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Math Anxiety, Math Achievement and Gender Differences among Primary School Children and their Parents from Palestine

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Abstract. This study explored the math anxiety (MA) level and math achievement of primary school children and the association of these variables to their gender differences and parents' math anxiety. Also, we investigated the potential interaction between child MA and parental variables on child math outcomes. The sample consisted of 230 students in the 3rd and 4th grades (Mean age = 8.9; SD = .59), including one parent for each child. The Scale for Early Math Anxiety, The Mathematics Anxiety Rating Scale, The Children Test Anxiety Scale, and the parental involvement survey was used for data collection. Palestinian children reported lower levels of MA compared to previous research, and the expected negative relation between students' MA and their math achievements was confirmed. Girls reported higher levels of both MA and test anxiety than boys. A positive correlation was found between mothers' MA and daughters' MA, while no association between fathers' MA and sons' MA was found. Moreover, child MA, parental MA and trait anxiety were found to significantly predict children's math achievement. This study contributed to a better understanding of some factors affecting mathematics achievements and future career orientations, such as Math anxiety, Test anxiety, and possible gender differences. We suggest implementing new strategies to reduce math anxiety, improve math achievement, and enhance females' contribution to math-related fields in the Palestinian community.

Keywords: Math anxiety; math performance; primary school children; parental influence; gender differences

1. Introduction

A core target of the educational system is to equip students with the essential skills needed in their studying phase and afterward. Although schools are considered the key vehicle for building children's academic competence and life

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aptitudes, parents also play a critical role in their children's success (Jacobs & Eccles, 2000). Parents are their children's first and long-term teachers, but what if parents are themselves anxious about the subjects their children are studying? Studies suggest that this is fairly common when it comes to mathematics (Chang & Beilock, 2016; Maloney et al., 2015) and that children's math performance can be hindered by both their own specific anxiety toward mathematics and by their parents' MA (Maloney et al., 2015). Additionally, children's math attainment varies as a function of both cultural (Daches Cohen & Rubinsten, 2017), and gender-related differences (Devine et al., 2012). Consequently, our study set out to explore both parental influences and gender-related differences in Palestinian children's MA and math achievement, in a society with inequitable gender norms.

According to the results of the international men and gender equality survey, Palestine represents a predominantly masculine society and displays inequitable gender attitudes. For instance, 80% of men believe that a "woman's most important role is to take care of the home and to cook for the family", while 83% of men reported that "when work opportunities are scarce, men should have access to jobs before women" (El Feki et al., 2017). Moreover, 87% of women stated that Palestinians need to do more to promote gender equality.

During the last 30 years, many studies have reported small or no actual gender differences in math outcomes (Devine et al., 2012). According to the annual national evaluation of primary schools' students in Arabic, Math, and science (2017-2018), the findings reported that the success percentage in mathematics for the 4th grade was only 38%, meanwhile, mathematics average score was 47 for girls and 42 for boys (the full score is 100). Also, according to the Palestinian statistical centre, girls outperformed boys in the high school general examinations for the last 5 years. For example, in 2018 the success percentage was (91.8 % vs. 98%) in the scientific pathway, (77.7% vs. 91.2%) in the commercial pathway, and (82.8% vs. 96.9%) in the vocational, for males vs. females, respectively. However, as reported by the Palestinian Statistical Centre (2017) females' percentage of graduated with a diploma or bachelor's in educational sciences was 21%, compared to 6.5% of their male counterparts, while in engineering it was 3%, compared to 9% of their male counterparts.

2. Literature and Previous Studies

2.1. Math anxiety

Across all ages, a widespread apprehension about mathematics is noticeable, termed MA. It is defined as an overwhelming feeling of tension and worries accompanied by negative thoughts that occur as a response to math-related activities, and a corresponding tendency to appraise math as threatening stimuli and to react with rising levels of anxiousness (Lyons & Beilock, 2011). A large body of literature views MA as a subject-specific manifestation of test anxiety (Ho et al., 2000; Ma, 1999), with the test anxiety defined as a set of negative emotions and worries that occur especially during any evaluation context (Hembree; 1990).

