

DYSCALCULIA AMONG PRIMARY SCHOOL CHILDREN: A CASE STUDY ON North 24 parganas DISTRICT OF WESTBENGAL

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ABSTRACT

SUMMARY

Formal education, daily living activities and jobs require knowledge and application skills of counting and simple mathematical operations. Problems with mathematics start in primary school and persist till adulthood. This is known as dyscalculia and its prevalence in the school population ranges from 3 to 6.5%. The study included 1424 third-grade students (aged 9-10) of all primary schools in the Barahanagar of North 24 Pargana. Tests in mathematics were given in order to determine their mathematical achievement. 1078 students (538 boys and 540 girls) completed all five tests. The frequency of dyscalculia in the sample was 9.9%. The difference between boys and girls according to the total score on the test was statistically significant ($p < 0.005$). The difference between students according to their school achievement (excellent, very good, good, sufficient and insufficient) was statistically significant for all tests ($p < 0.0005$). The influence of place of residence/school was significant for all tests ($p < 0.0005$). Independent prognostic variables associated with dyscalculia are marks in mathematics and language. Frequency of dyscalculia of 9.9% in the sample is higher than in the other similar studies. Further research should identify possible causes of such frequency of dyscalculia in order to improve students' mathematical abilities.

Keyword *Quality Education, Social Change, Transmission of Culture, Social Values, and Cultural Lag.*

1.Introduction

In order to solve everyday problems it is necessary to use many skills that include a set of rules and algorithms (Ramaa et al. 2002). Moreover, formal education, daily living activities and jobs require knowledge and application skills of counting and simple mathematical operations related to addition, subtraction, multiplication and division (Floyd et al. 2003). Problems with mathematics start in primary school and persist till adulthood (Bojanin 2002). Considering the fact that mathematics is hierarchical, students who did not understand the previous material will, in addition to their problems in basic mathematics, also experience failure that may eventuate to mathematical anxiety (Miller et al. 1997). These combined difficulties appear in the clinical form called dyscalculia which is a set of specific difficulties in learning mathematics and in performing mathematical tasks in children with normal intelligence, access to education and without severe psychological problems (Bojanin 2002, Sharma 2001). Dyscalculia prevalence studies have been performed in many countries using different criteria (Jovanović et al. 2008). According to DSM IV (Shalev 2004) criteria, the incidence of dyscalculia is 1% of the school population. However, studies of dyscalculia in America, Europe and Israel show that the prevalence of developmental dyscalculia in these countries is about to 6.5% (Shalev & Gross-Tsur 2001). An epidemiological study derived on school population in Greece showed that the prevalence of dyscalculia was 6.3% (Koumoula et al. 2004) which coincides with a prevalence of dyscalculia 6.4% among children of school population in Bratislava (Kosc 1974). Other authors (Lewis et al. 1994) found prevalence of dyscalculia of 1.3% among children aged 9-10 years.

The similar results were obtained by Gowaramma (2000). However, Barbaresi (2005) found that cumulative incidence of dyscalculia by age 19 years varying from a low of 5.9% to a high of 13.8% depending on the mathematics learning disorder definition. So far, a unanimous opinion about the frequency of dyscalculia between genders does not exist. The general opinion is that boys do mathematics better than girls (Ardila et al. 2002). The opinion of teachers is that the sex has no influence on success in mathematics (Koumoula et al. 2004). In many epidemiological

studies, the researchers found a higher incidence of mathematical difficulties among boys (Share et al. 1988, Badian 1983, Von Aster 2000, Barbaresi et al. 2005). However, most prevalence studies of developmental dyscalculia point to equal rates between the sexes (Shalev et al. 2001, Lewis et al. 1994).

SUBJECTS AND METHODS

The study was conducted from 4 - 9 June 2008 and included 1424 third-grade students (aged 9-10) of 21 primary schools in the City of Kragujevac, Serbia. Before the study started we received permission from the Ministry of Education and approval of all school principals. Because there is not bengali validated version of any instrument for dyscalculia, we prepare the set of mathematical tests which covered different mathematical fields. All tests are consistent with the objectives required by the Regulations of the curriculum for the third grade of primary education of Ministry of Education of WestBengal. Tests were distributed together by a professional team of teachers. The students who did not complete the entire test were excluded from further processing. At the end of the first part of the study, 1078 students (538 boys and 540 girls) completed all five tests. The data were analyzed in software statistical package SPSS 17.0. We performed descriptive statistics for the total test and ANOVA to determine inter-group differences. We studied the correlation between marks and test results as well as between student achievements and performance on the tests.

