

Original Article

Dyslexia Prevalence among Elementary School Students in Iran: A Gender-Based Analysis

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Abstract

Background and Aim: Reading is a key academic skill that forms the foundation for learning across all subjects. Dyslexia, a specific learning disorder that affects reading accuracy and fluency, can lead to persistent academic difficulties if not detected and addressed early. This study aimed to estimate the prevalence of dyslexia among primary school children in Ardabil and to examine possible gender differences.

Materials and Methods: This descriptive cross-sectional study was conducted among male and female students in grades 3-5 from the four educational districts of Ardabil during the 2023–2024 academic year. Using a multi-stage stratified sampling method, 1,162 students were selected for the study. The Diagnostic Reading and Dyslexia Test (Nama, Karimi Nouri, & Moradi, 2004) was administered. Data were analyzed using SPSS version 27.

Results: Among 1,162 students, 74 (31 girls and 43 boys) were identified as having dyslexia, corresponding to prevalence rates of 5.36% among girls, 7.36% among boys, and 6.36% overall. Additionally, 39.1% of dyslexic students had a family history of dyslexia. The prevalence of dyslexia decreased significantly with increasing grade level in both genders ($p < 0.05$). According to the subtests of the diagnostic reading test, girls outperformed boys in reading words, rhymes, word comprehension, letter symbols, category symbols, and overall dyslexia scores ($p < 0.05$).

Conclusion: The findings suggest that dyslexia affects a considerable proportion of primary school students, particularly boys. Early identification and implementation of targeted educational interventions may help mitigate the negative impact of dyslexia on students' learning outcomes.

Keywords: Dyslexia; Learning disability; Prevalence; Primary school students; Gender differences

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Introduction

Dyslexia has been reported to be the most common specific learning disorder among school-aged children. It is characterized by persistent difficulties in developing literacy-related skills despite conventional instruction (1). Dyslexia can significantly interfere with the learning process of primary school students and is marked by impairments in accurately and fluently recognizing and spelling words, despite adequate instruction, normal intelligence, and intact sensory abilities (2). Also known as specific reading disability or specific reading disorder, developmental dyslexia accounts for approximately 80% of all learning disabilities (3). Evidence from cross-sectional and longitudinal studies indicates that children with reading difficulties, compared to typical reading peers, are at an elevated risk for mental health concerns, encompassing both internalizing and externalizing symptomatology (4). Specifically, they may experience social difficulties (e.g., withdrawal from social situations, shyness in interactions), emotional problems (e.g., anxiety, confusion, stress, nervousness, or fear during reading), behavioral challenges (e.g., inability to complete tasks, difficulty organizing time and materials), psychosomatic symptoms (e.g., headaches or dizziness), or psychomotor coordination problems (e.g., avoiding activities requiring movement or balance) (5). Beyond defining dyslexia, several theoretical frameworks have been proposed to explain its underlying mechanisms. The phonological processing theory posits that deficits in phonological awareness, phonological memory, and phonological retrieval constitute the core of dyslexia; children affected by these deficits often struggle with decoding and word reading (6). The rapid automatized naming (RAN) theory emphasizes the importance of retrieving verbal information from memory at a rapid speed, suggesting that slower retrieval predicts reading difficulties (7). In addition, the dual-route model of reading proposes that reading operates through two main pathways—graph-phonemic and lexical—and that impairments in either route can result in reading difficulties (8). The diagnosis of learning disabilities typically occurs after children have begun formal education; therefore,

elementary school represents a critical period for literacy screening and early intervention to identify potential reading difficulties and mitigate associated risk factors (9). Manifestations of dyslexia vary across developmental stages. Up to age four, language development is the strongest predictor of later reading performance; between ages four and five, phonological awareness becomes the dominant predictor; and with the onset of literacy, rapid automatized naming increasingly predicts reading fluency (3).

