Family Socioeconomic Status and Mathematical Achievement Among O/L Students: Evidence from Colombo Central Sri Lanka.

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ABSTRACT

This study examined the relationship between family socioeconomic status (SES) and mathematical achievement among students preparing for the G.C.E. Ordinary Level (O/L) examination in the Colombo Central Educational Zone, Sri Lanka. It addresses two objectives drawn from a wider thesis: to identify the SES-related factors associated with mathematical achievement, and to examine the strength and direction of the relationship between family SES and mathematical achievement. Family SES, a composite of parental education, occupation, and household income, was the independent variable; home learning resources, parental involvement, private tutoring, and mathematics motivation and self-efficacy were examined as four additional predictors. A quantitative, descriptive-correlational survey design was adopted. Data were collected from 360 Grade 11 students using a structured, piloted questionnaire (Cronbach's α = .79-.93; KMO = .876), while mathematical achievement was measured using term-test scores from school records. Data were analysed using descriptive statistics, Pearson correlation, and multiple linear regression. Family SES was strongly and positively correlated with mathematical achievement (r = .906, $p < .001$), as were home learning resources (r = .914), motivation and self-efficacy (r = .874), parental involvement (r = .856), and tutoring support (r = .737). Together, SES and the four additional predictors accounted for 93.8% of the variance in mathematical achievement in this sample (R^2 = .938, $p < .001$). Because these associations were unusually strong and all predictors came from a single self-report instrument, they may be inflated by constructing overlap or common-method effects. As the design was cross-sectional and student ability was not directly measured, the findings indicate association rather than causation. They suggest that, within this urban zone, family socioeconomic conditions and related material, social, and psychological resources are closely associated with mathematical achievement, and point to the need for targeted, resource-based support in socioeconomically disadvantaged school communities.

Keywords: Socioeconomic Status, Mathematical Achievement, Secondary School Students, Educational Inequality, Sri Lanka

INTRODUCTION

Background of Study

Education plays a central role in social mobility and national development by equipping individuals with essential cognitive and analytical skills. Within secondary education, mathematics occupies a particularly critical position due to its cumulative structure and its role as a gateway subject for science, commerce, and technology-oriented academic streams. In Sri Lanka, mathematical achievement at the General Certificate of Education Ordinary Level (G.C.E. O/L) examination is an important factor in students' eligibility for Advanced Level subject streams and may shape their subsequent educational and career opportunities. Despite Sri Lanka's longstanding commitment to free education, disparities in mathematical achievement remain evident, particularly in urban contexts such as Colombo, where students come from markedly diverse socioeconomic backgrounds. A substantial body of research indicates that mathematical achievement is

associated with variations in family resources, structured academic support, and opportunities for sustained practice.

Statement of the Problem

Although access to schooling in Sri Lanka is formally equal, educational outcomes are not uniformly distributed. Students from higher socioeconomic backgrounds often have greater access to enriched home learning environments, private tutoring, and parental academic support, whereas students from lower socioeconomic backgrounds may face constraints that limit sustained engagement with mathematics learning. Existing research in Sri Lanka has largely examined overall academic achievement or national-level trends, with comparatively little attention paid to subject-specific outcomes such as mathematics within urban educational zones. Furthermore, insufficient empirical evidence exists regarding precisely which SES components and associated factors, including home resources, parental involvement, tutoring, and student self-efficacy, are most closely associated with mathematical achievement within the Colombo Central context, and how strongly family SES as a whole predicts that achievement. This gap necessitates a focused, quantitative investigation into the components and strength of the SES-achievement relationship.

Research Objectives

This manuscript is drawn from a broader mixed-methods thesis and reports findings relevant to two of the study's original objectives. The remaining objectives of the wider thesis, concerning achievement disparities across SES categories and qualitative teacher perspectives on SES-related challenges, fall outside the scope of this paper and are reported separately.

Primary Research Question

What is the relationship between socioeconomic factors and mathematical achievement among secondary students in Colombo?

The specific objectives addressed in this manuscript are:

1. To examine the SES-related factors (home learning resources, parental involvement, private tutoring, and mathematics motivation and self-efficacy) that are associated with mathematical achievement among O/L students in Colombo.

2. To examine the relationship between family socioeconomic status (SES) and mathematical achievement among O/L students in Colombo.

Significance of the Study (Rationale)

The G.C.E. Ordinary Level examination plays a decisive role in determining students' educational and career pathways in Sri Lanka, particularly in highly competitive regions such as Colombo Central. Achievement in mathematics is particularly important because O/L results contribute to students' eligibility for Advanced Level subject streams. By quantifying both the overall strength of the SES-achievement relationship and the associations between specific SES-related factors and mathematical achievement, this study provides evidence that can inform targeted, resource-based interventions. The findings are intended to support zonal education authorities and school leaders in prioritising interventions, and to contribute empirical, subject-specific evidence to national efforts aligned with Sustainable Development Goal 4 (SDG 4), which calls for inclusive and equitable quality education for all.