Devine et al. (2012) conducted a study to investigate the relations between mathematics anxiety, test anxiety and math performance. The results showed a positive correlation between MA and test anxiety, while a negative correlation was found between MA and performance. Test anxiety was also negatively correlated with math performance. Moreover, Joseph (2009) revealed a positive correlation between MA and test anxiety. Another study conducted by Ashcraft and Moore (2009), revealed a positive correlation between MA and trait anxiety. As reported by Xie et al. (2018), MA was found to be positively correlated with both test anxiety and with general anxiety, while it was negatively correlated with math performance.

Numerous studies have indicated the negative impact of MA on math performance (Rubinsten et al., 2018). Math-anxious students score significantly less in mathematical exams compared to their non-anxious counterparts (Ramirez et al., 2018), they tend to avoid math-related activities (Carey et al., 2017) and are underrepresented in STEM domains (Maloney & Beilock, 2012).

2.2. Gender differences

Gender differences in math competence and MA have been frequently investigated, with several findings reporting that females are more anxious than males in math-related situations (Ashcraft, 2002; Else-Quest et al., 2010; Hopko et al., 2003). In 2012, as stated by the Programme for International Student Assessment (PISA), the data showed that in the majority of (OECD) countries girls reported stronger MA than boys. For instance, Devine et al. (2012) study among secondary school students in England, revealed no differences in mathematics performance, although girls scored higher on the MA scale. Similarly, findings were reported for German students (Frenzel et al., 2007) and also for Chinese students (Huang et al., 2019) revealed that boys reported less MA, while no significant gender differences were found in mathematics self-efficacy.

On the other hand, Erturan and Jansen (2015) showed a significant effect of gender on test anxiety, with girls reporting higher levels of test anxiety, while math scores and MA did not differ based on gender. A similar finding has been reported about the gender differences regarding test anxiety, with males obtaining lower scores than females on evaluative tests (Popa et al., 2019). The same results were also reported by Kavanagh et al. (2016), revealing higher levels of test anxiety among females, compared to males. Trait anxiety was also found to differ based on gender, according to Macher et al. (2011) study, higher levels of trait anxiety among female students than males were confirmed. In addition, many studies indicate that women tend to report higher trait anxiety scores than men do (Putwain & Daly, 2014).

2.3. Parental Math anxiety

Research has confirmed that home the environment including parents' feelings, attitudes, and perceptions about their children has a notable impact on children's emotions, attitudes, self-esteem, and even their cognitive abilities (Jameson, 2013; Mohr-Schroeder et al., 2017; Anbar & Visu-Petra, 2021). It is also noted that parents' own perception of the value of mathematics has a significant

impact on their children's motivation to pursue related fields in the future (Soni & Kumari, 2017).

Math-anxious parents are more likely to pass their MA to their children, particularly when trying to help their children with math homework frequently (Maloney et al., 2015). Parental expressed attitudes toward math, such as 'Oh, I used to hate math as a child' or 'doing math is difficult' are negatively related to children's success and attitudes toward math (Chang & Beilock, 2016). In contrast, studies suggest that children who are more engaged in-home math-related activities (e.g., board games, play with puzzles, cards) report more positive attitudes and better math achievement than those involved in fewer home math-related activities. Indeed, parents who try to enhance positive math attitudes as much as possible in the home environment, regardless of their emotions or their comprehension of math, are more likely to improve their children's achievements in math and establish positive behaviours toward math learning (Wilder, 2015).

A study conducted by Batchelor et al. (2017) indicated that children's MA is related to parents' MA. More specifically, a positive association between parents' MA and sons' MA was identified, while no association between mothers' and daughters' MA was found. The authors suggested that this could be justified by the mediating effect of parental involvement in the child's homework. Studies have investigated parental influences on children's math achievements, for instance, parents' MA is considered a strong predictor of children's math achievement (Casad et al., 2015; Maloney et al., 2015). Direct forms of parental involvement were sometimes negatively related to children's math achievement (Vukovic et al., 2013). Indeed, children's success in mathematics is not contingent upon parents' help, given that most parents haven't received formal teaching training. Besides, parents' involvement doesn't require parents to show high skill in math, rather, they can promote children's math performance by simply adopting positive attitudes about math learning (Pugsley & Jill, 2018; Vukovic et al., 2013).