Dyslexia is relatively prevalent, though its reported prevalence ranges from 5% to 17.5%, reflecting variability due to multiple factors. Differences in operational definitions, such as using 1 or 1.5 standard deviations below the age-specific reading mean, can affect prevalence estimates (10). Population-based studies, such as one conducted in Rochester, Minnesota, reported cumulative incidences of reading difficulties ranging from 5% to 11% (11). Studies in different countries have shown varying prevalence rates of dyslexia, ranging from 3.5% in Italy to 17% in India (12, 13). In several Asian cities, such as Qianjiang, Shantou, and Mysore, the reported prevalence has varied between 3.9% and 13.7%, with boys consistently showing higher rates than girls (14-16). Similarly, in Saudi Arabia, the prevalence among male students was found to be almost twice that of female students (5). In Iran, the reported prevalence of dyslexia ranges from 6% to 10%, with most studies indicating that boys are more frequently affected than girls (17, 18). A combination of individual, environmental, and linguistic factors influences the prevalence of dyslexia. Regarding age, this disorder typically becomes evident during the early years of reading instruction. Longitudinal studies have shown that early differences in language skills and rapid naming in preschool can predict later reading outcomes, highlighting the importance of early identification and intervention (19). Regarding gender, recent evidence suggests that although boys are more frequently diagnosed, observed differences may be influenced by parenting and caregiving practices rather than biological factors, as supportive home literacy environments reduce dyslexia symptoms in both sexes (20). Environmental factors, including low home literacy, lower socioeconomic status, and prenatal stress exposure, have also been identified as risk factors (21).

Despite the early detectability of dyslexia, diagnosis often occurs in the second or third grade or later, delaying effective reading instruction and contributing to academic underachievement. Evidence suggests that cognitive and language-based interventions implemented during preschool and first grade yield the most significant improvements in reading abilities and can help prevent long-term adverse outcomes (22). In Iran, research on the prevalence of dyslexia remains limited, and standardized diagnostic tools are scarce. Furthermore, the specific characteristics of Persian, including phonological and orthographic complexity, as well as the challenges associated with bilingualism, complicate the accurate assessment and design of interventions (23).

Considering that students with learning disabilities comprise more than half of all students with special needs, planning for early identification and support is essential (24). Given these issues, the present study aimed to estimate the prevalence of dyslexia among third- to fifth-grade students in Ardabil and to examine gender differences in the severity of the disorder. The findings are expected to provide a foundation for targeted educational interventions, inform longitudinal research, and enhance understanding of the developmental trajectories and psychological and academic consequences of dyslexia.

Methods

This study was conducted in Ardabil city, located in Iran, with a population of 1,270,420. The research method employed a descriptive-cross-sectional study. The statistical population consisted of all female and male students studying in the third, fourth, and fifth grades of elementary school in Ardabil during the 2023-2024 academic year.

The sampling method was multistage stratified. The sample size was calculated to be 1,162 people with 95% confidence and 0.87 power, using G*Power software. After receiving the ethics code and a referral letter from the Ardabil Education Organization, the necessary permit to enter the elementary schools in the two Ardabil districts was obtained, and schools were randomly selected from among these districts. Considering the total number of students in this period from the two educational districts, six schools were

purposefully selected from each district. Then, from each school, all students in grades 3, 4, and 5 who had no sensory impairments (such as visual and auditory impairments) and no motor impairments (such as cerebral palsy) were selected. All participants gave their informed consent before participating in the study. This study was conducted in accordance with the doctoral dissertation protocol, which was approved by the Research Ethics Committee of Mohaghegh Ardabili University (number: IR.UMA.REC.1403.051).

Materials

Demographic Questionnaire

This questionnaire was developed by the researcher to investigate demographic characteristics such as age, gender, grade level of the student, parents' education, and parents' occupation.

Nama Reading and Dyslexia Test

This test was developed by Karami Nouri and Moradi (25). Its reliability and factorial validity were examined by Moradi *et al.* in 2015 on 1,614 students (both male and female) across five grades in Sanandaj, Tabriz, and Tehran.

Raw scores and normative scores were calculated for each grade in each city. This test is designed to identify students with dyslexia and assess their reading performance. The test comprises 10 subtests: Reading Words, Word Chain, Rhyme, Picture Naming 1, Picture Naming 2, Reading Comprehension, Word Comprehension, Phoneme Deletion, Non-word Reading, and Signs/Category.

