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Original articles

Reading habits of Czech and Brazilian university students with and without dyslexia

Monika Ptáčková[1]
https://orcid.org/0000-0002-8677-7026

Bruce Martins[2]
https://orcid.org/0000-0001-5000-1149

Katerina Lukasova[3]
https://orcid.org/0000-0002-1137-7298

[1] Palacký University Olomouc, Faculdade de Pedagogia, Olomouc, República Tcheca.

[2] Universidade de São Paulo, Faculdade de Medicina, Hospital das Clínicas - HCFMUSP, Laboratório de Ressonância Magnética em Neuro radiologia (LIM44), São Paulo, São Paulo, Brasil.

[3] Universidade Federal do ABC - UFABC, São Bernardo do Campo, São Paulo, Brasil.

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Corresponding address:
Kateřina Lukášová
Centro de Matemática, Computação e Cognição (CMCC),
Universidade Federal do ABC
Avenida dos Estados, 5001- Bairro Bangu
CEP: 09210-580 - Santo André, São Paulo, Brasil
E-mail: katerina.lukasova@ufabc.edu.br

ABSTRACT

Purpose: to compare, with Adult Reading History Questionnaire results, the reading habits of adults with and without dyslexia of different cultures and languages.

Methods: the research comprised 119 university students (60 Czechs and 59 Brazilians, half of them with dyslexia) assessed by responding to the self-report reading history questionnaire and taking a reading level test. ARHQ scores were compared between the groups and countries with the analysis of variance (ANOVA), and their correlation was assessed with the Spearman's test, both with the significance level set at $p < 0.05$.

Results: adults with dyslexia had lower reading habit scores and reading level scores than typical readers in both languages. Reading habits were positively correlated with reading levels in both languages. Regardless of the group, Brazilians had lower reading habit scores than Czechs.

Conclusion: the results suggest that self-assessing reading habits is an effective way to screen for reading disorders. However, cultural and school factors must be considered.

Keywords: Reading; Dyslexia; Adult; Self-Testing

INTRODUCTION

Dyslexia is a specific learning disorder, whose estimated prevalence ranges from 5 to 15%, according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), of the American Psychiatric Association (APA)[1]. Although the specific reading disorder (dyslexia) is mainly diagnosed in childhood when it begins interfering with the process of learning to read and write, its symptoms may persist into adulthood. Moreover, many adults with dyslexia have never been diagnosed due to the lack of knowledge of this pathology and access to assessments when they were children. Hence, any estimates of its prevalence in adults can be imprecise.

Currently, the main way to assess and diagnose reading disorders in different periods of life involves psychological and neuropsychological tests that examine reading and writing, language, phonological awareness, memory, and other related skills that determine the cognitive profile of readers and their deviation from the norm. These assessments are effective when applied and scored by experienced professionals using instruments validated in their country[2,3]. However, assessing with these tools can take too long and be expensive, and their results may be influenced by factors such as the mental and emotional state at the moment of examination and the examiner's subjectivity.

Scientific studies report eye-screening methods that aim to show differences in eye movements between people with dyslexia and readers with typical performance in various activities. These tools are complementary and can provide more objective behavioral data, although they are still incipient as a means of clinical diagnosis. RADAR[4] is one of these tools available in English, which uses eye screening in 8-to-12-year-old children while they read texts to identify those with dyslexia, with a 94% sensitivity.

Another approach to assess reading disorders and identify dyslexia indices is with self-report inventories. These are less affected by the clinical examiner's experience or factors caused by the long testing (such as tiredness) and are usually rather accessible and effectively filled out. Their disadvantages include possible divergences between self-perception and external assessments (e.g., with a test), whose results are compared with a norm regarding the general population. Moreover, specific groups may have less self-assessment and self-perception capacity – such as children[5] or people with low educational attainments[6]. Thus, self-report tools can be used more effectively as screening tools, which identify the signs of a disorder to be later clinically assessed in adolescents and adults[7].

