

## **Modeling the Causal Relationships between Statistical Self-Efficacy, Academic Hardiness, and Statistics Anxiety among Postgraduate Students at King Faisal University**

**Sayed Ibrahim Ali<sup>1,2,\*</sup>, Sherif Adel Gaber<sup>3</sup>**

<sup>1</sup>Assistant Professor, Department of Family & Community Medicine, College of Medicine, King Faisal University, KSA. Email :  
ORCID:0000-0002-8808-6296

<sup>2</sup>Lecturer, Educational Psychology Department, College of Education, Helwan University, Egypt.

<sup>3</sup>Associate Professor, Department of Special Education, College of Education, King Faisal University, KSA, Email : sagahmed@kfu.edu.sa  
ORCID: 0000-0002-9787-8041

\*Corresponding author: Address: college of Medicine, King Faisal University, Saudi Arabia, Email: seali@kfu.edu.sa, phone number: 00966504472991

### **Abstract**

Statistics is essential in postgraduate programs. However, various intra- and interpersonal factors may contribute to the successful completion of required coursework in this area. This research aimed to model the causal relationships between statistical self-efficacy, academic hardiness, and statistics anxiety. This study had a sample of (200) male and female postgraduate students in college of Education at King Faisal University, Al-Ahs a government. In this study, the researchers used the descriptive correlative approach, using the following tools: the statistical self-Efficacy scale, the academic hardiness scale, and the statistics anxiety scale developed by the researchers, and appropriate statistical methods for data analysis. Results of the study showed that there was a statistically significant positive relationship at the significance level ( $\leq 0.05$ ) between statistical self-efficacy and academic hardiness, there was a statistically significant negative correlation at the significance level ( $\leq 0.05$ ) between academic hardiness and statistics anxiety, there was a statistically significant negative correlation at the level of significance ( $\leq 0.05$ ) between statistical self-efficacy and statistics anxiety, there was a direct effect of statistical self-efficacy on the academic hardiness, there was a direct effect of the academic hardiness on statistics anxiety, and there was an indirect effect of statistical self-efficacy on statistics anxiety through the academic hardiness.

**Keywords:** Modeling the Causal Relationships, Statistical Self-Efficacy, Academic Hardiness, Statistics Anxiety, Postgraduate Students.

### **1. Introduction**

Statistics is one of the most important and powerful tools in the field of scientific research, particularly in the psychological, social, and educational sciences. Thus, a postgraduate student in the humanities must be able to understand statistics and its principles and how to use it, given that he/she is about to prepare a research

proposal or a scientific thesis. Williams (2010) noted that students with statistics anxiety tend to expect high levels of annoyance during lectures, exams attendance, and statistical operations. Self-efficacy is one of the main concepts in social cognitive theory. Bandura (1977) proposed the concept of self-efficacy as a basis in behavior modification, based on

the assumption that an individual's behavioral patterns of any kind act as media that determine his personal orientation. Bandura showed that when an individual is engaged in a work, explains the results of this work, and uses explanations to form and develop beliefs about his capabilities to do such work, he behaves in light of those beliefs. A low level of statistical self-efficacy is one of the potential barriers postgraduate students face when attempting to solve statistics problems. Statistics instructors commonly introduce new concepts by presenting definitions, associated concepts, theory, and derivations of the corresponding mathematical representations. Then, they demonstrate how to solve a problem, often explicitly instructing postgraduate students to perform certain procedures while solving (Hall & Vance, 2010).

The American Psychological Association (2015) defines hardiness as the ability to easily adapt to unexpected changes, coupled with a sense of purpose toward everyday life and personal control over what happens in one's life. Hardiness also means mitigating the negative effects of stress, and it is considered a protective factor against disease (p. 482). Furthermore, hardiness is a form of moral coherence that creates a reasonable degree of individual, which fits the ability to deal with stressful events, thus leading to emotional and psychological development. Individuals with hardiness have many characteristics, beginning with flexibility and focusing on achieving more success by defining their internal destination. They also tend to lead, control, and feel obligated to participate in any societal developments; they rise to the challenge to meet new opportunities (Buheji & Jahrami, 2020, p. 803). Academic hardiness plays an essential role in reducing anxiety and negative emotions and enhancing learners' performance in learning situations. The interaction of academic hardiness with learning motivation affects students when making critical decisions about their academic adjustment. This, in turn, affects their academic achievement, and students' assessment of their academic attitudes plays an important role in shaping their academic expectations. A high level of

academic hardiness increases university students' motivation towards learning and pressures them to achieve high-performing academic perceptions, such as making a commitment to attend lectures and preparing for exams (Cole et al., 2004, Karimi & Venkatesan, 2009). An individual with high hardiness will have a natural safety mechanism to deal with stressful elements in life. Conversely, students with low academic hardiness occasionally show an increased sign of depression, accompanied by increased indicators of anxiety and psychological distress (Dogaheh et al., 2013).

### 1.1. Statement of the Problem

Anxiety is a state of intense, mysterious fear that an individual possesses, causing many negative feelings of distress, pain, and annoyance. An anxious person expects the worst, appears pessimistic and apprehensive, and loses faith in himself and his capacity to focus, therefore becoming hesitant and unable to resolve his affairs. The majority of postgraduate statistics courses require students to take at least one research statistics course. Previous studies have found that students experience a high level of statistics anxiety while taking a statistics course. Unfortunately, few studies have examined statistics anxiety in postgraduate students and its effects on their performance. In the university environment, the statistics course has become an essential course for all postgraduate students, as it is part of specialized programs for enrollees. Postgraduate students vary in their statistical background. Most lack skills and major requirements to study statistical topics, which results in a high level of concern during their enrollment in statistics-related courses. For many postgraduate students in the College of Education at King Faisal University, taking the statistics course is a matter that causes these students more anxiety, and this is reflected negatively on their attitudes towards taking the statistics course. This is referred to studies by Koh and Zawi (2014), Al-Qahtani (2015), and Mubarak (2019), which differ from the study of Al-Titi, Ibdah, and Jaradat (2015). The following questions were used to model the causal

relationships between statistical self-efficacy, academic hardiness, and statistics anxiety:

1- Is there a statistically significant relationship between statistical self-efficacy and academic hardiness among the study sample?