The cut-off point for dyslexia is 157; students scoring 157 or less (equivalent to 114 or more errors) are classified as dyslexic. Correct answers are determined according to the standardized scoring tables. Cronbach's alpha coefficients for the subtests were as follows: High-Frequency Words 0.97, Medium-Frequency Words 0.98, Low-Frequency Words 0.98, Word Chain 0.95, Rhyme 0.89, Picture Naming 1 0.67, Picture Naming 2 0.68, Reading Comprehension 0.48, Word Comprehension 0.71, Phoneme Deletion 0.95, Non-word Reading 0.95, and Pseudo-words 0.97 (26).

Raven's Progressive Matrices

Raven's Progressive Matrices is a nonverbal intelligence test developed by Raven in 1956. The test

contains 36 items, each presenting a partially incomplete diagram. Participants select the piece from a set of options that correctly completes the central diagram.

Percentage scores are calculated based on the participant's age and the total number of correct responses, as outlined in the scoring table. The test's validity, in correlation with the fourth edition of the Wechsler Intelligence Scale for Children, has been reported as 0.86, and its reliability ranges from 0.83 to 0.93. In the study by Poulton et al. (27), the reliability and validity of this test were reported to be 0.93 and 0.83, respectively.

Data Analysis: Descriptive statistics, including mean and standard deviation, were calculated. Frequencies and percentages were used to describe the prevalence of dyslexia. The difference in dyslexia prevalence between male and female students was examined using a test of significance for two independent proportions. Differences among the four educational districts of Ardabil were analyzed using analysis of variance (ANOVA) in SPSS version 22.

Results

Out of the 1,162 primary school students from grades 2–5 and their parents who were invited to participate in the study across twelve selected schools, 46 students were absent, and 64 had incomplete questionnaires.

Fifteen students were excluded because their IQ was lower than 75. Additionally, 15 students were excluded due to Students with hearing, visual, and brain impairments. After these exclusions, the final analysis included a cohort of 1,029 students. Out of 1,029 students, 910 students were excluded from dyslexia screening because they were not in the lowest 25% of their class's Iranian test results. Eventually, 252 students were eligible for dyslexia screening. Seventy-four students (5.9%, 95% confidence interval [CI]: 4.9–6.9%) were identified as dyslexic by the NAMA test (Figure 1).

The findings showed that the average age of the dyslexic group was 9.36 for girls and 9.72 for boys. In terms of socioeconomic status, 27% reported being well-off, 52% identified as middle class, and 21%

reported being low-income. According to parent reports, 39.1% of people with dyslexia had a family history of dyslexia. The average IQ of individuals with dyslexia was 91.7, with a standard deviation of 6.72. Table 1 presents the abundance and percentage of the initial sample group by gender and grade level.

As shown in Table 1, the sample group consisted of 1,162 individuals, comprising 578 girls and 584 boys. In terms of grade level, the groups were also relatively equal.

Table 2 shows the prevalence of dyslexia by grade level and gender based on the Nama test.

The results from Table 2 indicate that, according to the Nama test, a combined 6.77% of girls in the third grade, 5.01% in the fourth grade, and 3.44% in the fifth grade were diagnosed with dyslexia. Among boys, the corresponding figures were 8.99%, 7.14%, and 6.03% for grades 3, 4, and 5, respectively.

Overall, the findings revealed that 36% of the entire sample exhibited dyslexia. To compare the means and standard deviations between the groups of boys and girls, an analysis of variance (ANOVA) was conducted (Table 3 and 4).

Table 3 presents the mean and standard deviation of reading performance for the dyslexic group, categorized by gender. The findings indicate that the mean and standard deviation of reading performance were 123.96 and 5.93 for female students, and 118.72 and 5.05 for male students, respectively. Table 4 presents the results of the analysis of variance (ANOVA) for reading performance between male and female students.