Scope and Limitations

The study is limited to Grade 11 students preparing for the G.C.E. Ordinary Level examination in government schools within the Colombo Central Educational Zone. Mathematical achievement was measured using second-term test scores obtained from school records; these tests are set and marked by individual schools and

may not fully capture long-term achievement. By contrast, SES and the four additional predictors were measured through student self-report, which may be subject to recall and response bias. The implications of this difference in measurement sources are considered in the Discussion. Consistent with its two objectives, this manuscript is confined to the quantitative, correlational relationship between SES, the four additional predictors, and mathematical achievement; it does not report formal statistical comparisons across SES categories or the qualitative teacher-interview findings generated by the wider thesis. As the design was cross-sectional, causal interpretation of the reported associations should be made with caution.

LITERATURE REVIEW

Theoretical and Conceptual Foundations

Socioeconomic status (SES) has consistently been identified as an important correlate of academic achievement, particularly in cognitively demanding subjects such as mathematics. SES is typically conceptualised as a multidimensional construct comprising parental education, occupational status, and household income, which together shape students' access to educational opportunities and learning environments. To provide a theoretical basis for understanding the relationship between SES and mathematical achievement, the study draws on three complementary theoretical perspectives: Bourdieu's theory of capital, the Family Investment and Family Stress models, and Bandura's theory of self-efficacy.

Bourdieu's (1986) theory of capital provides a structural explanation of educational inequality by highlighting how economic, social, and cultural capital are unequally distributed across families. Economic capital enables access to material resources such as textbooks, digital devices, and private tutoring; social capital reflects networks and relationships that facilitate academic support; and cultural capital includes language practices, study habits, and dispositions aligned with school expectations. In mathematics learning, cultural and economic capital are particularly consequential because success in the subject requires abstract reasoning, disciplined practice, and access to structured, examination-oriented preparation. Students from higher socioeconomic backgrounds are therefore more likely to possess forms of capital that are associated with greater access to home learning resources and participation in tutoring (Bourdieu, 1986; OECD, 2023).

The Family Investment Model explains how higher-income and better-educated parents are able to invest more effectively in their children's academic development through structured learning environments, supervision, and enrichment activities such as textbooks, tutoring, and digital devices (Becker & Tomes, 1986; Carneiro & Heckman, 2003). Mathematical achievement is especially sensitive to such investment because skill acquisition in the subject requires consistent reinforcement and guided practice. In contrast, the Family Stress Model emphasises the psychological consequences of economic hardship: financial strain may reduce parental involvement, increase household stress, and create unstable learning environments that negatively affect students' academic engagement (Conger & Donnellan, 2007). Empirical research confirms that parental involvement and home learning conditions mediate the relationship between SES and academic outcomes (Davis-Kean, 2005; Yeung et al., 2002).

Bandura's (1977) theory of self-efficacy provides a psychological account of how structural conditions are internalised by students. Mathematics self-efficacy refers to students' beliefs in their capacity to successfully complete mathematical tasks; students with higher self-efficacy demonstrate greater persistence and resilience when confronted with challenging problems, whereas those with lower confidence are more likely to disengage. Socioeconomic status is understood to influence self-efficacy indirectly, by shaping students' mastery experiences, access to academic support, and exposure to role models who model success (Bandura, 1997; Pajares, 2005). Recent evidence indicates that disparities in digital access and academic support, particularly following the COVID-19 pandemic, have further widened confidence gaps in mathematics across socioeconomic groups (Kuhfeld et al., 2022; OECD, 2023). Taken together, these three frameworks provide a theoretical basis for expecting a positive association between family SES and mathematical achievement and for examining whether material, social, and psychological factors are also associated with mathematical achievement and that this relationship should operate substantially through material, social, and psychological mediators, precisely the components examined in this manuscript.

CONCEPTUAL FRAMEWORK

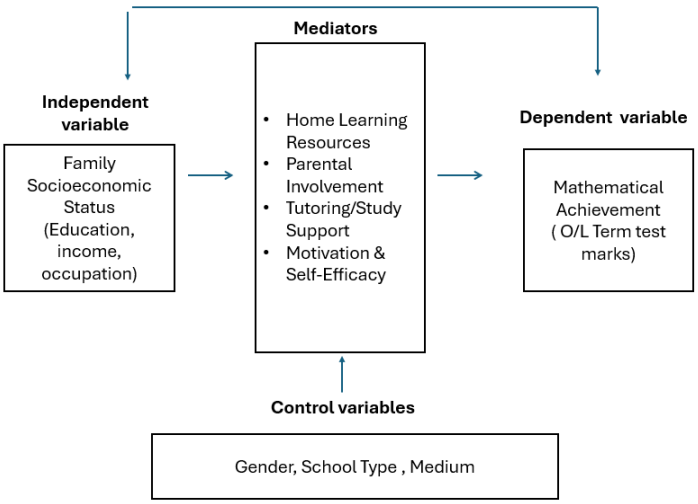


Figure 1: Conceptual framework linking family socioeconomic status, associating factors, and mathematical achievement.