2- Is there a statistically significant relationship between statistical self-efficacy and statistics anxiety among the study sample?

3- Is there a statistically significant relationship between statistics anxiety and academic hardiness among the study sample?

4- Is there an effect of statistical self-efficacy on academic hardiness among the study sample?

5- Is there an effect of academic hardiness on statistics anxiety among the study sample?

6- Is there an effect of statistical self-efficacy on statistics anxiety through academic hardiness among the study sample?

### 1.3 The Significance of the Research

The theoretical and practical importance of the current research is determined as follows:

#### A- Theoretical importance:

The theoretical importance stems from the significance of the research variables in the general field of education and, more specifically, in the fields of positive psychology, mental health, and special education. In these areas, the research deals with three variables: statistical self-efficacy, academic hardiness, and statistics anxiety. The theoretical importance of the study lies in adding rooting to the three variables and providing a set of recommendations in the interpretation of the causal relationships between the variables, due to the scarcity of Arab and foreign studies that deal with modeling these relationships.

#### B- Practical importance:

This importance comes from the results of the study, which may prove beneficial in opening the prospects of the extension study to develop the statistical self-efficacy in programs that prepare graduate students in general subjects and postgraduate students in the disciplines of psychology and special education. Foreign

theoretical frameworks and previous studies have indicated these potential benefits, particularly statistical self-efficacy's direct effects on academic hardiness and reducing statistics anxiety among postgraduate students. Additionally, an increasing interest of researchers to conduct more research and studies in this field leads to the improvement of the scientific preparation of the postgraduate students in the departments of psychology and special education.

### 1.4 Research Objectives

The current study aimed to accomplish the following:

1. Identify the nature of the correlation between the scores of the study sample on the scale of statistical self-efficacy and the scale of academic hardiness.

2. Identify the nature of the correlation between the scores of the study sample on the academic hardiness scale and the statistics anxiety scale.

3. Identify the nature of the correlation between the scores of the study sample on the scale of statistical self-efficacy and the statistics anxiety scale.

4. Determine the effect of statistical self-efficacy on the academic hardiness of the study sample.

5. Determine the effect of academic hardiness on the statistics anxiety among the study sample.

6. Determine the effect of statistical self-efficacy on the statistics anxiety through academic hardiness among the study sample.

### 1.5 Definitions of the Main Concepts

**Statistical Self-Efficacy:** Lane et al. (2004) have stated that statistical self-efficacy is a concept closely related to statistics anxiety. It is procedurally defined as "the postgraduate student's belief in his abilities and skills to achieve long-term goals related to statistics, his ability to persevere, exert effort and overcome difficulties in his assimilation of statistics knowledge, his flexibility with the difficulties he copes in understanding statistics, and to fulfill the assignments required of him, and to carry out activities to improve his comprehension of statistics."

Academic Hardiness: Introduced by Kobasa (1979), hardiness is considered a personality style consisting of the interrelated orientations of commitment (vs. alienation), control (vs. powerless), and perception of life changes and demands as a challenge (vs. threat). It is procedurally defined as "the ability of the postgraduate student to face academic difficulties and his awareness that he has the capabilities to achieve his academic goals, and his willingness to make personal sacrifices for academic achievement progress."

Statistics Anxiety: Onwuegbuzie et al. (1997) defined statistics anxiety as "a state-anxiety reaction to any situation in which a student is confronted with statistics in any form and at any time" (p. 28). It is procedurally defined as "feelings of tension experienced by a postgraduate student while studying a statistics course or while reading or conducting statistical analyses and their interpretation."

## 2. Literature Review

Schneider (2011) saw self-efficacy as a person's level of confidence in his ability to perform specific tasks under certain conditions or situations. Therefore, statistical self-efficacy is an individual's confidence in their ability to complete a particular statistics-related task. Academic hardiness helps in the development of transformational coping and social support abilities, but neither skill contributes to psychological well-being. Participants' ability to display their completely functioning self or fully functioning person can be improved by increasing commitment, control, and challenge when adapting to new academic demands (Wardani, 2020). Generalized Anxiety Disorder (GAD) affects 6.8 million adults, or (3.1%) of the adult population in the United States, but only (43.2%) receive treatment. Women are twice as likely as men to be affected. GAD is frequently associated with major depression (Anxiety & Depression Association of America, 2022). Results of the study by Rayan (2008) reveal significant differences in anxiety based on specialization, mid-term exam grade, and the number of failures. In addition, results do not show any significant differences associated with

gender, age, and academic year. DeVaney (2010) compared graduate students' levels of statistics anxiety and attitudes toward statistics in courses at the beginning and end of graduate-level educational statistics courses. He used the Survey of Attitudes Toward Statistics and three subscales of the Statistics Anxiety Rating Scale. Two anxiety scales (Interpretation and Test Anxiety and Class Anxiety) and two attitude scales (Affect and Difficulty) showed significant effects. Reduced anxiety and increased attitudes among online students encourage faculty to use materials and techniques to reduce anxiety and, hopefully, improve learning in online statistics courses. Perepiczka et al. (2011) investigated the extent to which 166 graduate students enrolled in master's and doctoral programs in colleges of education had a relationship between the self-efficacy to learn statistics, statistics anxiety, and the attitude toward statistics. The results showed that statistics anxiety and attitude toward statistics were statistically significant predictors of self-efficacy to learn statistics.

