



## Mainstream school readiness skills of a group of young cochlear implant users



Cila Umat<sup>a,b,\*</sup>, Siti Zamratol-Mai Sarah Mukari<sup>b</sup>, Norbaya Nordin<sup>a</sup>, Tiagarajan A/L Annamalay<sup>b</sup>, Basyariatul Fathi Othman<sup>b</sup>

<sup>a</sup> Audiology Program, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300, Kuala Lumpur, Malaysia

<sup>b</sup> Institute of Ear Hearing & Speech, Universiti Kebangsaan Malaysia, Jalan Temerloh, 53200, Kuala Lumpur, Malaysia

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### ABSTRACT

**Objectives:** The aims of the study were to compare the mainstream school readiness skills of young cochlear implant (CI) users to that of a group of normal hearing (NH) children and assessed the inter-rater agreement between parents and teachers on school readiness skills of the CI children.

**Methods:** A total of 11 parents and 8 teachers of the 6-year old CI children participated and rated the children using the *School Readiness Scale to Year One*. Data from 207 6-year old NH children from five states in Malaysia were also collected using the same scale which has nine domains. Results from the NH children were categorized into the 25th and 75th percentile scores to be the reference cut-offs for below average (below the 25th percentile), average (25th to 75th percentile) and above average (above 75th percentile).

**Results:** The school readiness skills of the CI children were lower than the NH group as rated by teachers especially in the *civic* and *language and communication* domains. Comparisons between parents' and teachers' ratings for 8 CI children indicated that teachers tended to rate the CI children's school readiness poorer than that of parents especially in the *academic* domain. Intra-class correlation analysis revealed poor inter-rater agreement.

**Conclusions:** The results suggest that our CI children, generally, need an intervention 'bridging' program to improve their school readiness skills. Parents and teachers had different views on the readiness of the CI children at school entry level.

### 1. Introduction

Mainstream school readiness refers to how prepared a child is to enter the Year 1 elementary school. Preparedness here refers to a child who is developmentally, emotionally and socially ready to enter a new world of learning that is different from their social environment at home or pre-school learning. Several studies [3,21] have shown the importance of development of self-regulation in young children and its association with better school readiness skills in these children. Parental involvement and/or family experiences are crucial in preparing these children for good school readiness skills [2,18,25] and so as the children's experiences and interaction with their pre-school teachers [6,17,24]. The present study examined the school readiness of a group of hearing-impaired children with cochlear implants (CI) to enter the Year One elementary schools in the Malaysian mainstream education as compared to a group of normal hearing (NH) six years old children, from the perspectives of their kindergarten teachers and parents.

It is known that childhood hearing loss presents challenges to speech and language development of the affected child especially spoken language. Language deficits in young hearing-impaired children influenced language-related areas of development such as their mind and literacy development [9]. These limitations have been shown to impact social interaction which is an important component in helping young children learn pre-literacy skills [4]. Mastering the pre-literacy skills consequently relate to their school readiness and academic performance [26]. A study which compared the executive functioning of 73 hearing-impaired children with CI (aged 3–5 years old and 7–17 years old) with that of matched age range of 78 children with NH revealed that children with CIs had two to five times greater risk of being 'clinically significant deficits' compared to the NH group [8]. This finding suggests that children with a CI have greater challenges in terms of acquiring sufficient level of experiences for development of their school readiness skills.

Our previous studies have shown that the majority of our CI

\* Corresponding author. Audiology Program, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300, Kuala Lumpur, Malaysia.  
E-mail address: [cila@ukm.edu.my](mailto:cila@ukm.edu.my) (C. Umat).

children were enrolled into the mainstream education [13,15]. However, they were not performing academically at par with their NH counterparts [14]. In the study by Mukari et al. [14] who studied 20 CI children attending the mainstream education, it was found that while 25% of these children achieved 'above average' academic performance (> 75th percentile) in their final year school exams, 56.25% were in the 'below average' range (< 25th percentile) compared to their NH classroom peers. The findings of our earlier study had motivated us to investigate how ready our CI children were at the school entry point to enrol into the mainstream education.