To sum up, the role of parental involvement in children's achievement is still debatable. Most findings reveal that parental involvement is positively related to children's math achievement and suggest that it may limit negative attitudes toward mathematics (Mohr-Schroeder et al., 2017). However, other meta-analytic findings suggest that at-home parental involvement is negatively related to children's achievement, as a negative correlation was found between students' academic performance and homework parental assistance (Wilder, 2015). Moreover, the gender gap in terms attitudes and anxieties transmission has been investigated in several studies, findings emphasizing the role of gender stereotype threats among adults and children (Chang & Beilock, 2016). For instance, parents reported that girls need to do more effort in math learning than boys do, while girls declared less confidence and less efficiency in their math abilities than boys, following many years of exposure to this type of math stereotype (Batchelor et al., 2017). It is very challenging to identify parental influences on the relation between academic achievement and MA, due to

various several factors, such as family structure, parent educational level, family income, parents' occupation, and the history of parents' performance in mathematics (Soni & Kumari, 2017).

3. Current study

3.1. The importance of the study

The current study extends the existing literature on the relationship between children's MA and math achievement in several directions. For the first time, to our knowledge, we measured both parents' and child's MA in the Palestinian community, investigating potential gender differences in relation to their mathematics achievement and the congruence with other forms of anxiety (trait and test anxiety). Also, we explored the possible predictors of child mathematics achievement. Finally, we attempted to investigate the possible interactive effects of child MA and parental variables, such as parental involvement in children's math homework, parental history of parents' math performance, and parental MA on child math outcomes. To our knowledge, this is the first study to investigate the interaction effect of parental variables on the relations between child MA and child math performance.

3.2. Study questions

* Is there a positive association between various forms of anxiety e.g., Math anxiety, Trait anxiety, and Test anxiety?
* Are there significant gender differences in Test/Math anxiety/Math achievement, for children and in Math anxiety for parents?
* Is there a negative relation between child Math achievement and both Math anxiety and Test anxiety?
* Is there a positive relation between a child's Math anxiety and parents' Math anxiety?
* Does Math anxiety, Test anxiety, Trait anxiety, Gender, or Parental variables play a role as a predictor of child's Math achievements?
* Are there possible interactive effects of child Math anxiety and parental variables, such as parental involvement in children's math homework, parental history of parents' math performance, and parental math anxiety on child math outcomes?

3.3. Hypotheses

First, following evidence regarding the common ground of these anxiety subtypes, a positive correlation among all forms of anxiety (math, test, and trait) was expected. Second, following evidence showing gender-related differences in MA, we predicted that female participants would report higher levels of MA, trait anxiety and test anxiety. Third, in accordance with recent meta-analyses revealing a moderate negative association between MA and math performance (e.g., Barroso et al., 2021; Zhang, Zhao, & Ping Kong, 2019), we predicted a replication of this result in our Palestinian sample. Importantly, regarding the influence of parents, we expected parental MA to be positively related to children's MA and negatively predict children's math achievement. Finally, parental involvement, parents' MA, and the history of parents' math

performance during their own childhood were hypothesized to be moderators of the relation between children's MA and their mathematics achievement.

4. Methodology

4.1. Participants

Participants were 230 students from four primary schools in Ramallah city (151 girls; Mean age = 8.9 years; SD = 0.59 Years) and from all students' parents (N = 230, 74.8% mothers). From the total sample (N = 230), 104 participants (37 boys, 67 girls) were enrolled in the third grade, whereas 126 (42 boys, 84 girls) in the fourth grade. All children were Palestinian, had intact or corrected vision, and had Arabic as their primary language. Most children had a middle-class background, with 88.8% of parents earning the average to above-average wage per capita, 37.4% of the mothers and 25.3% of the fathers having a high-school diploma, while 41.8 % mothers and 28.7% fathers had a college or university degree.

4.2. Materials

4.2.1. Child's measures

1- Math anxiety

The Scale for Early MA (SEMA; Wu, Amin, Barth, Malcarne, & Menon, 2012) was used. Via its 20 items, children are asked to indicate on a five-point scale how nervous they would feel if (1) they would have to answer certain math questions (e.g., "George bought two pizzas that had six slices each. How many total slices did George have to share with his friends?") and (2) in certain math-related situations (e.g., "You are in class doing a math problem on the board"). Hence, the first 10 items assess children's anxiety related to numeral processing and the last 10 items assess their situational and performance anxiety (e.g., "You are in class doing a math problem on the board"). The total score range is from 20 to 100, while the range of each subscale is from 10 to 50. A higher summed score indicates greater MA. In the present sample, this scale had good reliability, Cronbach's α = .87.

