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Investigation on Greater Bay Area students' academic burden: from perspectives of families, schools, and communities impacts

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Abstract. This article explores students' academic burden, influencing factors, and improvement strategies in Greater Bay Area (GBA), from the perspective of families, schools, and communities impacts on students' academic burdens in Guangdong-Hong Kong-Macao area, echoing to the backdrop of close cooperation and rapid development in GBA. The results indicate that: (1) students in cities with faster economic development (i.e., Shenzhen/Hongkong) experience higher academic stress; (2) female students tend to feel more academic stress than male students; and (3) students in the political centers of the region (i.e., Guangzhou) are more likely to be affected by school atmosphere and teacher management. Based on these findings, the study proposes effective strategies to alleviate academic burdens, aiming to build a high-quality educational ecosystem that reduces stress while enhancing learning efficiency in GBA.

Keywords: Guangdong-Hong Kong-Macao Greater Bay Area, academic burden, achievement emotions, compulsory education

1. Introduction

The Guangdong-Hong Kong-Macao Greater Bay Area (GBA), as one of the most open, economically dynamic, and innovation-driven regions in China, integrates the unique advantages of Hong Kong, the Macao Special Administrative Region, and nine cities in Guangdong Province. The region not only possesses an international outlook and advanced technological capacity but also boasts a profound cultural heritage. Education, as the cornerstone of national development, occupies a pivotal position in the construction and progress of the GBA [1]. Within this framework, compulsory education forms the foundation of the talent cultivation system, and its importance is self-evident. In a region characterized by innovation and cultural diversity, enhancing the quality of compulsory education and fostering talents equipped with creativity and global vision to meet the demands of the new era are of far-reaching significance for promoting sustainable regional prosperity and strengthening overall competitiveness [1]. Consequently, in this highly competitive and fast-evolving environment, various social roles face mounting pressures—including students in the stage of compulsory education [2].

With the implementation of the "Double Reduction" policy (aimed at reducing excessive homework and off-campus tutoring burdens), local governments across the GBA have formulated concrete measures based on regional conditions to ensure effective policy execution [3, 4]. These include optimizing school homework design, strengthening after-school services, and regulating off-campus training institutions, thereby alleviating students' academic burdens [5]. However, existing research on "burden reduction" has largely focused on students' cognitive aspects while neglecting the impact on their academic emotions. How to achieve both symptom relief and fundamental reform—how to "rebuild a new educational ecosystem"—has become a key challenge in current studies of the Double Reduction policy [6, 7]. Within the environments that shape students' learning and lives, it is essential to examine which forms of interaction influence students' emotions and what measures can genuinely foster emotional identification and mitigate negative learning emotions [8]. Doing so not only supports the goals of the Double Reduction policy but also represents a vital pathway toward building a high-quality educational system that reduces burdens while improving efficiency.

At present, the implementation of the Double Reduction policy in the GBA shows several notable trends. First, students are the direct subjects and ultimate beneficiaries of the policy; therefore, their experiences and perceptions should be given primary consideration. Second, emotions in the learning process are characterized by contextuality, controllability, and complexity—academic emotions emerge within multiple, intertwined systems of interaction [9]. Third, understanding academic emotions

scientifically, effectively, and in depth is a key factor in alleviating academic stress [10]. Based on these considerations, this study takes compulsory education students in the Guangdong-Hong Kong-Macao Greater Bay Area as its research subjects to explore the current state of their academic emotions, analyze the relationships between these emotions and diverse forms of interaction, and investigate feasible strategies for reducing students' academic burden through collaborative education among families, schools, and communities [11, 12]. Specifically, the study addresses the following questions:

1. What is the overall situation of academic burden among secondary school students in the Guangdong-Hong Kong-Macao Greater Bay Area?

2. Are there significant differences in academic burden among students of different genders, cities, and age groups?

3. How can collaborative education among families, schools, and communities help alleviate academic burden among secondary school students?

