

DEVELOPMENT OF A SCALE FOR THE EVALUATION OF LISTENING BEHAVIOUR OF CHILDREN WITH DOWN SYNDROME*

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Practical experience indicates a lack of clinical evaluation procedures for the evaluation of the listening behaviour of children with Down syndrome. This is especially important because these children are at risk for developmental communication delays concomitant to the high prevalence of recurrent otitis media and resultant auditory processing disorders. The aim of this study was to develop and then apply an evaluation procedure for listening behaviour to 10 children with Down syndrome. This scale was then evaluated in terms of its usefulness, by applying it to 56 children (younger than three years) attending an early intervention programme. Subsequently it was clinically used with 32 children with Down syndrome. It was found to be a useful and practical instrument for the assessment of listening behaviour.

Keywords: audiometry, auditory, clinical tool/instrument, developing country, hearing impairment, early intervention, listening behaviour, otitis media

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Introduction

Recent research concerning high-risk infants and more specifically children with Down syndrome, indicates that early intervention is of primary importance. This implies that intervention may even be necessary at a stage when overt abnormal communication behaviour cannot be clearly identified (ASHA, 1989). Such a concept underlines the importance of evaluation or diagnostic measures as the basis of any intervention programme. If the possibility of a hearing impairment is taken into consideration, it also emphasises the role of the audiologist as a member of the interdisciplinary early-intervention team.

Hearing loss is a common finding in children with Down syndrome. The prevalence of hearing loss in adults with Down syndrome is in the order of 60% (Werner, Mancini & Folsom, 1996) and similar prevalence has been reported for

children. The type of hearing loss and the aetiology is diverse.

20% of this hearing loss can be classified as sensory-neural hearing loss, with a precipitous loss above 4 000Hz. This can possibly be attributed to inner ear abnormalities like an abnormally short cochlea (Harado & Sando, 1981) or morphometric anomalies in the ventral cochlear nucleus (Gandolfi, Horoupian & De Teresa, 1981 in Werner et al, 1996). The implication hereof for early intervention is an elevated hearing threshold in the first instance. Furthermore, several stages of primary auditory processing can be affected and each of these strategies may develop along an abnormal trajectory (Werner, Mancl & Folsom, 1996).

About 80% of the hearing loss among children with Down syndrome appear to be conductive losses and can primarily be attributed to a high

prevalence of otitis media (Davies, 1988). This is possibly related to upper respiratory diseases, in combination with the oro-facial abnormalities characteristic of Down syndrome. The important implication of this condition for early intervention programmes is that there seems to be a close relationship between chronic middle-ear infections, auditory processing disorders and delayed language development.

Chronic middle-ear dysfunction has three important qualities that can influence the auditory processing abilities of the child with Down syndrome. These are:

A mild hearing loss - This can be described as the "muffling effect" caused by a small (not more than 10 dB) conductive loss. This results in speech sounds and short words with low acoustic energy not being perceived. This may have far-reaching implications for the gestalt processing of auditory stimuli and the eventual successful development of language.

Distortion of sound - Because of physiological changes in the middle-ear, caused primarily by the presence of fluid, the conducting of sound to the inner ear and the resultant integrated perceptual process can be distorted.

Fluctuating condition - Chronic middle-ear infection is of a fluctuating nature. This obliges the child to continually change his perceptual strategies. At the very least this can develop in the child the unconscious perception that auditory stimuli are bits of information which are usually unstable, and therefore should be ignored. Because of other characteristics like cognitive impairment and lack of flexibility in the handling of their environment in the case of children with Down syndrome, these fluctuations will result in a lack of compensatory strategies and eventually in severe auditory processing disorders.

Much energy has been spent in the development of reliable paediatric audiometric techniques (including ABR and behavioural audiometry) to evaluate peripheral auditory thresholds of children with Down syndrome. These techniques can even be applied - albeit with various degrees of success - to children younger than one year of age, in order to ensure the relevancy and accuracy of early intervention programmes. However, there seems to be a lack of clinical tools with which to identify and evaluate auditory processing disorders - i.e. the ability to listen to sound. In an early intervention programme concerned with communication development, this is an important requirement.