Tools for the self-assessment of reading difficulties in adulthood usually have multiple questions on their reading activity performance and experience, in a range of formats and lengths. It is important to validate tools in their cultural and linguistic context, which is also often done for clinical groups. For instance, Gimenez et al.[8] used the Spanish tool ATLAS and reported its good validity and reliability. Self-assessment questions are often used as part of larger screening procedures as well, such as the Multiple Diagnostic Digital Dyslexia Test, a Dutch tool for adult assessment[9]. A somewhat different approach is presented by the International Dyslexia Association (IDA), which provides quick self-report tools on its website (www.dyslexiaida.org)[10]. These tools aim to help visitors assess whether they have any indication of dyslexia or other reading disorders, which may point to the need for seeking professionals for a clinical diagnosis. IDA also furnishes schoolchildren tools, which are partly answered by their parents to estimate the risk of dyslexia in preschoolers. Part of such questions was taken from another adult tool, the Adult Reading History Questionnaire (ARHQ)[10].

ARHQ is a tool meant for adults with suspicion of dyslexia, originally based on the reviewed version of the Reading Questionnaire[11], published by Lefly and Pennington[12]. The authors demonstrated the relevance of the tool and its good test-retest validity and reliability in adults[12]. ARHQ had good results in reliably identifying people with and without reading difficulties – the total questionnaire score can estimate the level of risk of the specific reading disorder, although it is not indicated to be used alone to diagnose dyslexia[13].

The questionnaire has 23 to 26 questions mainly on school performance, memory, and reading habits[14]. The number of items varies from country to country, according to specific culturally and linguistically determined symptoms. For instance, a question on problems learning a second language was omitted in the American version because many participants had no contact with a second language and left the item unanswered[12]. In European countries, on the other hand, bilingual experiences are very common. Differences can also be found in some medical history questions, even though they are usually not included in the total score. The questionnaire is structured as a 4-point Likert scale, ranging from 0 (no problems) to 4 (great problems). In the original English version, total

scores higher than 39 for women or 42 for men indicate a significant risk of the specific reading disorder[15].

In recent years, ARHQ has been translated and assessed in various countries. The 2018 Swedish version (ARHQ-vux) is probably one of the most recent ones[16]. The Polish version (ARHQ-PL) for students can also be mentioned; it has been revised because some questions seemed to be outdated, according to the authors[13]. As previously said, there are also modified versions due to cultural and educational differences between the various countries – for example, an item was omitted in the Icelandic version[17]. The Czech version (ARHQ-CZ) has been used since 2014[18].

There is also a brief version (ARHQ-Brief), published by Feng et al.[14], which has only six items chosen based on factorial analyses of the questionnaire – the main items are related to dyslexia symptoms and current reading habits. This quick version of the assessment proved to have good sensitivity and specificity to identify adults with dyslexia. The factorial structure of ARHQ has been at the center of interest in some languages. The Icelandic study[17] identified three essential factors: dyslexia symptoms, current reading, and memory – most items on the scale (12 items) relate to dyslexia symptoms. The comparison of total scores within each factor between adults with and without dyslexia showed a significant difference in all of them, with internal consistency higher than 0.80 in Cronbach's alpha[17]. Welcome and Meza[19] identified six factors in 19 items: childhood reading, spelling, reversal, memory, current reading attitude, and print media use.

The Portuguese version of ARHQ was created by Alves and Castro[20], motivated by the lack of validated instruments to identify dyslexia in adults from Portugal. The questionnaire was translated from the English version and adapted to meet linguistic and cultural specificities. The internal validation and consistency were satisfactory, and the questionnaire distinguished well clinical from non-clinical groups of adults. The Portuguese version has already been used in a Brazilian study, but no report of its validation has been found. Medeiros[21] reported using ARHQ as a complementary measure to characterize the educational profile of students with dyslexia attending the *Universidade Federal do Rio Grande do Norte* (UFRN).

ARHQ was applied as part of a larger study on Czech and Brazilian university students with and without dyslexia to distinguish reading habits in different languages. The previous hypothesis was that ARHQ administered to high-performance populations comprising university students would distinguish well people with dyslexia from those without it and would have a similar performance in both countries. Some differences in ARHQ scores were expected because of linguistic differences, as Czech is a regular language and Portuguese is a semi-regular language regarding spelling, with a greater disadvantage to Portuguese.