Al-Tarkit and Al-Abbasi (2012) aimed to identify the construction factor to measure the statistics anxiety on a sample of Kuwaiti postgraduate students. The results showed two factors: the first contained test and class, anxiety interpretation, and fear of asking; the second contained worth of statistics, computation of self-concept, and fear of statistics teachers. The result showed the significant difference based on demographic factors (college, place of study, specialty, stage, gender) on each of the components of six anxiety statistics and degree of benefit of statistics. The study recommended the preparation of various programs to help students reduce anxiety and get trained in using a variety of strategies while learning statistics. Koh and Zawi (2014) aimed to determine the level of anxiety associated with statistics among postgraduate students.

Similarly, the present study will examine the factors contributing to statistics anxiety among postgraduate students at UKM's Faculty of Education. As a secondary outcome, this study also investigates the evaluation type preferred

by postgraduate students in relation to a statistics course. During the study period, all postgraduate students enrolled in the Research Statistics course in the Faculty of Education at the National University of Malaysia were invited to participate. The questionnaire was completed by 141 students, and the results are included in this paper. According to the findings of this study, a significant (21.7 percent) percentage of the students polled demonstrated experience anxiety in at least one of the statistics anxiety domains. Anxiety about class activities, attitude toward class, attitude toward mathematics, or self-perception of ability to perform in statistics are all factors.

The study of Al-Titi, Ibdah, and Jaradat (2015) showed a low level of statistics anxiety in graduate students in the College of Education at the University of Yarmouk. The results also showed no statistically significant differences in the level of statistics anxiety between the master's and doctoral programs due to university degrees and statistically significant differences in the level of statistics anxiety due to gender, in favor of females. In addition, the study showed statistically significant differences in the level of statistics anxiety among the three different sections (the Department of Educational Psychology and Counselling, the Department of Curriculum and Teaching Strategies, and the Department of Educational Administration and the foundations of Education) in favor of the Department of Educational Administration and the foundations of Education. The study of Al-Qahtani (2015) investigated the effect of using a learning contract strategy when teaching statistics on developing statistical thinking skills and reducing statistics anxiety. In addition, he applied these examinations to students from the master's program at the Faculty of Education and Arts University of Tabuk. Results showed a significant negative relationship between the degree of students on the anxiety scale and statistical thinking.

Abdel Sadaq (2016) aimed to discover the role of statistical self-efficacy and irrational beliefs in predicting the statistics anxiety of a sample of female college students in the psychological departments

and verify whether there are differences between high self-efficacy and low self-efficacy in predicting irrational beliefs from statistics anxiety. The study found significant negative relationships between self-efficacy and both irrational beliefs and statistics anxiety and significant positive relationships between irrational beliefs and statistics anxiety. The statistical self-efficacy was a greater predictor of statistics anxiety. The study also showed statistically significant relationships between the level of achievement and both self-efficacy and statistics anxiety, and there were significant differences in statistical self-efficacy and statistics anxiety according to students' past mathematics experience.

Qarni and Ahmed (2017) aimed to identify the contribution of both the positive attitude toward the future and self-regulation in predicting academic hardiness among outstanding students in various scientific and literary departments from the Faculty of Education at Minia University. There were statistically significant differences at (0.01) level between outstanding males and females in academic resilience in favor of females. There was a statistically significant positive correlation at (0.01) level between positive attitudes towards the future and academic resilience among outstanding students. There was a statistically significant positive correlation at (0.01) level between self-regulation and academic hardiness among outstanding students. The scores of positive attitudes towards the future and self-regulation contributed to predicting their scores in academic hardiness.

Another study looked at statistics self-efficacy and learning styles as determinants of statistics anxiety among University of Port Harcourt graduate students. Glory (2018) investigated statistics self-efficacy and learning styles as predictors of statistics anxiety among graduate students at the University of Port Harcourt and was guided by seven research topics and six null hypotheses. The study included 150 graduate students (86 male, 64 female) who were chosen using a stratified random sample procedure. Data was collected using three valid instruments: the statistics anxiety rating scale (STARS), the current statistics self-efficacy scale (CSSSES), and

the Grasham Reichmann student learning style scales (GRSLSC). Statistics anxiety was shown to be high among graduated students, and statistics self-efficacy and learning styles, both individually and collectively, were found to predict statistics anxiety. Similarly, Cheng et al. (2019) aimed to assess graduate students' academic hardiness (GSAH) and academic self-efficacy (GSASE), as well as the relationships between the two. A total of 202 graduate students from various disciplines were asked to complete two questionnaires (GSAH and GSASE). The GSAH and GSASE were found to be reliable for assessing graduate students' academic hardiness and academic self-efficacy in exploratory factor analyses. When we compared the scores of master and doctoral students on the GSAH and GSASE scales, we discovered that doctoral students outperformed master's students. The results also revealed that three GSAH dimensions (commitment, affect control, and challenge) were strong predictors of graduate students' academic self-efficacy. These findings confirm and strengthen the link between academic hardiness and academic self-efficacy in graduate students.

Mubarak (2019) aimed to identify the relationship between negative thinking and statistics anxiety among postgraduate students at the Faculty of Education, King Saud University. The results showed that master's students had a higher average level of statistics anxiety than doctoral students. Wardani (2020) aimed to determine new students' academic toughness using a model that incorporates transformational coping, social support, and psychological well-being. New students must adapt to requirements and academic assignments that are different from previous schools, and they must display strong perseverance characteristics to build their psychological well-being as persons undertaking an educational transition. This study used a non-experimental cross-sectional research design. The academic toughness, skills, and psychological well-being questionnaire was completed by 237 people, and the results were analyzed using SEM version 8.80. The findings suggest that academic

toughness directly impacts the psychological well-being of participants.