2. Methodology

2.1. Participants

This study selected one school each from Shenzhen (included Shenzhen-Hongkong cooperated), Guangzhou, Dongguan, and Foshan—four representative cities within the Guangdong-Hong Kong-Macao Greater Bay Area—to conduct surveys. Two online questionnaires, Achievement Emotions of Primary and Secondary School Students in the Greater Bay Area and Interactions among Students, Families, Schools, and Communities, were distributed via the Wenjuanxing platform. A total of 355 students participated in the survey, among whom 149 were male (42%) and 206 were female (58%). Junior secondary students accounted for 148 participants (41.7%), and senior secondary students for 207 (58.3%). The distribution by city was as follows: 28 students from Shenzhen (included Shenzhen-Hongkong cooperated) (7.9%), 122 from Guangzhou (34.4%), 138 from Dongguan (38.9%), and 67 from Foshan (18.9%). In terms of school type, 288 students (81.1%) were from public schools, and 67 (18.9%) were from private schools.

The specific description of the study population is shown in Table 1 below.

Table 1. Descriptive statistics of participants

Variable	Category	Frequency	Percentage
Gender	Male	149	42%
	Female	206	58%
Grade	Junior secondary	148	41.7%
	Senior secondary	207	58.3%
School Location	HongKong /Shenzhen	28	7.9%
	Guangzhou	122	34.4%
	Dongguan	138	38.9%
	Foshan	67	18.9%
School Type	Public	288	81.1%
	Private	67	18.9%

2.2. Instruments

2.2.1. Negative achievement emotion questionnaire

This study adopted the subscale of the Achievement Emotions Questionnaire (AEQ) developed by Pekrun et al. to assess students' achievement emotions. The original AEQ-M consists of 37 items across five dimensions [13]. From this, five items were selected to measure students' negative emotions during learning, such as anger (e.g., "I'm so angry that I want to throw my math homework out the window"). Participants rated each item using a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The Cronbach's alpha coefficient in this study for anger was 0.92. The CFA results in this study ($\chi^2 = 396.40$, $df = 50$, $p < 0.001$, CFI = 0.98, NFI = 0.98, RMSEA = 0.07) were also accepted.

2.2.2. Families, Schools, and Communities interaction questionnaires

To measure students' communication and interaction with their parents, schools, and communities, this study adopted the 12-item Student-Parent Communication Survey (SPCS) developed by Weintraub and Sax [14], 9-item Student-Teacher Interaction (QTI)

developed by Wubbels and Brekelmans [15], and 12-item Social Interaction Questionnaire (QSI) adapted from the Social and Emotional Learning Survey [16]. Specially, three dimensions as parental socialization, parent-student relationship, and parental influence in decision-making were included in Student-Parent Communication Survey; other three dimensions as teachers' leadership behavior, freedom-supporting behavior, and admonishing behavior were included in Student-Teacher Interaction Questionnaire; last three dimensions as sense of belonging, school climate, and strict expectations were included in Social Interaction Questionnaire. All items were rated on a 5-point Likert scale from 1 ("strongly disagree") to 5 ("strongly agree"). The Cronbach's alpha coefficients for all 12 dimensions were among 0.64-0.85. The CFA results in this study were ($\chi^2 = 509.34$, $df = 51$, $p < 0.001$, CFI = 0.94, NFI = 0.93, RMSEA = 0.08; $\chi^2 = 153.96$, $df = 24$, $p < 0.001$, CFI = 0.97, NFI = 0.98, RMSEA = 0.06; $\chi^2 = 521.26$, $df = 51$, $p < 0.001$, CFI = 0.97, NFI = 0.97, RMSEA = 0.08) respectively.

2.3. Data analysis methods

The reliability of the questionnaires was tested using SPSS 16.0 for internal consistency analysis and Amos 17.0 for confirmatory factor analysis. Cronbach's alpha coefficients were calculated to assess the internal consistency reliability of each subscale and the overall instruments. Independent-sample t-tests and one-way ANOVA were conducted to determine whether there were significant differences among student groups across different demographic and contextual variables.

3. Results

3.1. Differences in academic burden among primary and secondary school students in the Greater Bay Area

3.1.1. Differences in academic burden by gender and grade

To examine differences in negative achievement emotions among students of different genders and grades, this study used gender and grade as independent variables, and the anger dimension of achievement emotion as the dependent variable, conducting a 2×2 between-group factorial ANOVA. The results are shown in Table 2.

The findings indicate that senior secondary students experience significantly greater academic burden than junior secondary students, while there is no significant difference between male and female students.

