

Exploring the role of personal quantification in alleviating generalized anxiety disorder among Chinese PhD students

A cross-sectional study

Guilong Li, MD^{a,b}, Qiulan Su, BD^{a,*} 

Abstract

Personal quantification plays a crucial role in preserving individual mental health. However, in previous research, its effectiveness in alleviating generalized anxiety disorder (GAD) has not been conclusively established. This study explores the impact of personal quantification on GAD among PhD students. The research data was obtained through questionnaires distributed to 308 PhD students across universities in China. Among these students, 118 anxiety-free participants were excluded, yielding valuable data from 190 students with GADs. We employed Python programming language and SPSS software for the empirical analysis. The results illustrated that personal quantification significantly and negatively impacted GAD ($\beta = -0.148$, $P = .002$), concurrently producing a significantly positive effect on self-efficacy ($\beta = 0.359$, $P < .001$). Further analysis showed that through 5000 sampling iterations and a 95% confidence level, self-efficacy significantly reduced certain symptoms of GAD ($\beta = -0.1183$; $P = .026$; 95% CI: -0.2222 to -0.0144). Moreover, when the coefficient of self-efficacy was significantly negative, the impact of personal quantification on GAD remained statistically significant ($\beta = -0.1056$; $P = .033$; 95% CI: -0.2025 to -0.0087). The findings indicated that personal quantification has a significant role in alleviating GAD among PhD students, which is partly mediated through self-efficacy. This study contributes valuable insights to the nonpharmacological alleviation of GAD in Chinese PhD students.

Abbreviations: CBT = cognitive behavioral therapy, GAD = generalized anxiety disorder.

Keywords: cognitive behavioral therapy, generalized anxiety disorder, personal quantification, self-efficacy

1. Introduction

Generalized anxiety disorder (GAD) is one of the most common psychological disorders, typically exhibiting a chronic course.^[1] GAD is characterized by persistent worrying along with anxiety symptoms that linger long past triggering events or situations.^[2] Epidemiologically, the overall incidence of GAD in the total population is estimated as 5% to 7%^[3,4] with the lifetime prevalence rate reaching 6.2%, impairing individuals' quality of life significantly.^[5] Moreover, prolonged, intense anxiety, at times, escalates into severe mental disorders and causes suicidal tendencies.^[6]

PhD students commonly experience urgency, worry, and stress during their PhD studies. Financial, interpersonal, academic factors, and graduation pressure collectively create immense pressure for PhD students, making them a high-risk

group for GAD.^[7] A study on Flemish PhD students revealed that over 51% have experienced psychological distress, and approximately 32% were susceptible to or exhibited common mental disorders, especially depression.^[8] However, prior studies have focused on the impacts of prolonged or severe depression and psychological distress; the investigation into the treatment of GAD in PhD students is relatively limited.^[9–12] Therefore, this study aims to investigate the effect of a new cognitive behavioral therapy (CBT), personal quantification, on alleviating general anxiety in PhD students.

Numerous therapeutic approaches exist for GAD. While the commonly applied method involves Western medicine, its efficacy frequently falls short.^[13] In addition, acupressure,^[14] acupuncture,^[15,16] and the combination of traditional Chinese and Western medicine exhibit noticeable therapeutic efficacy as

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Ethical review and approval were waived for this study because data came from a questionnaire and the interviewees completed the questionnaire voluntarily. We included the informed consent on the first page of the questionnaire, and the submission of the questionnaire was considered as the participant providing informed consent.

^a Business School, Central University of Finance and Economics, Beijing, China,

^b School of Business Administration, Xinjiang University of Finance & Economics, Urumqi, Xinjiang, China.

* Correspondence: Qiulan Su, Business School, Central University of Finance and Economics, 39 South College Road, Haidian District, Beijing 100081, China (e-mail: suqiulan95@126.com).