To examine the assumptions of ANOVA, including the homogeneity of variance, Levene's test was employed. The results showed that none of the components of dyslexia were significant ($p > 0.05$), indicating that the variances of the two groups were equal. Furthermore, the Kolmogorov-Smirnov test was also non-significant for all components ($p > 0.05$), suggesting that the distribution of the variable was normal in both genders. As shown in Table 4, female students significantly outperformed male students in the components of word reading, rhymes, word comprehension, letter sounds, category sounds, and overall reading performance. Table 3 indicates that boys had more difficulties with dyslexia.

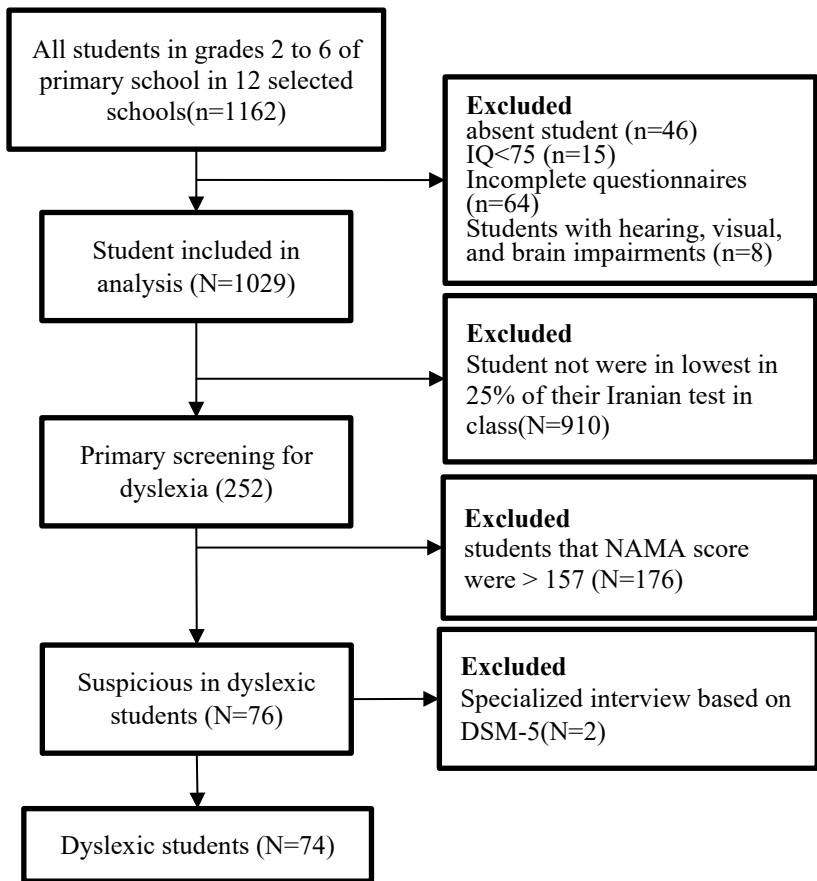


Figure 1. Screening dyslexia flowchart. IQ, intelligence quotient; NAMA, Nama Reading and Dyslexia Test; DSM-5, Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition

Table 1. Abundance and Percentage of the Initial Sample Group by Gender and Grade Level

Total Sample group	Gender	Grade Level	Frequency	Percentage
	Girl	Grade 3	192	33.21
		Grade 4	183	31.66
		Grade 5	203	35.21
		Total	578	100
	Boy	Grade 3	189	32.36
		Grade 4	196	33.56
		Grade 5	199	34.07
		Total	584	100
Total			1162	

Table 2. Frequency, Percentage, and Prevalence of Dyslexia by Gender and Grade Level Based on the Nama Test

Dyslexia	Gender	Grade Level	Frequency	Percentage
	Girl	Grade 3	13	6.77
		Grade 4	11	6.01
		Grade 5	7	3.44
		Total	31	5.36
	Boy	Grade 3	17	8.99
		Grade 4	14	7.14
		Grade 5	12	6.03
		Total	43	7.36
Total			74	6.36

Table 3. Mean and Standard Deviation of Nama Test and Its Components by Gender.