The framework positions family socioeconomic status (SES) as the single independent variable of the study, measured as a composite index of parental education, parental occupation, and household income. Mathematical achievement, measured by O/L term-test marks, is the dependent variable. Home learning resources, parental involvement, private tutoring/study support, and students' motivation and self-efficacy are treated separately from SES as four additional predictors. These variables are theoretically linked to the SES-achievement relationship and are measured using their own scales; they are not included in the SES index. These four variables correspond to the SES-related factors addressed by the first objective of this manuscript. Because no formal mediation analysis was conducted, they are examined in this paper as correlates and co-predictors of achievement rather than as confirmed mediators. Gender, school type, and medium of instruction are recognised as background variables that may be associated with achievement and were monitored, although formal group comparisons across these categories are outside the present scope.

Global Evidence on Socioeconomic Status and Mathematical Achievement

Regional Evidence: South Asian Context

International empirical research consistently shows a strong association between SES and mathematical achievement. Large-scale assessments such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) reveal persistent achievement gaps between students from advantaged and disadvantaged socioeconomic backgrounds across diverse national contexts (OECD, 2019; Mullis et al., 2020). Meta-analytic evidence further indicates that SES is substantially associated with academic performance, with relatively strong associations observed in mathematics (Sirin, 2005). Longitudinal studies indicate that socioeconomic disparities in mathematical achievement can widen over time, alongside differences in access to enrichment opportunities, structured practice, and academic reinforcement outside school (Duncan et al., 2017; Reardon, 2011). Recent research highlights that the COVID-19 pandemic intensified these pre-existing inequalities: students from lower socioeconomic backgrounds experienced greater disruptions in learning due to limited access to digital devices, stable internet connectivity, and supportive home environments, which affected not only academic performance but also motivation and confidence in mathematics (Kuhfeld et al., 2022; OECD, 2023).

Socioeconomic Inequality and Mathematical Achievement in Sri Lanka

Although Sri Lanka's Free Education Policy has expanded access to schooling, disparities in academic outcomes remain evident, particularly in high-stakes examinations such as the G.C.E. Ordinary Level.

Mathematical achievement continues to reflect differences in home resources, parental support, and access to supplementary instruction. A distinctive feature of the Sri Lankan education system is the widespread reliance on private tutoring, often described as "shadow education." Participation in tuition classes is strongly associated with household income, making it an important factor associated with socioeconomic differences in examination outcomes (Pallegedara, 2012). Research indicates that unequal access to private tutoring is associated with achievement disparities at the O/L level (Aturupane et al., 2013). In addition, the quality of the home learning environment plays an important role: access to textbooks, digital resources, quiet study spaces, and parental encouragement supports sustained engagement with mathematics tasks, while students lacking these resources are more likely to experience mathematics anxiety and reduced self-efficacy, which are associated with lower mathematical achievement (Jayaweera & Gunawardena, 2016).

Research Gap

While existing literature clearly establishes a relationship between socioeconomic status and academic achievement, gaps remain within the Sri Lankan context. First, much of the existing research focuses on general academic performance rather than subject-specific outcomes such as mathematics. Second, limited attention has been given to urban zonal contexts such as the Colombo Central Educational Zone, where socioeconomic diversity and academic competition are particularly pronounced. Third, few studies simultaneously quantify both the overall strength of the SES-achievement relationship and the associations between specific material, social, and psychological factors and mathematical achievement within a single analytical model. Addressing these gaps, the present study examines the SES components and related factors associated with mathematical achievement and quantifies the strength of the family SES-mathematical achievement relationship among secondary school students in Colombo Central, thereby contributing context-specific, subject-specific evidence to the broader literature on educational inequality.

METHODOLOGY

Research Design

This study adopted a quantitative, descriptive-correlational survey design to examine the relationship between family socioeconomic status (SES) as the independent variable, four additional SES-related predictors, and mathematical achievement among secondary school students in the Colombo Central Educational Zone. This design was selected because it is well suited to describing patterns within a population at a single point in time and to testing the strength and direction of association among multiple variables (Creswell & Creswell, 2018). The study forms the quantitative strand of a wider mixed-methods thesis; only the quantitative component relevant to the two objectives addressed here is reported in this manuscript.

Population and Sample

The target population comprised Grade 11 students preparing for the G.C.E. Ordinary Level examination in government schools within the Colombo Central Educational Zone, which included both national and provincial schools representing diverse socioeconomic and institutional contexts. A total of 360 students participated in the study. The minimum sample size was determined using established guidelines for finite populations at a 95% confidence level and a 5% margin of error, assuming maximum variability (Cochran, 1977; Krejcie & Morgan, 1970). A total of 360 students participated in the study.