2- Trait anxiety

We used the trait version of the State-Trait Anxiety Inventory (STAI-TC; Spielberger, 1973). It consists of 20 items measuring children's trait anxiety via items such as "I am afraid to do things wrong". Items are rated on a three-point scale (1 = almost never, 2 = sometimes, 3 = often), with higher scores indicating higher levels of trait anxiety. The scale showed high internal consistency in the current sample, Cronbach's α = .85.

3- Test anxiety

The Children Test Anxiety Scale (CTAS; Douglas & Jeri, 2004) is a 30-item self-report questionnaire used to assess children's test anxiety. A four-point Likert scale is used to measure children's frequency of autonomic reactions (physical anxiety, e.g., "My heart beats fast"), off-task behaviours (e.g., "I play with my pencil"), and worrisome thoughts (e.g., "I think about how poorly I am doing") while taking tests (1 = almost never, 2 = sometimes, 3 = often, 4 = almost

always). Higher scores indicate greater test anxiety. The scale showed good internal consistency, Cronbach's α = .88.

4- Math achievement

For students' math achievement, we used the teachers' final evaluation math records at the end of a semester. Hence, these records represent students' objective evaluation in math achievement at the end of the first school semester. Performance scale range was between 0 – 100.

4.2.2. Parent's measures

1- Math anxiety

The Mathematics Anxiety Rating Scale (MARS; Suinn &Winston, 2003) consists of 30 items, with the first 15 items assessing math situational performance anxiety (Math Test Anxiety) and the last 15 items assessing numerical processing anxiety (Numerical Anxiety). A five-point Likert scale was used to indicate how nervous the individual would feel (1 = I'm not nervous at all, 2 = I'm a little nervous, 3 = I'm somewhat nervous, 4 = I'm very nervous, 5 = I'm very nervous) during certain math-related situations, such as reading a cash register receipt. The total score was the sum of answers on all items. Higher scores indicate higher anxiety levels. In this sample, the scale showed a very good internal consistency, Cronbach's α = .93.

2- Parental involvement in children's homework

We used the Parental involvement survey used by Maloney et al. (2015). Parents completed a survey of five items, indicating how often they engage in certain behaviours in order to help their child with their math homework (e.g., "Check out the homework at the end"). A seven-point Likert scale was used to indicate involvement frequency (from 1 = never to 7 = more than once a day). Total scale score was computed summing all points received on the five items; hence, higher scores are indicative of high involvement. In the current study, the Cronbach's α = .93.

3- Parental history of school performance

To investigate parents' history of school performance, parents were asked to complete a nine-items form about their performance in mathematics, Arabic language, and general school performance in primary, middle and high school. A five-point scale was used to indicate their level of performance, (1 = Poor to 5 = Excellent) for each subject (i.e., mathematics, Arabic, other) during each school period (i.e., primary, middle school, high school). A higher score on indicated higher school performance. The Cronbach's alpha for the nine items scale was .94.

4.3. Procedure

After permission was granted from the school authorities, written informed consent was obtained from the parents whose children were in the 3rd and 4th grades. While children's consent was obtained verbally, and their participations were voluntary. Consequently, we organized a meeting during school hours with the students whose parents provided their informed consent. Children were also informed and assured about the confidentiality of their responses.

They were then asked to fill in the Arabic questionnaire in the following order: MA, test anxiety, trait anxiety. The researcher collaborated with two teachers during these meetings with the children, all children's questions were answered, and the ones who needed help in reading were helped, while no time restrictions were applied Parents who accepted to participate received the questionnaires via their child or while they were picking the child from school, they completed the forms in the following order: demographic information, parental involvement, parental history of school performance, and the MA scale. The researcher's contact details were provided for any clarifications.

5. Results

The SPSS statistics 25th version was used to process our raw data, the obtained results are in section below

5.1. Gender differences

Descriptive statistics regarding *children's* MA, trait anxiety test anxiety, math academic achievement, as a function of gender are displayed in Table 1.

