Chapter 8
Prevalence Rate of Dyscalculia According to Gender and School Location in Sabah, Malaysia

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Abstract Dyscalculia is a specific mathematics learning disability that affects 6 % of the population (Wilson AJ, Dyscalculia: why do numbers make no sense to some people? Retrieved on 1 Dec 2012, from www.aboutdyscalculia.org, 2008). The findings of (Devine A, Soltész F, Nobes A, Goswami U, Szucs D, Learn Instruct 27:31–39, 2013) and (Karimi S, Math Educ Trend Res 2013:1–7, 2013) confirmed that the prevalence of developmental dyscalculia was the same for girls and boys. These findings contrast with the studies of (Jovanović G, Jovanović Z, Banković-Gajić J, Nikolić A, Svetozarević S, Ignjatović-Ristić D, Psychiatr Danub 25(2):170–174, 2013) and (Gifford S, Rockliffe F, Proc Br Soc Res Learn Math 28(1):21–27, 2008), found that the difference between boys and girls was statistically significant. Reigosa-Crespo et al. (2012) reported that the prevalence of developmental dyscalculia was 3.4 % and the male to female ratio was 4:1. In another case, Koumoula A, Tsironi V, Stamouli V, Bardani I, Siapati S, Graham A et al, J Learn Disabil 37:377–388, 2004 found that the prevalence of developmental dyscalculia among rural students is higher than in urban schools. A contradictory findings of Nojabaee S, Arab J Bus Manag 3(5):50–59, 2014 show that the mathematics disability rate of prevalence is 1.49 % in urban areas and 1.57 % in rural ones, and there is no difference between urban and rural students in different levels due to mathematics disability. This research intends to identify the prevalence of dyscalculia according to gender and school location among LINUS students in Sabah, Malaysia. The results show that there is no significant gender difference in prevalence rates of dyscalculia, but there is a significant difference between LINUS students in urban and rural school.

Keywords Prevalence • Dyscalculia • Learning disability

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8.1 Introduction

The prefix *dys* comes from the Greek and means “badly”. Calculia comes from the Latin word *calculare*; meaning “to count”. More specifically, the term *calculare* refers to the ability to represent and manipulate numerical magnitude nonverbally on an internal number line (Jenson 2010). Pupils with disabilities may have difficulty performing mathematical calculations; having trouble knowing how to respond to the mathematical information, confusion of symbols and names, read and write mathematical symbols wrongly (Farrell 2009). In England, ‘dyscalculia’ has been defined as ‘the condition that affects the ability to acquire mathematical skills’. Dyscalculia is a term most commonly used for the disabled in Mathematics. Dyscalculia means severe or complete inability to count (Hallahan et al. 2005). Dyscalculia is a term that means “specific learning disability in mathematics” (Newman 1998).

The prevalence of learning disabilities among school children varies from country to country. It is largely dependent on the definition used to classify learning disabled children in each country. There are nearly three million students in the United States that are identified with specific learning disabilities who are receiving special education services. It affected about 5.5 % of the students in school (ages 6–17) for special education because of learning disabilities (Teoh and Lim 2007). In a study conducted by Komoula et al. (2004) of 240 Greek students between the ages of 7–11 from rural and urban areas, they have found that the prevalence of developmental dyscalculia among rural students was higher than in urban schools. Therefore, specific learning disability that is prevalent in other countries, and perhaps is especially more common among rural area students.

In Asian countries, the National Statistical Office of Thailand in 1991 reported a prevalence rate of 1.9 % of visual impairment, 5.4 % of speech impairment, 13.2 % of hearing impairment and 10 % of intellectual disability. In Malaysia, the Department of Special Education in 2002 reported 14,535 children with learning disabilities in 700 schools across the country. These statistics included children who have learning disabilities, hearing impairment and visual impairment in special schools or integrated schools (Teoh et al. 2008).

