

Role of early education in reading ability of deaf students

Bambang Udji Djoko Rianto

Abstract

Background Reading is a very complex process which includes cognitive process. Reading is initialized by visual analysis and letter transformation into vocabulary form, word identification by letter sound mapping, words correlation, and interpretation. Deafness causes difficulties in acquiring language information via hearing process thus inhibits a successful conversation process.

Objective To determine the role of early education in deaf students to reading ability.

Methods A cross sectional design was performed from September until December 2007. This study compared deaf students, younger than 6 years old, who received early education in special education schools B (group I), with deaf children aged 6 years old and older who received education in special education schools B/ conventional educational method (group II).

Results There were 22 deaf children in group I and 24 in group II. The measured variables included age, age of school enrollment, duration of studies, degree of deafness, sex, and parental educational level. Logistic regression analysis showed that the variables which significantly contributed to reading skills were the early education and duration of study. In early education group, the children had significantly better reading ability ($P=0.02$; $OR=19.95$; 95% CI 1.939 to 53.62), besides duration of study ($P=0.01$; $OR=70.754$; 95% CI 6.267 to 798.75), compared to conventional education.

Conclusion Compared to those who receive education in special education school B with a conventional educational method, deaf students who receive early education in special education schools B have better reading ability significantly. Duration of study also contribute significantly to reading skill. [Paediatr Indones. 2009;49:189-94].

Keywords: deaf student, reading ability, hearing aid

In a person's life, education is important for self development and sustainability of life. This is also implied for deaf students, as education is important to develop their abilities thus sustain a suitable life. There are several important goals in education of deaf students, which are to reach adequate language ability, sustain good mental health, have the ability of comprehensible speech, and able to communicate with other people effortlessly. If those goals are reached, thus it is possible to be successful in their lives.^{1,2} Reading is an activity needed in almost every aspect of life. Reading is one of human brain's highest levels of function, as a form of interaction between thought and language.³ Reading is also an important learning activity involved in the comprehension of other forms of knowledge. Only with a satisfactory ability to read, humans can search, find, and implement information, data, research results, knowledge and science for various necessities in their lives.⁴ A cognitive mode explains that reading is a complex process which involves the cognitive process,

From the Department of Otolaryngology Head Neck Surgery, Medical School, Gadjah Mada University, Dr. Sardjito Hospital, Yogyakarta, Indonesia.

Reprint request to: Bambang Udji Djoko Rianto, MD, the Department of Otolaryngology Head Neck Surgery, Medical School, Gadjah Mada University, Dr. Sardjito Hospital, Jl. Kesehatan No. 1, Sekip Utara, Yogyakarta 55281, Indonesia. Tel. +62-274-489726/ +62-274-561616. Fax. +62-274-583745.

a process initialized with visual analysis by transforming visual letters to the form of speech, identifying words with letter-sound mapping, connecting words with their meaning (alphabetical stage) and abstract visualization to receive a more accurate representation of a word (orthographic stage). The processes above will lead to the formation of accurate reading ability.⁵ For children, reading is an important skill and it supports the ability to receive new material.

The relationship between sound perception, sound production, and language development is very close. Furthermore, strong basic language abilities are important to the development of reading abilities.⁶ In students with normal hearing, most of them do not have difficulties in learning speech and language, however not all of them have the ability to read properly. Approximately 20% of elementary school students has low reading abilities.⁷ Students with hearing impairment who do not have verbal language abilities (speech) will experience weaknesses in the phonologic process to map letters into sounds. The low level of reading-writing abilities in deaf students compared with normal students is mostly caused by the difference between imperfect languages systems with the need to read based on a speech system.⁸

We aimed to find out the association between early education and reading ability in deaf students.

Methods

The research design was cross sectional study performed from September until December 2007 in two special education schools B (SLBs B).

Population and subjects

Group I consisted of deaf students who received early education in SLB B, while group II (control) consisted of deaf children who received education in special education schools B with a conventional educational method.

Inclusion criteria were complete school data of age recording, subject had entered the reading study phase, and subject or family agreed to cooperate by signing informed/proxy consent. Exclusion criteria were suffered from other impairments which could influence cognitive ability (mental retardation), and unilateral deafness.

Furthermore, reading ability test was performed using a validated reading list (**Table 1**).

Table 1. Items in the reading skills test

Reading Material	Competence		Amount
	Knowledge	Understanding	
1. Water buffalo	1.2	3.4	4
2. Planting corn	1.2	-	2
3. Planting rice	1.2	3	3
4. Our village	1.2	3.4	4
5. Fishing	1.3	2	3
Total			16

The higher percentage of correct answers achieved by subjects, the higher subjects' understanding to the reading material. The understanding to read was calculated with the following formula: the ability to read well if the reading ability score $\geq 50\%$ of the total score, whereas the ability to read bad if the reading ability reading score $< 50\%$ of the total score.

The t test statistical analysis was used for parametric data, χ^2 test for nonparametric data, while for determining the significance association between independent and dependent variables, we used logistic regression.

