International Journal of Pediatric Otorhinolaryngology 109 (2018) 104–111

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Comparison of the Reynell Developmental Language Scale II and the Galker test of word-recognition-in-noise in Danish day-care children☆

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ARTICLE INFO

Keywords:
Reynell Developmental Language Scale (2nd revision)
The Galker-test
Word-recognition-in-noise test
Tympanometry
Parental information
Pre-school teacher

ABSTRACT

Objective: To search for predictive factors for language development measured by two receptive language tests for children, the Galker test (a word-recognition-in-noise test) testing hearing and vocabulary, and the Danish version of Reynell Developmental Language Scale (2nd revision, RDLS II) test, a language comprehension test. The study analysed if information about background variables and parents and pre-school teachers was predictive for test scores; if earlier middle ear disease, actual hearing loss and tympanometry was important for language development; and if the two receptive tests differed in terms of the degree to which variables were able to predict test scores at the age of three to five years.

Methods: All children aged three and five years attending 20 day-care centres for children without cognitive development issues from the Municipality of Hillerød, Denmark, were invited to participate. We used questionnaires to the parents and day-care teachers and examined the children using tympanometry, hearing test and the two receptive language tests. We performed unadjusted and adjusted analyses of raw and grouped scores and background variables, as well as stepwise regression analysis with group scores as outcome.

Results: The results of the two tests were surprisingly similar in relation to background variables. The same variables were predictive for scores in the two receptive language tests. The predictive variables were: age group (22–31%), having no sibling (2–3%), being a boy (1%), information from the parents about the child's vocabulary (3%), phonology (0–2%). information from the pre-school teachers on the child's vocabulary (4–6%), and hearing beyond 25 dB in best ear (mean of four frequencies) (1%).

Conclusion: We found that nearly the same variables were predictive for the test score and the grouped score in pre-school children in the RDLS II and the Galker test. Information from the pre-school teachers was more predictive of the test score than information from the parents. In the adjusted analysis, beside age group, information about the child's vocabulary was the most predictive information explaining 4–6% of the variation.

1. Introduction

The importance of otitis media (OM) and hearing loss for language development has been discussed for many years and remains controversial [1–8]. One of the main challenges in this area is how to identify children with OM in need for treatment. We have studied the effect of different models of tympanometry screening and concluded that tympanometry screening alone is too sensitive for screening young children [3,9]. Therefore, we developed and calibrated a screening test, a word-recognition-in-noise-test called “The Galker35 test” to identify children with language or communication problems needing further examination to determine the reason for their language development delay and suggest possible treatment [10–12]. The Galker35 test, in the present paper just called the Galker test, is easy and quick to use on a personal computer (6–7 min plus instruction) and easy to score without special training [11].

The aim of this paper was to search for predictive factors for receptive language development measured by means of two different tests for children, the Galker test (word recognition) and the Danish version of the RDLS II test language comprehension test [13]. We sought to analysed if information about background variables and parents and pre-school teachers was predictive for test scores; if earlier middle ear disease, actual hearing loss and tympanometry was important for language development; and if the two receptive tests differed in terms of

List of abbreviations: daPa, decapascal (nearly mm water pressure); RDLS II, Reynell Developmental Language Scales (2nd revision); OM, Otitis media; OME, Otitis media with effusion; 95% CI, 95% confidence interval; ANOVA, Analysis of variance

☆ Some of the results have been presented at the 19th International Symposium on Recent Advances in Otitis Media, Gold Coast, Australia, 4–8 June 2017.

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https://doi.org/10.1016/j.ijporl.2018.03.036
Received 11 November 2017; Received in revised form 26 March 2018; Accepted 28 March 2018
Available online 03 April 2018
0165-5876/

the degree to which variables were able to predict test scores at the age of three to five years.

2. Method

Data were collected by Maj-Britt Glenn Lauritsen and partly published in her PhD thesis "Identification of the preschool child at risk of developmental effects from history of otitis media, hearing loss or middle ear effusion" [14].

2.1. Study population and setting

All children aged three and four years attending 20 day-care centres for children without cognitive development issues from the Municipality of Hillerød, Denmark, were invited to participate. We focussed on three-to-four-year-old children because they were old enough to take the test, and the frequency of middle ear disease, including otitis media with effusion (OME) and hearing problems is still fairly high at this age. A few children were included even though they were somewhat younger because their older brothers or sisters participated and because their parents requested that they participate too. Some of the children turned five years before the testing took place (Table 1). Day-care centres were chosen as a setting for this study as 90% of Danish pre-school children attend such centres. This setting was hence ideal for obtaining a relatively large and unselected study population of children without cognitive function issues. Thus, using this population permitted us to perform a large-scale investigation of scale properties in children with no OME and children with various degrees of middle ear problems. Parents of 388 of 513 children gave their written consent to participate, and of those 362 completed both the RLDS II and the Galker test. However, for technical reasons, we lost five Galker scores leaving 357 children with valid scores. These scores are the material for the present analysis. The data were collected from April 2002 to February 2003, a season with high occurrence of upper respiratory tract infection and thus of OME [14,15]. All tests were performed at the day-care centre. Five authorised speech therapists and one physician (MGL) collected the data. The research ethics committee of the County of Frederiksborg, Denmark approved the study.