8.2 Literature Review

Geary (2004) found that between 5 and 8 % of children in school age have some form of disability in mathematics. These figures are confirmed in different countries by a number of researchers. Voutsina and Qaimah Ismail (2007) find a prevalence of 5 % in the South England study. Fuchs (2006) studies report prevalence rates between 4 and 7 %, Belgium researchers find prevalence between 3 and 8 % (Desoete et al. 2004), and Flanagan and Alfonso (2011) in a survey of recent work of authors find prevalence of 7 %.

As a finding of Ramjee’s (2003) study suggests that girls are more learning disability than boys, it may be due to the reasons that the girls have to do more work at home than boys, due to the parents’ negative behavior to them. A contrary finding of Reigosa-Crespo et al. (2011) found that basic numerical deficits affect 3.4 % of the school – aged population and affect more boys than girls. However, Gifford and Rockliffe (2008) found that dyscalculia is unusually affecting equal numbers of boys and girls. It is obvious that better teaching helps in reduction of learning disabilities. Although there area number of individuals dyscalculia are quite similar in terms of gender, Adler (2008) has been found with his experience that gender comparison study in dyscalculia is very less. However, if there is, they both are often treated in a "lump" together with students with other mathematical difficulties.

Jovanovic et al. (2013) found that the difference of dyscalculia between boys and girls to the total score on the test was statistically significant. This finding is supported by Devine et al. (2013), stated that the prevalence of developmental dyscalculia according to gender was significantly different when using a mathematical-reading discrepancy definition. The ratio of dyscalculia between male and female was 4:1 (Reigosa-Crespo et al. 2011). However, Karimi (2013) and Nilesh Shah and Tushar Bhat (2008) have claimed that the prevalence of dyscalculia in the school-aged population is as common in girls as in boys.

For findings related to the school location, Nojabaee (2014) found that the mathematics disability rate of prevalence among elementary students was 1.52 %, and there is no difference between urban and rural students in different levels due to mathematics disability. In a study conducted by Komoula et al. (2004) of 240 Greek students between the ages of 7–11 years from rural and urban areas, he found that the prevalence of developmental dyscalculia among rural students is higher than in urban schools. However, there were no differences between genders in arithmetical performance.

8.3 Methods and Procedures

This study involved the quantitative research design and intended to identify the prevalence of dyscalculia among LINUS students in Sabah, according to their gender and school location. At the end of the study, the researchers would identify the prevalence of dyscalculia among students and provide information on whether they have significant differences in gender and school location.

8.3.1 Instrument

The Malaysian Dyscalculia Instrument Plus (MDI+) is a computer application that used to measure four variables, that including Simple Reaction Time, Short Term Memory, Numerosity and Arithmetics (Chin et al. 2014). MDI, a subset of MDI+, is an instrument used to measure a numerosity ability, which consists of four constructs namely number sense, matching items, dot enumeration and number comparison (see Table 8.1). The MDI that was developed by Chin et al. (2014) has been used to identify the students who suffered from dyscalculia. This instrument, which

Table 8.1 Constructs of Malaysian dyscalculia instrument plus (Chin et al. 2014)

No.	Construct	Description of items	Capacity/Test
1	Simple reaction time	10 items for the left	Response time
		10 items for the right	
2	Short term memory	10 items	Short term memory
3	Numerosity		
	(a) Number sense	10 items	Sense of numerosity
	(b) Matching items	10 items	Numerosity as a property of sets
	(c) Dot enumeration	10 items	Enumeration (counting)
	(d) Number comparison	10 items	Sense of ordered numerosities
4	Arithmetic test	10 items	Arithmetic

Table 8.2 Demography of respondents

Region of Sabah	Sample size
North-West	88
South-West	112
East	161
Rural	87
Total	**448**

is a computer-based assessment system for children, aims to identify the characteristics of dyscalculia by measuring response accuracy and response time to test items. In addition, MDI+ distinguishes between low mathematics achievement and specific learning difficulties in assessing an individual's ability and understanding of numbers size, simple addition and simple subtraction.

