European Journal of Contemporary Education
E-ISSN 2305-6746
2025. 14(3): 285-292
DOI: 10.13187/ejced.2025.3.285
https://ejce.cherkasgu.press

Gender and Mathematical Anxiety by Younger School-Age Children

Róbert Osaďan [a, *], Katarína Žilková [a], Anežka Hamranová [a], Ján Gunčaga [a]

[a] Faculty of Education, Comenius University Bratislava, Slovakia

Abstract

Studies on mathematical anxiety have long suggested a relationship between mathematical anxiety and gender. At the same time, the question arises whether mathematical anxiety is already present in younger school-age children. Previous research has shown inconsistent results, highlighting the need for further data. Therefore, the primary aim of this study was to determine whether mathematical anxiety occurs in younger school-age children and, if so, what the relationship is between mathematical anxiety and the gender of the children. Participants consisted of 257 fifth graders. Our results did not confirm the presence of mathematical anxiety in the studied sample of younger school-age children, nor did show a statistically significant difference between boys and girls in anxiety levels. The inconsistency in research results could also be explained by other variables that may affect mathematical anxiety. The presented results should serve as a basis for further research aimed at identifying factors that influence the development of mathematical anxiety and the specifics of its occurrence with respect to age categories.

Keywords: math anxiety, gender, primary education.

1. Introduction

The term mathematical anxiety was defined by Richardson, Suinn (1972) and characterized as “a feeling of tension that significantly interferes with the manipulation of numbers and the solving of mathematical problems” (Richardson, Suinn, 1972: 551). It also involves feelings of fear, worry, and/or anxiety with behavioural manifestations such as tension, frustration, helplessness, anxiety, and mental disorganization (Richardson, Suinn, 1972), which arise from mathematical stimuli (Ashcraft, 2002).

Scientists long believed that the onset of mathematical anxiety begins only after transitioning to upper elementary school, despite numerous accounts from adults who reported that their mathematical anxiety stemmed from early experiences with mathematics (Jackson, Leffingwell, 1999). The lack of data on mathematical anxiety in younger school-age children in the past was

* Corresponding author
E-mail addresses: osadan@fedu.uniba.sk (R. Osaďan)

likely due to studies that did not show any consistent relationship between mathematical anxiety and performance in elementary school (Dowker et al., 2012; Krinzinger et al., 2009), which may have led some researchers to doubt whether young children experienced mathematical anxiety and, if so, whether they were capable of describing their feelings. The ability of children to report experiencing mathematical anxiety is still a topic of professional discussion (Ashcraft, Krause, 2007; Vuković, Kieffer et al., 2013; Ganley, McGraw, 2016). However, recent research indicates that younger school-age children are capable of understanding and reporting their feelings of mathematical anxiety. Cognitive tests and interviews in several studies have shown that children have a good understanding of what it means to be nervous, anxious, or tense about mathematics (Ramirez et al., 2013; Vuković, Kieffer et al., 2013, Ganley, McGraw, 2016). Interestingly, even children at the very beginning of their schooling reported experiencing mathematical anxiety (Ramirez et al., 2013; Gunderson et al., 2017).

Studies comparing levels of mathematical anxiety between men and women indicate that women typically exhibit higher levels of mathematical anxiety than men (Miller, Bichsel, 2004; Devine et al., 2012; Ferguson et al., 2015; Jansen et al., 2016). Significant differences in mathematical anxiety have also been found among high school students, with girls reporting higher levels of mathematical anxiety than boys (Else-Quest et al., 2010; Goetz et al., 2013; Hill et al., 2016). In a study by Stoet et al. (2016) mathematical anxiety was measured among 761,655 high school students from 68 countries. The researchers found that female participants reported greater mathematical anxiety than male participants, and this difference was even larger in economically developed countries with higher levels of gender equality. Similarly, a study by Devine et al. (2012) on high school students shows that girls exhibit higher levels of mathematical anxiety than boys. Researchers in China also reached the same conclusion, finding that female high school students exhibited statistically significantly higher levels of anxiety than their male counterparts (Luo et al., 2008).