Sampling Technique

A stratified cluster sampling technique was employed. Schools were first stratified by governance category (national and provincial) and school type (1AB, 1C, and Type 2). Twelve schools were then selected as clusters from across these strata, and within each selected school, 30 students were chosen using systematic random sampling, resulting in a final sample of 360 students (12 schools × 30 students).

Research Instrument

Quantitative data were collected using a structured student questionnaire (Appendix A) consisting primarily of close-ended items. The instrument measured family socioeconomic status (parental education, occupation, and household income), home learning resources (study space, textbooks, internet access, digital devices), parental involvement (academic monitoring and encouragement), private tutoring participation and its perceived impact, and mathematics motivation and self-efficacy. Likert-scale items were scored on a five-point scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), and composite scores were computed for the SES index and, separately, for each of the four additional predictor scales; none of the four additional predictors contributed items to the SES index. Items measuring motivation and self-efficacy were adapted from the OECD PISA 2022 Mathematics Framework. Mathematical achievement was measured using students' most recent Grade 11 second-term mathematics examination scores obtained from school records.

A pilot study involving 40 students from a school outside the main sample was conducted to assess item clarity and reliability prior to the main data collection. Internal consistency of the multi-item scales was acceptable to excellent (Home Resources $\alpha = .859$; Parental Involvement $\alpha = .933$; Tutoring/Study Support $\alpha = .791$; Motivation & Self-Efficacy $\alpha = .913$). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .876, and Bartlett's Test of Sphericity was statistically significant, $\chi^2(10) = 771.18$, $p < .001$, indicating adequate intercorrelations among the measured constructs.

Data Collection Procedure

Prior to data collection, permission was obtained from the Zonal Director of Education and from the principals of the selected schools. Students were briefed on the purpose of the study and assured of confidentiality before completing the questionnaire during supervised classroom sessions. Completed questionnaires were collected immediately to minimise missing responses, and mathematical achievement scores were subsequently obtained from school records with administrative approval.

Data Analysis Techniques

Quantitative data were coded and entered into SPSS for analysis. Descriptive statistics were computed to summarise the demographic characteristics of the sample and the key study variables. Pearson correlation analysis was used to examine the strength and direction of the relationship between SES, each of the four additional predictors, and mathematical achievement. Multiple linear regression analysis was then conducted with mathematical achievement as the dependent variable. SES total score was entered as the independent variable, together with the four additional predictors (home learning resources, parental involvement, tutoring/study support, and motivation and self-efficacy), to examine their combined association with mathematical achievement. 95% confidence intervals were computed for all unstandardised regression coefficients.

Prior to regression analysis, the assumptions of linearity, normality of residuals, independence of errors, and multicollinearity were assessed; multicollinearity was evaluated using Variance Inflation Factor (VIF) and tolerance statistics, with all predictors falling within acceptable thresholds. As supplementary analyses, independent-samples t-tests and one-way ANOVA were used to examine whether mathematical achievement differed by gender, school type, and medium of instruction. Statistical significance for all analyses was evaluated at the 0.05 level.

Ethical Considerations

Ethical approval was obtained from relevant educational authorities. Participation was voluntary, and informed consent was obtained from students and their parents/guardians. Anonymity was ensured through the use of identification codes, and no personally identifiable information was included in the dataset. All data were used solely for academic purposes and stored securely.

FINDINGS

Descriptive Statistics of the Sample

A total of 360 Grade 11 students participated in the study, drawn from a range of school types and media of instruction within the Colombo Central Educational Zone. Table 1 summarises the demographic characteristics of the sample.

Table 1: Demographic Characteristics of the Student Sample (N = 360)

Variable	Category	Frequency	Percentage
Gender	Male	215	59.7%
	Female	145	40.3%
Medium of instruction	Sinhala	114	31.7%
	Tamil	127	35.3%
	English	119	33.0%
School type	National	92	25.6%
	Type 1AB	89	24.7%
	Type 1C	99	27.5%
	Type 2	80	22.2%

Family socioeconomic status was measured using a composite index built from the five items in Section B of the questionnaire (Appendix A). Each item was scored ordinally according to the order of its response categories. Father's and mother's highest educational qualification were each scored from 1 (no schooling) to 7 (postgraduate), giving a combined range of 2-14; father's and mother's occupation were each scored from 1 (unemployed) to 5 (business owner), giving a combined range of 2-10; and approximate monthly household income was scored from 1 (below Rs. 50,000) to 5 (above Rs. 200,000).

The five item scores were summed with equal weighting to produce an SES total score with a possible range of 5 to 29 points, where higher scores indicate higher socioeconomic status. This additive approach reflects the multidimensional nature of SES, with higher composite scores representing greater socioeconomic advantage (Tiwari, 2014). For descriptive purposes, the composite scores were categorised into low (5–16), middle (17–22), and high (23–29) SES groups. The SES total score, rather than these categories, was used in all correlation and regression analyses.