Subtest	Gender	M	SD
Total Reading Score	Girls	123.96	5.93
	Boys	118.72	5.05
Word Reading	Girls	31.64	1.94
	Boys	30.37	1.79
Word Chains	Girls	9.70	1.67
	Boys	9.25	1.38
Rhymes	Girls	4.16	0.93
	Boys	3.62	0.57
Picture Naming	Girls	7.45	1.31
	Boys	16.95	1.06
Text Comprehension	Girls	6.87	1.21
	Boys	6.25	1.17
Word Comprehension	Girls	6.83	1.21
	Boys	6.25	1.17
Phoneme Deletion	Girls	4.81	1.24
	Boys	4.93	1.09
Nonword Reading	Girls	12.85	2.42
	Boys	12.93	0.91
Letter Sounds	Girls	5.19	1.15
	Boys	4.65	0.84
Category Sounds	Girls	26.41	1.58
	Boys	25.30	1.69

Table 4. Analysis of Variance of Mean Scores on the Nama Test and Its Components.

Dependent variable	Sum of squares	df	Mean square	F	P
Word reading	29.19	1	29.19	8.43	0.005
Word chain	3.71	1	3.71	1.62	0.20
Rhymes	5.12	1	5.12	9.17	0.003
Picture naming	4.47	1	4.47	3.23	0.07
Text comprehension	3.31	1	3.31	2.43	0.12
Word comprehension	6.12	1	6.12	4.30	0.04
Phoneme deletion	0.24	1	0.24	0.18	0.67
Nonword reading	0.09	1	0.09	0.03	0.85
Grapheme-phoneme correspondence	5.36	1	5.36	5.53	0.02
Category cues	22.47	1	22.47	8.23	0.005
Reading performance	495.28	1	495.28	16.72	0.001

Discussion

The present study revealed a dyslexia prevalence of 6.36% (5.36% among girls, 7.36% among boys) based on the NAMA test. The male-to-female ratio was approximately 1:1.37 in favor of boys, indicating a higher risk among males. The observed gender difference is consistent with many epidemiological reports that document a higher prevalence of dyslexia in boys than in girls (13). Some suggest that this discrepancy may partly reflect referral or selection biases in school-based samples (22), particularly when identification depends on teacher referrals or

classroom performance. Nevertheless, our findings align with a broader view that sex-related biological and neurodevelopmental factors may contribute to the disparity. At a neurogenetic level, variants in the CNTNAP2 gene have been linked to sex differences in dyslexia (28). Krafnick et al. (29) also review sex differences in brain activation and structure underlying reading, supporting the notion that differential neural organization (e.g., hemispheric lateralization) might underlie gendered vulnerability to reading difficulties. Moreover, genome-wide association studies suggest that dyslexia is a highly polygenic trait, with little evidence for sex-specific genetic architectures (i.e., the

genetic etiology appears broadly shared across sexes) (30). Thus, the gender gap may stem not from wholly different causal genes but from sex-linked modulation of expression (e.g., hormonal, epigenetic, or neurodevelopmental timing effects). We also found that the prevalence of dyslexia decreased with advancing grade (from grade 3 to grade 5) in both sexes. This trend might suggest compensatory development, whereby children gradually improve through practice, instruction, or remediation in reading, thus reducing disadvantage by later grades. This observation aligns with findings by (13) that showed a higher prevalence in lower grades than in higher ones. However, other studies have found no clear association between grade or age and the prevalence of dyslexia (19). The discrepancy might arise from differences in screening criteria, reading curricula, or cumulative exposure to instruction. In our sample, girls significantly outperformed boys on several reading-related measures: word reading, rhyme, word comprehension, letter sounds, category sounds, and total reading score (ANOVA results). These differences indicate not only a prevalence disparity but also a performance disparity in underlying reading processes. This pattern suggests that even among dyslexic children, sex moderates the severity of deficits in phonological, lexical, and semantic processing domains. From a theoretical standpoint, the multiple-deficit model of dyslexia posits that reading disorder emerges from the interaction of cognitive risk factors (e.g., phonological awareness, rapid naming, and orthographic processing) with domain-general abilities (e.g., executive control and processing speed). In our sample, sex differences in performance may reflect differential weighting or compensation across these component skills. For instance, girls may rely more on semantic or contextual cues to compensate for phonological deficits, whereas boys may show a more “pure” phonological weakness.

