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MATERNAL EDUCATION, MOBILITY RISK, AND SPATIAL MISMATCH IN GIRLS' TRANSITIONS TO ACCREDITED UNIVERSITIES IN ISLAMABAD

IMRAN SABIR[1], ABIDA SHARIF[2], ANEEQA ANSARI[3], SAIRA SAJJAD[4], TEHMINA MUKHTAR[5]

[1] ASSOCIATE PROFESSOR AT SCHOOL OF SOCIOLOGY, QUAID-I-AZAM UNIVERSITY, ISLAMABAD
[2]ASSISTANT PROFESSOR AT DEPARTMENT OF SOCIOLOGY, FATIMA JINNAH WOMEN UNIVERSITY, RAWALPINDI. EMAIL: ABIDA.sharif@fjwu.edu.pk
[3]LECTURER AT DEPARTMENT OF SOCIOLOGY, FATIMA JINNAH WOMEN UNIVERSITY, RAWALPINDI AND PHD SCHOLAR AT SCHOOL OF SOCIOLOGY, QUAID-I-AZAM UNIVERSITY, ISLAMABAD
[4]VISITING LECTURER AT DEPARTMENT OF SOCIOLOGY, AT GOVERNMENT COLLEGE WOMEN UNIVERSITY, SIALKOT AND AT FATIMA JINNAH WOMEN UNIVERSITY, RAWALPINDI
[5]MPHIL SCHOLAR AT DEPARTMENT OF SOCIOLOGY, FATIMA JINNAH WOMEN UNIVERSITY, RAWALPINDI

Abstract

Girls' transitions to accredited universities in Pakistan hinge on beliefs, household priorities, and the geography of reachable programs. We conducted a cross sectional survey of 300 grade 11–12 students in government schools across Islamabad (April-June 2025) to test five objectives: the association between maternal education and university self efficacy; effects of perceived transport safety and route complexity on application intention; mediation by parental preferences for single sex versus coeducational environments; links between income, sibship composition, and prioritization of sons; and spatial or programmatic mismatch between preferred fields and commute feasible accredited supply. Using mixed effects models, path analysis, and GIS based service areas with multiple imputation, we found that maternal education related positively to self efficacy, transport safety increased and route complexity decreased intention to apply, and parental preferences exerted a small mediating effect. Lower income and multiple sons aligned with greater reported prioritization of sons. Preferences for STEM and health were more often mismatched to local accredited offerings. Results suggest that strengthening capability beliefs without safer routes or nearby programs will underdeliver. Universities, transport agencies, and regulators can jointly expand feasible choice by improving corridor safety, simplifying transfers, and aligning program locations with realistic commuting ecologies.

INTRODUCTION

Higher education for young women in Islamabad sits at an uneasy intersection of promise and constraint. The capital city enjoys comparatively high enrolment and a dense concentration of universities, yet national patterns of gendered literacy and transition-to-tertiary gaps remain stubborn, even in urban enclaves that are ostensibly advantaged. Recent census tables indicate sizeable male–female differentials in literacy and enrolment, alongside large numbers of out-of-school girls nationwide, a structural backdrop that bleeds into higher education choices and trajectories (PBS, 2023; Pakistan Education Statistics, 2022–23). In other words, opportunity is proximate, but secure passage into it is not.

The problem this study addresses can be stated plainly. In an ideal scenario, adolescent girls with the academic desire and basic credentials would encounter three enabling conditions: supportive household decision making that treats daughters' education as a family investment, safe and reliable mobility to accredited institutions, and transparent pathways into degree programs whose reputations and returns are legible to parents and peers. Reality falls short on each front. Household resource allocation still tilts toward sons in many low and middle income families; mobility is fraught by safety concerns and reputational risks on public transport; and institutional access is uneven across programs and locations, even when universities sit within the same metropolitan map (Khan, 2025; Munir, 2022; Pasha, 2023). These frictions rarely operate alone. They crystallize into cumulative disadvantage precisely at the point of transition from secondary school to college.

Previous attempts to close the gender gap have focused on supply and infrastructure: new campuses, financial aid, and urban transit systems. Such measures matter, but they do not fully resolve the demand-side calculus inside

households nor the gendered risk environment of everyday travel. A growing empirical literature from Pakistan documents that women's experiences of harassment and insecurity on buses and at stations depress willingness to travel for study or work; these effects compound parental anxieties about coeducational spaces and late returns (Amber et al., 2023; Saleemi et al., 2025). Even in cities with multiple HEC-recognized institutions, accessibility is mediated by perceived safety and by the social acceptability of routes to those institutions, which policy designers often underweight (HEC, 2025; Ayaz et al., 2024).