In order to be of value to early intervention programmes, such a tool must be easily applicable, should not need much time or complicated instrumentation to execute, and should be relevant for use with children between birth and three years of age. Additionally, this tool must allow for the specifications attached to the context of the early intervention programme. In our case we accepted that, being part of a developing country, the constraints and characteristics of health care in such a context should be taken into consideration. This specifically implies that any useful clinical tool should allow for:

- lack of funds earmarked for developing material/tools;
- unsophisticated population that may restrict the content/procedure of a tool;
- multicultural and multilingual population;
- the possibility that the clinical tool be accessible to untrained (non-specialist) clinicians.

Materials and Methods

The following aims were established:

- To develop a clinical instrument whereby the listening behaviour of children with Down syndrome can be evaluated. This instrument should be easily applicable to all population groups in the Republic of South Africa, should be inexpensive and not time consuming, and should provide information that can be used in early intervention programmes.
- To apply this instrument in a clinical situation so that the usefulness can be evaluated.

In order to realise these aims an action-research design was implemented, so that the researchers' involvement in the action process could ensure the direct application of the results to the practical situation.

An interdisciplinary team consisting of a speech-language therapist specialising in early intervention, a speech- language therapist specialising in the neonatal population and parental guidance, a paediatric audiologist and a psychologist, developed an evaluation scale. This team was attached to the Centre for Early Intervention in Communication Pathology at the University of Pretoria. During the initial evaluation of 10 children with Down syndrome, this scale was applied. Thereafter it was also evaluated in the assessment of 56 other high risk

Aetiology	History: otitis media	Age groups
Hearing-impaired: 5	History of more than three episodes and/or grommets	birth to 6 months
Down syndrome: 10		7 to 12 months
Expressive language impairment: 23	no history of recurrent otitis media	12 to 18 months
Neurological disorders: 10		19 to 24 months
Cleft lip/palate: 16		25 to 30 months
Emotionally disturbed: 2		31 and older

Table 1. Characteristics of high risk population

children between the ages of five to 34 months attending an early intervention clinic.

The main characteristics of the population are presented in Table 1.

The above population was used to evaluate the scale for assessment of listening behaviour. The final scale is presented in Appendix A, but the most important characteristics will be briefly described.

It was decided to use a 3-point scale for the evaluation of listening behaviour, where 1 indicated "good listening" and 3 "poor listening". This behaviour was evaluated in two situations that form part of the traditional initial assessment situations of most programmes for early intervention:

Situation 1 - During the communication evaluation where the primary aim was to evaluate communication functions, content and form, the listening behaviour was evaluated in terms of good responses to speech sounds, whispers, environmental noises and situational sounds (i.e. four parameters).

Situation 2 - During the hearing test (visual response audiometry, play audiometry or behaviour response audiometry), the listening behaviour that was evaluated included the ease with which the child could be conditioned to respond to auditory signals, the constancy of responses to sound, discernability of listening responses, and distractibility (i.e. eight parameters).

Results and Discussion

Each child's performance as scored on the two components of the listening scale was computed and used as a basis for statistical analysis. In the case of the evaluation of the communication situation, the maximum score indicating a very poor listener was 12, while the maximum score for the listening behaviour in the audiometric situation defining a very poor listener was 24. In order to realise the stated aims, three research questions were formulated:

Does the listening scale distinguish between good and poor listeners?

In order to answer this question, an exploratory analysis using descriptive measures was utilized. The mean, standard deviation and correlation coefficient of responses to both evaluation responses were computed to get an indication of the normalcy of the spread. These are indicated in Table 2.

Statistical indicators	Situation 1	Situation 2
Mean	6.939394	13.68182
Standard deviation	2.822322	4.677801
Correlation coefficient	40.67101	34.1899

Table 2. Test for normalcy in two evaluation situations

In both situations there was a relatively wide spread with a near normal curve. This indicates that the scale in both situations gave a good indication of poor as well as good listeners. In other words, the listening scale can be used to differentiate between good and bad listeners.

