schools? on 20 November 2020 at Thematic Course on Education of Students with Hearing Impairment and Speech and Language Impairment, The Education University of Hong Kong by CHEUNG Sau-ping, Pamela.

Child development and developmental problems on 3 November 2020 at Hong Kong Children's Hospital by Dr LEE Mun-yau, Florence.

Management of cerebral palsy, the Child Assessment Service Perspective on 16 October 2020 at Tuen Mun Hospital Department of Paediatrics and Adolescent Medicine by Dr WONG Lai-yin.

Paediatric acquired brain injury - the need for assessment and rehabilitation on 12 September 2020 at Multi-specialty Medical Mega Conference by Dr LIU Ka-yee, Stephenie.

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