Table 1: Means and standard deviations for children's measures

	N = 230	**Boys n= 79**	**Girls n= 151**		
	M (SD)	**M (SD)**	**M (SD)**	**t-test (228)**	**Cohen's d**
Math anxiety	29.09 (10.32)	26.92 (8.36)	30.20 (11.07)	-2.32*	.33
Trait anxiety	30.18 (7.27)	28.55 (6.73)	31.03 (7.41)	-2.48*	.35
Test anxiety	52.39 (14.83)	50.72 (14.72)	53.26 (14.86)	-1.23	-
Math achievement	84.70 (12.12)	85.99 (11.81)	(12.26)	1.34	-

Note. **p < .001, *p < .005

Looking at gender-related differences in *parental reports*, mothers reported higher levels of MA, t (169) = -2.43, p = .016, Cohen's d = 0.40, while nonsignificant differences were found between mothers and fathers in terms of parental involvement and history of math performance. Means and standard deviations as function of parents' gender are presented in Table 2.

Table 2: Means and standard deviations for parents' measures

	Fathers		**Mothers**	
	n	**M(SD)**	**n**	**M(SD)**
Parents' Math anxiety	74	71.23 (25.69)	124	81.26 (23.40)
Parents' involvement in homework	57	27.15 (6.13)	168	27.82 (6.28)
Parents' history of math performance	47	10.61(2.90)	146	10.90 (2.98)

5.2. Correlations among study variables

Pearson correlations revealed positive moderate correlations among the three forms of anxiety measured in children: MA, trait anxiety, and children test anxiety (see Table 3), suggesting that while they all tap the same general concept, they measure different faucets of anxiety. Negative correlations were found between children's math achievement and their MA, and test anxiety, respectively. Moreover, children's math achievement was also negatively associated with their parents' own MA, but positively associated with parental involvement in children's math homework and history of math performance. Nevertheless, the correlation between parents' MA and their children's MA did not reach significant levels. Additionally, we found a negative moderate correlation between parents' MA and their own math performance history.

Table 3: Correlations among study variables

	Measures	1	2	3	4	5	6
1	Math anxiety	-					
2	Trait anxiety	.55**	-				
3	Test Anxiety	.55**	.52**	-			
4	Math achievement	-.25**	-.08	-.14*	-		
5	Parents' Math anxiety	.13	.07	.09	-.27**	-	
6	Parents' involvement in homework	-.04	.03	-.04	.15*	-.07	-
7	Parents' history of math performance	-.15*	-.01	-.06	.37**	-.55**	.23**

Note. **p < .001, *p < .005

To check for potential different associations between the same-gender parent-child dyads, additional zero order correlations were calculated between same-gender parents' MA and child MA. Correlations computed between mothers and daughters and between fathers and sons revealed a significant positive association between mother's MA levels and daughters' levels of MA, ($r = .25$, $p = 0.02$). In contrast, nonsignificant associations were found between fathers' MA levels and sons' MA ($p = .98$)

5.3. Predictors of children's math achievement

To analyse contributions of individual characteristics, parental factors, and specific math-anxiety factors to children's math achievement variation, a three-step hierarchical multiple regression was conducted with children's math achievement as the criterion. Potential baseline individual differences (gender, grade, trait anxiety, test anxiety) were entered Step 1. Based on previous results and current correlations, parental variables (parents' MA, parental involvement in children's math homework, and the history of parents' math performance) were added in Step 2. To test whether children's own MA levels contribute to variations in math achievement over and above the influence of parental history with math and homework involvement, children's MA was added in Step 3 (see Table 4).

Table 4: Summary of hierarchical regression analysis for potential predictors of children's math achievement

Predictor	B	β	t	R	R2	ΔR2	p
Step 1				.23	.05	.05	.07
Gender	-2.83	-.11	-1.42				
Grade	-3.12	-.12	-1.54				
Trait anxiety	.17	.09	.94				
Test anxiety	-.16	-.19	.04*				
Step 2				.40	.16	.11	.00
Parents' history of math performance	.77	.14	1.47				
Parents' Math anxiety	-.10	-.12	-2.12*				
Parents' involvement in homework	.28	.17	1.69				
Step 3				.46	.21	.05	.03
Gender	-3.54	-.13	-1.83				
Grade	-3.14	-.12	-1.67				
Trait anxiety	.41	.21	2.11*				
Test anxiety	-.07	-.08	-.92				
Parents' history of math performance	.55	.09	1.08				
Parents' Math anxiety	-.09	-.19	-2.12*				
Parents' involvement in homework	.25	.12	1.57				
Math anxiety	-.38	-.29	-3.32*				