School readiness skills of a young child are multi-dimensional [10]. Therefore, a tool to measure school readiness of Malaysian children was constructed based on five components of readiness: child readiness; home or family readiness; school readiness; global readiness and community readiness [10]. The development of the Web-based Ecological Assessment System (WEBEASR) involved many stakeholders in a child development, namely preschool teachers (100 respondents), 100 primary one teachers, 100 parents and 100 community leaders (school principals, professionals and government officials). The *School Readiness to Year One* scale which is a component of the WEBEASR has high internal consistency with the overall  $\alpha$  value of 0.9773 [11]. The scale consists of 80 items in nine domains: *academic* (10 items), *socio-emotional* (8 items), *gross motor* (8 items), *fine motor* (8 items), *self-help skills* (7 items), *language & communication* (12 items), *moral* (8 items), *aesthetic & creativity* (9 items) and *civic* (10 items). A total of 26 kindergarten teachers rated the readiness of 377 kindergarten children using this scale. It was found that these NH Malaysian children had very high readiness (more than 4 point on the Likert scale) in six out of nine domains (*gross motor*, *self-help skills*, *language and communication*, *moral*, *aesthetic and creativity* and *civic*). That study also found that children with higher level of school readiness had parents who were more often involved with the child development and spent more quality time with the child than those who did not.

The present study investigated the school readiness skills of a group of young CI users and compared that to a group of NH 6-years old children using the *School Readiness to Year One* scale [11]. Since parents and teachers both play important roles in enriching a child's development and experience prior to school entry, this study also compared the agreement between the two groups of raters (parents and kindergarten teachers) in judging the school readiness of the CI children at the school entry point.

## 2. Material and methods

### 2.1. Ethical approval

This study has been approved by the Universiti Kebangsaan Malaysia (UKM) Human Ethics Committee with the reference code UKM PPI/111/8/JEP-2016-557.

### 2.2. Participants

For the CI group, respondents were parents and teachers of the six years old CI children in the UKM Cochlear Implant Program. The inclusion criteria were six years old in 2016, using oral communication mode, and a consistent CI user. Children who use sign language as their main communication mode and/or non-users were excluded from the study. A total of 11 parents and teachers of the CI children who fulfilled the criteria were invited to participate. Parents or teachers of the CI children who fulfilled the inclusion criteria but did not give their consent to participate in the study were also excluded.

For the NH group, respondents were the kindergarten teachers of six years old children. Apart from having normal hearing, the children must had normal physical and language development as reported by teachers. Teachers were recruited among those in the government pre-schools (Tabika KEMAS) and teachers of the CI children in private

kindergartens nationwide. Teachers who did not consent to participate were excluded from the study.

### 2.3. Instrument

The *School Readiness to Year One* scale [11] as described above, was utilized in this study. Each item used a 5-point Likert scale with 1 being *strongly disagree* and 5 for *strongly agree*.

### 2.4. Procedure

Parents of the identified CI children were contacted through telephone to get their consent to participate, to confirm their contact addresses and school contacts, if they agreed to participate. The school readiness scale was then mailed out to the participants together with the consent form and the study information sheet. The teachers of the CI children were also requested to rate the CI children as well as the NH children in their respective classrooms.

For the NH group, approval letter was first obtained from the Malaysian Ministry of Woman and Family Development to contact the government pre-schools (Tabika KEMAS) throughout Malaysia for the teachers to participate in the study. Upon getting their approval, the scale was mailed out to the teachers to provide data for each of the children in their classes.

All respondents were asked to return the completed questionnaires to the researchers using the stamped envelope provided.

