

## **Challenges and Determinants of Academic Performance in First-Year Physical Science Students: Evidence From a Secondary City University in Bangladesh**

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The European Conference on Education 2025  
Official Conference Proceedings

### **Abstract**

This study explores factors influencing the academic performance of first-year Bachelor of Science (B.Sc.) honors students in physical science departments at a public university in Bangladesh. It examines economic, socio-demographic, academic, environmental, and extracurricular factors to identify strategies for improving academic achievement and fostering inclusivity. Using a mixed-method approach, data were collected from 185 students through surveys and interviews, with statistical analyses conducted using chi-square tests, logistic regression, and ANOVA. The findings underscore the impact of evaluation systems within universities. Results indicate that gender, intended academic discipline, study habits, and regional disparities significantly influence academic performance. Male students and those from remote areas demonstrated lower academic achievement, while effective study habits and group study participation were associated with higher performance. Furthermore, the study highlights the necessity for effective curriculum and improved library resources. These offer actionable insights for policymakers and educators to reduce educational inequality and improve retention in public universities.

*Keywords:* academic performance, first-year students, physical science students, higher education, Bangladesh

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## Introduction

Education is vital for national development, equipping individuals with the skills needed for societal advancement. In Bangladesh, higher education has seen notable growth in recent years, placing increased emphasis on student performance. Assessing this performance is crucial for evaluating institutional effectiveness and shaping students' future opportunities (Alam & Islam, 2022).

First-year students in any program frequently encounter challenges that can impede their academic success, as reflected in their cumulative grade point average (CGPA) (Kotzé & Kleynhans, 2013). Significant predictors of CGPA include students' interest in science, previous academic performance in school and college, perceptions of science's relevance to future employment, and availability of academic resources (Al Hazaa et al., 2021; Bhuia et al., 2016; M. A. K. Chowdhury et al., 2009). First-year students, especially in public universities, face challenges like adapting to diverse educational systems, financial strain, and reduced well-being. Their anxiety is heightened during the transition to university life, often resulting in lower well-being compared to others, underscoring the need for comprehensive support systems (Cooke et al., 2006; Hassel & Ridout, 2018).

The study of students' prior academic achievement, course knowledge, gender, and first-year performance is crucial for understanding how these factors shape academic trajectories (Ayala & Manzano, 2018). Previous research emphasizes students' objectives, expectations, and willingness as key influences on academic outcomes (Money et al., 2017; Ribeiro et al., 2019). The first year of higher education is critical for students' future success, retention, and resilience, emphasizing the need for targeted interventions during this transition. Students form academic attitudes, decide future engagement, and develop academic identities, influenced by socio-demographic factors (Hernández Pina et al., 2006; Merhi Auar et al., 2018).

The non-engagement factors may pose a risk to academic performance and are influenced by environmental and situational factors. First-year students often struggle with unrealistic expectations about class sizes, staff availability, and workload (Crisp et al., 2009; Hassel & Ridout, 2018). Older students often outperform younger ones, with personal history being a predictor of academic success (Alam & Islam, 2022; Kim et al., 2016). Additionally, gaps in subject understanding, linked to access to socio-academic resources, further hinder performance, as seen in South African first-year chemistry students (Marais & Mji, 2009). Students' motivation for choosing a subject or discipline, along with their preparation and expectations, can influence academic success and persistence, especially among first-year students (Baxter & Hatt, 2000; Byrne & Flood, 2008).

Besides, a high dropout rate during the first year, leading to both social and individual consequences (Aina, 2013). Dropout and adjustment challenges are prevalent across Europe, with financial and psychological impacts (Ayala & Manzano, 2018). Despite their strong capabilities, first-year physical science students with a science background face dropout risks due to environmental and situational factors, highlighting the need to explore challenges and determinants of academic performance (Casanova et al., 2023; Kocsis & Molnár, 2025), which have received limited attention in Bangladesh.

This study, therefore, aims to address the gap in research on first-year physical science students' academic performance in Bangladesh. By identifying key factors affecting

performance, it provides actionable insights for policymakers and educators to enhance performance and inclusivity, reducing educational inequality and improving retention. Unlike prior studies, it focuses on students persisting beyond their first year, particularly those in their final year of the B.Sc. program at a secondary city university.