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alternative treatments.^[13] However, considering the psychological root of GAD, exclusive reliance on medicinal interventions addresses only the outward manifestations of the disease. In contrast to pharmacotherapy, CBT has demonstrated considerable effect in treating GAD.^[17-19] Techniques such as meditation,^[20] dialectical behavioral,^[21] acceptance and commitment,^[22] yoga behavioral,^[23] and mindfulness-based cognitive therapies^[24,25] facilitate the identification and alteration of negative thought patterns and behaviors and promote healthier emotions and behaviors. Despite advancements in CBT for GAD treatment, the absence of active patient engagement becomes the most important factor for limiting its efficacy.

In contrast to conventional CBT for treating GAD, personal quantification stands out because of its attributes of active participation, self-monitoring, and goal orientation. Personal quantification refers to an individual's use of applications and tools to monitor well-being parameters and activities (such as step count or reading volume) for self-reflection and knowledge acquisition.^[26-28] Previous research indicates that engaging in personal quantification activities can effectively contribute to individual health and happiness.^[29] However, limited attention has been paid to investigating the impact of personal quantification on GAD. Within the progress of personal quantification, individuals develop a sense of self-efficacy by establishing goals, engaging in self-monitoring, and striving to achieve these goals. Self-efficacy can reduce an individual's anxiety levels.^[30-33] Therefore, this study suggests that personal quantification practice can alleviate GAD by improving self-efficacy.

2. Materials and methods

This study investigates the anxiety status, its causes, and the role of personal quantification in alleviating GAD among Chinese PhD students. We employ a questionnaire survey on 350 PhD students in various universities in China and conduct empirical testings. First, we apply descriptive statistics to the anxiety data of Chinese PhD students and analyze the general patterns of anxiety phenomenon among this demographic. Second, we employ the text analysis technique to conduct word frequency statistics on the causes of anxiety among PhD students for an in-depth analysis of the primary factors of these students' anxiety. Finally, we conduct regression analysis to explore the relationships between personal quantification, self-efficacy, and GAD.

2.1. Participants

The survey encompassed PhD students from various universities in China, specifically those with experience in using personal quantification tools. The inclusion criteria required participants to meet both the requirements of being PhD students in China and having experience with self-quantification. Participants' fields of study were not restricted due to the possibility that general anxiety among Chinese doctoral students could be a prevalent challenge across research disciplines. Additionally, all participants were required to sign an informed consent form prior to survey participation. This document provided a detailed overview of the survey's purpose and data usage, along with a commitment to safeguarding participants' privacy.

2.2. Data collection procedure

The data collection methodology employed in this study was based on a questionnaire survey approach. Specifically, participants were administered questionnaires through the online survey platform, Creadmo. This platform is an effective system of disseminating survey instruments with a wide user-base. Two diagnostic criteria were incorporated into the questionnaire to determine participant eligibility, namely, the confirmation of

PhD student status and verification of experience in personal quantification activities. Subsequently, 350 questionnaires were distributed through the Creadmo platform, and 42 respondents who did not meet the stipulated criteria were excluded. Consequently, 308 valid questionnaires were accepted for analysis. Following the methodology established by Spitzer et al,^[1] 118 respondents without GAD were excluded, resulting in a final dataset comprising 190 participants diagnosed with anxiety disorders. Moreover, we set an incentive of 10 CNY (approximately US\$1.4) as a reward for the completion of each questionnaire.

2.3. Variable measurement and reliability analysis

2.3.1. Personal quantification. We measured personal quantification using the 5-point Likert-type scale developed by Maltseva et al,^[34] which comprises 5 question items. In the ensuing reliability analysis, Cronbach alpha coefficient for the personal quantification scale attained a value of 0.870, indicating a high level of reliability.

2.3.2. Generalized anxiety disorder. The measurement of GAD employed a 7-item scale developed by Spitzer et al.^[1] Each item within this scale carries a scoring range of 0 to 3 points contributing to a cumulative score range of 0 to 21 points. Specifically, scores falling within the range of 0 to 4 denote an absence of anxiety disorder, whereas scores ranging 5 to 9, 10 to 14, and 15 to 21 signify mild, moderate, and severe anxiety disorder, respectively. The reliability analysis established a Cronbach alpha coefficient of 0.796 for the GAD Scale, suggesting robust reliability.