Note. *p < .05, **p < .01, ***p< .001

The hierarchical multiple regression revealed that baseline individual differences predictors had no significant contribution to the regression model. Introducing the parental variables explained an additional 11.1% of variation in children math achievement and this change in R^2 was significant, $F(3,158) = 4.35$, $p < .001$. As visible in Table 4, parents' MA was a significant predictor of children's math achievement, with higher levels of parental anxiety predicting lower math achievement scores in children. On the other hand, parental history in terms of math achievement and parental involvement with the child's math homework did not prove to be significant predictors of the child's math achievement. Adding children's own MA to the regression model explained an additional 4.6% of the variation in the dependent variable, $F(1,157) = 5.14$, $p < .001$. When all independent variables were included in this third step of the regression model, the significant predictors of children's math achievement were: baseline differences in children's trait anxiety, parents' MA, and children's MA. This final model accounted for 20.7% of the variance in children math achievement.

5.4. The potential interaction effects between children's Math anxiety and parental variables on children's math outcomes

Additional models analysing potential interaction effects between children's MA and parental variables (parent's MA, parent involvement in child math homework, and the history of parents' math performance) revealed nonsignificant interaction effects of child and parental MA on children's math outcome, b = 0.01, p = .08, BCa CI [-0.001, 0.011], of children's MA and parents' involvement in math homework, b = 0.01, p = .28, BCa CI [-0.01, 0.04], and of children's MA and parents' math performance, b = 0.05, p = .16, BCa CI [-0.02, 0.13].

6. Discussion

The study aimed to investigate the prevalence of MA and identify gender differences among primary school students and their parents, and explore the relation between MA and math achievement as a function of parental factors. The main findings included confirming higher levels of MA among girls/mothers than among boys/fathers, a negative relation between children's MA and their math achievement, also a negative association between children's math achievement and their parent's MA. In addition, we uncovered the possible predictors of math achievement and the possible moderating role of parental variables in the relation between children's MA and their math achievement. Next, we will discuss these results, integrating them in the growing body of literature on factors generating or minimizing MA in primary school children.

6.1. Gender differences

6.1.1. Gender differences in Math anxiety

The results showed significant gender differences in MA, as girls reported higher scores compared to boys, consistent with many previous studies conducted in China, Poland, England, and Uganda (see Xie et al., 2018; Schnell et al .2013; Devine et al .2012; Hunt et al., 2021). Similarly, mothers reported higher MA compared to fathers (Else-Quest et al., 2010). Our findings are in line with the results of a meta-analysis of 151 studies (Hembree, 1990), which found that females tend to have higher levels of MA than males do, which may account for some of the gender gaps in math achievement and math-related professions.

A similar finding was reported by Carey et al. (2017), among British children aged 8–13, where a significantly higher levels of MA among girls compared to boys were found. A study was conducted by Ho et al. (2000) among 6th-grade students from the USA, China, and Taiwan revealed that there were significantly higher scores of MA among Taiwanese girls, while no MA gender differences were found among Chinese and American students. On the other hand, Birgin et al. (2010) or Tapia (2004) reported no significant difference between boys and girls in MA.

One potential explanation for girls/females generally experiencing greater levels of MA than males may stem from the gender differences in socialization practices. In particular, women are socialized to express their feelings and emotions, this may result in the inclination for women to admit their fears more

than men do (Devine, 2012; Kavanagh et al., 2016). Another potential reason is that math is traditionally seen as a male domain, so females may be socialized to perceive their mathematical skills as less competent and therefore may even avoid mathematical activities. It was expected for females in this study to report higher levels of MA compared to males, according to the Arabic culture that imposes such gender roles, where boys are raised to be tough and brave, which can lead them to report lower levels of MA. Not surprisingly, females may be more willing to admit their worries and anxiety (Kavanagh et al., 2016). Also, there is less recent research examining the gender biases in the Palestinian school mathematics textbooks indicating these textbooks are male-biased, with females being less likely to be represented by names, pictures, verbs (actions), pronouns and professions (Karama, 2020). Women's underrepresentation in science, technology, engineering, and mathematics (STEM) fields emerges from these gender biases, Palestinian women avoid math-related positions due to their beliefs that these areas are unimportant or even damaging to their self-image as females (Rube & Ehrenfeld, 2020).