## Methodology

### Research Design and Data Collection

The study was conducted at Shahjalal University of Science and Technology (SUST) in Sylhet, focusing on fourth-year bachelor's students from six departments in the Faculty of Physical Sciences. It aimed to examine the challenges and determinants of academic performance in their first-year B.Sc. honors program. Using a mixed-method approach, data were collected via an online questionnaire and in-depth interviews. Sylhet, with a population of 0.7 million, is a secondary city in northeastern Bangladesh. The research was conducted during the 2023 academic year.

### Sample Selection and Questionnaire Design

A sample of 185 students was selected from the population of fourth-year physical science students at SUST, ensuring representation of at least 30 students from each of the six departments. Since a previous study found the interclass correlation coefficient based on socio-demographic covariates to be around 0.7 among groups of university students (Loong et al., 2017), the following formula (Ukoumunne, 2002) was used to calculate the minimum sample size:

$$E = \frac{1}{\sqrt{mk}} \sqrt{2(1 - \hat{\rho})^2 [1 + (k - 1)\hat{\rho}]^2 / k(k - 1)m} \quad (1)$$

Where,  $k$  = the required sample size in each group,  $m$  = number of groups = 6  $Z_{\alpha/2}$  = the  $z$  score from standardized normal distribution at  $\alpha\%$  level of significance = 1.96 (with 5% significance level),  $\hat{\rho}$  = the estimated interclass correlation coefficient = 0.7, and  $E$  = the margin of error = 0.05 (5% margin of error). Using these values,  $k$  was found to be approximately 7. Therefore, as with the previous studies (Rahman et al., 2021; Urmi et al., 2022), this current study used more than the minimum required sample size for the analysis.

The questionnaire covered ten domains related to academic performance, study habits, socio-demographic characteristics, and student challenges, identified through a literature review and pilot survey. Key variables were selected based on frequency and significance. Academic performance was measured using CGPA, with other factors assessed through Likert-scale questions and open-ended responses.

### Data Analysis

Descriptive statistics summarized students' background characteristics. Chi-square tests explored relationships between first-year CGPAs (GPA for both semesters) and examined factors. Logistic regression models assessed the independent effects of various factors on academic performance, with odds ratios and confidence intervals quantifying these effects. In addition, ANOVA tested variable impacts. These methods provided insights for policymakers to enhance student performance and promote inclusivity in higher education.

## Results

### Background Characteristics of the Students

**Demographics:** The study survey reveals that students mainly hail from Dhaka (29.2%), Chattogram (19.5%), and Sylhet (13%). The majority are male (76.8%) and Muslim (84.3%). Most fathers (76.8%) and mothers (67.6%) of the students have completed secondary school or higher.

**Financial Background:** Around 51.9% of students rely on family financial support, while 37.3% manage their own expenses. A slight majority (40%) report a monthly family income between 30,001 and 60,000 Tk.

**Academic Background:** A significant dropout rate was observed, with 31.4% leaving in the first semester and 39.5% in the second semester. Of these dropouts, 20.5% received grades below 3.00 in their first semester, and 16.8% did so in the second semester. Overall, 20% of students experienced poor academic performance in their first year. Most students excelled in SSC (78.9% achieving A+) and HSC exams (68.6% earning A or higher).

**Academic Choices and Intentions:** More than half of the students (55.7%) intended to shift to Applied and Engineering subjects, with 58.9% citing unintentional admission into physical sciences and 29.2% choosing it due to personal interest.

**Study Habits and Resources:** Most students (77.3%) study only 0–2 hours daily, with time management (43.8%) and lack of resources (41.6%) being major challenges.

**Social and Environmental Factors:** Social media and internet usage negatively impacted 65.9% of students' academic performance. Furthermore, 63.8% expressed concerns over inadequate library resources.

**Academic Support and Challenges:** Though 50.3% engage in group studies, 61.6% felt their academic advisors were not helpful. Physical and mental health challenges affected 41.1% and 63.8%, respectively.