Table 2. Two-way ANOVA of mathematics achievement emotion by gender × grade

		Male		Female		ANOVA F-value		
Academic Emotion	Grade	Mean	SD	Mean	SD	Gender	Grade	Effect
Anger	Junior Secondary	3.894	0.984	3.852	0.874	0.193	4.593*	Senior > Junior
	Senior Secondary	3.668	1.078	3.616	0.983			

3.1.2. Differences in academic burden by city and gender

To explore differences in students' negative achievement emotions across different cities and genders, school region and gender were used as independent variables, with anger scores as the dependent variable, analyzed using two-way ANOVA. The results are shown in Table 3. The findings reveal significant differences in students' academic burden across cities. Students from Shenzhen/Hongkong experience the highest academic pressure, followed by those from Guangzhou, Dongguan, and Foshan. However, no significant gender differences were found in students' anger-related achievement emotions.

Table 3. Two-way ANOVA of achievement emotion by gender × school region

		Male		Female		ANOVA F-value			
Academic Emotion	School Region	Mean	SD	Mean	SD	Gender	School Region	Gender * School Region	Effect
Anger	Shenzhen/ Hongkong	4.600	0.469	3.860	0.919	0.860	4.816**	1.279	Shenzhen/Hongkong > Guangzhou > Dongguan > Foshan
	Guangzhou	3.856	0.976	3.849	0.865				
	Dongguan	3.781	0.984	3.688	0.860				
	Foshan	3.219	1.305	3.504	1.152				

3.2. Parent-child interaction in different cities of the greater bay area and difference analysis

To investigate the interaction between students and parents across different genders and cities in the Greater Bay Area, this study treated school region and gender as independent variables and the scores of different types of parent-child interactions as dependent variables. A 4×2 two-way ANOVA was conducted, and the results are presented in Table 4. The findings indicate that, in terms of gender, female students reported stronger experiences of parental socialization and parental influence on decision-making than male students, whereas there was no significant difference in parent-student relationship quality. Regarding school region, students in Guangzhou reported significantly higher levels of parental socialization than those in Foshan; the parent-student relationship was significantly stronger in Guangzhou compared with Dongguan and Foshan; and for parental decision-making influence, only students in Dongguan reported significantly higher levels than those in Foshan.

Table 4. Two-way ANOVA of parental interaction by gender × school region

		Male		Female		ANOVA F-value			
Parental Interaction Dimension	School Region	Mean	SD	Mean	SD	Gender	School Region	Gender * School Region	Effect
Parental Socialization	Shenzhen/ Hongkong	2.300	0.325	2.445	0.797	8.573**	5.158**	3.028*	Female > Male; Guangzhou > Foshan
	Guangzhou	2.495	0.728	2.650	0.589				
	Dongguan	2.310	0.791	2.500	0.505				
	Foshan	1.726	0.911	2.521	0.900				
Parent–Student Relationship	Shenzhen/ Hongkong	1.850	0.782	1.934	0.929	3.710	8.037**	2.334	Guangzhou > Dongguan, Foshan
	Guangzhou	2.162	0.721	2.157	0.662				
	Dongguan	1.795	0.731	1.961	0.645				
	Foshan	1.321	0.647	1.918	0.762				
Parental Decision-Making Influence	Shenzhen/Hongkong	3.350	0.335	2.934	0.942	5.056*	4.835**	5.905**	Female > Male; Dongguan > Foshan
	Guangzhou	2.960	0.728	3.073	0.595				
	Dongguan	2.844	0.845	3.191	0.681				
	Foshan	2.047	1.231	3.119	1.007				

3.3. Analysis of teacher-student interactions across cities in the Greater Bay Area

To examine the teacher-student interaction patterns among students of different genders and cities in the Greater Bay Area, this study conducted a 4×2 between-subjects two-way ANOVA, with school region and gender as independent variables and the scores of various types of teacher-student interactions as dependent variables. The results are presented in Table 5. The findings reveal that, in terms of gender, female students are more likely than male students to perceive their interaction with teachers as free-oriented. In terms of regional differences, students in Guangzhou are more inclined than those in Shenzhen/Hongkong and Foshan to regard the current teacher-student interaction as leadership-oriented. Moreover, significant interaction effects were observed between gender and school region, indicating that the perception of teacher-student relationships varies jointly by these two factors.