METHODS

Participants

This is a cross-sectional study with data collected from four groups of adults – two groups had subjects diagnosed with dyslexia (one Brazilian and the other Czech) and two control groups (one Brazilian and the other Czech). Data were collected in the Czech Republic and Brazil to better assess the influence of cultural and educational factors on the instrument being evaluated. All participants signed an informed consent form, approved by the respective Ethics Committees of the *Universidade Federal do ABC* (Brazil; number 089/11) and *Universidade Palackého Olomouc* (Czech Republic, number 6/18). Data were collected in both countries between 2018 and 2020.

Adult Czech (N = 60; mean age = 23.55; SD = 3.00; men = 30; people with dyslexia = 31) and Brazilian readers (N = 59; mean age = 25.10; SD = 5.76; men = 24; people with dyslexia = 18) participated in this study. The inclusion criteria were as follows: being an undergraduate student or having a bachelor's degree and being a native speaker of their respective language. Also, for the experimental group, they had to be diagnosed with dyslexia by an accredited professional or institution, qualified to this end. For the control group, it was verified whether they had no diagnosis, complaints of learning disorders, or any other self-reported academic difficulties. The exclusion criteria were the following: history of traumatic brain injury, substance abuse, and history of neurological and/or psychiatric diseases.

All participants were submitted to the neuropsychological test battery (whose report is not an objective of this publication) and filled out a questionnaire on reading. The tests assessed their intelligence, text reading, writing, sustained attention, working memory, and rapid automatized naming. The control group scores in the tests did not indicate any deviation from normality.

Instruments – Questionnaires

ARHQ, Czech version (ARHQ-CZ)

The questionnaire, created and tested by Jira[18], has 23 items set in the same order as the English questionnaire[15]. In each item, participants must check a number from 0 to 4, according to their assessment in response to the statement. The data obtained from administering the instrument to 157 Czech readers identified three main factors (reading skills, reading habits, and memory), and Cronbach's alpha was 0.95 – which indicates good consistency of the instrument, corresponding to the results obtained by Lefly and Pennington[12]. The present study used the total score and asked the medical history questions as well, which precede the questionnaire but are not scored. It was administered as described by Jira[18].

ARHQ, Portuguese version (ARHQ-PT)

The questionnaire was adapted to European Portuguese by Alves and Castro[20] and used in Brazil by Medeiros[21]. Unlike the Czech version, it has 25 items because two items were included to meet language specificities. As in other languages, the answer is given on a scale from 0 to 4, according to their assessment in response to the statement. The study used the total score, calculated by summing the scores, but excluding the additional two items that differ it from the Czech version.

Instruments – reading assessment

Reading was assessed with instruments validated for the language of each country. Since there is no valid test for both languages – Czech and Brazilian Portuguese –, the study used different instruments, which however can estimate with reliable measures each participant's reading level.

Pseudoword reading (Czech version)

The pseudoword reading task was taken from DysTest[22], a diagnostic battery for adults. It is commonly used in the Czech Republic, usually in university students. The task was created by Matějček, Štruma, and Vágnerová[23] and has 170 pseudowords conceived according to the Czech phonetic rules. The pseudowords were read aloud, obtaining the total correct reading score in the first, second, and third minutes of the test, which resulted in metrics related to the estimated reading speed (total words read per minute) and precision (total words correctly read/total words read).

International Reading Speed Texts (IReST[24]), Brazilian Portuguese version[25]

The test was developed in Germany to create a tool that assessed text reading skills in different languages. It has 10 short texts taken from a 9-to-11-year-old-child encyclopedia and other sources in the German school curriculum, with low-difficulty passages. Although intended to assess adolescents and adults, texts with low comprehension difficulty were chosen to prevent the reader's intellectual level and overall knowledge from influencing reading quality and comprehension. The texts translated and adapted into Portuguese have an average of 813 characters. The texts were presented in sequence, and participants were asked to read them aloud, as fast as possible, making no mistakes. The total reading time for each text was timed, and the reading speed was calculated by dividing the number of words correctly read by the time.

Procedures

All Czech and Brazilian participants underwent similar procedures. The reading test was taken in one

session, along with other neuropsychological tests and magnetic resonance imaging (not reported in this study).