8.3.2 Population and Sample

This study population consisted of all LINUS students of the primary schools in Sabah. The population was chosen because of the low achievement in public examination of Sabah primary school students, especially in the mathematics subject; and the basic numeracy skill of 92.51 % reported after three screenings of LINUS numeracy test, which was still below LINUS numeracy target of 95 % (Prime Minister's Department 2011). LINUS is an abbreviation of Literacy and Numeracy Screening (Nazariyah Bint Sani & Abdul Rahman bin Idris 2013).

The cluster sampling was employed as the main sampling method in this study. The reason of cluster sampling is cost efficiency (economy and feasibility) and also the large and widely dispersed geographies of the population (Cohen et al. 2002). Considering the sample of pupils aged between 7 and 9 years old, the researcher had obtained parental consent through the parent's consent form. The parents' consent forms were distributed to the selected school administrators of this study based on the research sampling method. Unfortunately, only 13 primary schools were successfully involved and 448 consent forms were collected (see Table 8.2), instead of 16 primary schools and 444 samples that were obtained through the cluster sampling approach.

8.4 Results

8.4.1 Prevalence Rate of Dyscalculia According to Gender

Table 8.3 shows the prevalence rate of dyscalculia among primary school students according to their gender. There were 3.47 % of males and 4.38 % of females who were suffering from dyscalculia. These results unveiled that females were slightly higher in number than males.

8.4.2 Prevalence Rate of Dyscalculia According to Location of the School

The analysis of prevalence according to school location revealed that, 3.91 % of urban students and 3.42 % of rural students had shown the evidence of dyscalculia (see Table 8.4). These results indicated that the students in the urban area had higher prevalence rate, which may affect the mathematics learning process on the mathematics learning in their schools.

8.4.3 Difference in the Prevalence Rate of Dyscalculia According to Gender

H_{0^1} *: there is no significant difference in prevalence rates of dyscalculia among primary school students according to gender*

Table 8.5 depicted the probability value of 0.403 derived from the analysis of independent sample T-test in SPSS was more than the specified alpha value (.025). As a result, the null hypothesis (H_{0^1}) was unsuccessfully rejected. There was substantial evidence to conclude that the mean of prevalence rates of dyscalculia for

Table 8.3 Prevalence of dyscalculia according to gender

Gender	Total sample	Dyscalculic students	Prevalence
Boy	288	10	3.47 %
Girl	160	7	4.38 %

Table 8.4 Prevalence of dyscalculia according to location of school

Location	Total sample	Dyscalculic students	Prevalence
Urban	331	13	3.91 %
Rural	117	4	3.42 %

Table 8.5 Results of T-test for H_{01}

Group statistics

	Gender	N	Mean	Std. deviation	Std. error mean
Dys	Boy	288	4.87500	1.348312	.079450
	Girl	160	4.98906	1.438560	.113728

Independent samples test

		Levene's test for equality of variances		T-test for equality of means						
									95 % confidence interval of the difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	Lower	Upper
Dys	Equal variances assumed	.318	.573	−.838	446	.403	−.114063	.136184	−.381705	.153580
	Equal variances not assumed			−.822	311.025	.412	−.114063	.138731	−.387033	.158908

both males and females were equal. It means that there was nonsignificant gender difference between male and female groups. This conclusion was formed based on the significance level of $\propto = .05$ (5 %) or confidence level of 95 %.

8.4.4 Difference in the Prevalence Rate of Dyscalculia According to School Location

H_{0^2}*: there is no significant difference in prevalence rates of dyscalculia among primary school students according to school location*

According to the analysis of independent sample T-test in SPSS, the probability value of 0.000 was less than the specified alpha value of .025 (see Table 8.6). Consequently, the null hypothesis (H_{0^2}) was successfully rejected and it could be concluded that the mean of the prevalence rates of dyscalculia for both urban and rural school students were different. In other words, there was a significant difference between students in the urban and rural schools (significance level of $\propto = .05$ or confidence level of 95 %).