### 2.5. Data analyses

Data distribution was first assessed to determine its normality. For the analyses, the scores in each domain were averaged. Descriptive data were reported using mean values, range and standard deviations (SDs). The data for the NH children were used to provide the reference cut-offs for the 25th and 75th percentiles for each domain. In this study, the children's scores were classified into three groups; 1) *above average* for scores greater than the 75th percentile, 2) *average*, for scores between the 25th to the 75th percentile, and 3) *below average*, for scores below the 25th percentile. The CI data (from teachers only) were then mapped onto these references which were presented using the boxplots and tables. The intra-class correlations were conducted to examine the agreement between the parents and teachers ratings on the school readiness skills of the CI children in each domain. All analyses were done using the *Statistical Package for the Social Sciences* (SPSS) version 23.0.

## 3. Results

### 3.1. Participants

A total of 11 parents and eight teachers provided the school readiness data of the CI children. The eight teachers also provided the data for the NH children in their classes. Apart from that, 14 teachers from Tabika KEMAS participated in which four were from the northern state of Peninsular Malaysia (Kedah), six were from the East Coast (Kelantan), two were from the south (Melaka) and two were from the central region of Peninsular Malaysia (Selangor). These teachers contributed to a total of 207 six years old NH children in Malaysia to be the reference data of school readiness of Malaysian children. Table 1 shows the demographic details of the CI and NH children in this study.

About 63.6% of the parents had tertiary education as their highest level of education and 36.4% completed their high school education. In terms of their socioeconomic status, 36.4% had more than RM 5000/month, 27.3% had a monthly household income between RM 3500.00 to RM 4999.00 and 27.3% had an income of less than RM 2500/month.

**Table 1**  
Demographic profiles of the CI and NH children.

Children's Profiles	Cochlear implant (CI)	Normal hearing (NH)
Number of participants	11	207
<i>GENDER</i>		
Males	7	116
Females	4	91
<i>RACES</i>		
Malays	5	182
Chinese	5	24
Indians	1	1
<i>SCHOOLS</i>		
Kindergartens (6 years old)	11	207
<i>TYPES OF SCHOOLS</i>		
Government	3	158
Private	8	49
<i>AGE (Months)</i>		
Mean age of implantation	29.91 ± 10.73	N/A
Range of age of implantation	14–43	N/A
Mean duration of CI experience (months)	46.45 ± 10.64	N/A
Range of duration of CI experience (months)	30–59	N/A

### 3.2. School readiness scores

Table 2 shows the means and the standard deviations (SDs) for the NH children for each domain including the 25th and the 75th percentiles scores. The values indicated that, generally, most of the NH children scored highly in all domains of school readiness scale, with six out of the nine domains had the 25th percentile score of 4 or over. The other three domains which were *language and communication* (domain F), *aesthetic and creativity* (domain H) and *civic* (domain I) had the 25th percentile cut-off scores of 3.67, 3.56 and 3.90, respectively.

Fig. 1 reveals the school readiness data of the CI children (the black dots) when plotted against the NH performances (in box plots) for each of the school readiness domains. It is seen from the figure that the largest data spread is seen for the domain of language and communication.

Table 3 shows the teachers' ratings of the CI children as compared to that of the NH peers. As can be seen in Table 3, the CI children performed remarkably poorer than the NH children especially in the areas of *civic* in which 80.0% were rated as below average and *language and communication* (62.5% were below average).

### 3.3. Comparing teachers' and parents' school readiness scores

Eight CI children had their school readiness rated by both their teachers and parent (Table 4). Note that the total number of responses in each domain was different as in some domains, participants opted

**Table 2**  
The school readiness scores for the NH children as rated by their teachers.

Domains	Mean	SD	25th percentile	75th percentile
A. Academic	4.53	0.57	4.08	5.00
B. Socio-emotional	4.39	0.60	4.00	5.00
C. Gross motor	4.27	0.60	4.00	4.88
D. Fine motor	4.53	0.52	4.13	5.00
E. Self-help	4.53	0.49	4.14	5.00
F. Language and communication	4.19	0.68	3.67	4.83
G. Moral	4.45	0.56	4.00	5.00
H. Aesthetic and creativity	4.05	0.64	3.56	4.56
I. Civic	4.11	0.49	3.90	4.40

not to answer. Of importance, from Table 4 however, teachers tended to rate the CI children's school readiness poorer than that of parents except in the domains of *self-help* skill, in which the children received similar ratings from both raters and *civic*, where parents gave poorer rating than teachers'.