6.1.2. Gender differences in other forms of anxiety

Girls reported higher levels of trait anxiety than boys, confirming many similar findings in the literature across various age groups (Macher et al., 2011; Putwain & Daly, 2014), while no significant gender differences were found in test anxiety. The results among Australian, American, Romanian, and Chinese students confirmed our previous findings of no gender differences in test anxiety (Kavanagh et al., 2016; Popa, 2019; Xie, 2018). However, our results are not in line with previous studies that did find gender differences in test anxiety in favour of boys (Erturan & Jansen, 2015) or in favour of girls (McDonald, 2001; Putwain & Daly, 2014).

A cautionary note refers to the overall lower levels of test anxiety found in our sample. In the Palestinian educational system, primary students during 1st to 4th grades are not exposed to formal examination sessions, but teachers still have to evaluate children's performance using many strategies such as team or pair work, homework, and class evaluative papers. The absence of standardized tests or formal examination environments could explain the lower levels of test anxiety compared to Wren and Benson (2004) findings, who used the same scale of children's test anxiety.

6.1.3. Gender differences in Math achievement

Although the results indicated that girls were more math anxious than males in math-related situations, no significant differences in math achievements were documented. This result is confirming many previous findings suggesting that the gender gap in math performance has been significantly minimized in the last decades, especially within primary school students (Devine et al., 2012; Schnell et al., 2013). One possible explanation for girls outperforming or performing equally in math is that girls are more self-disciplined than boys, in general girls tend to study longer hours and do more homework, while boys need more monitoring to do their homework (Duckworth & Seligman, 2006). On the other hand, our results do not confirm previous findings suggesting that males outperform females in math (Else-Quest et al., 2010, see also, Erturan & Jansen, 2015; Osborne, 2006). Although many recent studies showed the gender gap

minimizing across the years (Gunderson et al., 2011; Hyde et al., 2008; Schnell et al, 2013) fewer girls end up pursuing math courses or math-related career paths (Eccles, 2009), a tendency visible in Palestine as well (Rubel & Ehrenfeld, 2020).

6.2. Correlations among study variables

6.2.1. Congruence between anxiety measures

Findings revealed a positive moderate correlation between the MA and the Trait Anxiety. Similar findings were revealed by Ashcraft and Moore (2009), who reported a positive correlation between MA and trait anxiety. Although we confirmed this consistency among the mentioned scales, it also appears that each one of them still measures different aspects of anxiety. A positive correlation between MA and Test Anxiety was found, also a positive correlation between Trait Anxiety and Test Anxiety. Similarly, Devine's et al. (2012) study among secondary school students in England, and Joseph (2009) study among secondary students in Singapore also reported positive correlations between MA and test anxiety. In fact, MA was conceptualized as a situation-specific anxiety demonstrated in mathematics-related activities (Rubinsten et al., 2015), while Test Anxiety was seen as a situation-specific personality trait, which specifically arises in evaluative situations (Schnell et al. 2013).

6.2.2. Math anxiety and math performance

The results also found a negative correlation between child math performance and child MA. In this respect, Hembree's meta-analysis (1990) showed that MA negatively correlates with math achievement and math grades. Later, a similar finding was confirmed by Ma (1999) in his meta-analysis. Also, Cipora et al. (2015) and Schnell et al. (2013) findings revealed a negative association between MA and math performance among Polish and German students, respectively.

6.2.3. Parent-child Math anxiety

On parent-child math anxiety results indicated that parents' MA and child math achievements were negatively correlated. Similar results were found by Berkowitz et al. (2015), who conducted a study about math at home and child achievements. Such results suggested when parents are more math anxious, their children learned less math during first grade compared to children of less math-anxious parents. Another study reported that children's math performance was negatively associated with high parent MA, but only when both mothers and daughters or when fathers and sons had high MA (Casad et al., 2015).

The results also showed significant associations between mothers' MA and their daughter's MA, while no correlation was found between fathers and sons. A possible explanation for this gender effect arises from the fact that mothers and girls in this study are found to be more math-anxious compared to males. Also, the gender stereotype threat of math as a male domain may negatively affect female's MA levels across the lifespan.