Table 2: Distribution of Students by Socioeconomic Status Category

SES Category	Frequency	Percentage
Low SES	304	84.4%
Middle SES	46	12.8%
High SES	10	2.8%
Total	360	100.0%

The distribution indicates that the large majority of students in the sample (84.4%) came from low-SES households, with only a small proportion (2.8%) classified as high SES. This pronounced concentration reflects the socioeconomic composition of the participating schools and underscores the relevance of examining SES-related resource disparities within this zone.

Table 3: Descriptive Statistics of Key Study Variables

Variable	**Mean**	**SD**	**Min**	**Max**
Mathematics score (0-100)	34.21	22.46	0	90
SES total score	13.14	3.86	8	26
Home learning resources	2.99	0.97	2.00	4.67
Parental involvement	3.93	0.75	3.00	5.00
Motivation & self-efficacy	3.71	0.98	2.00	5.00
Tutoring/study support	3.01	0.66	1.00	5.00

Skewness and kurtosis values for all key variables fell within acceptable limits for parametric analysis (±2 and ±5, respectively). The mean mathematics score of 34.21 (SD = 22.46) indicates substantial variability in mathematics achievement across the sample, with a relatively low mean score, while the SES total score (M = 13.14, SD = 3.86) confirms a sample concentrated in the lower and middle range of the socioeconomic index.

Objective 1: SES-Related Factors Associated with Mathematical Achievement

Pearson correlation analysis was used to examine the strength and direction of the relationship between each of the four additional predictors and mathematical achievement.

Table 4: Correlations Between the Four Additional Predictors and Mathematical Achievement

Additional Predictor	**r with Mathematical Achievement**	**Sig.**
Home learning resources	0.914	$p < .001$
Motivation & self-efficacy	0.874	$p < .001$
Parental involvement	0.856	$p < .001$
Tutoring/study support	0.737	$p < .001$

All four additional predictors were positively and significantly correlated with mathematical achievement. Home learning resources showed the strongest association ($r = .914$, $p < .001$), followed closely by motivation and self-efficacy ($r = .874$, $p < .001$) and parental involvement ($r = .856$, $p < .001$). Tutoring/study support, while still strongly and significantly correlated ($r = .737$, $p < .001$), recorded the comparatively weakest raw correlation among the four additional predictors.

To examine the combined association of these variables with mathematical achievement, a multiple linear regression analysis was conducted with mathematical achievement as the dependent variable, SES total score as the primary predictor, and the four additional predictors (home learning resources, parental involvement, tutoring/study support, and motivation and self-efficacy) entered simultaneously alongside it. Table 5 presents the regression coefficients together with 95% confidence intervals for the unstandardised coefficients (B).

Table 5: Multiple Regression Coefficients Predicting Mathematical Achievement, with 95% Confidence Intervals

Predictor	**B**	**Std. Error**	**95% CI for B**	**t**	**Sig.**
(Constant)	-54.94	1.70	[-58.28, -51.60]	-32.38	< .001
SES total score	2.02	0.16	[1.71, 2.33]	13.00	< .001
Home learning resources	6.71	0.72	[5.29, 8.13]	9.35	< .001
Parental involvement	6.32	0.73	[4.88, 7.76]	8.70	< .001
Motivation & self-efficacy	4.62	0.63	[3.38, 5.86]	7.39	< .001
Tutoring/study support	1.30	0.164	[0.98, 1.62]	7.92	< .001

Note. SES total score is the independent variable; the remaining four variables are additional predictors examined as correlates of mathematical achievement. B = unstandardised coefficient; CI = confidence interval for B, Dependent variable: mathematical achievement (term-test score, 0-100).

All predictors were statistically significant in the multiple regression model ($p < .001$), and none of the 95% confidence intervals for the unstandardised coefficients included zero. SES total score remained significantly associated with mathematical achievement after the four additional predictors were taken into account (B = 2.02, 95% CI [1.71, 2.33]). Among the four additional predictors, home learning resources (B = 6.71, 95% CI [5.29, 8.13]) and parental involvement (B = 6.32, 95% CI [4.88, 7.76]) recorded the largest unstandardised coefficients, followed by motivation and self-efficacy (B = 4.62, 95% CI [3.38, 5.86]) and tutoring/study support (B = 1.30, 95% CI [0.98, 1.62]). Each coefficient represents the expected difference in mathematics marks for a one-point difference on that variable's scale, holding the other predictors constant. Because the scales differ in range and response format, these unstandardised coefficients describe the size of each association in its own units and should not be used to rank the predictors by relative importance; the overlapping intervals for home learning resources and parental involvement reinforce this caution. Collinearity diagnostics indicated that multicollinearity was not a serious concern (VIF range = 1.21-5.42; tolerance range = .18-.83), supporting confidence in the stability of these coefficient estimates.

Objective 2: The Relationship Between Family SES and Mathematical Achievement

Pearson correlation analysis was conducted to determine the overall strength and direction of the association between the SES composite score and mathematical achievement.