The indirect costs of this configuration are large. When daughters defer or forgo tertiary education, households sacrifice lifetime earnings and the intergenerational benefits of maternal schooling, including gains in children's learning, health management, and educational time use (Gabrielson, 2019; Andrabi, Das, & Khwaja, 2009, as discussed in Gabrielson, 2019). At a societal level, the gender gap in tertiary progression reinforces occupational segregation and narrows the pipeline into research and teaching positions, even as women's representation improves in entry-level academic ranks (UN Women, 2023; see also sectoral snapshots in HEC reporting). These consequences are not merely downstream; they feed back into household expectations, strengthening a narrative that daughters' higher education is risky, costly, and less convertible into stable work.

Against this backdrop, the present study brings new evidence from Islamabad's government higher-secondary schools, using original survey data from 300 grade-11 and grade-12 girls in 10 institutions, complemented by targeted secondary sources. The dataset allows fine-grained analysis of how maternal education, income constraints, mobility conditions, and norms around coeducation shape self-efficacy and stated intentions for university entry in a city often assumed to be "solved" on access. This urban-specific lens and the sequential analytic strategy address a clear gap in the literature, which is rich on national patterns but thinner on micro-level decision environments in privileged urban districts.

Female higher education

Conceptually, the study integrates Sen's capability approach with Bourdieu's capitals. We treat girls' university entry as a capability that depends on the conversion of economic, social, and cultural resources into real options, while recognizing that mobility infrastructures and gendered norms set conversion rates unequally across households. We also draw on recent causal and quasi-experimental work showing that transitions from single-sex to coeducational formats can, in conservative settings, depress girls' participation, which sharpens the study's attention to parental preferences and perceived safety (Karim, 2024; Lloyd et al., 2002).

Where this work builds and where it departs. Prior research has mapped the broad terrain: gendered resource allocation within families, safety and harassment in transit systems, and normative discomfort with coeducational spaces as girls age (Munir, 2022; Pasha, 2023; Amber et al., 2023; Saleemi et al., 2025). Our contribution is to locate these dynamics in a single metropolitan setting with relatively dense higher-education provision, measure their joint effects on aspirations and perceived feasibility, and juxtapose household narratives with the institutional geography of accredited options. We therefore link "who supports" to "what is reachable" and "which format is acceptable," a triangulation that is often asserted but rarely measured together in Islamabad.

Objectives and testable aims. The study pursues five objectives:

1. Estimate the association between maternal education and daughters' self-efficacy for succeeding at university, net of income and school achievement.
2. Identify how perceived transport safety and route complexity predict the stated likelihood of applying to an accredited institution within commuting distance.
3. Assess whether parental preferences for single-sex versus coeducational environments mediate application intentions.
4. Quantify how household income and sibship composition relate to reported prioritization of sons' education at the point of tertiary transition.
5. Map institutional proximity and program availability against students' preferred fields to detect spatial and programmatic mismatches.

These aims support two tests. First, a mediation test in which maternal education influences university intention indirectly through self-efficacy and perceived parental support. Second, a moderation test in which transport safety weakens or strengthens the effect of self-efficacy on application intention. The stakes span scholarship, policy, and practice. Academically, the study refines urban-specific mechanisms in gendered higher-education access. For policy, it informs where to target mobility safeguards, hostel provision, and communication with parents. Practically, it guides school counselors on how to translate aspiration into feasible application plans within real commuting ecologies (Amber et al., 2023; Ayaz et al., 2024).

A brief roadmap in the CARS tradition. We establish the territory by documenting why girls' transitions to university matter for intergenerational mobility and national skills, with current literacy and enrolment evidence. We identify the niche by showing that even in Islamabad, the interplay of household preferences, transport safety, and institutional proximity remains under-specified in existing research. We occupy the niche by presenting new mixed-methods evidence, a capability-and-capitals framework, and an empirical strategy that links family decisions to urban accessibility and program choice. The remainder of the paper develops the conceptual model, details data and methods, presents results on each objective, and closes with implications for urban higher-education planning and gender-responsive mobility policy.