It was applied individually between a participant and an administrator in a silent room; the neuropsychological tests took about 90 minutes. The time to fill out the ARHQ was not limited, taking about 5 minutes, and all participants were free to ask any questions they had about the questionnaire. In Brazil, ARHQ was administered online, via Google Forms, with a link sent to participants via e-mail or WhatsApp. The administration had to be changed because the Portuguese version was not yet available at the beginning of the project, which was interrupted by the COVID-19 pandemic.

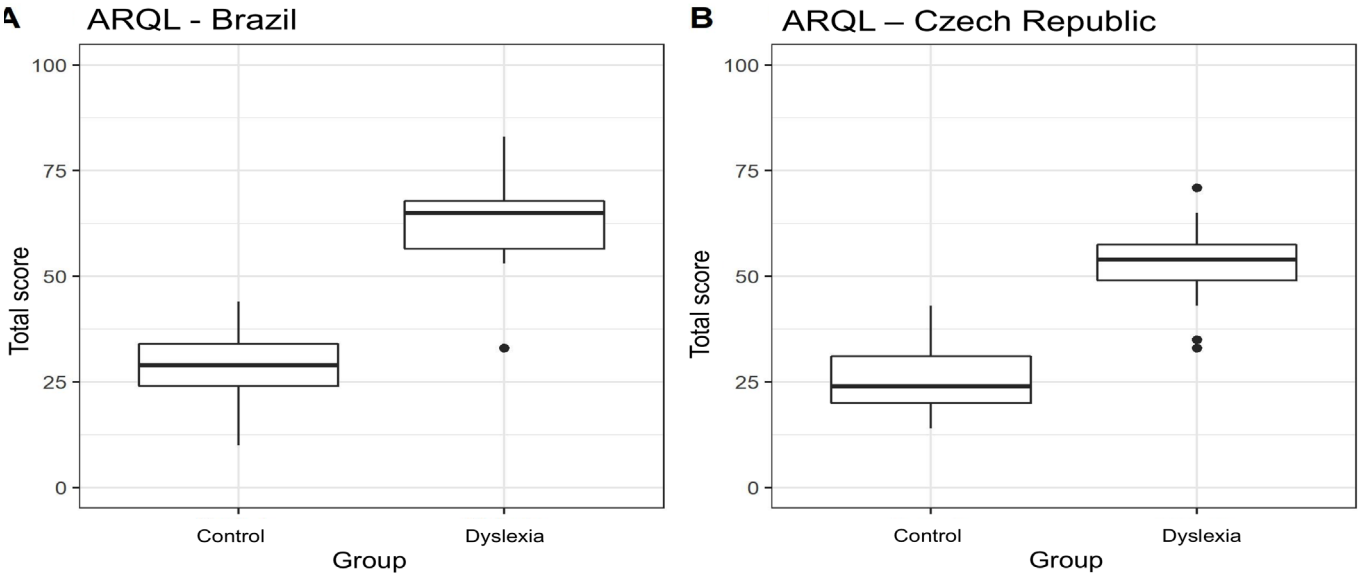
The total ARHQ score was calculated by summing all items checked by participants on the scale (higher scores suggest a greater risk of reading problems). No unanswered or invalid items were detected.

Data analysis

ARHQ scores were tested for differences between the groups (university students with and without dyslexia) in each country and between the countries with the independent samples t-test. ARHQ item scores were summed within theme groups adapted from the Icelandic study[17], such as dyslexia symptoms, memory, and school achievements. The grouped item scores were compared between the groups with the analysis of variance (ANOVA) for group (dyslexic vs. control) and country effect (Brazilians vs. Czechs). The study also analyzed the correlation between scores in ARHQ and performances in the pseudoword reading (Czech group) and text reading tests (Brazilian group) with the Spearman correlation coefficient. The analyses were performed using R[26] programming language with the graphic interface of R Studio[27] software.

RESULTS

Brazilian adults with dyslexia had higher ARHQ scores than their controls ($t = -12.20$; $DF = 24.80$; $p < 0.001$; $d = 3.68$). The same result was found in the Czech group ($t = -12.80$; $DF = 57.50$; $p < 0.001$; $d = 3.31$), as those with dyslexia had higher scores than the controls. The comparison between the countries showed higher scores in Brazil in both adults with dyslexia ($t = 6.20$; $DF = 28.10$; $p < 0.001$; $d = 1.90$) and controls ($t = 5.56$; $DF = 57.40$; $p < 0.001$; $d = 1.36$). The data are shown in Figure 1.