Table 6: Correlation Between SES Total Score and Mathematical Achievement

Variable	**r with Mathematical Achievement**	**Sig.**
SES total score	0.906	$p < .001$

The results indicate a strong, positive, and statistically significant relationship between family SES and mathematical achievement ($r = .906$, $p < .001$), indicating that students with higher family SES tended to have higher mathematics achievement scores in this sample. To examine the combined predictive performance of the model, a multiple regression analysis was performed with SES total score and the four additional predictors entered simultaneously as predictors of mathematical achievement.

Table 7: Regression Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.969	0.938	0.937	7.89

The multiple correlation coefficient was R = .969. R is the correlation between students' observed mathematics scores and the scores predicted by the model from SES and the four additional predictors combined; it indicates how closely the model's predictions match the observed scores and being non-directional, does not by itself show the direction of any individual relationship. The R^2 value of .938 indicates that 93.8% of the variance in students' mathematics scores was statistically accounted for by SES and the four additional predictors combined. The remaining 6.2% was not accounted for by the variables included in the model. As discussed below, this unusually high value may partly reflect overlap among the predictors and the shared self-report measurement method and should be interpreted with caution. The overall model was statistically significant, $F(5, 354) = 1070.0$, $p < .001$. Supplementary analyses (independent-samples t-tests and one-way ANOVA) showed no statistically significant differences in mathematical achievement by gender ($p = .64$), school type ($p = .24$), or medium of instruction ($p > .05$).

DISCUSSION

The present study examined two related questions: which SES-related factors are associated with mathematical achievement, and how strongly family SES predicts mathematical achievement among Grade 11 students in the Colombo Central Educational Zone. The findings reveal a strong, positive association between SES and mathematical achievement, with SES and the four additional predictors collectively explaining a very substantial proportion of variance in achievement ($R^2 = .938$). These results align with extensive international evidence highlighting socioeconomic conditions as an important correlate of academic outcomes, particularly in mathematics (OECD, 2019; Sirin, 2005), while the magnitude of the relationship observed here is notably higher than comparable South Asian studies (cf. Hussain et al., 2018; Kingdon & Teal, 2007), which may partly reflect the socioeconomic composition of the sample, in which 84.4% of students were classified as low SES and only 2.8% as high SES. Consistent with Bourdieu's (1986) theory of capital, students with greater access to economic and cultural resources appear to benefit from advantages that are associated with higher mathematics scores. The strong association between home learning resources and achievement ($r = .914$; $B = 6.71$) is consistent with the role of material and environmental resources in shaping educational opportunities, including access to textbooks, study space, and digital resources, echoing findings from the local literature on home learning environments (Jayaweera & Gunawardena, 2016). The findings also support the Family Investment Model (Becker & Tomes, 1986; Carneiro & Heckman, 2003): parental involvement was both strongly correlated with achievement ($r = .856$) and statistically significant in the multiple regression model ($B = 6.32$), indicating that parental involvement was positively associated with mathematical achievement after accounting for SES and the other predictors.

Among the four additional predictors, tutoring/study support showed the weakest correlation with achievement ($r = .737$) and the smallest unstandardised coefficient ($B = 1.30$, 95% CI [0.98, 1.62]), although it remained statistically significant in the multiple regression model. Tutoring/study support was not measured as a simple yes/no behaviour. The questionnaire (Appendix A, Section E) recorded whether students attended private mathematics tuition, together with the number of hours per week, the duration of attendance, and four Likert-type items on the perceived usefulness of tuition, confidence gained through tuition, comfort in asking questions, and the perceived need for extra study support. The composite therefore combines participation, intensity, and students' evaluations of the support they receive, recorded on different response formats, so the size of its coefficient depends on how this mixed-format composite was scaled and is not directly comparable with those of the other predictors. In addition, several of the evaluative items, particularly those concerning confidence and comfort, overlap conceptually with the motivation and self-efficacy scale, so part of the tutoring association may reflect students' broader confidence in mathematics rather than tutoring access alone. With these caveats, the result is consistent with research in the Sri Lankan context, where private tutoring, commonly referred to as "shadow education", plays an important role in examination preparation and may

operate alongside pre-existing socioeconomic differences rather than independently of them (Pallegedara, 2012; Aturupane et al., 2013).

The psychological dimension of the findings further supports Bandura's (1977) theory of self-efficacy. Motivation and self-efficacy were significantly and strongly correlated with achievement (r = .874) and remained statistically significant in the multiple regression model after accounting for SES and the other additional predictors (B = 4.62, 95% CI [3.38, 5.86]), indicating that motivation and self-efficacy were positively associated with mathematical achievement after accounting for SES and the other predictors. Socioeconomic conditions may shape self-efficacy indirectly, through differential exposure to mastery experiences, structured academic support, and encouragement (Bandura, 1997; Pajares, 2005), a pattern consistent with recent evidence of widening confidence gaps in mathematics following educational disruptions (Kuhfeld et al., 2022; OECD, 2023). The exceptionally high proportion of explained variance suggests that SES-related factors do not operate independently but rather form an interconnected system through which socioeconomic advantage is associated with measurable differences in academic outcomes, consistent with the cumulative disadvantage process described in longitudinal research, where early inequalities compound over time (Duncan et al., 2017; Reardon, 2011). Supplementary analyses found no statistically significant differences in mathematical achievement by gender, school type, or medium of instruction. These findings should be interpreted within the specific context and sample of the present study.