2.3.3. Self-efficacy. Self-efficacy was gauged through a 5-point Likert-type scale developed by Salsman et al, comprising 10 question items.^[35] The ensuing reliability analysis result showed a Cronbach alpha coefficient of 0.908, indicating a high degree of reliability.

3. Results

3.1. Test for common methods bias

This study employed a questionnaire survey to collect data, which posed the risk of generating artificial covariation between predictor and effector variables, thereby potentially compromising the scientific validity of the results. Consequently, a Harman single-factor test was conducted on the research data. Among the identified factors, 4 exhibited eigenvalues >1. The primary factor, explaining 20.86% of the variance, fell below the critical threshold of 40.00%. Therefore, there is no evidence of a common method bias in this study.

3.2. Descriptive statistical analysis

Table 1 shows the results of the descriptive statistics. Among 308 PhD students, 190 individuals exhibit varying degrees of GAD, which constitutes 61.69% of the participants. This finding underscores a considerable prevalence of GAD among Chinese PhD students, with 3 out of every 5 students, on average, suffering from GAD. The analysis also reveals a noteworthy disparity in the prevalence of GAD between unmarried and married PhD students. Specifically, 69.8% of unmarried PhD students exhibit GAD, in contrast to 54.1% of their married counterparts. This marked difference implies that familial support has mitigating effects on patients' psychological well-being, suggesting that such support may bolster resilience and facilitate effective coping mechanisms in the face of stressors. Furthermore, on examining the age variable, no PhD students aged 36 years or older exhibit severe GAD

Table 1
Descriptive statistics.

		Total sample	Number of people with anxiety	Number of people with mild anxiety	Number of people with moderate anxiety	Number of people with severe anxiety
Gender	Male	308	190	120	48	22
	Female	116	69	41	14	14
Marital status	Married	192	121	79	34	8
	Unmarried	159	86	56	20	10
Age (yr)	≤25	149	104	64	28	12
	26–30	64	52	33	14	5
	31–35	132	82	51	20	11
	36–40	69	32	19	7	6
	>41	25	14	8	6	0
Monthly income	≤¥1000*	18	10	9	1	0
	¥1001–¥2000	3	2	1	0	1
	¥2001–¥3000	22	17	10	2	5
	¥3001–¥4000	37	31	16	9	6
	¥4001–¥5000	35	27	16	11	0
	>¥5000	37	26	19	4	3
Grade	Dr first grade	174	87	58	22	7
	Dr second grade	111	84	57	19	8
	Dr third grade	76	45	26	15	4
	Dr fourth grade	67	33	18	8	7
	Other grades	32	18	10	5	3
		22	10	9	1	0

*¥1 = \$7.14 (exchange rate on October 18, 2023).

symptoms. However, among students under the age of 36, 22 individuals are diagnosed with severe GAD. This discrepancy implies that older PhD students tend to manifest higher levels of psychological resilience, thereby reducing their susceptibility to severe anxiety disorders. Regarding the correlation between income levels and anxiety symptoms among PhD students, findings reveal a noteworthy difference. Specifically, 50% of PhD students receiving a monthly income exceeding 5000 CNY (approximately US\$700.45) exhibit symptoms of anxiety; meanwhile, 76.87% of PhD students with a monthly income below 5000 CNY show such symptoms. This result suggests that increased financial support may contribute to a reduction in anxiety levels among PhD students. Finally, analyzing the distribution of GAD patients according to PhD program years, 51.35% of first-year students primarily exhibit mild anxiety disorder, which is significantly higher than that observed in subsequent years; 19.74% of students in second-year experience moderate anxiety disorder that exceeded the prevalence in other academic years. Third-year PhD students emerge as a subgroup with a heightened incidence of severe anxiety disorder, with 10.45% of students showing severe anxiety symptoms, which was the highest recorded percentage among all academic years.

3.3. Word cloud analysis of factors contributing to PhD students' anxiety

To further explore factors leading to GAD among PhD students, we administered an open-ended questionnaire, soliciting the 2 primary sources of anxiety. We used Python 3.7 programming language (www.python.org) to create a word cloud diagram based on the identified sources of anxiety.