As the data suggests, the search for a relationship between mathematical anxiety and gender has been the subject of numerous studies in mathematical education. However, these studies do not arrive at definitive conclusions, which may be due to the application of various research tools. For example, Arigbabu et al. (2012) found in a sample of high school students in Nigeria that men are more anxious than women. The authors also note that the research results may have been influenced by recent awareness-raising in Nigeria, which educates and motivates women to take more mathematics courses. Other studies, however, indicate that there is no significant difference between the mathematical anxiety of men and women (Hamza, Helal, 2013; Keshavarzi, Ahmadi, 2013). Levels of mathematical anxiety among high school students in Malaysia also showed no significant difference between men and women (Zakaria et al., 2012). These research results suggest social and cultural determination, as residents of different regions show different results (Zhang et al., 2019). The finding that mathematical anxiety is observed worldwide (Barroso et al., 2021) and is more likely to occur in women and individuals with low income also supports the influence of social factors as a factor in mathematical anxiety (OECD, 2013).

It could be said that the relationship between gender and mathematical anxiety has not yet been definitively proven despite numerous studies, as the findings have been inconsistent. While there are many studies that have found significantly higher levels of mathematical anxiety in women compared to men, there are also many studies that show no gender-based differences in mathematical anxiety within the population. Additionally, there are several studies that have found higher levels of mathematical anxiety in men compared to women. Birgin et al. (2010) suggest that the lack of consistent gender effects may be due to mathematical anxiety not being consistently defined or measured.

Despite the ambiguous research results, some scientists continue to operate on the premise that mathematical anxiety is more common in women than in men. To this day, however, there is no definitive answer to the question of why women and girls should exhibit higher levels of mathematical anxiety compared to men.

Beilock et al. (2007) proposed a possible explanation, suggesting that the gender difference in reporting mathematical anxiety is a result of social stereotypes. This hypothesis is supported by research (Goetz et al., 2013), in which students were asked to describe their mathematical anxiety outside of a school setting. The result was that girls reported greater mathematical anxiety than boys. However, when researchers gathered information from students about their mathematical anxiety in real-time during a math test, girls did not exhibit more symptoms of anxiety than boys. Further research revealed that mathematical anxiety was higher among students with low

mathematical self-esteem and those who endorsed the traditional gender stereotype that mathematics is traditionally a male-dominated field (Bieg et al., 2015).

The question of whether gender differences in mathematical anxiety occur in primary school children remains unanswered. Of the few studies conducted, most have found no differences between genders in reporting mathematical anxiety (e.g. Gierl, Bisanz, 1995; Vukovic et al., 2013; Newstead, 1998; Punaro, Reeve, 2012; Ramirez et al., 2013; Young et al., 2012). However, some studies indicate that girls already exhibit higher levels of mathematical anxiety than boys at the primary school age (e.g. Griggs et al., 2013; Yüksel-Şahin, 2008).

2. Discussion and results

Research objectives and research design

We sought to answer the following research question: Does gender significantly affect levels of math anxiety among primary school children?

Research hypotheses:

H_0: There is no statistically significant difference in the level of mathematical anxiety between boys and girls.

H_1: There is a statistically significant difference in the level of mathematical anxiety between boys and girls.

Theoretical background: The research is grounded in the cognitive-affective model of math anxiety (Ashcraft, 2002), which views anxiety as an emotional reaction interfering with cognitive processing. Additionally, elements of social role theory (Eagly, 1987) provide a framework for interpreting potential gender differences in anxiety experiences.

The aim of this study was to investigate the prevalence of math anxiety among primary age children and to examine the relationship between math anxiety and gender of elementary school students.

In this research, a combination of descriptive and quantitative research design was used, focusing on the analysis and description of the distribution of mathematical anxiety in children. The following elements highlight specific aspects of the research design:

a) Data Collection: The dataset was obtained using the mAMAS-E questionnaire, which assessed mathematical anxiety on a scale from 1 to 5. This approach allowed for the systematic collection of students' subjective evaluations.

b) Descriptive Statistics: The research focused on describing basic statistical characteristics. Histograms and box plots provided a visual overview of the distribution of mathematical anxiety, which is typical for a descriptive design.

c) Group Comparison: The research analyzed differences between groups (boys vs. girls) using box plots and the Kolmogorov-Smirnov test, examining the relationship between gender on anxiety. This aspect corresponds to the quantitative approach within the descriptive design.

d) Hypothesis and Testing: The null hypothesis regarding the concordance of distribution functions was tested for both genders, which is a common procedure in empirical research, enhancing the rigor of the design.

Software: All statistical analyses were conducted using R (version 4.0.3, R Foundation for Statistical Computing).