The magnitude of these associations nevertheless requires careful interpretation. Correlations of .906 between SES and achievement and .914 between home learning resources and achievement are considerably higher than those typically reported: meta-analytic evidence places the average student-level SES-achievement correlation in the moderate range (Sirin, 2005), and the South Asian studies reviewed earlier report weaker relationships. Two explanations, which are not mutually exclusive, should be considered alongside a substantive interpretation. The first is construct overlap. The SES index and the home learning resources scale both capture aspects of household material wealth (household income on the one hand; digital devices, textbooks, and a study space on the other). Several tutoring items (for example, "Tuition has improved my confidence in mathematics") are conceptually close to the motivation and self-efficacy items, and the parental involvement and motivation scales both reflect the academic climate of the home. Predictors that share this much conceptual content are likely to share variance, which is consistent with the upper end of the VIF range observed (5.42). Such overlap may contribute to the high combined R^2 while making the separate coefficients more difficult to interpret individually. The second explanation is common-method variance. SES, home learning resources, parental involvement, tutoring/study support, and motivation and self-efficacy were all reported by the same students, on the same questionnaire, in a single sitting. Shared method influences, such as consistent response styles, social desirability, or a generally positive or negative outlook, can therefore inflate the correlations among these predictors. Students' ratings of their confidence and motivation may also partly reflect their awareness of their own previous mathematics marks, which could contribute to the observed association between self-reported motivation/self-efficacy and achievement. Procedural steps were taken to limit such effects, including anonymity, the assurance that there were no right or wrong answers, and supervised completion, but no statistical test for common-method bias (such as Harman's single-factor test or a marker-variable approach) was conducted. The R^2 of .938 should therefore be interpreted cautiously as the proportion of variance statistically accounted for by the variables included in this model, rather than as a precise estimate of their causal or explanatory contribution.

A related issue concerns the different sources of measurement. Mathematical achievement was obtained from school records, whereas SES and the four additional predictors came from student self-report. This separation is a strength in one respect: because the outcome was not self-reported, the correlations between the predictors and achievement are less vulnerable to common-method inflation than the correlations among the predictors themselves. However, the two sources introduce different forms of error. On the predictor side, Grade 11 students may not know their parents' exact income or educational qualifications and may report them with some degree of inaccuracy or social desirability bias, which could lead to misclassification on the SES index. On the outcome side, second-term mathematics tests are set and marked by individual schools rather than standardised across the zone, so differences in test difficulty and marking among the 12 participating schools may be reflected in the scores and may coincide with differences in the socioeconomic intake of those schools.

Achievement was also measured on a single occasion. The associations reported here should therefore be read as relationships between students' self-reported family circumstances and school-based test scores. Future research would benefit from parent-reported or documentary SES data and from standardised achievement measures, such as G.C.E. O/L examination results.

CONCLUSION

This study examined the association between family socioeconomic status, four SES-related factors, and mathematical achievement among Grade 11 students preparing for the G.C.E. Ordinary Level examination in the Colombo Central Educational Zone. In response to the first objective, all four additional predictors, namely home learning resources, parental involvement, tutoring/study support, motivation and self-efficacy, were significantly and positively associated with mathematical achievement. Home learning resources showed the strongest correlation with achievement, and all four predictors remained statistically significant when entered together with SES. In response to the second objective, family SES was strongly and positively correlated with mathematical achievement ($r = .906$) and remained statistically significant when the four additional predictors were included in the model ($B = 2.02$, 95% CI [1.71, 2.33]). Together, SES and the four additional predictors accounted for 93.8% of the variance in students' mathematics scores, although this figure may partly reflect construct overlap among the predictors and shared measurement methods and should therefore be interpreted cautiously.

These results reinforce theoretical perspectives that explain educational inequality as a multidimensional process operating across structural, familial, and psychological dimensions. Consistent with Bourdieu's (1986) theory of capital, access to economic and cultural resources appears to be associated with students' academic outcomes; consistent with the Family Investment Model, household-level investment in learning environments and supplementary instruction is closely associated with mathematical achievement; and consistent with Bandura's (1977) theory of self-efficacy, students' beliefs in their own academic competence are meaningfully associated with mathematical achievement. The findings highlight the relevance of family circumstances to differences in mathematical achievement observed in this sample. However, given the cross-sectional, correlational design, the reliance on student self-report, and the concentration of the sample within a single educational zone, the findings do not establish causal relationships or demonstrate that family factors are the primary source of observed disadvantage. Further research using broader samples, standardised achievement measures, and multiple sources of SES data would help clarify the relationships between family circumstances, school contexts, and mathematical achievement.