Figure 1 illustrates that GAD among PhD students occurs for various reasons. The more frequently a factor is mentioned by PhD students, the larger its font size will appear in the word cloud. Academic stress is frequently diagnosed as the main reason for anxiety disorder. Pursuing a PhD, demands intensive research and academic commitment that put great pressure on PhD students. Tasks such as completing research projects, writing high-quality papers, and engaging in academic conferences

require substantial time and energy investment, which create considerable psychological pressure.

The pressure associated with graduation also triggers anxiety among PhD students. Currently, doctoral degree-granting institutions impose rigorous standards for doctoral graduation, including mandates for publishing in high-impact journals, intricate graduation thesis processes, and with a much likelihood of blind review failure. Among the many hurdles, the formidable challenge of publishing papers in top-tier international journals, coupled with a lack of expert guidance and assistance from tutors, leads to heavy psychological burden on PhD students, resulting in generalized anxiety symptoms over time.

Pressure regarding employment emerges as another significant cause of GAD among PhD students. The overarching objective of most PhD students is to secure their desired employment opportunities and many of them believe that PhD studies will lead to better career prospects. However, due to China's demographic magnitude, a high annual influx of PhD student enrollment has been observed. The recent trend of layoffs and reduced recruitment in numerous industries has amplified the sense of insecurity among the PhD students. Other anxiety-inducing factors for PhD students have been worries around ageism, competition, and family responsibilities.

3.4. Impact of personal quantification on GAD

To explore the relationship between personal quantification and GAD, we conducted a hierarchical regression analysis using SPSS 27.0 software. The results presented in Table 2 illustrate that personal quantification significantly and negatively impacts GAD ($\beta = -0.148$, $P = .002$), concurrently producing a significantly positive effect on self-efficacy ($\beta = 0.359$, $P < .001$). This finding signifies that involvement in personal quantification activities not only mitigates general anxiety symptoms among PhD students but also stimulates their self-efficacy. However, further investigation is imperative to find further evidence for self-efficacy functioning as a mediating factor in the relationship between personal quantification and GAD.

Table 3
Mechanism of self-efficacy.

Variable	Coeff	SE	t	P	LLCI	ULCI
Constant	2.5316	0.2439	10.3796	.0000	2.0504	3.0129
Gender	-0.0780	0.0743	-1.0506	.2948	-0.2246	0.0685
Age	-0.0135	0.0421	-0.3215	.7482	-0.0966	0.0696
Marital status	0.0998	0.0955	1.0452	.2973	-0.0886	0.2883
Monthly income	-0.0877**	0.0282	-3.1161	.0021	-0.1433	-0.0322
Grade	0.0505	0.0341	1.4810	.1403	-0.0168	0.1179
Personal quantification	-0.1056*	0.0491	-2.1508	.0328	-0.2025	-0.0087
Self-efficacy	-0.1183*	0.0527	-2.2470	.0258	-0.2222	-0.0144

* Indicates $P < .05$.

** Indicates $P < .01$.

states. People with anxiety disorders can share their data with friends and doctors to aid in a more effective management of their emotions, thus mitigating symptoms of anxiety.^[41]

Furthermore, we found that self-efficacy is an effective mediating mechanism for personal quantification to alleviate GAD among PhD students. Self-efficacy refers to an individual's confidence and belief in their capacity to successfully execute particular tasks,^[30,42] holds paramount importance in fostering student success.^[43] Grounded in the tenets of CBT,^[44] the primary rules to overcome anxiety disorders involve enhancing self-awareness, restructuring negative thought patterns, and generating positive emotions. Personal quantification tools assist self-efficacy development through the processes of goal setting, continuous monitoring, and goal attainment, thus fostering self-recognition.^[45,46] Within the process of personal quantification, individuals track their physical activities, athletic performances, and recreational experiences using body sensors (e.g., wristbands or smart watches) and mobile applications. Through the establishment of goals, real-time data monitoring, and self-motivational practices, individuals boost their self-efficacy, deepen their self-awareness, and develop confidence in academic task management, which helps alleviate their anxiety symptoms.^[30,33]