Overall, this research utilized a combination of descriptive and quantitative approaches to analyse and interpret the results, with an emphasis on precise measurement and data visualization.

Research sample

Overall, 345 children from 21 different Slovak schools took part in the study. Schools that participated were chosen from all regions of Slovakia including cities and villages. The classroom size consisted of 13 to 30 pupils whose socio-economic status varied. Participants with incomplete questionnaires were excluded. Thus, the final sample consisted of 257 children who were 10 to 13 (M = 10.9, SD = 0.48) years old. There were 134 male and 123 female participants all attending 5th grade.

Materials for testing

To examine the math anxiety among primary age children, the Modified Abbreviated Math Anxiety Scale for Elementary Children (mAMAS-E) was used.

The mAMAS-E (Carey et al., 2017) is a nine item, self-reported questionnaire designed to measure MA. The mAMAs-E uses five-point Likert-type scale, where one represents no anxiety at all and five corresponds to high levels of MA. We used the pictorial Likert scale with a verbal

description of emotions. The MA score was calculated by summing up all the item scores, with total score ranging from 9 to 45 points. It takes approximately 15 minutes to complete the mAMAS-E (Osaďan et al., 2022).

Reliability: The internal consistency of the mAMAS-E in this study was not computed; however, reliability was supported by previous studies reporting Cronbach's alpha = 0.85 (Carey et al., 2017).

The mAMAS-E (Carey et al., 2017) is a nine item, self-reported questionnaire designed to measure MA. The mAMAs-E uses five-point Likert-type scale, where one represents no anxiety at all and five corresponds to high levels of MA. We used the pictorial Likert scale with a verbal description of emotions. The MA score was calculated by summing up all the item scores, with total score ranging from 9 to 45 points. It takes approximately 15 minutes to complete the mAMAS-E (Osaďan et al., 2022).

Testing procedure

The tests were administered by the teachers at each school. Prior to the experiment, each school received instructions on test administration. These instructions included reading the mAMAS-E questions aloud to the children and providing them with a definition of anxiety written in age-appropriate language. The teachers were asked to define and explain the terms to the children. All students completed the testing within one day.

Data analysis and results

Mathematical anxiety in children was calculated based on the mAMAS-E questionnaire, which contained nine items related to anxiety in mathematics. The student indicated the level of anxiety for each item on a scale from 1 (very low anxiety) to 5 (very high anxiety). The resulting score of mathematical anxiety was obtained as the sum of the scores for all items, meaning the student's final anxiety score could range from 9 to 45. The frequency distribution for individual values is shown in graph (see Figure 1).