Scores in the Adult Reading History Questionnaire (ARHQ) in the dyslexic adult groups and control groups in Brazil (Chart A) and the Czech Republic (Chart B). The boxplots show the median, quartiles, and interquartile ranges in each group. The difference between the groups in both countries was $p < 0.001$.

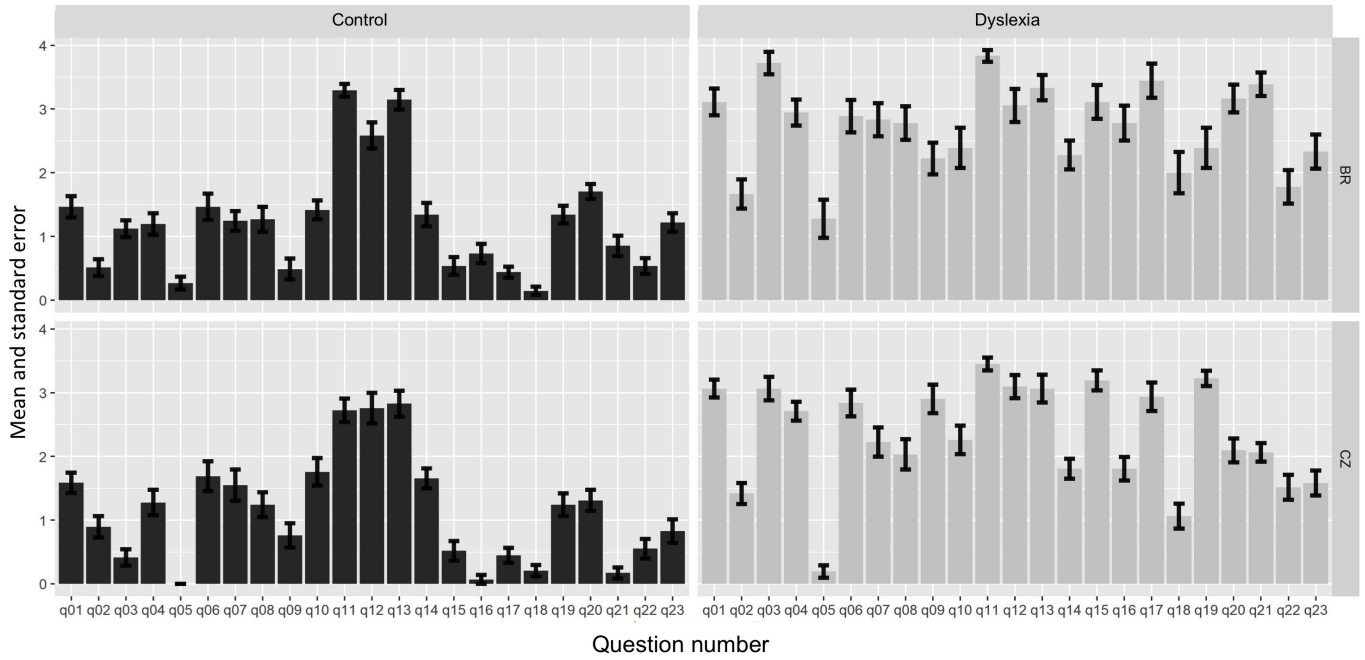
Figure 1. Scores in the Adult Reading History Questionnaire (ARHQ)