Is there a good correlation between the two evaluation situations used in the scale?

This question was formulated to determine whether the evaluation of listening in one situation could give another picture of listening behaviour and if this were the case, which evaluation provided the better picture. To answer this question the Pearson Correlation Coefficients were determined. The results were as follows: $r = 0.73266$; $p\text{-value} = 0.0001$; and the coefficient of determination was 54%. These figures indicate that there was a good correlation between the two situations, although the coefficient of determination was only 54%. It is possible, however, that this impression may change with a bigger sample.

Do children with Down syndrome differ significantly from children with other aetiologies?

Six broad diagnostic groups were identified, namely hearing impairment, Down syndrome, developmental communication pathology, neurological impairment, cleft lip and palate, and emotionally disturbed children. From the above it is clear that these diagnoses are in part based on known risk factors like Down syndrome and cleft lip or palate, while others are mainly related to biological risk factors like neurological impairment because of low birth weight and prematurity. One group, the developmental

communication pathology, is a descriptive classification, serving in this case as a “waste paper basket” in instances where other clear classifications were unsuccessful.

To answer the question, a Duncan multiple range test was performed. The results are presented in Table 3.

Diagnosis (groups)	Mean in sit. 1	Duncan grouping *
Hearing impaired	18.800	A
Down syndrome	14.800	A B
Comm devel. path.	14.348	A B
Neur. Dysf.	13.500	A B
Cleft lip/palate	10.938	B
Emotionally disturb.	10.500	B

Table 3.

Analysis of multiple range test for the diagnostic groups (* means with the same letter are not significantly different.)

From the above it is clear that the children with Down syndrome are the second worst performers in listening behaviour. This seem to correlate with observations as to either the high prevalence of middle ear pathology, the possibility of high frequency hearing losses (which cannot be easily detected in free field testing with this age group) or the possibility of impairment in listening skills related to cognitive impairment (Young, 1984). It is also possible that the results are indicative of an abnormality of primary sensory processing which can lead to elevation in the auditory thresholds of infants with Down syndrome. This may be related to neural auditory immaturity combined with deviations in attention described as “increased rate of inattentiveness to the auditory detection task” (Werner, Mancini & Folsom, 1996, p.466).

Application and conclusion

After the scale was developed and applied to the various experimental groups, it was successfully used in a clinical situation with 32 children with Down syndrome in an early intervention programme.

The results indicate that the listening evaluation scale that was developed can be used successfully in a diagnostic situation with children younger than three years of age. This scale is easily applicable, not time consuming, and is well able to differentiate between poor and good listeners. Some inferences can be made from the data on the scale as to intervention strategies, although the long-term applicability of this aspect remains to be evaluated.

In conclusion: The infant with Down syndrome is predisposed to many developmental delays. One of the most important of these - the communication development - can directly be linked to auditory processing disorders associated with recurrent middle-ear infections. It has been suggested that preventive measures for middle-ear infections should consist of providing good nutrition, sanitation, good health and a concerned household. To this should be added: providing early intervention programmes which include hearing health care, with equal attention to intervention measures for hearing impairment, as well as impairment of listening behaviour.

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Appendix A

Listening evaluation scale

Reaction to...	Good (1).....	Poor (3)
environmental sounds	1	2	3
whispered speech	1	2	3
non-speech sounds (toys)	1	2	3
Speech	1	2	3

Situation 1: during communication evaluation

Reactions evaluated...	Good (1).....	Poor (3)
1. Conditioning to sound:	Easy		Difficult
	1	2	3
2. Localisation of sound:			
• Speed of reaction	Immediate		No reaction
	1	2	3
• Responses can be identified as..	Clear		Unsure resp
	1	2	3
3. Constancy of responses:	Always		Inconsistent
	1	2	3
4. Listening behaviour:			
• Attentive to sound	Always		Never
	1	2	3
• Mobilisation to sound	Search		Ignore
	1	2	3
• Reaction to speech	Good		Poor
	1	2	3
• Distractibility	Never		Very/Hyper
	1	2	3

Situation 2: during hearing evaluation/test