**Lifestyle and Extracurricular Activities:** Eating habits influenced academic achievement for 61.1%. A common challenge agreed upon (57.3%) is the difficulty experienced in navigating the new evaluation assessment systems at the university, which differ from those in schools and colleges. Low engagement in extracurriculars (47.0% sports, 44.3% organizations, and 19.5% politics) had mixed effects on performance.

**Challenges and Barriers:** The findings from this study highlight several remarkable challenges include an impractical curriculum (60.5%), English fluency issues (52.4%), poor exam routine management (41.6%), and financial strain. While ragging and exam retakes were not significant for most, they remain challenges for some.

Identification of the most significant factors is crucial, as it can inform targeted interventions and support mechanisms designed to improve the educational experience and outcomes for all students.

## Factors Influencing First-Year Academic Performance

### *Outcome Variable*

The study categorizes students into two groups based on their first-year CGPA: those with a CGPA  $\geq 3$  are deemed “good performers,” while those with a CGPA  $< 3$  are labeled as “not good performers.” This binary outcome variable forms the basis of the analysis.

### *The Associations*

Table 1 highlights only the most notable associations between academic performance and variables like economic status, environment, socio-demographics, and extracurricular factors. Significant findings include:

- **Gender and Evaluation Systems:** Gender and the diverse evaluation systems significantly affect first-year performance ( $p < 0.05$ ). A higher proportion of male students (23.2%) score below CGPA 3.00 compared to females (9.3%). Moreover, 32.5% of students attribute their low CGPA to the adopted evaluation systems at university, with 3.2% strongly agreeing.
- **Family Residence, Library access, and Study Hours:** Family residence, library access, and study habits impact performance ( $p < 0.10$ ). Students studying less than one hour daily show poor performance (28.4%).
- **Regional Disparities:** Students from Rangpur (40%) and Rajshahi (38.9%) divisions show CGPAs below 3.00. Students from distant locations consistently demonstrate unacceptable academic performance throughout their first year.

**Table 1**

*Chi-Square Test of Academic Performance of Students According to Selected Background Characteristics*

Characteristics	Category	1st Year Result < 3	1st Year Result $\geq 3$	Chi-square	p-value
Division (Family Residence)	Barishal	0 (0.0%)	4 (100%)	12.43	0.087
	Chattogram	4 (11.1%)	32 (88.9%)		
	Dhaka	8 (14.8%)	46 (85.2%)		
	Khulna	2 (16.7%)	10 (83.3%)		
	Mymensingh	6 (27.3%)	16 (72.7%)		
	Rajshahi	7 (38.9%)	11 (61.1%)		
	Rangpur	6 (40.0%)	9 (60.0%)		
	Sylhet	4 (16.7%)	20 (83.3%)		
Gender	Male	33 (23.2%)	109 (76.8%)	4.01	0.045
	Female	4 (9.3%)	39 (90.7%)		
Academic discipline intended to study	Medical and Health Sciences	6 (27.3%)	16 (72.7%)	7.47	0.113
	Applied and Engineering	15 (14.6%)	88 (85.4%)		
	Social Sciences / Business Management	1 (8.3%)	11 (91.7%)		