Given Brazilians' higher ARHQ scores, the scores of each question were described (Table 1). The means per group can be seen in Figure 2. It shows that items on dyslexia symptoms (ARHQ items 9 and 15 to 18) were scored as more impaired in adults with dyslexia (Brazilians and Czechs), which was likewise observed in the items related to memory (ARHQ items 6 to 8). The scores in dyslexia symptoms and memory items were summed and compared per group and country with ANOVA. The result showed a statistically significant difference for groups (with and without dyslexia), but no interaction was found for group and country (reading difficulty: $F[1.115] = 263.46$; $p < 0.001$; $d = 3.13$; memory: $F[1.115] = 42.02$; $p < 0.001$; $d = 1.24$). Items on school achievement were subject to the influence of cultural and school system differences. For instance, item 19 – which asked about the subjective assessment of reading performance in comparison with elementary school peers – was seen as more impaired by Czech dyslexics than Brazilian ones. ANOVA showed statistically significant interaction in this item for group and country, as Czech dyslexics scored higher than Brazilian ones ($F[1.115] = 6.73$; $p < 0.01$; $d = 1.56$). On the other hand, in item 5 – which asked whether the parents had considered the possibility of their children being held back a year due to school difficulties –, Czech dyslexics checked a minimum possibility, whereas Brazilian ones indicated it was considered. ANOVA showed statistically significant interaction in this item for group, country, and interaction for group and country, as Brazilian subjects scored higher than the Czechs ($p < 0.002$; $d < 0.90$).

Table 1. Questions in the Adult Reading History Questionnaire (ARHQ)

Number	Question
1	How would you compare your current reading speed to that of others of the same age and education?
2	How much reading do you do in conjunction with your work (if retired or not working, how much did you read when you were working?)
3	How much difficulty did you have learning to spell in elementary school?
4	How would you compare your current spelling to that of others of the same age and education?
5	Did your parents ever consider having you repeat any grades in school due to academic failure (not illness)?
6	Do you ever have difficulty remembering people's names or names of places?
7	Do you have difficulty remembering addresses, phone numbers, or dates?
8	Do you have difficulty remembering complex verbal instructions?
9	Do you currently reverse the order of letters or numbers when you read or write?
10	How many books do you read for pleasure each year?
11	How many magazines do you read for pleasure each month?
12	Do you read daily (Monday-Friday) newspapers?
13	Do you read a newspaper on Sunday?
14	Which of the following most nearly describes your attitude toward school when you were a child
15	How much difficulty did you have learning to read in elementary school?
16	How much extra help did you need when learning to read in elementary school?
17	Did you ever reverse the order of letters or numbers when you were a child?
18	Did you have difficulty learning letter and/or color names when you were a child?
19	How would you compare your reading skill to that of others in your elementary classes?
20	All students struggle from time to time in school. Compared to others in your classes, how much did you struggle to complete your work?
21	Did you experience difficulty in high school or college English classes?
22	What is your current attitude toward reading?
23	How much reading do you do for pleasure?