Results

Subject characteristics

The total number of subjects for this study was 46 children, comprised 22 children from the early education group and 24 children from the standard education group. The variables measured and analysed in this research were: sex, degree of deafness, duration of education, parents' education state, class level in school, and age when the subject was enrolled in school. Subjects in the group I were deaf students who attended early education (age of enrollment was under the age of 6 years old), whereas group II were deaf students who attended standard education (age of enrollment was 6 years old and above). All subjects were located in the Yogyakarta (**Table 2**).

Table 3 shows average age when subjects enrolled to school in both groups. There is significant difference between early education (group I) and standard/ conventional education ($P = 0.001$).

Table 2. Characteristics of subjects

Variable	Early education	Conventional education	P
Sex:			
- female	10	13	0.38
- male	12	11	
Degree of deaf:			
- moderate	3	4	0.55
- severe	19	20	
Length of education:			
- > 3 y	17	13	0.09
- ≤ 3 y	5	11	
Father's education level:			
- basic	14	22	0.025
- high	8	2	
Mother's education level:			
- basic	14	23	0.007
- high	8	1	
Class:			
- 1-3	19	13	0.019
- 4-6	3	11	
Age enter school:			
- < 6 yo	22	0	0.001
- ≥ 6 yo	0	24	

Table 3. Data of average age of enrollment

	Average age of school enrollment	Standard Deviation	P
Group I	3.929 years old	1.1829	0.001
Group II	6.771 years old	0.4260	

The results of the reading ability test of both groups in this research can be seen in **Table 4**. There is statistically significance difference in reading ability test score between both groups (P= 0.002).

The correlation between early education with the ability to read

The correlations between early education prognosis factors with the ability to read in a cohort study can be assessed by calculating the prevalence risk. The prevalence risk is also known as the prevalence risk ratio which can be calculated by comparing the incidence of reading ability between the subjects group with prognostic factors of early education and without prognostic factors (standard education) to

Table 4. Reading ability test scores in deaf children

	Average reading ability score	Standard Deviation	P
Group I	7.3636	4.077	0.002
Group II	4.5	4.7	

the incidence of reading ability. Thus the correlation between early education and reading ability can be assessed (**Table 5**).

Table 5. Reading ability in deaf children based on group

Group	Reading category Poor (%)	Excellent (%)	P	PR	95% CI
Group I	23 (65.7%)	2 (34.3%)	0.009	3.67	1.369 to 9.858
Group II	12 (34.3%)	23 (65.7%)			

PR: prevalence risk

A significant correlation can be seen in **Table 5** between the educational group with the ability to read (P < 0.05). Group I with standard education had a risk to develop poor reading abilities 3.67 times more compared to group II with early education.

Based on bivariate analysis result, there was statistically significant difference between duration of study and education method in both groups, but not in sex and degree of deafness variables (**Table 6**).

Other factors assessed was sex, in this study the ability to read was not affected by the sex shown with P > 0.05. This is not similar with study by Kelly *et al*,¹⁰ in 1999, who stated that the pattern of brain function development for language correlated with sex, where the myelinization of nerve cells is affected by estrogen hormones thus brain development in females is much faster than in males. Magnetic Resonance Imaging reveal that central nervous system activation in females occurs diffusely compares to males during the phonologic process. In males, the brain activity is more dominant on the left inferior frontal gyrus, whereas in females the right and left regions have the same activity.

The results of this study showed that the factor of deafness degree did not influence the ability to read significantly, this was supposedly due to the condition

Table 6. Analysis of the correlation between variables and reading abilities

Factor	Reading ability		P
	Poor n (%)	Excellent n (%)	
Sex	Female	16 (43.2)	0.231
	Male	19 (57.6)	
Length of study	≤ 3 years	18 (94.7)	0.001
	> 3 years	1 (5.3)	
Degree of deafness	Severe	17 (33.3)	0.232
	Moderate	34 (66.7)	
Education	Severe	30 (53.6)	0.009
	Moderate	5 (35.7)	
	Standard	9 (64.3)	
	Early	12 (34.3)	23 (65.7)
	Early	23 (65.7)	12 (34.3)

that the deaf children were homogeny with severe deafness. This is similar to the study by Pramujianta (2006), who studied BERA results in children experiencing developmental delays at Sardjito General Hospital since September 2005 until July 2006. The results showed abnormality of 72% with total or severe peripheral neural hearing loss.

The results of logistic regression analysis of all the calculated variables illustrated that the variables which significantly contributed to reading skills were duration of study and early education. In early education group, subjects had better reading ability significantly ($P=0.02$; OR: 19.95; 95% CI 1.939 to 53.62) and duration of study ($P=0.01$; OR: 70.754; 95% CI 6.267 to 798.75) compared to conventional education. While the other independent variables were not significantly different between both groups of sample (Table 7).