Table 5. Two-way ANOVA of teacher-student interaction by gender and school region

		Male		Female		ANOVA F-value			
Parental Interaction Dimension	School Region	Mean	SD	Mean	SD	Gender	School Region	GenderXSchool Region	Effect
Leadership-Oriented	Shenzhen/Hongkong	1.226	0.434	1.608	0.686	2.317	8.735**	2.061	Guangzhou＞Shenzhen; Guangzhou＞Foshan; Dongguan＞Foshan
	Guangzhou	1.953	0.807	1.800	0.747				
	Dongguan	1.772	0.829	1.879	0.638				
	Foshan	1.158	0.478	1.536	0.657				
Free-Oriented	Shenzhen/Hongkong	1.333	0.408	1.840	0.680	4.138*	18.325**	1.414	Female＞Male; Guangzhou＞Shenzhen; Guangzhou＞Dongguan＞Foshan
	Guangzhou	2.368	0.942	2.297	0.854				
	Dongguan	1.813	0.795	2.009	0.694				
	Foshan	1.317	0.562	1.644	0.618				
Admonitory-Oriented	Shenzhen/Hongkong	4.200	0.836	4.101	0.774	0.533	2.101	1.869	
	Guangzhou	3.637	0.949	4.005	0.804				
	Dongguan	4.096	0.960	3.972	0.764				
	Foshan	3.984	1.235	4.231	0.797				

3.4. Analysis of Student-Society Interactions Across Cities in the Greater Bay Area

To investigate differences in social interaction patterns among students of different genders and school regions, a 4×2 between-subjects two-way ANOVA was performed, with school region and gender as independent variables and scores of various social interaction types as dependent variables. The results are summarized in Table 6. The analysis indicates that gender differences in all types of social interaction are not statistically significant. However, clear regional variations exist. Students in Dongguan and Guangzhou are more likely than those in Shenzhen/Hongkong to be influenced by the school climate, while students in Guangzhou are more affected by external expectations than those in Dongguan and Foshan. In terms of sense of belonging, students in Guangzhou and Dongguan report stronger feelings of inclusion and identity compared with those in Foshan.

Table 6. Two-way ANOVA of student-society interaction by gender and school region

		Male		Female		ANOVA F-value			
Parental Interaction Dimension	School Region	Mean	SD	Mean	SD	Gender	School Region	Gender X School Region	Effect
School Climate	Shenzhen/Hongkong	1.850	0.858	2.152	0.855	0.497	2.629*	1.141	Dongguan> ShenzhenGuangzhou> Shenzhen
	Guangzhou	2.666	1.048	2.461	0.679				
	Dongguan	2.397	0.750	2.520	0.678				
	Foshan	2.261	1.243	2.407	0.929				
Expectation	Shenzhen/Hongkong	2.150	0.802	2.391	0.922	1.693	4.797**	1.469	Guangzhou> Dongguan; Guangzhou> Foshan
	Guangzhou	2.745	0.976	2.611	0.581				
	Dongguan	2.340	0.764	2.541	0.659				
	Foshan	2.047	1.139	2.391	0.955				
Sense of Belonging	Shenzhen/Hongkong	1.850	0.821	2.152	0.841	1.378	4.827**	1.970	Guangzhou> Foshan; Dongguan> Foshan
	Guangzhou	2.526	0.891	2.319	0.644				
	Dongguan	2.215	0.797	2.357	0.744				
	Foshan	1.809	0.897	2.141	0.831				

4. Conclusions and Implications

4.1. Economic development and academic burden in the Guangdong-Hong Kong-Macao Greater Bay Area

The survey results reveal that students in economically developed cities within the Guangdong-Hong Kong-Macao Greater Bay Area (such as Shenzhen/Hongkong) experience higher levels of academic burden. This finding is consistent with research conducted in other economically advanced regions of China, such as the Yangtze River Delta. Previous studies have shown that compared with less developed areas, families in the Yangtze River Delta exhibit a pronounced tendency toward "over-education" in their parenting practices [17]. Because high-quality educational resources are concentrated and competition is intense in these regions, parents—driven by the desire to maintain or improve their social status—tend to exert excessive financial (e.g., purchasing school district housing, paying for extracurricular tutoring) and temporal investments (e.g., daily supervision of study activities). These forms of over-investment transmit parental stress to their children, ultimately increasing students' academic burden [18]. This phenomenon confirms the link between rapid economic growth and educational involution. For instance, comparative studies between China's more developed eastern regions and the less developed western regions have shown that parental educational investment is significantly higher in the east. Such high levels of investment are closely associated with elevated parental anxiety, which, in turn, is transmitted to students, thereby intensifying their academic pressure. Moreover, middle-class families often display stronger enthusiasm for educational investment and higher academic expectations, both of which further exacerbate students' academic stress [19]. As one of China's most dynamic and innovative regions, the Greater Bay Area's educational development should ideally synchronize with its economic progress, forming a mutually reinforcing relationship that promotes sustainable educational quality and cultivates the next generation of talents vital for the region's continued growth. Hence, while pursuing excellence and competitiveness, economically advanced cities must avoid pushing students into excessive competition [20]. Balanced educational approaches that respect students' well-being and academic endurance are essential to ensure sustainable development in both education and society.