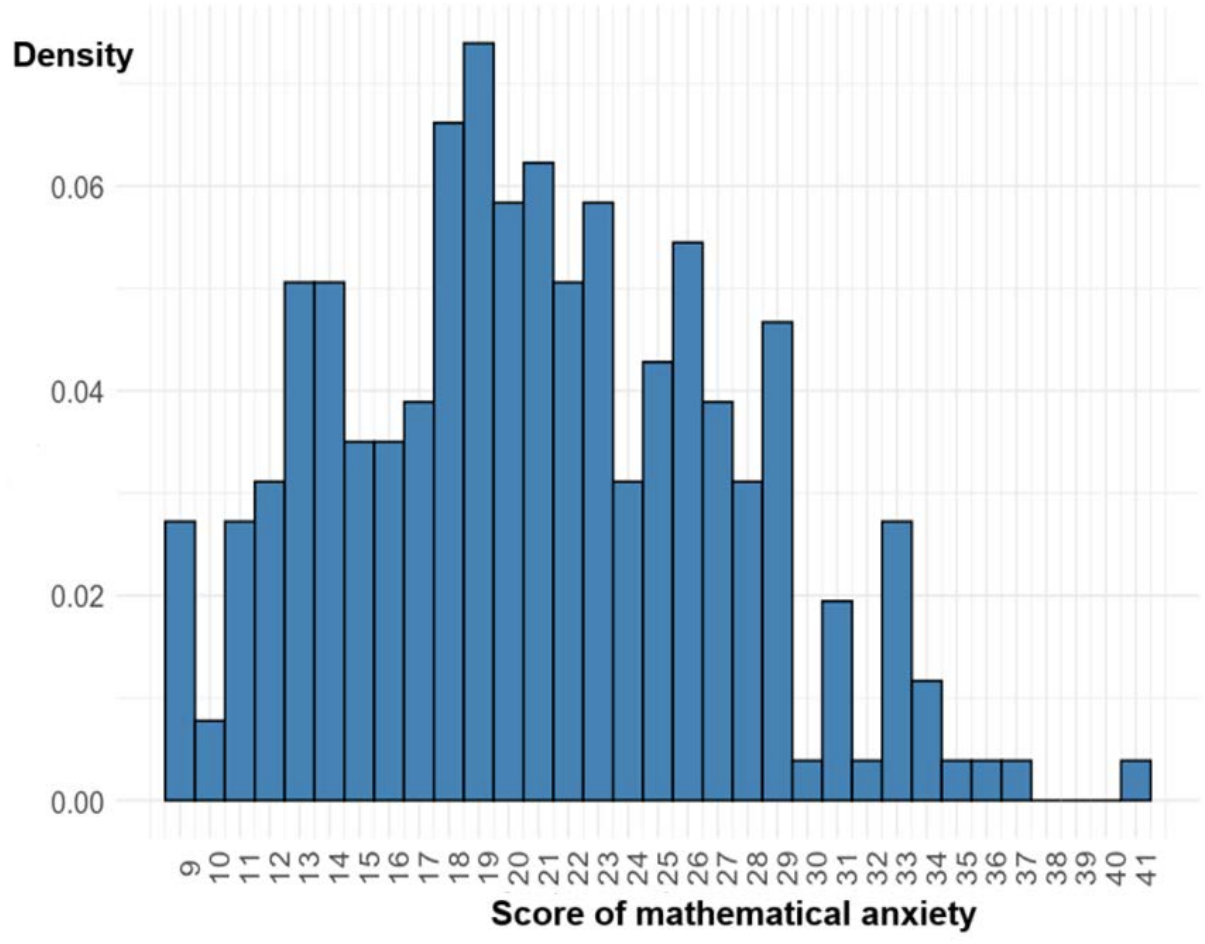

Fig. 1. Histogram of mathematical anxiety

The minimum value of mathematical anxiety in our dataset was 9 (the lowest possible level of mathematical anxiety), and the maximum value was 41. Values of 42–45 (the highest level of anxiety) did not occur. The maximum value of 41, achieved by only one student, can be considered an extreme value in terms of mathematical anxiety, as the scores of other students ranged between 9-37. The average score of mathematical anxiety is 20.86, with a median of 20. The most common score is 19 (19 students, i.e., 7.39 %). From the histogram, we can see that higher scores of mathematical anxiety (35 and above) were achieved by a minimum number of students. Based on these observations from the histogram, it can be assumed that the probability distribution of mathematical anxiety scores will be skewed to the right and will have a heavier right tail. This means that students are generally considered to be less anxious about mathematics.

Relationship between mathematical anxiety and gender

Box plots (see Figure 2) characterize the scores of mathematical anxiety separately for boys and girls. In both populations, the minimum score was 9. The maximum score for boys is 34, which is lower than for girls, whose maximum reached 41. The average values are marked by a dot in the graph and are very similar for both populations. The average score for boys is 20.30 (sd = 6.17), and for girls, it is 21.48 (sd = 6.61). The median values are very close to the averages, being 20 for boys and 21 for girls, and are represented as the center of the box in the box plot. Based on the graph and numerical characteristics, we see that girls' scores tend to be higher than boys'. The edges of the boxes in the box plot are formed by the 25th and 75th percentiles, indicating that the values of mathematical anxiety for girls are slightly higher than for boys.