Additionally, the predictability of statistics anxiety can be examined through the dimensions of negative thinking (positive expectations, positive riskiness, learning, cognitive development, and feeling of satisfaction). Mahmoud (2021) aimed to reveal the relationship between the patterns of the thinking center and the academic hardiness among the employees from higher studies students. The research results showed no relationship between researcher type and academic hardiness. Further, a negative relationship existed between loyalist type and academic hardiness, and a positive relationship was found between enthusiastic type and academic hardiness among the employees from higher studies. Enthusiastic type is the basic personality type for patterns of the thinking center, according to the Enneagram theory. Moreover, the patterns of the thinking center can predict the academic hardiness among the employees from higher studies. Alotaibi (2021) examined female postgraduate students at King Saud University and Imam University, finding a high level of academic hardiness among the students. The study also discovered a strong positive relationship between the academic hardiness and the self-efficacy of female students, the existence of differences in the measure of academic resilience between groups of students in favor of the older age group, the existence of differences in the scale of self-efficacy between groups of students in favor of the older age group, and the possibility of predicting academic hardiness through the students' self-efficacy. Selim (2021) aimed to uncover the contribution of the variables of self-efficacy, academic hardiness, and perceived academic support in shaping research competence for postgraduate students at Dammanhur University. Additionally, his study attempted to discover the nature of the relationship between research competence, self-efficacy, and academic hardiness and perceived academic support. The results showed a statistically significant relationship between general self-efficacy

and academic hardiness of postgraduate students at Damanhur University.

**Research model:** The researchers of the present study assumed that the causal relationships could be modeled between the three variables, which are the independent variable (statistical self-efficacy), the mediating variable (academic hardiness), and the dependent variable (statistics anxiety). Figure (1) illustrates the hypothetical model. This model is based on the fact that the statistical self-efficacy of the graduate students is responsible for their academic hardiness, which in turn affects their statistics anxiety. The arrow

from the statistical self-efficacy to statistics anxiety through academic hardiness represents an indirect effect relationship, and the arrow from statistical self-efficacy toward statistics anxiety represents a direct effect relationship. Accordingly, the study assumes the following: the existence of direct causal relationships between the variables, the existence of indirect causal relationships in which academic hardiness plays a mediating role between the variables, and the direct causal relationship of academic hardiness with statistics anxiety.

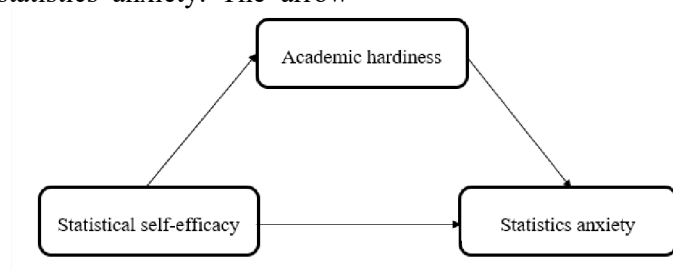


Figure 1: Proposed Research Model

#### 2.1. Study Hypotheses:

H1: There is a statistically significant relationship at ( $\leq 0.05$ ) level of significance between statistical self-efficacy and academic hardiness among the study sample.

H2: There is a statistically significant relationship at ( $\leq 0.05$ ) level of significance between statistical self-efficacy and statistics anxiety among the study sample.

H3: There is a statistically significant relationship at ( $\leq 0.05$ ) level of significance between statistics anxiety and academic hardiness among the study sample.

H4: There is an effect of statistical self-efficacy on academic hardiness among the study sample.

H5: There is an effect of academic hardiness on statistics anxiety among the study sample.

H6: There is an effect of statistical self-efficacy on statistics anxiety through academic hardiness among the study sample.

### 3. Materials and Methods

**3.1 Research sample:** The original sample consisted of (200) postgraduate students (Professional Diploma, Master, Ph.D.) in all departments at the College of

Education in King Faisal University, Saudi Arabia, during the period from 2018-2022. Participants' ages between 26-35 years with a mean of  $28.71 \pm 3.37$  standard deviation.

#### 3.2. Research instruments:

##### 3.2.1: Statistical Self-Efficacy Scale (SSES)

This scale aimed to measure the statistical self-efficacy among postgraduate students in the College of Education at King Faisal University. This scale consists of 26 items and has three options: 3 points for always applicable, 2 points for sometimes applicable, and 1 point for never applicable. The validity of the external criterion for the degrees of the Statistical Self-Efficacy test prepared by Dopa Pathirage (2015) was calculated on a sample of 30 postgraduate students, and the validity coefficient was 0.81, therefore the scale is valid. The Cronbach's alpha reliability was 0.865, which is highly reliable.

##### 3.2.2 Academic Hardiness Scale (AHS)

This scale aimed to measure the academic hardiness among postgraduate students in the College of Education at King Faisal University. This scale consists of 20 items and has three options: 3 points

for always, 2 points for sometimes, and 1 point for never. The validity of the external criterion for the degrees of the Academic Hardiness test prepared by Wardani (2020) was calculated on a sample of 30 postgraduate students, and the validity coefficient was (0.76), therefore the scale is valid. The Cronbach's alpha for reliability was (0.746), which is highly reliable.

### 3.2.3 Statistics anxiety Scale (SAS)

This scale aimed to measure the statistics anxiety among postgraduate students in the College of Education at King Faisal University. This scale consists of 17 items and has three options: 5 for always worries me, 4 for often worries me, 3 for sometimes worries me, 2 for rarely worries me, and 1 for never worries me. The external criterion validity for the degrees of the statistics anxiety test prepared by Chew, Dillon, and Swinbourne (2018) was calculated on a sample of 30 postgraduate students, and the validity coefficient was (0.81), therefore the scale is valid. The Cronbach's alpha reliability was (0.925), which is highly reliable.