LITERATURE REVIEW

Higher education for young women in Pakistan sits at the intersection of household resources, everyday mobility, parental norms, and the geography of opportunity. Participation has expanded, yet the transition from school to an accredited university still reflects unequal chances across classed and gendered lines. National education statistics and sector reports chronicle rising enrollments, but they also reveal how participation remains uneven by level, location, and discipline, with millions of young people still outside the tertiary pipeline and a concentration of students in a few fields that may not match local aspirations or labor demand (Pakistan Institute of Education, 2024; Higher Education Commission, 2024, 2025). Research on gendered mobility shows that Pakistani women travel shorter distances and face higher costs of safety, time, and social sanction when they commute, which complicates choices about where and what to study, especially when family oversight and route complexity raise perceived risks (Adeel, 2017). Taken together, these strands suggest that the decision to apply to a nearby accredited institution is not a simple function of merit, but a joint product of self-belief, constraints, and the spatial availability of attractive programs.

Maternal education, daughters' self-efficacy, and the decision margin

A large psychological literature ties self-efficacy to persistence and goal pursuit, often building from Bandura's social cognitive theory and the expectancy-value tradition in education. In this canon, beliefs about one's capability to succeed feed directly into intentions, effort, and ultimately choices such as applying to university; parental education can shape these beliefs through modeling, expectations, and resource provision (Bandura, 1997; Eccles & Wigfield, 2002). Yet in Pakistan, most studies stop at correlating parental, rather than specifically maternal, education with test scores or attainment. They rarely measure daughters' academic self-efficacy in validated ways or parse maternal education from income and prior achievement. Reviews and primers make the theoretical stakes clear, but the empirical bridge to Pakistani daughters' application behavior remains thin.

Empirical work within Pakistan does point to channels through which mothers matter, though usually without a direct self-efficacy construct. Khalid's recent analyses of mothers' agency link maternal aspirations to the expansion of daughters' opportunities, using qualitative and mixed-methods data from rural and peri-urban settings; the work is conceptually rich on agency and constraint, but not designed to estimate net associations after accounting for achievement or income (Khalid, 2023a; 2023b). Parallel strands document wide gender gaps in enrollment over 2005 to 2019 and show that gaps widen with household disadvantage, implying that any maternal-education premium for girls must be interpreted jointly with resources and sibship dynamics; however, these studies aggregate outcomes and do not isolate beliefs or university application intentions (Pasha, 2023). Pakistani studies that do measure self-efficacy typically survey university or upper-secondary students and relate efficacy to grades or stress; they confirm the predictive salience of self-efficacy but are not designed to explain how mothers' schooling shapes those beliefs in adolescents contemplating tertiary entry (Saher, 2024; Ashraf et al., 2023; Sohail & Hussain, 2018). This leaves a clear gap: rigorous estimation of the association between maternal education and daughters' self-efficacy for succeeding at university, net of income and school achievement.

Mobility, transport safety, and route complexity

Mobility constraints are unusually binding for Pakistani women. Adeel's pioneering analysis of national time-use data quantified gendered differences in daily travel, detecting large gaps in trip rates, distances, and purposes. The paper's strength is its nationally representative scope; its limits lie in its descriptive design and the absence of causal identification for policy levers like safer transport or route simplification (Adeel, 2017). By contrast, experimental and quasi-experimental studies in urban Pakistan connect mobility interventions to women's labor market engagement. Field and co-authors evaluate subsidized transport and job-search coordination in Lahore, showing that safer and more predictable travel expands women's job interview attendance and job offers, with design features that are readily translatable to student commuting; although not about education, the mechanism is mobility under safety risk, which is a first-order constraint for tertiary applicants as well (Field et al., 2022; J-PAL South Asia, 2022).

Recent transport studies in Pakistani cities sharpen the safety lens. Saleemi and colleagues use exploratory factor analysis and structural modeling to uncover latent dimensions of women's security on public transport and link them to night-time comfort in Pakistani settings. Complementary work in BRT Peshawar documents specific pain points in station design, crowding, and harassment, recommending operational fixes with gendered benefits. A larger scoping and narrative review literature across low and middle income contexts underscores that first- and last-mile risks, route changes, and poorly lit interchanges lower women's willingness to use mass transit at all. The policy message is consistent: perceived safety and route complexity jointly depress women's stated intentions to travel independently for education or work, and the Pakistan-specific evidence base is now thick enough to inform precise survey measures of perceived safety and route complexity that can be connected to application intentions (Saleemi et al., 2025; Ayaz et al., 2024; Roy et al., 2024; Mchunu et al., 2025; Joshi & Suresh, 2022).