*The order of the questions is the same as that of the ARHQ Czech version

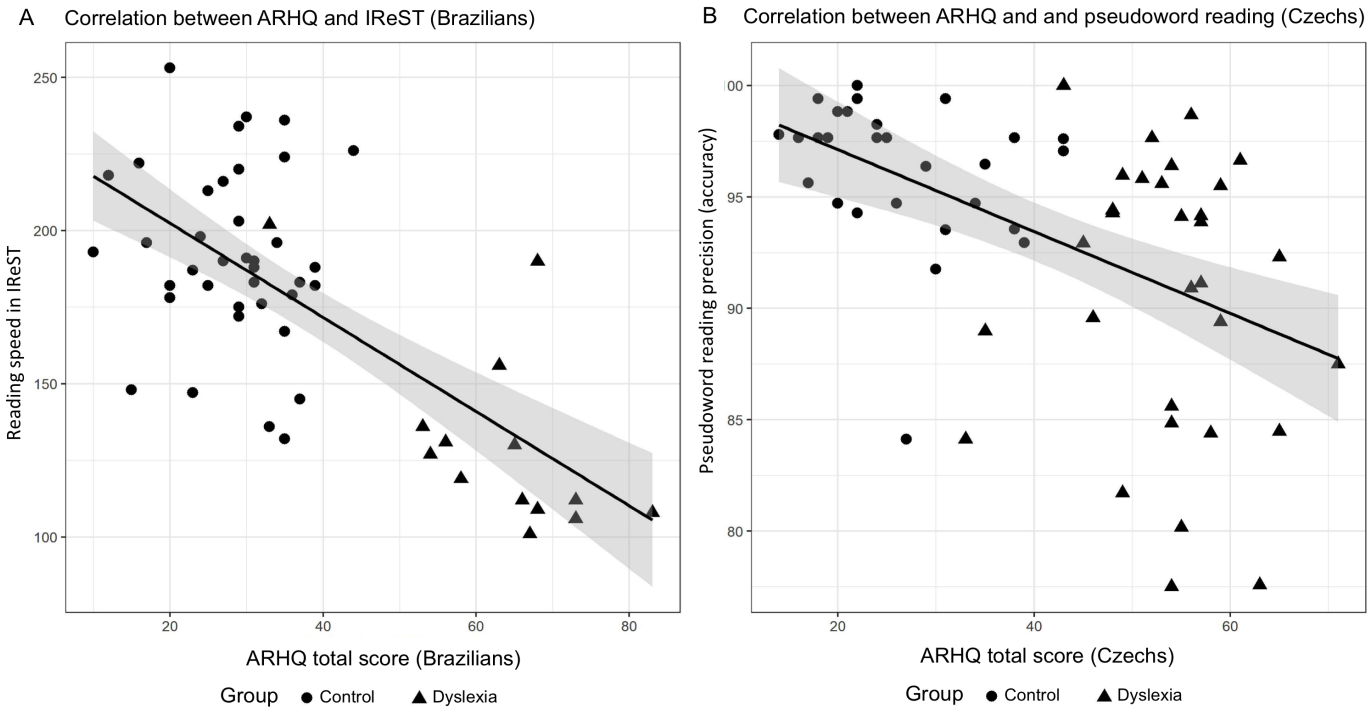


Mean score (and standard error) per ARHQ question, per country and group. Brazilians (upper charts) scored higher in some ARHQ items than Czechs (lower charts).

Figure 2. Mean and standard error per question of the control and dyslexia groups of both nationalities

The Pearson correlation was used to assess the relationship between reading habits and reading skills in each country. ARHQ scores were correlated with IReST (regarding Brazil [BR]) and the pseudoword reading test (concerning the Czech Republic [CR]), with two measures (reading speed and precision). The Pearson correlation was high and negative for both Brazilians and Czechs (BR: $r = 6.69$, $p = p < 0.001$; CR speed: $r = 6.58$, $p = p < 0.001$; CR reading precision: $r = 4.45$, $p = p < 0.001$). The correlations can be seen in Figure 3. The negative correlation between reading habits and reading skills shows that people with greater everyday difficulties in reading activities and with low self-perception also perform worse when asked to read pseudowords or texts.

Lastly, the reading measures were also compared with the t-test between the control and dyslexic groups in each country. In Brazil, controls performed better in IReST than the dyslexics ($t = 6.35$; $DF = 21.30$; $p < 0.001$; $d = 2.02$). In the Czech Republic, controls likewise performed better than dyslexics in pseudoword reading precision ($t = 4.60$; $DF = 45.80$; $p < 0.001$; $d = 1.18$) and speed ($t = 6.98$; $DF = 57.90$; $p < 0.001$; $d = 1.80$). This result was expected since reading difficulties are the main symptom of developmental dyslexia.



Correlation between total scores in the Adult Reading History Questionnaire (ARHQ) and reading speed in the International Reading Speed Test (IReST) regarding Brazilians (Chart A) and pseudoword reading precision regarding Czechs (Chart B).

Figure 3. Correlation between reading habits and reading skills

DISCUSSION

The quality of reading and writing in adulthood is rarely assessed in research, as indicated in a systematic review focused on anglophone countries that found only one study (out of 14) focused on adults (Sadusky et al.)[28]. Based on this result, the authors of the study suggested that reading difficulties in adulthood are underestimated by science and probably by clinical practice as well.

This study aimed to show the usefulness of the self-report tool in different languages (in Brazil and the Czech Republic) to assess reading skills in adults and distinguish them from people with reading disorders. The self-report tool scores were different between dyslexic and control groups in each linguistic domain, which points to the importance of self-report tools in the process of diagnosing dyslexia. On the other hand, the scores differed between the countries, indicating the need for validating and standardizing the instrument for it to be adequately used and its results properly interpreted in each linguistic, cultural, and school context.