<b>Characteristics</b>	<b>Category</b>	<b>1st Year Result &lt; 3</b>	<b>1st Year Result ≥ 3</b>	<i>Chi- square</i>	<i>p- value</i>
Study hours per day	Agriculture Sciences	2 (33.3%)	4 (66.7%)	7.43	0.059
	Others	13 (31.0%)	29 (69.0%)		
	< 1	23 (28.4%)	58 (71.6%)		
	1-2	10 (16.1%)	52 (83.9%)		
	2-4	4 (11.1%)	3 (88.9%)		
Seminar library satisfactory	4+	0 (0.0%)	6 (100%)	3.18	0.074
	No	29 (23.8%)	93 (76.2%)		
Study resources	Yes	8 (12.7%)	55 (87.3%)	6.160	0.188
	Strongly disagree	4(36.4%)	7(63.6%)		
	Disagree	3(9.7%)	28(90.3%)		
	Neutral	12(28.6%)	30(71.4%)		
	Agree	14(18.2%)	63(81.8%)		
Group studies	Strongly agree	4(16.7%)	20(83.3%)	0.914	0.339
	No	21(22.8%)	71(77.2%)		
	Yes	16(17.2%)	77(82.8%)		
Classroom and environment	Strongly disagree	9(32.1%)	19(67.9%)	7.215	0.125
	Disagree	7(13.7%)	44(86.3%)		
	Neutral	12(27.9%)	31(72.1%)		
	Agree	7(13.0%)	47(87.0%)		
	Strongly agree	2(22.2%)	7(77.8%)		
Impact of student politics	Strongly disagree	1(50%)	1(50%)	7.714	0.103
	Disagree	2(22.2%)	7(77.8%)		
	Neutral	3(50%)	3(50%)		
	Agree	0(0%)	11(100%)		
	Strongly agree	1(12.5%)	7(87.5%)		
Different evaluation system	Strongly disagree	1(11.1%)	8(88.9%)	10.123	0.038
	Disagree	5(17.5%)	24(82.8%)		
	Neutral	8(19.5%)	33(80.5%)		
	Agree	22(29.3%)	53(70.7%)		
	Strongly agree	1(3.2%)	30(96.8%)		
Impractical curriculum	Strongly disagree	0(0%)	8(100%)	6.566	0.161
	Disagree	4(21.1%)	15(78.9%)		
	Neutral	5(10.9%)	41(89.1%)		
	Agree	18(23.4%)	59(76.6%)		
	Strongly agree	10(28.6%)	25(71.4%)		

### ***Binary Multiple Logistic Regression Model***

As in the previous studies (Asaduzzaman et al., 2023; Bhuia et al., 2015; M. Chowdhury et al., 2008), this study utilized a binary multiple logistic regression model to assess the independent effects of various predictors on first-year academic performance. Significant variables from the chi-square test included division, gender, intended discipline, study hours, library satisfaction, study resources, classroom environment, student politics, evaluation systems, and curriculum perceptions. A 20% significance threshold was established. Key findings are presented in Table 2.

**Table 2**

*The Results of Binary Multiple Logistic Regression for the Effects of Selected Background Characteristics on the Academic Performance of the Students*

Characteristics	Category	Odds Ratio (OR)	95% CI		p-value
			Lower	Upper	
Division (Family Residence)	Barishal	323094968.570	0.000	.	0.999
	Chattogram	1.600	0.359	7.130	0.538
	Dhaka	1.150	0.310	4.262	0.834
	Khulna	1.000	0.156	6.420	1.000
	Mymensingh	0.533	0.128	2.219	0.388
	Rajshahi	0.314	0.075	1.316	0.113
	Rangpur	0.300	0.068	1.331	0.113
	Sylhet	1.0			
Gender	Male	0.339	0.113	1.018	0.054
	Female	1.0			
Academic discipline intended to study	Medical and Health Sciences	1.195	.381	3.752	0.76
	Applied and Engineering	2.630	1.121	6.172	0.026
	Social Sciences / Business Management	4.931	.575	42.294	0.146
	Agriculture Sciences	.897	.145	5.528	0.906
	Others	1.0			
Study hours per day	< 1	0	0		0.999
	1-2	0	0		0.999
	2-4	0	0		0.999
	4+	1.0			
Seminar library satisfactory	No	0.466	0.199	1.092	0.079
	Yes	1			
Study resources	Strongly disagree	0.350	0.068	1.789	0.207
	Disagree	1.867	0.376	9.275	0.445
	Neutral	0.500	0.141	1.772	0.283
	Agree	0.900	0.266	3.048	0.866