Intra-class correlations (ICC) were performed to examine the agreement between the parents' and teachers' scores on the CI children school readiness skills. The results revealed poor inter-rater agreement with ICC values of less than 0.5 for all the domains as shown in Table 4.

## 4. Discussion

This study examined the mainstream school readiness skills in nine domains for a group of six-year olds CI children and compared that to a pool of NH children of matched chronological age as rated by teachers. It also assessed the agreement between parents' and teachers' ratings on the readiness skills of the CI children.

Our first main finding was that the NH children were rated by the teachers with relatively high scores in all domains suggesting their readiness to enrol into the mainstream education. This finding is consistent with that reported by Majzub & Rashid [11]. According to the developmental psychobiological approach as discussed by Blair & Raver [3], these findings, in which NH children achieved high scores in all domains suggest that at the age of six, they have developed sufficient self-regulation abilities that allow them to engage effectively in learning. According to the above model, when children are able to manage stimulation and attention from the environment (friends and teachers), they are considered as ready to start school. The domain with the lowest score was '*Aesthetic and Creativity*' with a mean of 4.05 ± 0.64 (out of 5 on the Likert scale). The 25th and 75th percentile scores for this domain were at 3.56 and 4.56, respectively. *Aesthetic and creativity* domain involves dynamic interactions of large-scale brain systems [1] and that right-brain hemispheric dominance underlying such complex cognitive processes [5]. Among the items in this domain are '*able to create simple origami*', '*able to utilise natural materials to produce an object*', and '*able to draw and make collages*'. Creativity relates a lot to experience especially in parent-child interaction and their home learning environment [16]. A study have shown that the brain can be trained to be more creative [22]. According to Parker et al. [16], increment in parents' understanding for play and thus, their ability to facilitate their children's learning through play, increases the children's creativity or curiosity. This leads to positive behaviour in classrooms. Our findings may suggest that in Malaysians' parenting style, play activities in parent-child interaction might be lacking that to some extent, has impacted the children's creative thinking process.

In comparing the CI children school readiness skills to that of their NH counterparts, teachers rated them as 'below average' for many of the domains. In 3 out of 9 domains, 50% or more of the CI children were rated as performing at below average. These domains include *civic* (80.0%), *language and communication* (62.5%), and *academic* (50.0%). Revisiting the relation between school readiness and self-regulation using the developmental psychobiological approach, self-regulation is about 'adjustment in response to experience'. In CI children, less than optimum auditory experience may have negatively impacted the integrated developmental processes at the biological and behavioural levels underlying self-regulation and consequently, school readiness skills of these children. Our results in part support the earlier study reported by Pratt et al. [18]. They examined how multiple family risk factors experienced during the first three years of life predicted children's school readiness. Using cumulative risk model, their findings revealed that a greater number of risks across infancy, toddlerhood and early preschool years significantly predicted poorer school readiness outcomes in the kindergarten years. In this case, hearing loss is considered as a risk factor. Congenital hearing impairment affects many aspects of the child's live. Kronenberger et al. [8] reported that a large majority of CI children were at greater risk of clinically significant