Our prevalence estimate (6.36%) is somewhat lower than specific earlier Iranian reports (10%) (14) but comparable to the lower bound of international estimates (5–7%). The variation across Iranian studies likely stems from divergent screening instruments, cutoffs, and sampling frames—some may have overestimated by including mild reading lag rather

than apparent dyslexia. Our stricter algorithm (the lowest 25% in class plus NAMA confirmation) likely yields a more conservative, yet more specific, estimate. Compared to English-speaking contexts, the prevalence of dyslexia is often reported to be between 5% and 12%, depending on the criteria and orthography used. Our estimate falls within that lower to middle range, which is plausible for a semi-transparent orthography like Persian. Recent large-scale genetic work (30) supports the notion that dyslexia’s genetic architecture is broadly consistent across languages, although the effect sizes of specific variants may differ by orthographic depth. Regarding gender disparities, our male-to-female ratio is more modest than some studies (which report 2:1 or 3:1), possibly because of our universal screening approach rather than clinic-based referrals (which may exacerbate male overrepresentation). Our results support the notion that the male predominance is real but may be exaggerated in biased samples.

Given that about 1 in 16 children (6.36%) in our screened sample were classified as dyslexic, implementation of routine universal screening in early elementary grades is justified. Early identification allows timely, evidence-based interventions (such as phonics instruction, structured literacy programs), which are known to improve reading outcomes and self-esteem. From an educational policy standpoint, embedding dyslexia screening protocols within school systems (rather than relying on ad hoc teacher referrals) can reduce bias, ensure equity, and allocate resources to students who would otherwise be overlooked. Clinically, awareness should be raised among psychologists, speech-language pathologists, and special educators to adopt a multi-component diagnostic algorithm, as we have done, rather than relying solely on single reading tests. Furthermore, differentiated interventions may be required for boys and girls, given sex differences in component deficits. Parent training is also crucial: educating caregivers about early warning signs (e.g., phonological awareness, letter knowledge) and engaging in interactive reading at home can foster literacy skills before significant reading failure occurs.

Strengths of this study include a large initial sample size ($N = 1,162$) and rigorous exclusion criteria for sensory or neurological impairments, thereby increasing internal validity. Use of a multi-stage screening

algorithm (class-level bottom quartile + confirmatory test), which enhances specificity and reduces false positives. Diagnosis confirmation by trained professionals reduces measurement bias. Attention to gender and grade-level analyses allows for nuanced insights into moderating factors.

Limitations include:

1. Geographic limitation: The study was conducted in a single city (Ardabil), which limits its generalizability to other regions or linguistic groups in Iran.
2. Cross-sectional design: We cannot infer developmental trajectories or causal factors; longitudinal studies are needed to confirm compensatory gains over time.
3. Lack of control for socioeconomic or academic performance covariates: These factors may confound results and should be included in multivariate models in future work.
4. Screening restriction: Only the lowest 25% in class were further evaluated, which may miss some dyslexic children whose reading is relatively better within a weak class environment.
5. Absence of neuroimaging or genetic data: We could not link behavioral data with neural or molecular correlates; future research should integrate cognitive, neurobiological, and genetic measures.

Conclusion

In summary, this study found a 6.36% prevalence of dyslexia among students in grades 3–5, with a higher risk in boys (7.36%) compared to girls (5.36%). Girls showed superior performance in several reading components, indicating that sex moderates both prevalence and severity. These findings corroborate some prior epidemiological and neurobiological studies while highlighting the need for local, rigorous screening methods. Given the persistent impact of reading difficulties on academic achievement and psychosocial outcomes, early and universal screening, as well as targeted intervention, are essential in school settings. Tailored intervention programs and training for teachers and parents can mitigate long-term consequences. Finally, ethical standards were maintained throughout: informed written consent was obtained from both parents and children; participant anonymity and confidentiality were protected in

accordance with the APA guidelines and Iranian psychological ethics codes (as you already stated). No conflicts of interest were declared, and the project was approved by the relevant institutional review board (or ethics committee).

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Conflict of Interest

The authors declare that they have no conflict of interest.

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