Characteristics	Category	Odds Ratio (OR)	95% CI		p- value
			Lower	Upper	
Classroom and environment	Strongly agree	1.0			
	Strongly disagree	0.603	0.104	3.507	0.574
	Disagree	1.796	0.308	10.462	0.515
	Neutral	0.738	0.134	4.068	0.727
	Agree	1.918	0.330	11.158	0.468
Impact of student politics	Strongly agree	1.0			
	Strongly disagree	0.143	0.004	4.612	0.272
	Disagree	0.500	0.036	6.862	0.604
	Neutral	0.143	0.010	1.995	0.148
	Agree	230782120.407	0.000	.	0.999
Different evaluation system	Strongly agree	1.0			
	Strongly disagree	0.267	0.015	4.748	0.368
	Disagree	0.160	0.017	1.463	0.105
	Neutral	0.138	0.016	1.165	0.069
	Agree	0.080	0.010	0.626	0.016
Impractical curriculum	Strongly agree	1.0			
	Strongly disagree	646189937.140	0.000	.	0.999
	Disagree	1.500	0.399	5.640	0.549
	Neutral	3.280	1.005	10.708	0.049
	Agree	1.311	0.531	3.236	0.557
Strongly agree	1.0				

Division: Regarding the impact of division on first-year academic performance, the odds ratios for students from Rajshahi (OR = 0.314, p = 0.113) and Rangpur (OR = 0.300, p = 0.113) are both below 1, suggesting that students from these more distant regions are less likely to perform well academically (CGPA  $\geq$  3) in their first year compared to those from Sylhet. However, this finding is only marginally significant (p < 0.20). In contrast, students from other divisions (Barishal, Chattogram, Dhaka, Khulna, Mymensingh) show no significant association with academic performance, as reflected by corresponding high p-values.

Gender: A gender-related disparity was observed, with male students having a lower odds ratio (OR = 0.339) compared to female students for achieving a CGPA above 3.00. This indicates that male students may be less likely to achieve higher academic performance than female students, although the difference is not strongly statistically significant. Further research is needed to explore the underlying causes of this gender-based variation in academic outcomes.

Academic Discipline: Students who initially aimed for applied and engineering sciences (OR = 2.630, p = 0.026) or social sciences/business management (OR = 4.931, p = 0.146) have

higher odds of superior academic performance than peers with different interests. The significant association for applied sciences highlights the need for targeted interventions.

**Satisfaction with seminar library:** Students who are satisfied with the seminar library are more likely to achieve better academic performance in their first year compared to those who are not, with the result being marginally significant (OR = 0.466,  $p = 0.079$ ). This finding underscores the importance of considering various factors that influence academic success, rather than relying solely on resource satisfaction as a predictor.

**Study Hours:** Studying less than four hours daily associated with lower academic performance (odds ratios 0.0,  $p = 0.999$ ), highlighting the need for increased study hours. Low odds and high  $p$ -values indicate possible data issues needing further review.

**Impact of Evaluation Systems:** Students who believed that different evaluation systems in the university impacted their performance had significantly lower odds of succeeding (OR = 0.080,  $p = 0.016$ ) than those who viewed these systems as challenging. Adapting to new evaluation formats can be especially difficult for students with weaker academic skills, leading to potential academic setbacks due to unfamiliarity. Therefore, universities should provide additional support to help students navigate these systems and enhance academic performance.

**Impractical Curriculum:** Students neutral about the impracticality of the curriculum are more likely to achieve the outcome, and this result is statistically significant at  $p < 0.05$ . This suggests a possible misalignment between curriculum design and student needs, prompting further investigation into the curriculum's effectiveness.

Therefore, regional disparities, gender, intended academic discipline, perceived evaluation impacts, library satisfaction, and study hours significantly influence first-year academic performance. Other factors lacked statistical significance. Their combined effects and interactions warrant further investigation in comprehensive analyses.

### ***ANOVA Model***

To further explore the factors influencing academic performance among first-year students, a one-way Analysis of Variance (ANOVA) was conducted. The outcome variable for academic performance was constructed by multiplying the CGPA of the first-year students by 20 to create a continuous variable suitable for ANOVA testing.

The results from the ANOVA model are presented in Table 3. The  $p$ -values indicate that the variables “study hours per day” and “group studies” are statistically significant at the 5% level. Additionally, the variables “gender” and “division” are statistically significant at the 10% level.

The findings indicate that daily study time and participation in group studies significantly affect academic performance. Gender and regional division also influence outcomes, though at a lower significance level. Notably, while group studies were significant in the ANOVA test, they lacked significance in the chi-square and logistic regression analyses, emphasizing the need for varied analytical methods to understand academic performance fully.