Table 7. Results of logistic regression analysis between variables with the ability to read

Variable	β	P	Exp β	95% CI
Early education	2.993	0.02	19.95	1.939 to 53.62
Duration of study	4.259	0.001	70.754	6.267 to 798.75

Discussion

In this study, the proportion of boys and girls in both groups was quite equal. In the early education group, there were 12 boys (54.5%) and 10 girls (45.5%), while in the standard education group there were 11 boys (45.8%) and 13 girls (54.2%). Statistically, the difference between gender in both groups was not significant with $P=0.38$ (Table 2). This proportion is similar to the reports of the two previous studies, Setiajit (1994) who acquired the proportion of 32 deaf boys (45.72%) and 38 deaf girls (54.28), and Mashari (2000) who acquired a proportion of 40 deaf boys (48.78%) and 42 deaf girls (51.22%).^{5,10}

A factor suspected to play a role in reading ability is the duration of study at school. The longer a student undergo formal education, the easier the reading process becomes. In this study, duration of study between both groups was not significant ($P = 0.09$). The family environment factor which showed significant differences in both groups was the level of

parental education. This can be explained statistically that the level of parental high education level was higher in group I compared to group II (Table 2).

The cognitive factor was not assessed in this study because every deaf student in this study had been assessed during their orientation period and if the results were abnormal the child would be attending a double handicap class thus, every child in the B Special Education class only had hearing impairments. This is different compared to the results of Mashari,² in 2000, who reported that 10.98% of deaf children had IQ between 66 to 79, 15.85% between 80 to 90, 50 between 91 to 110, 17.07% between 111 to 120, and 6.10% between 121–127.

From Table 3 above, the average age during school enrollment in group I was 3.929 years old (SD 1.1829), whereas in group II was 6.771 years old (SD 0.4260). Both groups can be compared because based on t test statistical results, the average age difference during enrollment was statistically significant ($P=0.001$).

Ideally, confirmation of the basis of early education is before three years old according to the language development theory of golden age period for children's language development. However, the amount of deaf children underwent education since two years old were limited and most of them were in playgroups or kindergartens which did not have reading competences, whereas in developed countries the advancement of education for deaf children was more optimal as reported by Moeller,¹¹ in 2000, where six months after detection, every deaf child can enroll in daily preschool programs with the average age of enrollment of 15 months.¹¹

Reading ability test

The reading ability test is devised to asses the speed and ability to comprehend reading for students in the reading competence phase. The form of this test is a passage which consists of three to five declarative statements followed by several questions. Inferential questions are presented in the form of multiple choice questions with three alternative choices. The reading ability test was devised by Widyana (2006) and validity test had been done in several elementary schools in the Yogyakarta area.²

The reading ability test was given individually to each subject and 20 minutes were allocated to

complete it. The reading ability test scores were grouped into excellent and poor based on previous research results by Wiguna⁷ (2002) who stated that a score of 8 or above was considered excellent and < 8 is considered poor.

In this research, the reading ability score was higher in group I compared to group II, which was significant statistically 0.001 ($P < 0.05$). This was not similar with other studies in developed countries which stated that there was more advanced deafness screening technology for infants resulting in early deafness detection and early intervention which can be done consequently therefore reading abilities for deaf children compared to children with normal hearing in the same age group were similar.¹²

The correlation between other variables with the ability to read

Language is a symbolic system for storage or information exchange, whereas speech is a mechanic aspect from voice production. Expressive language represents the ability to produce symbolic outputs which are visual (writing, signing) or auditory (speech).¹³ Receptive language signifies the ability to read other individual's output language code consisting of visual (reading) and auditory (conversation listening) abilities. Based on above, reading skills in children is a part of language abilities which are influenced by social environment, input system, speech and language central system, and output system.

In this study, the environmental factors assessed were the familial factors such as parental educational level and child's early education. There was statistically significant difference between parental educational level of both groups ($P < 0.05$). Other analyzed factors showed significant differences in reading skills with $P < 0.05$ other than early education as well as the factor of duration of study and the usage of hearing aid (**Table 6**).

Other factor assessed was sex. In this study, the ability to read was not affected by the sex shown with $P > 0.05$. This result is not similar to study by Kelly¹⁰ who stated that the pattern of brain function development for language correlated with sex, where the myelinization of nerve cells was affected by estrogen hormones thus brain development in females was much faster than in males. MRI examination

reveal that central nervous system activation in females occurs diffusely compares to males during the phonologic process. In males, the brain activity is more dominant on the left inferior frontal gyrus, whereas in females the right and left regions have the same activity.¹⁰

The results of this study showed that the degree of deafness factor did not influence the ability to read significantly, this was supposedly due to the condition that deaf children were homogeny with severe deafness, similar to the study by Pramujianta (2006) based on BERA (Brainstem Evoked Response Audiometry) study results in children experiencing developmental delays at Sardjito General Hospital since September 2005 until July 2006. The study results showed abnormality of 72% with total or severe peripheral neural hearing loss.

In conclusion, deaf students who receive early education and have longer duration of study in special education schools B (SLB B) have better reading ability significantly compared to deaf children who receive a conventional educational system in special education schools B with a conventional educational system.

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