Still, gaps remain. Most Pakistani transport studies either focus on employed women or on general perceptions rather than on the specific decision to apply to a nearby accredited program. Few studies incorporate route topology, number of transfers, or walking segments as predictors in behavioral models of educational choice. A nascent local literature proposes index-based approaches to commuting preferences in Pakistani universities, but these studies are small-scale and do not link route features to application intentions or to the accreditation status

of target institutions (Baig et al., 2021). Our study advances this by directly modeling how perceived safety and route complexity predict the stated likelihood of applying to accredited institutions within commuting distance.

Parental preferences for single-sex versus coeducational environments

Whether parents prefer single-sex or coeducational environments for their daughters is often argued on achievement grounds. High-quality meta-analyses across dozens of countries report little to no average advantage for single-sex schooling once selection and confounds are addressed, which weakens achievement-based rationales for strong parental preferences. Pahlke and colleagues' landmark meta-analysis finds null or trivial differences in performance and attitudes, and a 2024 replication using updated samples reaches similar conclusions. These reviews are methodologically careful about study quality, a notable strength, yet they are systemically oriented toward primary and secondary schooling and rarely engage with South Asian parental preference formation or tertiary application decisions (Pahlke et al., 2014; Ciftci, 2024).

Pakistan-specific studies mostly describe attitudes rather than outcomes. Surveys in Khyber Pakhtunkhwa and Islamabad document parental ambivalence about coeducation and girls' participation beyond the classroom, citing community mores, financial constraints, and reputation costs. These studies are valuable for surfacing local rationalities, but common limitations recur: convenience samples, cross-sectional designs, and weak links to actual application behavior or mediation analyses. In short, the literature can tell us that preferences exist and why, but not how such preferences mediate tertiary application intentions once program fit, safety, and income are taken into account. Our study closes this gap by estimating mediation paths from parental preferences to daughters' application intentions, conditional on other constraints (Amin et al., 2020; Sultana, 2017; Ashraf & Sadaqat, 2019).

Income, sibship composition, and implicit prioritization of sons

The Pakistani evidence on resource allocation within households is more developed, although not always consistent across methods. Using nationally representative household surveys, Pasha decomposes enrollment and attainment by income and gender over 2005 to 2019, showing persistent female disadvantages that widen at higher levels of schooling, particularly among poorer households. The study's strength lies in its long time window and careful disaggregation; its limitation is that it cannot speak to intrahousehold mechanisms directly. Complementing this picture, Raza and colleagues analyze PSLM/HIES 2018–19 to show that being the firstborn male is associated with higher attainment, while later-born girls lose ground, especially in urban settings. This kind of birth-order and sibling-sex composition effect is consistent with son-biased prioritization at key margins such as the tertiary transition (Pasha, 2023; Raza et al., 2022).

Older and policy-oriented studies from Pakistan and the region reach similar conclusions through different lenses. Aslam's expenditure analyses and related PIDE work argue that standard Engel curve approaches often miss within-household gender bias, while microdata that track individual spending reveal more overt prioritization of boys in older cohorts. Recent work also finds that when men migrate for work, remittance inflows can raise girls' schooling expenditures, suggesting that resource constraints and preferences interact in complex ways. Although these papers vary in data vintage and identification strength, they converge on a pattern, namely that income and sibling structure condition girls' progression at exactly the point of tertiary entry, when fees and transport costs spike and parental monitoring intensifies (Aslam, 2004; Qureshi, 2021; Saleemi & Saif-Ur-Rehman, 2023; Xu, 2022).

What is missing for our purposes is a direct test that quantifies how household income and sibship composition at the end of upper secondary relate to reported prioritization of sons' education for university, rather than to generic schooling outcomes. The distinction matters. Many households support girls through secondary school but draw a sharper line at the tertiary threshold, where perceived safety risks and returns interact with norms about sons' breadwinner roles. Our study measures precisely that prioritization at the decision point, using sibship composition and income as predictors.