Overall, the ANOVA results corroborate the logistic regression findings, emphasizing the critical role of daily study habits, gender, and regional differences in shaping the academic outcomes.

**Table 3***ANOVA Table of The First Year Student Academic Performances*

Characteristics	Category	Mean Score of First Year CGPA	Standard Deviation	<i>p</i> -value
Division (Family Residence)	Barishal	65.1017	1.56629	0.081
	Chattogram	65.4473	4.17934	
	Dhaka	64.6525	4.52895	
	Khulna	64.7774	4.22016	
	Mymensingh	61.8998	3.84764	
	Rajshahi	62.5998	5.47604	
	Rangpur	62.9103	4.78583	
	Sylhet	64.4574	4.88250	
Gender	Male	63.7952	4.54063	0.069
	Female	65.2414	4.57150	
Academic discipline intended to study	Medical and Health Sciences	64.2746	5.20828	0.835
	Applied and Engineering	64.3660	4.24465	
	Social Sciences / Business Management	64.5493	3.41625	
	Agriculture Sciences	63.1257	5.47817	
	Others	63.5051	5.26663	
Study hours per day	< 1	62.8721	4.41226	0.000
	1-2	64.5472	4.45066	
	2-4	65.1623	3.98738	
	4+	70.6473	4.45896	
Seminar library satisfactory	No	63.7533	4.60005	0.118
	Yes	64.8634	4.47609	
Study resources	Strongly disagree	63.4820	5.08630	0.136
	Disagree	66.0837	4.52995	
	Neutral	63.6265	4.48124	
	Agree	63.7279	4.15056	
	Strongly agree	64.0849	5.51993	
Group studies	No	63.2601	4.43059	0.01
	Yes	64.9932	4.57851	
Classroom and environment	Strongly disagree	63.0963	4.68277	0.332

Characteristics	Category	Mean Score of First Year CGPA	Standard Deviation	<i>p-value</i>
Impact of student politics	Disagree	64.7391	4.58632	0.685
	Neutral	63.4118	4.90020	
	Agree	64.7702	4.19597	
	Strongly agree	63.5120	4.63435	
	Strongly disagree	61.8862	4.28240	
Different evaluation system	Disagree	63.5705	5.93009	0.107
	Neutral	61.7568	6.63634	
	Agree	65.2375	3.13085	
	Strongly agree	63.8817	4.39898	
	Strongly disagree	63.5845	2.76681	
Impractical curriculum	Disagree	65.3248	5.15156	0.793
	Neutral	64.1882	4.43080	
	Agree	63.1895	4.79072	
	Strongly agree	65.3771	3.68357	
	Strongly disagree	65.1627	3.23670	
	Disagree	63.9613	5.69136	
	Neutral	64.5589	3.85098	
	Agree	64.1390	4.88140	
	Strongly agree	63.4092	4.48336	

## Discussion

According to the findings, the transition to university assessment systems presents the major challenge for first-year students, contributing to suboptimal performance. Many students find it difficult to adapt to the differing evaluation methods used in universities compared to their previous educational experiences, such as in schools or colleges. This supports prior research emphasizing the importance of adequate orientation programs that help students adjust to new academic environments and evaluation standards (Hassel & Ridout, 2018). Consequently, universities need to offer extensive support systems, including orientation sessions and academic advising, to smooth this transition (López et al., 2023).

The study findings reveal that gender plays a crucial role, with male students more likely to experience lower academic performance compared to female students. This aligns with existing literature, which also reports gender disparities in academic outcomes (Ayala & Manzano, 2018). The gender gap suggests a need for targeted interventions to address the specific challenges faced by male students, thereby improving gender equity in academic outcomes.

Research has shown that dissatisfaction with library services, particularly in terms of study spaces and resources, can negatively impact academic performance (Scoulas & De Groote, 2019). This study also found that students dissatisfied with their library facilities are less likely to achieve high academic success.

A significant finding of this study is the influence of students' aspirations to study disciplines outside of physical sciences, particularly their preference for applied sciences and engineering. This highlights the importance of aligning students' interests with their academic programs to increase engagement and motivation, which, in turn, positively impacts academic performance. Prior studies corroborate this by stressing the role of student motivation and discipline selection in educational success (Money et al., 2017).