8.5 Discussion and Conclusion

Dyscalculia can involve making sense of numbers, difficulties with arithmetic, remembering numbers and formulae, estimating numbers, estimating distance and time (Adler 2008). Therefore, the presence of dyscalculia may affect mathematic performance among normal students. This learning difficulty in mathematics occurs among individuals across the whole IQ range. The estimated prevalence of dyscalculia range is between 3 and 6% of the population. However, the prevalence of learning disabilities among school children varies from country to country. It is largely dependent on the definition used to classify learning disabled children in each country.

The findings of this study show that there were 3.47 % of boys and 4.38 % of girls are suffering from dyscalculia. These results indicated that the prevalence of females was slightly higher than the males (males:females ratio was 0.79:1). This finding was supported by the finding of Ramjee's (2003) study which suggested that girls had more learning disability than boys; it may be due to the reasons that the girls had to do more work at home than the boys, because of the parents' negative behavior to them. Based on the analysis of independent sample T-test discussed above, there was no significant gender difference between male and female groups. This result was supported by the finding of Karimi (2013) and Nilesh Shah and Tushar Bhat (2008) who found that the prevalence of dyscalculia in the school-aged population is as common in girls as in boys. Yusha (2013) in his gender difference study concluded that the treatment given to the experimental groups was

Table 8.6 Results of T-test for H_{0^2}

Group statistics

	Area	N	Mean	Std. deviation	Std. error mean
Dys	Urban	331	4.75529	1.325797	.072872
	Rural	117	5.36966	1.436740	.132827

Independent samples test

		Levene's test for equality of variances		T-test for equality of means					95 % confidence interval of the difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	Lower	Upper
Dys	Equal variances assumed	2.367	.125	−4.214	446	.000	−.614371	.145794	−.900900	−.327842
	Equal variances not assumed			−4.055	190.280	.000	−.614371	.151503	−.913213	−.315529

significantly effective for dyscalculic students and confirmed that no gender difference in academic performances at both pre-test and post-test levels. Apart from that, there were no difference between gender in the arithmetical performance (Komoula et al. 2004).

The analysis of prevalence according to school location revealed that 3.91 % of urban students and 3.42 % of rural students had shown the evidence of dyscalculia. This result seems to indicate that the students in an urban area have higher prevalence rates which may affect the mathematics learning process in their school. However, it should be realised that the respondents in this study were involved the LINUS students and their participation was entirely dependent on parental consent. Of the 448 students who participated in this study, there were only 117 students or 26.12 % who were from the rural area. This had led to a difficulty in obtaining the expected results, as rural area was poorer, and the teachers were less experienced and more absenteeism (Najabaee 2014). The analysis of independent sample T-test indicated that there was a significant difference between students in urban and rural schools. This finding was supported by a study conducted by Komoula et al. (2004) of 240 Greek students between the ages of 7–11 years old from rural and urban areas, and they had found a significant difference between both areas.

There is little research being done on dyscalculia in general, and Malaysia in particular. With the exception of a few small-scale studies carried out, little is known about the prevalence of the problem. With a dearth of a large nationwide data, the seriousness of the problem will continue to go unabated. Being touted as the dyslexia of mathematics, dyscalculia is still very much an unknown phenomenon. Much like a child who cannot connect sounds with letters, the dyscalculia child cannot relate that five fingers are the number “5”. However, unlike the dyslexic child who is identified, tested and offered remedial intervention, the child with dyscalculia often goes unnoticed. The cultural bias against mathematics in Malaysia today, where the mathematically inclined are thought to have superior intelligence and genetic predisposition, has created a climate where the mathematically disabled student is allowed to remain unnoticed and unchallenged.

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