In the line with the present findings, Casad et al. (2015) carried out a study among students in the 6th to 8th grades. Their results confirmed that parents' MA was related to children's MA and both variables interacted to predict mathematics outcomes. Also, in a sample of Indian children aged 10 to 15 years,

Soni and Kumari (2017) confirmed that parents' MA was positively associated with children's MA and negatively affected their math attitude. In contrast, Jameson (2013) examined the environmental factors relating to MA in 2nd-grade students (aged 7–9 years) and found no significant correlation between parents' MA and their children's MA. Another study conducted by Batchelor et al. (2017) indicated that children's MA is related to parents' MA, more specifically, a positive association between parents' MA and sons was calculated, while no association with daughter's levels of MA was found.

6.3. Predictors of child math achievement

A weak but positive correlation was found between parental involvement in child math homework and child math achievement. Similar findings were reported by Fan's and Chen's (2001) meta-analysis in which a positive association was calculated between academic achievement in young children and parental involvement at home and school. Our findings are not in line with other studies indicating home parental involvement to be negatively related to children's achievement (Wilder, 2015).

In order to identify the main predictors of child mathematics achievement, a hierarchical multiple regression in 3 steps was conducted. The regression analysis showed that child MA explained 4.6% of the variance in the math achievement score, while parental variables (parent's MA, parent involvement in child math homework, and the history of parents' math performance) explained 11% of the variance in children math achievement. Test anxiety was a predictor of child mathematics achievement only in the first stage of the regression model, while after controlling all other variables in the last stage, the ultimate predictors of math achievements were children's MA, parents' MA, and child trait anxiety.

Findings revealed that children's MA and parents' MA were both predictors of children's math achievement, being consistent with the Maloney et al. (2015) study, which confirmed the role of parents' MA as a predictor of children's math achievement but only for children whose parents were involved in math homework. Similar results were reported by Casad et al. (2015) who suggested parents' anxiety as a predictor of children's math education outcomes. In addition, a meta-analysis proposed that students' MA levels can significantly predict their mathematics performance (Ma, 1999). However, Hembree's meta-analysis (1990) revealed that MA was more predictive of math performance in boys than in girls.

In contrast to our findings that are not revealing a predictive role of parents' involvement in child math homework for their math performance, other studies confirmed the suggestion of parental involvement as an important predictor of math achievements (Harackiewicz et al., 2012; Hill & Taylor, 2004). Interestingly, the way parents interact with their children and their spontaneous reaction to math is a better predictor of children's outcomes than the level of school parental involvement (Wilder, 2015).

6.4. The potential interaction effects between children's Math anxiety and parental variables on children's math outcomes

A moderation interaction analysis was run to examine if parental variables (parent's MA, parent involvement in child math homework, and the history of parents' math performance) moderate the relation between child MA and child math performance. Findings of this study showed that none of them was playing a moderator effect on the relation. It is important to note that regardless of causal direction, parental variables didn't moderate the relation between anxiety and performance. In fact, a majority of parents in our sample tended to rate themselves as highly involved, so there was little variation in the levels of parent's involvement that could be a reason for making parental involvement moderate the relation between child MA and child math performance. Due to the self-reported measure used in this study, parents may have provided socially desirable responses about their level of involvement in their child's math homework, rather than indicating their actual parental involvement level (Warren et al., 2018).

7. Conclusion

The findings of this study substantially contribute to the growing body of literature addressing several factors affecting mathematics achievements and future career orientations: Math anxiety, test anxiety and possible gender differences. Moreover, the potential interaction between child MA and parental variables on child math outcomes revealed significant gender differences in Math levels, young girls in primary school and also their mothers, reported higher levels of MA. In addition, the study showed that MA levels significantly and negatively affected mathematics achievements. Both child's MA and their parent's MA were found to be strong predictors of children's math achievements. With this, the current study offers the first systematic investigation of MA in Palestinian primary schools, offering valuable insights into the relation between math achievements and MA and gender differences, in addition to parental role in the transmission of MA. Its results offer valuable avenues to monitor and enhance the female presence in math-related fields in the Palestinian workforce. Thus, it is recommended that further investigations of the barriers to females' participation in the Palestinian STEM workforce could be conducted.

8. Limitations

The study findings need to be interpreted in light of some limitations. The use of self-report measures for children and parents, which may result in systematic response distortions is considered the first limitation of the current study. A second limitation is that child's math achievement was based on teachers' records and, since the data are obtained from several schools, although the grading system was identical, this can mask different standards of performance for math achievement between schools. A third limitation refers to the sample composition, since the majority of the participants were females such as girls (65.6%), mothers (74.8%), the male sample size was rather small for the effect we wanted to observe.

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