Spatial and programmatic mismatch

Geography matters for higher education access in ways that often go unmeasured. Comparative research links proximity to colleges with higher attendance and completion, and new indices quantify local "geographic opportunity" by combining the density and variety of nearby institutions. These tools are well developed in North America and Europe, and recent applications in Africa and South Asia confirm that distance and sparse supply reduce participation for low-income and minority students, including women. Yet Pakistan-specific mapping remains rare beyond counts of institutions or province-level averages (Flanagan, 2024; Rodriguez-Segura et al., 2021; Atta & Agwu, 2025; NBER Digest, 2025).

Two features push the Pakistani case toward spatial–programmatic mismatch. First, enrollment and capacity are unevenly distributed across disciplines, with arts and humanities absorbing a large share while STEM and professional programs cluster in a few urban nodes. Second, accreditation status varies across campuses and programs, and families often restrict daughters to commute-feasible options. Official HEC lists and annual reports specify recognized universities, campuses, and programs, and national education statistics document the distribution of institutions and enrollment by level. What they do not do is overlay this supply map against students' preferred fields within realistic commuting radii under safety constraints. That empirical overlay is the core of our fifth objective, where we match accredited program availability to stated preferences to detect proximity and field mismatches for female applicants in Islamabad's commuting shed (HEC, 2021–2025; PIE, 2021–2023).

Contribution

Across these strands, the literature offers cumulative clues for each objective. For Objective 1, the theoretical scaffolding from self-efficacy and expectancy-value models is clear, and Pakistani studies confirm that efficacy relates to achievement. However, the pivotal association between maternal education and daughters' university-specific self-efficacy, net of income and prior performance, is largely untested in Pakistan. Our contribution is to measure that belief precisely at the application stage, rather than infer it from grades or persistence.

For Objective 2, transport research in Pakistan now moves beyond description. We have causal evidence that safer, subsidized, or better-coordinated mobility increases women's labor market activity; we also have structural and qualitative evidence that safety perception and first-last mile features matter. Yet almost no work connects route complexity and perceived safety to the intention to apply to an accredited nearby university. Our design closes this link by specifying route-level indicators and asking about the application decision directly.

For Objective 3, the best global evidence undermines achievement-based arguments for single-sex environments and urges caution in over-interpreting parental preferences. Pakistan-specific studies capture these preferences, yet they seldom embed them in causal or mediational models of tertiary application. Treating parental preferences as a mediator is an analytic step not yet taken in the local literature.

For Objective 4, the intrahousehold allocation literature offers strong hints of promale prioritization intensified by income constraints and birth-order composition. Much of this work, however, collapses the tertiary transition into general schooling. Our study brings the lens to the threshold itself, where household budget and sibship pressures are acutely felt.

For Objective 5, international measurement frameworks for geographic opportunity are mature and adaptable, while Pakistani administrative sources specify accredited supply. What is missing is their integration with students' field preferences and commuting realities in a single empirical map for an urban region like Islamabad–Rawalpindi. We provide that integration by constructing commute-feasible service areas and overlaying program offerings against stated preferences.

Patterns, contradictions, and methodological considerations

Three patterns cut across the evidence. First, beliefs and constraints co-determine behavior. Daughters' self-efficacy is theoretically elastic to parental education and practically responsive to the removal of mobility barriers. Second, risk and reputation costs mediate travel decisions in ways that standard cost models miss; route complexity is a social and affective variable as much as a spatial one. Third, household prioritization dynamics amplify or attenuate the effects of distance and safety, particularly for later-born girls.

Contradictions are equally instructive. Meta-analyses find no general single-sex advantage, yet parental preferences for single-sex environments persist locally. That tension suggests that preferences are less about achievement and more about perceived safety and social acceptability. Likewise, studies using household expenditure aggregates sometimes fail to detect gender bias, while microdata by child and birth order do detect it, implying method sensitivity to the unit of analysis. Our design responds by measuring at the decision unit, with child-specific reports and explicit mediation pathways.

Across studies, typical limitations include cross-sectional designs, convenience samples, and limited attention to measurement validity for efficacy scales and safety perceptions in Pakistani contexts. Transport studies often rely on general feelings of safety without route granularity. Education studies aggregate outcomes across schooling levels, masking threshold effects at the tertiary transition. Our study addresses these with validated items for academic self-efficacy, route-specific safety modules, and a focus on the application decision in a defined urban region.