4.2. Gender differences in academic burden among middle school students in the Greater Bay Area

The study also finds that female students experience greater academic burden than their male counterparts. This pressure arises from two primary sources: teacher-student interactions and parent-child relationships. First, regarding teacher-student interactions, research by Zhou et al. indicates that girls display stronger emotional reactions when perceiving teacher feedback related to academic frustration, especially in the forms of person-oriented criticism and person-oriented comfort [21]. This suggests that female students may be more sensitive to teachers' evaluations of their personal abilities, which amplifies their perceived academic stress when encountering setbacks. Furthermore, the study confirms a significant positive correlation between person-oriented criticism and students' academic stress, implying that critical feedback targeting individual capability can substantially increase students' emotional burden. Consequently, female students—due to their heightened sensitivity—are more likely to feel stressed in teacher-student relationships. Second, in parent-child interactions, while studies show that parental academic expectations do not differ significantly by gender, female students generally exhibit lower levels of optimism than males. Optimism plays a crucial moderating role in the relationship between parental expectations and academic pressure [22]. When optimism levels are low, higher parental expectations are more likely to translate into increased stress. Therefore, because female students tend to be less optimistic, they are more vulnerable to experiencing academic pressure in response to high parental expectations [23]. For teachers and parents, it is vital to recognize the psychological roots of negative academic emotions and to break away from gender-based stereotypes. Educational practices should be designed to support students equitably, acknowledging the developmental and emotional differences that may exist across gender. In subject areas such as mathematics, teachers and parents should avoid transmitting gender biases that could exacerbate stress levels [24]. Particular attention should be given to the emotional well-being of female students—especially by parents and school-community networks—to prevent the triggering of sensitive emotional responses that may lead to negative psychological outcomes.

4.3. Political climate and students' academic burden in the Guangdong-Hong Kong-Macao Greater Bay Area

The findings of this study indicate that students in political centers of the Guangdong-Hong Kong-Macao Greater Bay Area—such as Guangzhou, the provincial capital—are more likely to be influenced by school climate and teacher authority. This observation is consistent with prior studies suggesting that education policies in provincial capitals are often implemented more promptly and that school management tends to be more institutionalized (e.g., in areas such as teacher ethics development and disciplinary authority) [25]. Political centers often serve as demonstration zones for the implementation of central government educational policies. For example, the Opinions of the Central Committee of the Communist Party of China and the State Council on Promoting the Spirit of Educators and Strengthening the Construction of a High-Quality Professional Teaching Workforce in the New Era (2024) explicitly supports teachers' right to exercise educational discipline and requires local

governments to protect teachers' lawful rights and interests. In the course of policy implementation, schools in provincial capitals tend to enforce such measures more rigorously, thereby reinforcing teacher authority and cultivating a "discipline-first" school culture [26]. Furthermore, compared with other cities, provincial capitals generally enjoy a higher concentration of educational resources and stricter academic and behavioral standards, which further strengthen teachers' authority [27]. Survey data show that schools in these regions place greater emphasis on academic discipline and daily behavioral norms. Because of resource advantages, teachers possess stronger motivations and institutional capacity to exert control, and educational policies are more easily formalized and implemented in model schools within these areas [28]. As a result, students in Guangzhou exhibit a stronger dependence on teacher supervision and the overall school climate. Schools in such areas should therefore design targeted policies aligned with national "Double Reduction" guidelines to effectively alleviate students' academic burden [29]. For policymakers and local education authorities, it is crucial to develop a nuanced understanding of regional educational characteristics. Establishing a collaborative policy coordination and communication mechanism across cities in the Greater Bay Area is essential. By conducting joint research, leveraging intelligent data systems to analyze academic pressure across different cities, and producing evidence-based policy recommendations, education departments can formulate more adaptive strategies [30]. In Guangzhou—where academic burden is relatively high—schools should reinforce adaptive stress intervention, promote psychological counseling, and facilitate more frequent communication to support students' mental well-being [1].

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