## 4. Results

Discriminant validity: Hair et al. (2019) mentioned that discriminant validity should be assessed using the following criteria: variable indices must be less than (0.70); each construct's average variance extracted (AVE) must be equal to or greater than 0.5; the AVE square root of

each construct must be greater than the inter-construct correlations (IC) for a factor. For the present study, both constructs' discriminant validity was confirmed with values greater than 0.50 and significant at  $p = 0.001$ , as expected. The AVE square root shared by objects in a single construct should be smaller than the correlations between items in the two constructs factor analysis results with factor loadings of (0.70) or higher (Cronbach's alpha of 0.70 and composite reliability of 0.70 are acceptable). See Tables 2 and 3.

Construct Validity: The degree to which individual objects meet the purpose for which they were developed (Ing et al., 2020) is referred to as construct validity. This was determined by a thorough examination of previously tested items in the literature. Table 1 shows the items and their loadings that must be loaded into the model they were developed to evaluate (Chow & Teicher, 2012).

Convergent Validity: Since the factor loadings of 63 items loadings were more than 0.70 and composite reliability was greater than 0.70 (ranging from 0.960 to 0.978), they were found acceptable. Cronbach's alpha coefficient values ranged from 0.795 to 0.937, suggesting high reliability. The numbers for AVE ranged from 0.579 to 0.588. (Hair et al., 2019). See Table 2.

Table 1. Loadings and cross-loadings of items

	Items	Academic Hardiness	Statistics Anxiety	Statistical Self-Efficacy
Academic Hardiness	AH1	0.756	0.247	0.338
	AH2	0.802	0.337	0.354
	AH3	0.793	0.233	0.346
	AH4	0.728	0.243	0.299
	AH5	0.745	0.384	0.215
	AH6	0.761	0.323	0.168
	AH7	0.797	0.308	0.487
	AH8	0.766	0.294	0.333
	AH9	0.745	0.266	0.384
	AH10	0.762	0.384	0.323
	AH11	0.797	0.323	0.308
	AH12	0.745	0.384	0.276
	AH13	0.761	0.207	0.266
	AH14	0.797	0.323	0.308

	AH15	0.766	0.308	0.325
	AH16	0.745	0.287	0.384
	AH17	0.761	0.266	0.323
Statistics Anxiety	SA1	0.327	0.745	0.308
	SA2	0.289	0.789	0.285
	SA3	0.384	0.797	0.266
	SA4	0.323	0.766	0.452
	SA5	0.308	0.745	0.565
	SA6	0.284	0.778	0.467
	SA7	0.266	0.797	0.403
	SA8	0.384	0.766	0.258
	SA9	0.323	0.739	0.138
	SA10	0.308	0.768	0.258
	SA11	0.457	0.767	0.209
	SA12	0.266	0.745	0.357
	SA13	0.384	0.761	0.402
	SA14	0.323	0.744	0.357
	SA15	0.384	0.745	0.308
	SA16	0.384	0.761	0.258
	SA17	0.323	0.797	0.257
	SA18	0.308	0.766	0.158
	SA19	0.295	0.745	0.278
	SA20	0.266	0.761	0.357
Statistical Self-Efficacy	SE1	0.365	0.447	0.706
	SE2	0.355	0.415	0.779
	SE3	0.375	0.504	0.716
	SE4	0.384	0.257	0.745
	SE5	0.323	0.369	0.775
	SE6	0.308	0.402	0.797
	SE7	0.282	0.327	0.745
	SE8	0.384	0.266	0.761
	SE9	0.323	0.384	0.797
	SE10	0.308	0.384	0.746
	SE11	0.402	0.323	0.739
	SE12	0.266	0.308	0.743
	SE13	0.384	0.282	0.767
	SE14	0.323	0.266	0.761
	SE15	0.308	0.384	0.797
	SE16	0.284	0.323	0.766
	SE17	0.266	0.308	0.739
	SE18	0.384	0.198	0.778
	SE19	0.384	0.266	0.767

	SE20	0.323	0.384	0.745
	SE21	0.384	0.157	0.761
	SE22	0.384	0.276	0.797
	SE23	0.323	0.408	0.766
	SE24	0.308	0.207	0.774
	SE25	0.28	0.327	0.743
	SE26	0.266	0.401	0.767

Table 2. Factors loadings and confirmatory factor analysis results.

	Items	Loadings	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)	R <sup>2</sup>
Academic Hardiness	AH1	0.756	0.809	0.96	0.588	0.656
	AH2	0.802				
	AH3	0.793				
	AH4	0.728				
	AH5	0.745				
	AH6	0.761				
	AH7	0.797				
	AH8	0.766				
	AH9	0.745				
	AH10	0.762				
	AH11	0.797				
	AH12	0.745				
	AH13	0.761				
	AH14	0.797				
	AH15	0.766				
	AH16	0.745				
	AH17	0.761				
Statistics Anxiety	SA1	0.745	0.795	0.966	0.584	0.788
	SA2	0.789				
	SA3	0.797				
	SA4	0.766				
	SA5	0.745				
	SA6	0.778				
	SA7	0.797				
	SA8	0.766				
	SA9	0.739				
	SA10	0.768				
	SA11	0.767				
	SA12	0.745				