RESULTS

The frequency of the dyscalculia in the sample is 9.9%. Some socio-demographic characteristics of children with dyscalculia and the whole sample are shown in Table 1. According to all tests results we found that 5% of the pupils have less then or equal 34.13. points; 10% of the pupils have less then or equal 52.65 points; 25% of the pupils have less then or equal 87.33 points and 50% of the pupils have less then or equal 115.70 points (Table 2). Differences between subtests form subtest T1 to T5 were given in the Table 3. Areas under ROC curve shows that subtests T1, T2, T3, T4 and T5 could be markers for dyscalculia. Subtest T3 related to student's

Table1: Table 1. Some sociodemographic characteristics of the total sample and in the sample of children with dyscalculia

Gender	Total sample(N)	Mean SD	Children with dyscalculia	Mean SD
Male	538	105.39 ± 39.55	70	33.52 ± 11.29
Female	540	114.46 ± 36.79	38	38 31.31 ± 13.07
Total	1078	119.03 ± 30.07	107	32.76 ± 11.92

Place	Total sample(N)	Mean SD	Children with dyscalculia	Mean SD
Urban	840	113.04 ± 36.658	70	33.52 ± 11.29
Suburbun	141	96.36 ± 41.29	38	38 31.31 ± 13.07
Rural	97	102.78 ± 44.10	15	28.22 ± 13.31
Total	1078		107	

Table 2. Distribution of students according to total points

Total sample	Points	%
53	34.13	5
107	52.65	10
269	87.33	25
539	115.70	50

Table 3. Sensitivity and specificity of mathematical subtests in the whole sample of children

	AUROC	P	Cut-off	Sensitivity (%)	Specificity (%)

T1	0.836	0.021	11	77.1	75.7
T2	0.974	0.007	15	93.5	92.7
T3	0.980	0.004	9.75	93.5	93.3
T4	0.961	0.007	14	91.6	87.4
T5	0.939	0.010	15	86.9	84.8

Table 4. Subtest T3 related to student's abilities to multiplication and division shows the best sensitivity

Total sample	Total sample	The sample of children with dyscalculia
Test 3 < 9.75	906	7
Test 3 ≥ 9.75 65 10	Test 3 ≥ 9.75 65 10	Test 3 ≥ 9.75 65 10

Table 5. General success/school achievement and marks in mathematics and Serbian language of the total sample and in the dyscalculia sample

	Total sample			The sample of children with dyscalculia		
	General success	Marks in math	Marks in Serbian	General success	Marks in math	Marks in Serbian language
Excellent	725 (67.3%)	469 (43.5%)	576 (53.4%)	8 (7.5%)	0 (0%)	0 (0%)
Very good	252 (23.4%)	315 (29.2%)	298 (27.6%)	37 (34.6%)	11 (10.3%)	22 (20.5%)
Good	94 (8.7%)	195 (18.1%)	131 (12.2%)	55 (51.4%)	35 (32.7%)	27 (25.2%)
Sufficient	4 (0.4%)	96 (8.9%)	72 (6.68%)	4 (3.7%)	58 (54.2%)	53 (49.6%)
Insufficient	3 (0.3%)	3 (0.3%)	2 (0.2%)	3 (2.8%)	3 (2.8%)	2 (1.9%)
Total	1078 (100.0%)	1078 (100.0%)	1078 (100.0%)	107 (100.0%)	107 (100.0%)	107 (100.0%)

Factors that influence the occurrence of dyscalculia

To test the relationship between gender, place of school, general school success, marks in mathematics, marks in Bangla language, we used logistic regression. Independent prognostic variables for occurrence of dyscalculia are marks in mathematics ($p < 0.0005$) and Bangla language ($p = 0.013$) (Table 6). Odds ratio of marks in mathematics is 0.321 (0.181-0.570) i.e. the better marks in mathematics for 1 unit decreases risk for dyscalculia around three times. Odds ratio of marks in Bangla language is 0.466 (0.256 -0.849).