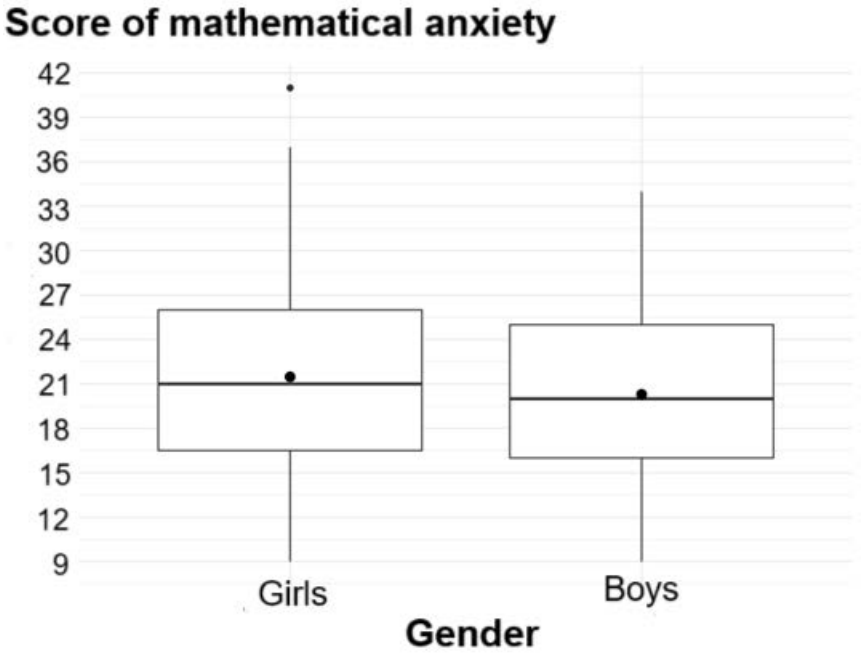

Fig. 2. Box plots of mathematical anxiety by gender

We tested whether there are differences in mathematical anxiety scores between genders at a 5 % significance level using the two-sample Kolmogorov-Smirnov test. The null hypothesis was the equivalence of the distribution functions of the scores for girls and boys, which would mean that the data come from the same probability distribution and therefore do not differ by gender. Justification: The Kolmogorov-Smirnov test was selected due to its non-parametric nature and its suitability for comparing distributions that may differ in both shape and central tendency. Given the right-skewed distribution observed in the histogram, the use of this test was considered more appropriate than the Student's t-test, which assumes normality. The value of the test statistic is D = 0.10, with a corresponding p-value of 0.55. Therefore, at the 5 % significance level, we do not reject the null hypothesis of the equivalence of distribution functions. The data did not show a statistically significant difference between the mathematical anxiety of boys and girls (Osaďan et al., 2022).

3. Conclusion

The aim of this study was to investigate the prevalence of math anxiety among primary age children and to examine the relationship between gender differences and math anxiety in Slovak elementary children. Overall, our results did not record the occurrence of mathematical anxiety in younger school-age children in Slovakia.

This finding suggests the need for further research on mathematical anxiety, focusing on its causes, diagnosis, age categories, and possibilities for its elimination. Our additional finding shows that there was no statistically significant difference in mathematical anxiety between boys and girls in the studied sample. Therefore, gender differences in mathematical anxiety likely do not represent a significant aspect in the studied age category.

Our research findings are consistent with studies (Szczygieł, 2019) that did not find significant differences in the level of mathematical anxiety between boys and girls of younger school age. The similarity of our research findings with the studies of M. Szczygiel with Polish children likely reflects the cultural closeness of the research participants. It can be assumed that the perception of gender, or its socio-cultural understanding in society, is similar in both Polish and Slovak societies. Our research findings suggest that an individual's gender is likely a significant factor in mathematical anxiety, but not the only one. Recent research, therefore, focuses on the socio-cultural aspect of mathematical anxiety. These studies indicate differences in measured mathematical anxiety when comparing participants from different cultures (Brown, 2020). The socio-cultural aspect of mathematical anxiety thus appears to be a factor that plays a significant role in the differences or similarities in mathematical anxiety among participants.

Given that research on mathematical anxiety has not yet been conducted in Slovakia, we could not compare its prevalence or trend among different age categories. Research on mathematical anxiety in children at the upper elementary level and higher age categories could provide results that would complement current knowledge about its development.

4. Support and acknowledgements

The contribution was supported by the scientific grant agency of the Ministry of Education of the Slovak Republic KEGA 026UK-4/2022entitled "The concept of Constructionism and Augmented Reality in STEM Education (CEPENSAR)".

References

Arigbabu et al., 2012 – *Arigbabu, A.A., Balogun, S.K., Oladipo, S.E., Ojedokun, O.A., Opayemi, S. A., Enikanoselu, O. A.* (2012). Examining correlates of math anxiety among single-sex and co-educational schools in Nigeria. *Global Journal of Human-Social Science*. 12(E10): 55-63.

Ashcraft, 2002 – *Ashcraft, M.H.* (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science*. 11(5): 181-185.

Ashcraft, Krause, 2007 – *Ashcraft, M.H., Krause, J.A.* (2007). Working memory, math performance, and math anxiety. *Psychonomic Bulletin & Review*. 14(2): 243-248.