This result is coherent with other international studies indicating that ARHQ has a good discrimination capacity for clinical groups in other linguistic adaptations. For example, the Icelandic version[17] has high sensitivity (84.5%) and specificity (83.7%) and a 43-point cutoff score. As shown in the results of the present study, some ARHQ items are probably more sensitive to linguistic characteristics and sociocultural factors of the country. Therefore, the cutoff must be estimated based on the representative sample of each country.

The benefits of using standardized tools on reading habits rather than homemade questionnaires are unquestionable in both research and clinical practice. ARHQ is commonly used in many languages and has proved to be an effective tool to both screen and help diagnose dyslexia.

Correlation results between ARHQ and reading tests are similar to the results in this research. In the original English study[12], the correlation between ARHQ total score and reading skills was moderate-to-high (0.57-0.7). The high-correlation results in the present study (r = approximately 7) indicate that using the questionnaire in combination with another reading assessment (word, pseudoword, or text reading) further increases the power to discriminate between good readers and those with difficulties. In realities such as the one in Brazil, where access to broad neuropsychological

assessment is difficult due to the time and cost it demands, ARHQ in combination with sensitive reading tests could be useful and reliable to initially screen and survey difficulties, decreasing the odds of later referrals, as done in other cultures (e.g., ARHQ-vux in Sweden[16] and ARHQ-PL in Poland[13]).

ARHQ factorial analyses in different languages show factors that describe reading habits, reading history, and memory problems. These seem rather stable in different linguistic cultures (e.g., Jira[18] in ARHQ-CZ and Bjornsdottir et al.[17] in ARHQ-Ice identified these three factors). Based on the results, the value of these factors can be discussed regarding countries with greater socioeconomic and school access variability – in Brazil, the results showed differences in aspects such as reading and short-term memory problems.

Furthermore, since it is a self-report tool, responses on reading impairment and subjective or external perception can be more sensitive to cultural factors and school practices. This was perceived in some questionnaire item results in the present study. For example, item 19 scored differently possibly because of a greater homogeneity in the performance of children who are learning to read and write in the Czech Republic, whose language has transparent spelling, the socioeconomic conditions are more leveled, and the method used in schools to teach to read and write is more synthetic. Contrarily, Brazil has a semi-transparent language, children from various socioeconomic levels, and methods to teach to read and write that are strongly influenced by the type of school the children attend and their families' realities. In this heterogeneous Brazilian context, children with signs of failure when learning to read and write are not as different from their peers. Also, the possibility of being held back a year is culturally unacceptable in the Czech Republic and rarely happens in its schools. In Brazil, however, retentions are more common and can occur for various reasons, including school difficulties.

An important aspect of this study is the specific research sample, which comprised only university students. Similar samples can be found in other studies, such as the Swedish[16] or the Czech one, by Jira[18]. Nevertheless, some differences must be pointed out between this high-performance sample and one with the general population. It can be assumed that this population belongs to a family context that values education; hence, since it is an important part of their personal lives, respondents may have been more sensitive to questions on their history of learning to read and write and school achievements. Sener[29] shared a profound view of the specificities of university students' reading habits. The author calls attention to the fact that different results could be obtained from assessing adults with different educational attainments. As observed in a study in convicts, reading disorder self-assessments have lower predictive validity in populations with lower educational attainments[6]. Nonetheless, ARHQ has been used as a self-assessment tool in different populations with different educational attainments – which requires further investigation[12].

In summary, this study showed that ARHQ is well capable of distinguishing reading disorders in university students who spoke either Brazilian Portuguese or Czech. The limitations of the study include the use of different instruments to assess reading levels, as Brazilians were assessed with text reading and the Czechs, with pseudoword reading. Due to this difference, it was not possible to directly compare the four groups' reading performance – although the correlation analysis showed similar relationships with ARHQ performance and reading levels. The lack of standardized and validated instruments in different languages is a problem in international studies. Another limitation is the educational level, which this study limited to people in higher education. To estimate the predictive validity of the instrument, future studies must broaden the sample to groups in other educational levels.

CONCLUSION

Comparing intercultural groups with ARHQ proved to effectively distinguish adults with dyslexia from those with typical reading and relate reading habits to reading fluency levels, despite their differences in language, culture, teaching styles, and educational systems. Subtle differences were found in questions regarding their self-assessment in the school setting and the functioning of the school system in each country.

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