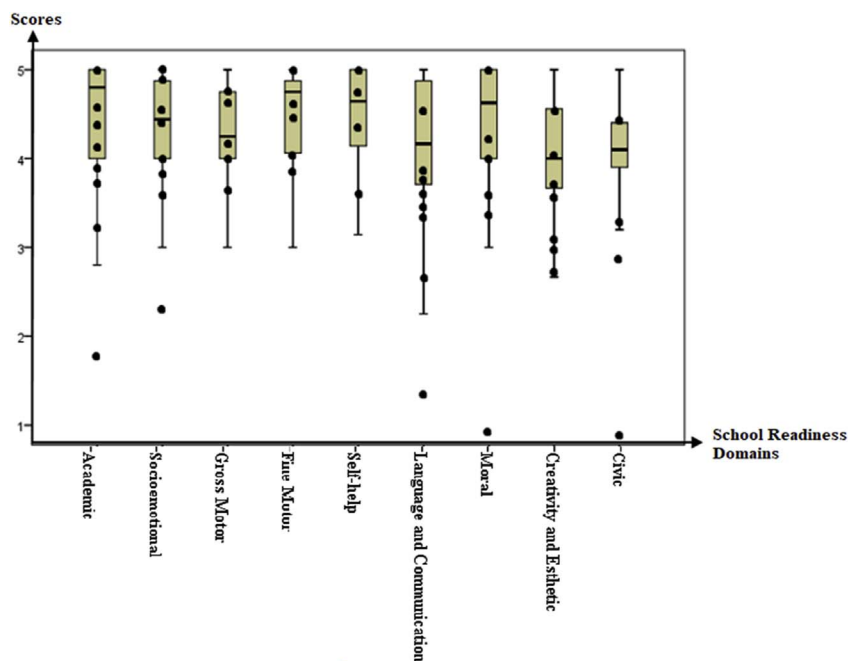


Fig. 1. The school readiness scores of the CI children in each of the domain against the NH children as rated by their teachers.<sup>1</sup>  
<sup>1</sup>Horizontal lines in the box plot indicate 50th percentile cut-off points.

**Table 3**  
 Teachers' ratings of the CI children as compared to that of the NH children.

Domains	Below average (%)	Average (%)	Above average (%)
A. Academic	50.0	37.5	12.5
B. Socio-emotional	37.5	62.5	0.0
C. Gross motor	14.3	85.7	0.0
D. Fine motor	33.3	66.7	0.0
E. Self-help	20.0	80.0	0.0
<b>F. Language and communication</b>	<b>62.5</b>	37.5	0.0
G. Moral	37.5	62.5	0.0
H. Aesthetic and creativity	37.5	50.0	12.5
I. Civic	<b>80.0</b>	20.0	0.0

The bolds indicate the top two domains where the CI children were performing at below average (as rated by teachers).

**Table 4**  
 Parents' (P) and teachers' (T) ratings for 8 out of 11 CI children.

Domains	Respondents	Number of responses (n)	Below average (%)	Average (%)	Above average (%)	Intra-class correlation (ICC)
A. Academic	Teachers (T)	8	25.0	50.0	25.0	0.3
	Parents (P)	8	25.0	12.5	<b>62.5</b>	
B. Socio-emotional	T	7	14.3	85.7	0.0	-2.7
	P	7	42.9	57.1	0.0	
C. Gross motor	T	7	14.3	71.4	14.3	-0.4
	P	7	14.3	85.7	0.0	
D. Fine motor	T	5	20.0	60.0	20.0	-0.8
	P	5	0.0	80.0	20.0	
E. Self-help	T	5	20.0	60.0	20.0	12.625
	P	5	20.0	40.0	40.0	
F. Language and communication	T	7	14.3	42.8	42.9	-0.1
	P	7	14.3	71.4	14.3	
G. Moral	T	8	25.0	50.0	25.0	-0.3
	P	8	37.5	50.0	12.5	
H. Aesthetic and creativity	T	8	25.0	50.0	25.0	-10.7
	P	8	12.5	75.0	12.5	
I. Civic	T	4	0.0	75.0	25.0	-3.6
	P	4	0.0	75.0	25.0	