Barroso et al., 2021 – *Barroso, C., Ganley, C.M., McGraw, A.L., Geer, E.A., Hart, S.A., Daucourt, M.C.* (2021). A meta-analysis of the relation between math anxiety and math achievement. *Psychological Bulletin*. 147(2): 134-168.

Beilock et al., 2007 – *Beilock, S. L., Rydell, R.J., McConnell, A.R.* (2007). Stereotype threat and working memory: Mechanisms, alleviation, and spillover. *Journal of Experimental Psychology: General*. 136(2): 256-276.

Bieg et al., 2015 – *Bieg, M., Goetz, T., Wolter, I., Hall, N.C.* (2015). Gender stereotype endorsement differentially predicts girls' and boys' trait-state discrepancy in math anxiety. *Frontiers in Psychology*. 6. Article 1404.

Birgin et al., 2010 – *Birgin, O., Baloglu, Çatlioglu, H., Gürbüz, R.* (2010). An investigation of mathematics anxiety among sixth through eighth grade students in Turkey. *Learning and Individual Differences*. 20: 654-658.

Dowker et al., 2012 – *Dowker, A., Bennett, K., Smith, L.* (2012). Attitudes to mathematics in primary school children. *Child Development Research*. 1-8.

Devine et al., 2012 – *Devine, A., Fawcett, K., Szűcs, D., Dowker, A.* (2012). Gender differences in mathematics anxiety and the relation to mathematics performance while controlling for test anxiety. *Behavioral and Brain Functions*. 8(1): 33.

Eagly, 1987 – *Eagly, A.H.* (1987). Sex differences in social behavior: A social-role interpretation. Hillsdale, NJ: Lawrence Erlbaum Associates.

Ferguson et al., 2015 – *Ferguson, A.M., Maloney, E.A., Fugelsang, J., Risko, E.F.* (2015). On the relation between math and spatial ability: The case of math anxiety. *Learning and Individual Differences.* 39*:* 1-12.

Ganley, McGraw, 2016 – *Ganley, C.M., McGraw, A.L.* (2016). The development and validation of a revised version of the math anxiety scale for young children. *Frontiers in Psychology*. 7*:* 1181.

Gierl, Bisanz, 1995 – *Gierl, M.J., Bisanz, J.* (1995). Anxieties and attitudes related to mathematics in grades 3 and 6. *Journal of Experimental Education.* 63(2): 139-158. DOI: https://doi.org/10.1080/00220973.1995.9943818

Goetz et al., 2013 – *Goetz, T., Bieg, M., Lüdtke, O., Pekrun, R., Hall, N.C.* (2013). Do girls really experience more anxiety in mathematics? *Psychological Science.* 24(10): 2079-2087.

Griggs et al., 2013 – *Griggs, M.S., Rimm-Kaufman, S.E., Merritt, E. G., Patton, C.L.* (2013). The responsive classroom approach and fifth grade students' math and science anxiety and self-efficacy. *School Psychology Quarterly*. 28(4): 360-373. DOI: https://doi.org/10.1037/spq0000026

Gunderson et al., 2017 – *Gunderson, E. A., Hamdan, N., Sorhagen, N. S., D'Esterre, A.P.* (2017). Who needs innate ability to succeed in math and literacy? Academic-domain-specific theories of intelligence about peers versus adults. *Developmental Psychology*. 53(6): 1188-1205.

Hamza, Helal, 2013 – *Hamza, E.G.A., Helal, A.M.* (2013). Maths anxiety in college students across majors: A cross-cultural study. *Educational Futures.* 5(2): 58-74.

Hill et al., 2016 – *Hill, F., Mammarella, I.C., Devine, A., Caviola, S., Passolunghi, M.C., Szűcs, D.* (2016). Maths anxiety in primary and secondary school students: Gender differences, developmental changes and anxiety specificity. *Learning and Individual Differences.* 48*:* 45-53.

Jackson, Leffingwell, 1999 – *Jackson, C.D., Leffingwell, R.J.* (1999). The role of instructors in creating math anxiety in students from kindergarten through college. *Mathematics Teacher: Learning and Teaching PK–12.* 92*:* 583-586.

Jansen et al., 2016 – *Jansen, B.R.J., Schmitz, E.A., van der Maas, H.L.J.* (2016). Affective and motivational factors mediate the relation between math skills and use of math in everyday life. *Frontiers in Psychology*. 7. Article 513.