	SA13	0.761				
	SA14	0.744				
	SA15	0.745				
	SA16	0.761				
	SA17	0.797				
	SA18	0.766				
	SA19	0.745				
	SA20	0.761				
Statistical Self- Efficacy	SE1	0.706	0.937	0.978	0.579	
	SE2	0.779				
	SE3	0.716				
	SE4	0.745				
	SE5	0.775				
	SE6	0.797				
	SE7	0.745				
	SE8	0.761				
	SE9	0.797				
	SE10	0.746				
	SE11	0.739				
	SE12	0.743				
	SE13	0.767				
	SE14	0.761				
	SE15	0.797				
	SE16	0.766				
	SE17	0.739				
	SE18	0.778				
	SE19	0.767				
	SE20	0.745				
	SE21	0.761				
	SE22	0.797				
	SE23	0.766				
	SE24	0.774				
	SE25	0.743				
	SE26	0.767				

Table3. Discriminant validity

	Statistics Anxiety	Statistical Efficacy	Self- Academic Hardiness
Statistics Anxiety	0.764		
Statistical Self- Efficacy	0.636	0.761	
Academic Hardiness	0.395	0.485	0.767

To initially examine the structural model between the variables, the

correlational matrices between the observed variables were calculated. Table 4 shows the correlation between the observed variables of the research.

Table 4 shows that there was a significant positive relationship between statistical self-efficacy and academic hardiness (H1) ( $r = 0.325$ ,  $p$  value = 0.001).

Additionally, there was a significant negative relationship between academic hardiness and statistics anxiety (H2) ( $r = -0.200$ ,  $p$  value = 0.046). Furthermore, there was a significant negative relationship between statistical self-efficacy and statistics anxiety (H3) ( $r = -0.536$ ,  $p$  value = 0.0001).

Table 4. The correlation matrix between the studied variables

		Academic Hardiness	Statistics Anxiety
Statistics anxiety	Pearson Correlation	-0.200*	
	P value	0.046	
Statistical Self-Efficacy	Pearson Correlation	0.325**	-0.536**
	P value	0.001	0.0001

\*significant at 0.05

\*\* significant at 0.01

To validate the research hypotheses and examine construct relationships, Smart PLS 3.0 was used. The path coefficient findings are presented in Figure 2.

Table 5 summarizes the results of the study, including all participants.

For the direct effect of statistical self-efficacy on academic hardiness (H4) ( $\beta = 0.130$ ,  $SE = 0.038$ ,  $t = 3.411$ ,  $p < 0.01$ ), the hypothesis was accepted. For the direct

effect of academic hardiness on statistics anxiety (H5) ( $\beta = 2.01$ ,  $SE = 0.337$ ,  $t = 2.011$ ,  $p < 0.05$ ), the hypothesis was accepted.

For the indirect effect of statistical self-efficacy on statistics anxiety through academic hardiness (H6) ( $\beta = -0.715$ ,  $SE = 0.123$ ,  $t = 5.810$ ,  $p < 0.0001$ ), the hypothesis was accepted.

Table 5. Hypotheses testing of path analysis

Path of Hypotheses	Path coefficient ( $\beta$ )	Standard Error	T-Values	Decision
Statistics Self-Efficacy $\rightarrow$ Academic Hardiness (H4)	0.13	0.038	3.411**	Accepted
Academic Hardiness $\rightarrow$ Statistics Anxiety (H5)	-2.01	0.337	2.011*	Accepted
Statistics Self-Efficacy $\rightarrow$ Statistics Anxiety (H6)	-0.715	0.123	5.810***	Accepted

\*\*\* Significant at 0.001

\*\* significant at 0.01

\* significant at 0.05

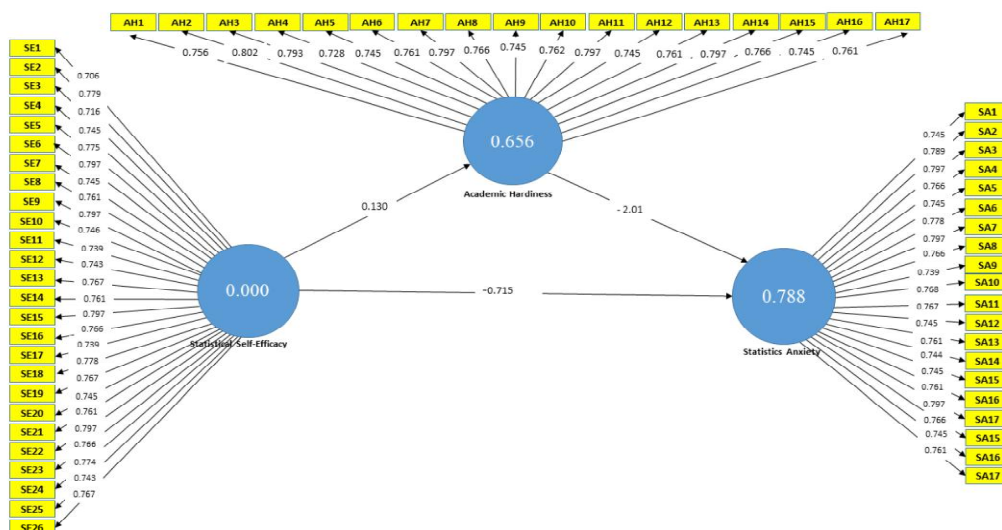


Figure 2. Path coefficient findings

## 5. Discussion

This study showed a positive, statistically significant relationship between statistical self-efficacy and academic hardiness among the study sample. These results agree with the study of Al-Qahtani (2015), which revealed the impact of using the learning contract strategy in teaching statistics on developing statistical thinking skills and reducing statistics anxiety. Additionally, the present study's results correspond with those of Cheng et al. (2019), which indicated that there is a relationship between academic hardiness and academic self-efficacy among graduate students. A study by Al-Otaibi (2021) found a strong positive relationship between statistical self-efficacy and academic hardiness, and research by Salim (2021) indicated a statistically significant relationship between general self-efficacy and academic hardiness among graduate students. These results differ from Mahmoud's study (2021), which revealed no relationship between the type of researcher and academic hardiness and a negative relationship between the loyal type and academic hardiness.