RECOMMENDATIONS

Recommendations for Educational Practice

Given that home learning resources showed the strongest association with achievement and tutoring/study support was also statistically significant in the regression model, schools may consider establishing structured, low-cost mathematics support programmes, such as supervised study sessions and shared resource libraries, targeted at students from socioeconomically disadvantaged backgrounds. Because motivation and self-efficacy remained statistically significant in the regression model after accounting for material resources, classroom practices that build students' mathematical confidence, including scaffolded problem-solving, structured mastery experiences, and constructive feedback, could be systematically integrated into instruction (Bandura, 1977).

Recommendations for Policy Makers

The findings indicate that equal access to schooling does not automatically translate into equal learning

outcomes. Policymakers may consider targeted resource-allocation strategies for schools serving lower-SES communities, particularly investment in home learning materials and digital infrastructure, given the strong association between home resources and achievement identified here. Given the association between

tutoring/study support and achievement, strengthening school-based academic support mechanisms could provide an alternative source of academic support for students who have limited access to paid tuition.

Recommendations for Future Research

Future research could adopt longitudinal designs to examine how the relationship between SES, the four SES-related factors, and mathematical achievement evolves over the course of secondary schooling, and to evaluate whether targeted interventions are associated with changes in the achievement gap identified here. Companion analyses examining disparities in achievement across SES categories, and qualitative investigation of teacher and parent perspectives, would complement and extend the quantitative relationships reported in this manuscript. Expanding this line of research to additional educational zones and subject areas would further enhance the generalisability of these findings.

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APPENDIX A: Student Questionnaire

Socioeconomic Status and Mathematics Achievement among O/L Students

Instructions: This questionnaire is part of an academic research study conducted for a Master's degree. All information provided will be kept strictly confidential and used only for research purposes. There are no right or wrong answers. Please tick (✓) the most appropriate response or write where required.

Section A: Demographic Information

1. Gender: ☐ Male ☐ Female

2. Medium of Instruction: ☐ Sinhala ☐ Tamil ☐ English

Section B: Family Socioeconomic Status

Parental Education

1. Father/Male Guardian's Highest Educational Qualification: ☐ No schooling ☐ Primary ☐ O/L ☐ A/L ☐ Diploma ☐ Degree ☐ Postgraduate

2. Mother/Female Guardian's Highest Educational Qualification: ☐ No schooling ☐ Primary ☐ O/L ☐ A/L ☐ Diploma ☐ Degree ☐ Postgraduate

Parental Occupation

3. Father/Male Guardian's Occupation: ☐ Unemployed ☐ Manual labour ☐ Skilled trade ☐ Professional ☐ Business owner

4. Mother/Female Guardian's Occupation: ☐ Unemployed ☐ Manual labour ☐ Skilled trade ☐ Professional ☐ Business owner

Household Income

5. Approximate Monthly Household Income: ☐ Below Rs. 50,000 ☐ Rs. 50,001-100,000 ☐ Rs. 100,001-150,000 ☐ Rs. 150,001-200,000 ☐ Above Rs. 200,000

Section C: Home Learning Resources (1 = Strongly Disagree to 5 = Strongly Agree)

1. I have a quiet place at home to study mathematics.
2. I have access to mathematics textbooks and reference books at home.
3. I have access to the internet or digital devices for learning mathematics.
4. I have all the necessary stationery and mathematical instruments needed for my studies.

Section D: Parental Involvement (1 = Strongly Disagree to 5 = Strongly Agree)

1. My parents encourage me to do well in mathematics.
2. My parents monitor my homework and studies.
3. My parents discuss my academic progress with my teachers.
4. My parents talk to me about the importance of mathematics for my future career or higher education.

Section E: Tutoring and Study Support

1. Do you attend private mathematics tutoring classes? ☐ Yes ☐ No
2. If yes, how many hours per week do you attend mathematics tuition? _____ hours per week
3. How long have you been attending mathematics tuition? ☐ Less than 6 months ☐ 6-12 months ☐ More than 1 year

Please indicate how much you agree with the following statements (1 = Strongly Disagree to 5 = Strongly Agree):

4. The mathematics tuition I attend helps me understand lessons better.
5. Tuition has improved my confidence in mathematics.
6. I feel comfortable asking questions and clarifying doubts in tuition.
7. Extra study support is essential for me to succeed in the O/L exam.

Section F: Motivation and Self-Efficacy in Mathematics (1 = Strongly Disagree to 5 = Strongly Agree)

1. I feel confident when solving mathematics problems.
2. I try my best even when mathematics questions are difficult.
3. I am confident that I can understand even difficult mathematics topics if I put in enough effort.
4. I believe I can get a good grade in mathematics if I practice consistently.

Section G: Mathematics Achievement

1. Latest Mathematics 2nd Term Examination: ____ marks