Keshavarzi, Ahmadi, 2013 – *Keshavarzi, A., Ahmadi, S.* (2013). A comparison of mathematics anxiety among students by gender. *Procedia-Social and Behavioral Sciences.* 83(3): 542-546.

Krinzinger et al., 2009 – *Krinzinger, H., Kaufmann, L., Willmes, K.* (2009). Math anxiety and math ability in early primary school years. *Journal of Psychoeducational Assessment.* 27(3): 206-225.

Luo et al., 2008 – *Luo, X., Wang, F., Luo, Z.* (2009). Investigation and analysis of mathematics anxiety in middle school students. *Journal of Mathematics Education.* 2(2): 12-19.

Miller, Bichsel, 2004 – *Miller, H., Bichsel, J.* (2004). Anxiety, working memory, gender, and math performance. *Personality and Individual Differences.* 37(3): 591-606. DOI: https://doi.org/10.1016/j.paid.2003.09.029

Newstead, 1998 – *Newstead, K.* (1998). Aspects of children's mathematics anxiety. *Educational Studies in Mathematics.* 36(1): 53-71.

OECD, 2013 – OECD. PISA 2012 assessment and analytical framework: Mathematics, reading, science, problem solving and financial literacy. OECD Publishing. 2013. DOI: http://dx.doi.org/10.1787/9789264190511-en

Osaďan et al., 2022 – *Osaďan, R., Žilková, K., Hamranová, A., Kondeková, A., Žilková, V.* (2022). Genderový aspekt matematickej úzkosti detí mladšieho školského veku [Gender aspect of mathematics anxiety by younger school-age children]. Bratislava: Comenius University Bratislava. [in Slovak]

Punaro, Reeve, 2012 – *Punaro, L., Reeve, R.A.* (2012). Relationships between 9-year-olds' math and literacy worries and academic abilities. *Child Development Research*. 1-11.

Ramirez et al., 2013 – *Ramirez, G., Gunderson, E.A., Levine, S.C., Beilock, S.L.* (2013). Math anxiety, working memory, and math achievement in early elementary school. *Journal of Cognition and Development*. 14(2): 187-202.

Richardson, Suinn, 1972 – *Richardson, F., Suinn, R.M.* (1972). The Mathematics Anxiety Rating Scale: Psychometric Data. *Journal of Counseling Psychology*. 9: 551-554. DOI: http://dx.doi.org/10.1037/h0033456

Szczygieł, 2019 – *Szczygieł, M.* (2019). How to measure math anxiety in young children? Psychometric properties of the modified Abbreviated Math Anxiety Scale for Elementary Children (mAMAS-E). *Polish Psychological Bulletin*. 50(4): 303-315.

Stoet et al., 2016 – *Stoet, G., Bailey, D.H., Moore, A.M., Geary, D.C.* (2016). Countries with higher levels of gender equality show larger national sex differences in mathematics anxiety and relatively lower parental mathematics valuation for girls. *PLoS ONE*. 11(4). Article e0153857.

Vukovic et al., 2013 – *Vukovic, R.K., Kieffer, M.J., Bailey, S.P., Harari, R.R.* (2013). Mathematics anxiety in young children: Concurrent and longitudinal associations with mathematical performance. *Contemporary Educational Psychology*. 38(1): 1-10. DOI: https://doi.org/10.1016/j.cedpsych.2012.09.001

Young et al., 2012 – *Young, C.B., Wu, S.S., Menon, V.* (2012). The neurodevelopmental basis of math anxiety. *Psychological Science*. 23(5): 492-501.

Yüksel-Şahin, 2008 – *Yüksel-Şahin, F.* (2008). Mathematics anxiety among 4th and 5th grade Turkish elementary school students. *International Electronic Journal of Mathematics Education*. 3(3): 179-192. DOI: https://doi.org/10.29333/iejme/225

Zakaria et al., 2012 – *Zakaria, E., Zain, N.M., Ahmad, N. A., Erlina, A.* (2012). Mathematics Anxiety and Achievement among Secondary School Students. *American Journal of Applied Science*. 9: 1828-1832.

Zhang et al., 2019 – *Zhang, J., Zhao, N., Kong, Q.P.* (2019). The relationship between math anxiety and math performance: A meta-analytic investigation. *Frontiers in Psychology*. 10. Article 1613.