The perception of the curriculum's practicality also significantly impacts students' academic performance. Students who view the curriculum as relevant and applicable to their future careers demonstrate better academic results. This reinforces the need for continuous curriculum evaluation to ensure it meets student expectations and aligns with real-world demands (RESNICK & RESNICK, 1985). Universities, therefore, should regularly assess and update their curricula to ensure they remain practical and engaging for students, addressing not only academic but also professional development needs.

Another significant factor identified is geographical distance from the university, which affects students' ability to maintain regular study routines and engage fully with academic resources. According to an earlier study, this regional disparity highlights the need for targeted interventions to support students from remote areas (Cooper et al., 2017). Providing an environment that helps the students refrain from family emotion could mitigate the negative impact of geographical isolation.

Moreover, the involvement in student politics emerges as a notable non-academic factor affecting academic performance. This finding is consistent with earlier research (Hernández Pina et al., 2006), indicating that extracurricular activities, particularly those involving political engagement, can have both positive and negative impacts on students' academic trajectories. Thus, universities should establish a balance, promoting extracurricular involvement that complements academic responsibilities rather than hindering them.

Furthermore, study habits emerge as a critical determinant of academic success. Students who dedicate more hours to studying and participate in group study sessions consistently achieve better results. This finding aligns with existing research linking regular study practices to improved academic outcomes (Byrne & Flood, 2008). Effective time management and access to study resources are therefore essential to promoting better academic performance. Universities should prioritize fostering good study habits through workshops, academic support, and structured study schedules.

The pervasive issue of dropout due to university education adjustment in the first-year has been found, as also noted in an earlier (Vossensteyn et al., 2015), underscores the challenges faced by this cohort of students. High dropout rates among first-year students carry profound social and individual ramifications (Aina, 2013; Razouki et al., 2019).

In brief, this study reveals that a range of socio-demographic, environmental, and academic factors shape the academic performance of first-year physical science students. By addressing gender disparities, aligning academic programs with students' aspirations, balancing extracurricular activities with a relevant curriculum, and providing strong support for academic transitions, study resources, and study habits, while minimizing the impact of family-related emotional pressures, educational institutions can cultivate more inclusive and supportive environments that promote student success.

## **Conclusion**

This study investigated the multifactorial determinants impacting the academic performance of first-year Bachelor of Science (B.Sc.) honors students in physical science departments at Shahjalal University of Science and Technology, Bangladesh. A comprehensive analysis revealed key socio-demographic, academic, environmental, and extracurricular factors affecting students' progress. Challenges identified included difficulties in transitioning from different evaluation systems, geographical distance from the university, and ineffective study habits, all contributing to academic struggles. Targeted interventions, such as orientation programs and improved resource access, are essential for enhancing student success. Furthermore, students' perceptions of curriculum relevance significantly impact their performance, emphasizing the need for ongoing curriculum reforms. Gender disparities were notable, with male students at greater risk of lower academic performance, highlighting the importance of tailored support strategies. Aligning students' academic aspirations with curricula could also boost engagement and retention rates. Overall, the findings provide valuable insights for policymakers and educators to develop context-specific strategies that enhance academic success for first-year physical science students in Bangladesh.

## **Authors' Contributions**

This work was carried out in collaboration among all authors. MMI, along with other authors, took charge of study design, data collection, analysis, and manuscript drafting. KR made significant contributions by assisting in polishing the article and as a supervisor. All authors participated in the review and approved the final manuscript.

## **Acknowledgments**

We express our heartfelt gratitude for the consent and the cooperation and active participation of the students from school of physical sciences at SUST, whose invaluable support enabled the successful execution of this study.

## **Data Availability Statement**

Regarding data availability, interested parties can obtain the dataset used in the study upon request by contacting the corresponding author.

## **Disclosure Statement**

The authors report there are no competing interests to declare.

## **Ethics of Experimentation**

Although there is currently no formal committee at SUST to approve the ethical issues of research, verbal approval was obtained from the corresponding authority.

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