2.2. Background information

Parents and pre-school teachers answered questionnaires about each child and its family focused on the following aspects of daily functioning: social interaction, hearing problems, ear problems and parental education. Table 1 shows variables with significant relation to one or both test scores.

2.3. Hearing

For the assessment of hearing sensitivity, conditioned play audiometry was administered by MGL. Air conduction was tested with pure tones at 500, 1000, 2000 and 4000 Hz via earphones. Testing was performed in a quiet room with an AS216 Interacoustic Screening Audiometer, Interacoustics, Denmark. A summary index of hearing level (HL) for each ear was calculated by averaging thresholds. Hearing was categorised into three groups: HL less than 25 dB, 25–29 dB, and 30 dB or worse in best and worst ear.

2.4. Middle ear condition

Children were examined with an MT10 Interacoustics hand-held impedance audiometer connected to an MTP10 Interacoustics thermal printer. The pressure range from +300 to −600 daPa was examined. Blinded to any other information, a physician (JL) classified the tympanograms according to the modified Jerger/Nikolajsen classification [16]. Children were classified according to the tympanometric result of the best ear and then placed in five groups: 1. Children with at least one ear with a curve of type A or C1; 2. Children with either C2/C2, or C2/B; 3. Children with tympanic perforations or functioning grommets; 4. Children with BB curve configurations; 5. Unknown (Table 1).

Otoscopy was performed before tympanometry to determine the presence of grommets, perforation or cerumen.

2.4.1. The Galker test

All the children were tested with the Galker-test (50-item version), and the scores were later converted into the new standard with 35 items, called the Galker35 or just the Galker test, with scores ranging from 0 to 35 points [11,12]. The Galker test is a "word-recognition-in-noise test" that tests both hearing and word recognition at the same time. The test demands recognition of the spoken word, which is identified by the child who points at one of two pictures illustrating the spoken word. Thus, the Galker test is a vocabulary test as well as a hearing test. For some analyses, the scores were categorised into four groups: 0–21, 22–23, 24–26, 27–35 correct answers after statistical advice in relation to MGL's PhD thesis [11,12,14].

2.4.2. Comprehension language development (RLDS II)

Within a maximum of two weeks after the hearing test and an ear examination and after having conducted a coordinating pre-test to guarantee comparable scoring, an authorised speech therapist (logoped) assessed the child's receptive language based on the Danish version of the RLDS II of verbal comprehension [13,14]. The test consists of 67 sentences with instructions of rising verbal complexity, which the child must follow with the use of different tools and toys. The test is scored as the sum of correct answers. Thus, the minimum and maximum scores are 0 and 67, respectively. No child achieved less than 25 points. For some analyses, the scores were categorised into four groups: 25–50, 51–55, 56–60, and 61–67 points for statistically reasons.

2.5. Blinding

The physician and the speech therapists were blinded to each other's results. Parents accompanying children to the sessions were asked not to reveal any information about the child before the clinical assessment.

2.6. Statistical analysis

Analysis of variance (ANOVA, unadjusted) was used on raw scores and grouped scores. Linear stepwise regression was used to measure the associations, adjusted for earlier included variables, and to calculate partial explanation of the variance using IBM SPSS statistical software version 24.

3. Results

3.1. Unadjusted analyses

The results of unadjusted analyses of the raw RLDS II and Galker test scores are seen in Table 1. A history of OM or tympanostomy tubes was not statistically significant and therefore not included in Table 1. Age group was the most important background variable (high F-value), with a difference between the youngest and the oldest age group of 14 points in the RLDS II and 8 point in the Galker test. Girls had significantly higher Galker scores than boys. In both tests, children with siblings scored better than children without siblings. Information on language other than Danish at home was missing in 14 children. The mean score for these 14 children was somewhat lower than the score for children speaking only Danish at home (Table 1). Speaking another language than Danish at home was an important factor in both tests. A few children speaking other languages than Danish at home were not included in the study because their parents could not complete the Danish parental questionnaire. Mother's education was significantly related to