Table 6. Factors that influence the occurrence of dyscalculia

Factors	p
Gender $p < 0.0050$	Gender $p < 0.0050$
General school success $p < 0.0005$	General school success $p < 0.0005$
Marks in math $p < 0.0000$	Marks in math $p < 0.0000$
Marks in Serbian $p < 0.0000$	Marks in Serbian $p < 0.0000$

DISCUSSION

There are many ways to define a learning disability in mathematics but one of the standard methods is that the children must score at least 1.5 SD below the normative values on the applied test. By applying this criterion, we discovered that the incidence of dyscalculia in our sample was 9.9%. Using the ICD 10 research criteria, according to which the test results should be below 2 SD or alternatively a low criteria in clinical practice (< 1 SD), our criterion is a compromise solution. Using ICD 10 (< 2 SD) criteria, the frequency of dyscalculia approaches 4.5% while the larger portion of children fall between 1.5 and 2 SD, that is 5.4%. The opinions of teachers on children's

mathematical achievements has proved to be relatively balanced and can be indicative of which children to expect lower scores. Most researchers classify children with difficulties in learning mathematics by using the cut-off criteria by which children should have 35% of the mean values of the mathematics test, but not less than 2 SD. In order to avoid false positive results, some authors used more stringent criteria that rely on reports of teachers and 3 SD below the mean (Landerl, Bevan et al. 2004).

In our research, we found that girls were better in all tests except the fourth, where there was no significant difference. Among 107 students with low mathematical achievement, 70 were boys and 37 girls (boys to girls ratio was 1.9 : 1). Share came to similar results in his research-the ratio between boys and girls was 1.7 : 1 for children with specific difficulties in mathematics (Share et al. 1988). Also, in epidemiological study conducted in the United States, Badian found a higher incidence of developmental dyscalculia in boys than in girls 2.2 : 1.0 (Badian 1983). (Barbarese et al. 2005) are found more boys than girls, with male: female relative risk ranging from 1.6 to 2.2 depending on the formula applied. In a sample of 93 children with low mathematical achievement, divided into four subgroups, von Aster found a difference in three sub-groups, where there were more boys than girls in the ratio 2 : 1 (Von Aster 2000). In an earlier study, von Aster claimed that girls had more difficulty with mathematics because of frequent emotional problems (Von Aster 1994). In a survey conducted in India, researchers found that there were more boys with calculation problems, although their teachers reported that girls achieve less than boys (Gowramma 2000). The findings of epidemiological studies are mixed as far as differences between the sexes are concerned. This finding was unexpected, considering that some isolated problems with learning (dyslexia and ADHD) are more frequent in males and in ratio 3.6 : 1 (Koumoula et al. 2004).

This study confirmed that the students' poor results in mathematics and Serbian language were significantly associated with dyscalculia and that these students had difficulties with learning in general. In addition, many researchers have found that students with learning disabilities have greater difficulties in mathematics than their peers with no disabilities. Given that mathematics has its own language that includes special terms, number syntax and symbols, language skills are very important for mathematics achievement. Students who have problems with reading and writing may have problems with mathematics, too. Reading requirements of textual tasks increase with each year so that many students who have difficulty in reading will have problems in solving the tasks set in words. In addition, the written work in mathematics can be difficult for children with difficulties in handwriting, grammar and writing composition (Wadlington E & Wadlington LP 2008). Heterogeneity is evident in the classroom where we find students without disabilities and students with learning difficulties, as well as students with mild mental retardation, all studying together. All of them are forced to participate in maths classes continuously, although they have different abilities for adopting mathematical content. They show different results and require special instructions (Wadlington & Wadlington 2008). We found differences in frequency of dyscalculia between students from rural, suburban and urban areas. Are rural areas poorer, families larger, teachers less experienced in rural areas; or are there more absenteeism from school between children in rural areas; all are questions we investigate in the second phase of the research when we will test the children individually.

CONCLUSION

Dyscalculia frequency of 9.9% in the sample is higher than in the other studies. New epidemiological studies in school population in Bengal will show whether this relatively high prevalence of dyscalculia is constant. Further research should also identify possible causes of dyscalculia in order to improve students' mathematical abilities. The earliest diagnosis of disability in mathematics in children could provide them with timely expert help and prevention of school failure occurrence with the psychological consequences.

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