Moreover, our investigation reveals a noteworthy disparity in the prevalence of severe anxiety disorders among PhD students based on gender. Specifically, the incidence is markedly higher among male doctoral candidates compared to their female counterparts. Additionally, an observation emerged concerning the marital status of PhD students, with a significantly elevated occurrence of anxiety disorders among those who are married as opposed to their unmarried counterparts. This discrepancy may be attributed to the additional roles and responsibilities shouldered by married individuals pursuing a PhD. This outcome aligns with the findings reported by Liu et al,^[47] who similarly observed an increased prevalence of anxiety disorders among married PhD students, suggesting a consistent pattern in the literature. This study also highlights a correlation between income levels and anxiety disorders among PhD students. Notably, anxious PhD students with higher incomes exhibit lower rates of GAD compared to their counterparts with lower incomes. This finding aligns with existing research on the relationship between income and mental health, where higher income levels are associated with improved mental well-being among individuals.^[48] Thus, our study corroborates the broader understanding of the positive impact of higher income on mental health, as substantiated by previous literature.

The contributions of this study are manifold. First, this study proposes a novel non-pharmacological therapy for alleviating GAD—namely, personal quantification. Relative to other therapies, the advantages of personal quantification in alleviating GAD among PhD students primarily manifest in its capacity to deliver objective assessments, personalized treatment modalities, assistance in time management, and real-time

feedback. These attributes collectively serve to more effectively cater to the distinct requirements of PhD students within the academic realm. Second, this study identifies recurrent GAD symptoms among PhD students across gender, age, and other differentiators and illustrates the mechanism of personal quantification for reducing the symptoms of GAD. This study fulfills the gap that existed in the investigation of GAD in PhD students. Third, this study employs text mining techniques to construct a word cloud diagram, elucidating the multifaceted origins of anxiety prevalent among PhD students, providing powerful tools and references for in-depth research and effective intervention.

The empirical findings of this study have several practical implications. The findings can better direct the active engagement of PhD students in personal quantification to enhance self-efficacy and mitigate anxiety. Furthermore, institutions can use the findings to extend additional attention and support selected PhD students proactively, given the variations in anxiety levels depending on various individual and commonly found factors.

4.1. Limitations

This study has several limitations. First, the sample is limited by geography, and further research is necessary to broaden the sample scope and undertake cross-national comparative analyses of GAD manifestations among PhD students hailing from diverse countries. Moreover, in the examination of mechanisms, our findings indicate that self-efficacy serves as a mediating factor in the relationship between self-quantification and GAD. However, it is crucial to emphasize that self-efficacy constitutes only a partial mediating factor. Further research should delve deeper into investigating alternative mechanisms through which self-quantification may impact GAD.

5. Conclusion

In this study, we found that the manifestation of anxiety in PhD students varies across different academic levels, age groups, and income brackets. Furthermore, we identified 3 primary stressors of GAD among PhD students, namely, academic research demands, doctoral graduation requirements, and employment concerns. Moreover, this study reveals that the personal quantification not only exerts a direct mitigating effect on GAD but also diminishes it by enhancing individual self-efficacy. Thus, this study offers valuable insight into the non-pharmacological methods of alleviating GAD in PhD students.

Author contributions

Conceptualization: Guilong Li.

Data curation: Guilong Li.

Formal analysis: Guilong Li, Qiulan Su.

Funding acquisition: Guilong Li.

Investigation: Guilong Li, Qiulan Su.

Methodology: Guilong Li.

Project administration: Guilong Li, Qiulan Su.

Resources: Guilong Li.

Software: Guilong Li, Qiulan Su.

Supervision: Guilong Li, Qiulan Su.

Validation: Guilong Li.

Visualization: Guilong Li, Qiulan Su.

Writing – original draft: Guilong Li, Qiulan Su.

Writing – review & editing: Guilong Li, Qiulan Su.

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