The present study showed a negative, statistically significant relationship between academic hardiness and statistics anxiety among the study sample. These results are consistent with Rayan's study (2008), which found statistically significant differences in anxiety based on specialization, mid-term exam score, and number of failure times. Al-Titi, Ibdah, and Jaradat (2015) provided evidence indicating a low level of statistics anxiety among graduate students in the College of Education. Additionally, a study by Al-Tarkit and Al-Abbasi (2012) showed the absence of statistically significant differences in the level of statistics anxiety between the master and doctoral stages. This study also demonstrated a statistically significant negative relationship between statistical self-efficacy and statistics anxiety among the study sample. These results agree with the study of Abdel-Sadeq (2016), which concluded that there is a negative statistically significant relationship between statistical self-

efficacy and statistics anxiety.

There was a direct relationship between statistical self-efficacy and academic hardiness in the present study's sample, which agrees with Al-Otaibi's study (2021), indicating the possibility of predicting academic hardiness through self-efficacy. This study also showed a direct relationship between academic hardiness and statistics anxiety among the study sample. These results are consistent with the study by Koh and Zawi (2014) and the results found by Qarni and Ahmed (2017), which indicated the existence of a positive, statistically significant relationship between self-regulation and academic hardiness. The present study also showed an indirect relationship between statistical self-efficacy and statistics anxiety through the academic hardiness of the study sample. These results are consistent with the study of Abdel-Sadiq (2016), which indicated that statistics anxiety could be predicted through statistical self-efficacy, and Perepiczka et al. (2011), whose results indicated that statistics anxiety could be predicted with statistical self-efficacy. Similarly, this study's results align with those of DeVaney (2010) and Mubarak (2019), which indicated the possibility of predicting statistics anxiety through the dimensions of negative thinking.

## 6. Conclusions

The results of this research showed a statistically significant positive relationship between statistical self-efficacy and academic hardiness. A statistically significant negative correlation between academic hardiness and statistics anxiety. A statistically significant negative correlation between statistical self-efficacy and statistics anxiety, a direct effect of statistical self-efficacy on the academic hardiness, a direct effect of the academic hardiness on statistics anxiety, and an indirect effect of statistical self-efficacy on statistics anxiety through the academic hardiness.

## 7. Recommendations

Considering the results, the researchers recommend developing motivational plans

within the colleges of education to advance graduate students and enhance their statistical self-efficacy and academic hardiness, thus reducing students' statistics anxiety. In addition, further quasi-experimental research and studies should focus on identifying the effectiveness of counseling programs in improving statistical self-efficacy, increasing academic hardiness, and reducing statistics anxiety among postgraduate students. Furthermore, it is recommended that additional research and descriptive studies be conducted to reveal the levels of statistical self-efficacy and academic hardiness among postgraduate students in other departments to reduce their statistics anxiety.

#### Acknowledgments

The authors acknowledge the Deanship of Scientific Research at King Faisal University for obtaining financial support for research, authorship, and the publication of research Grant Nasher No. (NA000100).

#### REFERENCES

- Abdel Sadaq, F. (2016). The role of statistical self-efficacy and irrational thoughts in predicting statistics anxiety among university students in light of the variables of achievement level and experience in studying mathematics. *Journal of the College of Arts*, 76(3), 221-298. <https://search.mandumah.com/Record/845962>
- Al-Otaibi, R. (2021). Academic hardiness and its relationship to self-efficacy among female graduate students. *Educational Journal*, 87, 881-922.
- Al-Qahtani, O. (2017). The effect of using the contract learning strategy in teaching the educational statistics course on developing statistical thinking skills and reducing statistical anxiety among graduate students at the College of Education, University of Tabuk. *Specialized International Educational Journal*, 6(1), 229-244. <http://search.shamaa.org/FullRecord?ID=116930>
- Al-Tarkit, F. & Al-Abbasi, A. (2012). Components of statistical anxiety and the benefit of studying statistics courses and their relationship to demographic and personal characteristics. *The Egyptian Journal of Psychological Studies*, 22(75), 303-337. <https://search.mandumah.com/Record/1010500>
- Al-Titi, M., Ibdah, R., & Jaradat, M. (2015). The level of statistics anxiety among graduate students in the college of education and its relationship to some variables. *Specific Education Research Journal*, (37), 2-33. <https://search.mandumah.com/Record/911521>
- American Psychological Association. (2015). *APA Dictionary of psychology* (2<sup>nd</sup> ed).
- Anxiety & Depression Association of America. (2022). Facts and statistics. <https://adaa.org/understanding-anxiety/facts-statistics>.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. Freeman.
- Buheji, M., & Jahram, H. (2020). Analysing hardiness resilience in COVID-19 pandemic – using factor analysis. *International Journal of Management*, 11(10), 802-815. [doi: 10.34218/IJM.11.10.2020.074](https://doi.org/10.34218/IJM.11.10.2020.074)
- Cheng, Y-H., Tsai, Ch-Ch. & Liang, J-Ch. (2019). Academic hardiness and academic self-efficacy in graduate studies. *Higher Education Research and Development*, 38(5), 907-92. <http://dx.doi.org/10.1080/07294360.2019.1612858>
- Chew, P., Dillon, D., & Swinbourne, A. (2018). An examination of the internal consistency and structure of the statistical anxiety rating scale (STARS). *PloS one*, 13(3), e0194195. <https://doi.org/10.1371/journal.pone.0194195>
- Chow, Y. & Teicher, H. (2012). *Probability Theory: Independence, interchangeability, martingales*. Springer Science Business Media: Berlin, Germany. <https://link.springer.com/book/10.1007/978-1-4612-1950-7>
- Cole, M., Field, H., & Harris, S. (2004). Student learning motivation and psychological hardiness: Interactive effects on students' reactions to a management class. *Learning & Education*, 3(1), 64-85. [doi:10.5465/AMLE.2004.12436819](https://doi.org/10.5465/AMLE.2004.12436819)