The bold indicates the top domain which shows the largest inconsistency between parents' and teachers' ratings.

deficits across multiple domains of executive functioning as compared to the NH children. In that study, the relative risks for pre-schoolers and school aged CI children were greatest in the following areas: comprehension and conceptual learning, factual memory, attention, sequential processing, working memory and novel problem-solving. In a more recent publication by Hall et al. [7] it was concluded that language deprivation and not auditory deprivation due to hearing impairment that may impair executive function. The CI children in this study were implanted at relatively late age (mean age of implantation at  $29.9 \pm 10.7$  months) with the mean duration of implant experience at  $45.5 \pm 10.6$  months, which was less than four years of hearing experience. Thus, it is not surprising that the CI children were rated by their teachers to have poorer school readiness skills as compared to their NH peers in many of the domains.

The third main finding was that parents' and teachers' ratings of the school readiness skills of the CI children were different. In response to this finding, we revisited the developmental psychobiological approach [3] as the unifying framework for the study of school readiness. According to this model, the environment and interpersonal interactions



are embedded biologically to shape the development of a child's brain and behaviour. In this context, parents are the one who provide that 'world experiences' to a child before they enter pre-school. This is further emphasized by a longitudinal study on maternal mind-mindedness that aimed to study the mechanism on how family environment, specifically maternal mind-mindedness, relate to a child's school readiness [2]. In that study, it was found that maternal mind-mindedness in infancy impacted on the child's language at age two, consequently support effortful control at ages three and four, and finally promote school readiness of the child in kindergarten. Effortful control is defined as *the ability to suppress a dominant response in favour of a more context appropriate response* [20]. Parents therefore, judged their hearing-impaired children's school readiness skills based on their experiences and interactions with their children since birth. While teachers on the other hand, must have based their judgments from their interactions with these children at schools and compared their developmental skills to that of their NH peers within a relatively shorter period of time. Teacher-child interaction and class activities have been shown to significantly associated with school readiness skills of a child [6,24]. The mismatch between the expectations of the school environment as seen by teachers and the expectations of the environment or world experiences that prepare a child for school entry as seen by parents was evidenced in this study.

The implications from this relatively small study suggest for the need of an intervention or intermediate 'bridging' program to improve school readiness skills of the CI children. Several studies have shown that intervention could help to address this issue [12,19,21]. Schmitt et al. [21] for example, conducted an 8-week self-regulation intervention study on 276 children in 14 Head Start classrooms in the United States. Results indicate that children in the intervention group achieved stronger levels of self-regulation and academic achievement over the preschool year as compared to the control group. In cases of hearing-impaired children, it is also important to improve the language environment so as to support the children's spoken language development [23]. Language deficits and differences in hearing-impaired children, particularly in the development of grammar [9] have detrimental effects in language-related areas of development which underlie various school readiness skills as evidenced in this study.

In the Malaysian Education system, all seven-year old children must commence their primary school education as age is used as a criterion to consider that the child is developmentally ready for school. Our results suggest that the CI children, being deprived auditorily due to hearing impairment which consequently has widespread effects on their brain development, should be placed in the intervention program before commencing their mainstream education. This warrants for executive action in terms of policy change.

However, that the present study was conducted on a relatively small sample of CI children, and the CI children in this group were implanted relatively late. It is possible that early implantation, resulting in better speech and language development would lead to better school readiness score. Further study is undergoing to collect more evidence on the school readiness skills of the six years old CI children in Malaysia.

## 5. Conclusions

It is concluded from this study that CI children were lacking behind their NH peers in terms of their school readiness skills at the school entry point. Parents and teachers agreement on their school readiness skills were poor. It is suggested that an intervention or bridging program to improve the school readiness skills of the CI children before enrolling into the mainstream education should be implemented.

## Conflicts of interest

The authors declare that there is no conflict of interest involved in this study.

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### Conference presentation

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