- DeVaney, T. (2010). Anxiety and attitude of graduate students in on-campus vs. online statistics courses. *Journal of Statistics Education*, 18(1), 1-15. <http://www.amstat.org/publications/jse/v18n1/devaney.pdf>
- Dopa Pathirage, N. A. P. (2015). *The development and validation of the self-efficacy in statistical practices scale*.
- Hair, J., Hult, G., Ringle, C., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)*, (2<sup>nd</sup> ed.). Sage: Thousand Oaks.
- Hair, J., Risher, J., Sarstedt, M., Ringle, C. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, 31, 2-24. <https://www.emerald.com/insight/content/doi/10.1108/EBR-11-2018-0203/full/html>
- Hall, S., & Vance, E. (2010). Improving self-efficacy in statistics: Role of self-explanation & feedback. *Journal of Statistics Education*, 18(3). <http://jse.amstat.org/v18n3/hall.pdf>.
- Ing, H. C., Yahaya, N., Kumar, L., & Al-Rahmi, W. M. (2020). Examining learners' interaction pattern in asynchronous text-based online learning. *i-manager's Journal of Educational Technology*, 16(4), 9. <https://imanagerpublications.com/article/16597/>
- Karimi, A., & Venkatesan, S. (2009). Mathematics anxiety, mathematics performance and academic hardiness in high school students. *International Journal of Educational Sciences*, 1(1), 33-37. doi: [10.1177/0258042X0903400406](https://doi.org/10.1177/0258042X0903400406)
- Kobasa, S. (1979). Stressful life events, personality and health: An inquiry into hardiness. *Journal of Personality and Social Psychology*, 37, 111. doi: [10.1037//0022-3514.37.1.1](https://doi.org/10.1037//0022-3514.37.1.1)
- Koh, D. & Zawi, M. (2014). Statistics anxiety among postgraduate students. *International Education Studies*, 7(13), 166-174. doi: [10.5539/ies.v7n13p166](https://doi.org/10.5539/ies.v7n13p166)
- Lane, A.M., Hall, R., & Lane, J. (2004). Self-efficacy and statistics performance among sport studies student. *Teaching in Higher Education*, 9, 435-448. <https://doi.org/10.1080/1356251042000252372>
- Mahmoud, M. (2021). Thinking center patterns and their relationship to academic hardiness among working graduate students. *The Arab Journal of Educational and Psychological Sciences*, 5(19), 343-370. <http://search.shamaa.org/FullRecord?ID=276696>
- Mubarak, W. (2019). The predictive ability of negative thinking with statistical anxiety among graduate students. *Specialized International Educational Journal*, 8(1), 76-85. <http://search.mandumah.com/Record/999579>
- Onwuegbuzie, A., Da Ros, D., & Ryan, J. (1997). The components of statistics anxiety: A phenomenological study. *Focus on Learning Problems in Mathematics*, 19(4), 11-35. <https://eric.ed.gov/?id=EJ558838>
- Perepiczka, M., Chandler, N., & Becerra, M. (2011). Relationship between graduate students' statistics self-efficacy, statistics anxiety, attitude toward statistics, and social support. *Research and Practice*, 1(2), 99-108. doi: [10.15241/mpa.1.2.99](https://doi.org/10.15241/mpa.1.2.99)
- Qarni, S., & Ahmed, A. (2017). The relative contribution of positive orientation towards the future and self-regulation in predicting academic resilience among academically outstanding students at the Faculty of Education, Minia University: A study from the perspective of positive psychology. The Third International Conference: The Future of Teacher Preparation and Development in the Arab World: Faculty of Education, October 6 University, in cooperation with the Arab Educators Association, 1, Giza: October 6 University - College of Education, the Association of Arab Educators, and the Professional Academy for Teachers, 185-225. <https://search.mandumah.com/Record/840932>
- Rezaei D., Khaledian, M., & Mohammadi, A. (2013). The relationship of psychological hardiness with emotional intelligence and workaholism. *Practice in Clinical Psychology*, 1(4), 211-217. <http://jpcp.uswr.ac.ir/article-1-129-en.html>
- Ryan, A. (2008). Statistics anxiety among Al-Quds open university students and its relationship to some variables. *Journal of Educational and Psychological Sciences*, 9(3), 153-173.

<https://search.mandumah.com/Record/2936>  
Schneider, W. (2011). *The relationship between statistics self-efficacy, statistics anxiety and performance in an introductory graduate statistics course*. [Unpublished doctoral dissertation]. University of South Florida.  
[http://gateway.proquest.com/openurl?url\\_ver=Z39.88-2004&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:dissertation&res\\_dat=xri:pqdiss&rft\\_dat=xri:pqdiss:3450237](http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&res_dat=xri:pqdiss&rft_dat=xri:pqdiss:3450237)

Wardani, R. (2020). Academic hardiness, skills, and psychological well-being on new student. *Jurnal Psikologi*, 19(2), 188-200. <https://doi.org/10.14710/jp.19.2.188-200>

Williams, A. (2010). Statistics anxiety and instructor immediacy. *Journal of Educational Statistics*, 18(2), 1-18. <http://www.amstat.org/publications/jse/v18n2/williams.pdf>