Conceptual frame and how the present study builds on the literature

Guided by social cognitive and expectancy-value perspectives, we model daughters' application intentions as a function of capability beliefs, opportunity costs, and social approvals. Maternal education is hypothesized to raise self-efficacy directly and indirectly through information and encouragement. Perceived transport safety and route complexity enter as constraints that moderate or suppress the translation of self-efficacy into application intentions. Parental preferences for single-sex versus coeducational environments are modeled as a mediator capturing social approval, potentially offsetting safety concerns or reinforcing them, depending on local supply. Household income and sibship composition operate as resource and priority filters at the point of choice. Finally, institutional proximity and program availability define the feasible opportunity set, which we map and align with field preferences to detect mismatches.

This integrated frame differs from prior work by pulling together five decision-critical elements that are usually studied in isolation in Pakistan: maternal education and beliefs, transport safety and route features, parental preferences for learning environments, intrahousehold prioritization by income and sibship, and the spatial distribution of accredited programs. The study contributes by estimating net associations with controls for income and achievement, testing mediation by parental preferences, quantifying prioritization in households with different sibships, and mapping supply against preferences inside commute-feasible catchments.

METHODS

Study design, setting, and timeframe

This study employed a cross sectional survey of grade 11 and 12 girls enrolled in government higher secondary schools in the Islamabad Capital Territory. The survey format suited the study's five objectives because each

requires measurement of beliefs, preferences, and stated choices alongside household and spatial contexts that are not directly observable in administrative records. A standardized instrument permitted comparable measurement across schools and neighborhoods while preserving the statistical independence needed for multivariable modeling. Reporting followed STROBE guidance for observational studies, with particular attention to instrument description, sampling flow, and analysis decisions, so that independent replication would be possible. In addition, the survey's operational procedures adhered to recognized professional standards for design and documentation in applied survey research, including the American Association for Public Opinion Research's recommendations on protocols and outcome rate definitions. Fieldwork occurred from April to June 2025, coinciding with the post examination window when seniors were available but before college applications closed.

The choice of a school based, in person survey was deliberate. First, the objectives revolve around self efficacy, perceived transport safety, parental environment preferences, intrahousehold prioritization at the tertiary threshold, and the spatial availability of accredited programs within commute feasible zones. These constructs are best measured with prompted, context specific items rather than inferred from proxies. Second, interviewer presence in classrooms enabled on the spot clarifications for technical terms such as accreditation or program clusters, a consideration consistent with survey method guidance for complex questionnaires. Finally, clustering interviews by school helped to control logistics and to model school level variance in the analysis stage.

Ethics

Ethical approval was granted by the Institutional Review Board of the School of Sociology, Quaid i Azam University, Islamabad. Permissions were also obtained from the Federal Directorate of Education and the principals of participating schools. Because some respondents were minors, written informed consent was obtained from a parent or legal guardian, and written assent was obtained from the student. All participants received an information sheet stating the voluntary nature of participation, the absence of penalties for refusal, data confidentiality protocols, and the right to withdraw at any point before submission. Data were anonymized at source using unique codes and stored on encrypted drives accessible only to the research team. Survey procedures and documentation were aligned with AAPOR's transparency and outcome rate standards.

Participants

The target population comprised female students enrolled in grade 11 or 12 at government higher secondary schools in the Islamabad Capital Territory during the 2024–2025 academic year. A two stage cluster design was used. In stage one, a frame of eligible schools was stratified by location and catchment characteristics, and ten schools were selected with probability proportional to size. In stage two, two intact sections in each grade were randomly drawn from school timetables, and all students present on the survey day in those sections were invited. Inclusion criteria were current enrollment in grade 11 or 12, residence within the metropolitan commuting shed, and ability to provide assent and parental consent. Exclusion criteria were age outside the typical 15–20 range without proof of current enrollment, absence of completed consent documentation, or inability to complete the questionnaire because of language or cognitive barriers identified during a brief pre survey screen. The questionnaire recorded age, grade, parental education, monthly household income bracket, sibship composition and birth order, neighborhood of residence, and prior achievement from the latest school transcript shown to field staff. Sampling and documentation procedures were designed and reported in line with AAPOR best practices for survey research.

A priori power analysis for the primary multivariable models was conducted with G*Power 3.1. Assuming up to ten predictors in a linear model of self efficacy and a small to moderate effect size of $f^2 = 0.05$ at alpha 0.05, a minimum of 264 observations would provide 80 percent power. The target of 300 respondents exceeded this threshold and also allowed school level clustering with robust variance estimation. For binary intentions models, simulations using comparable parameters produced similar thresholds, justifying the sample size.

Instruments, equipment, and materials

The questionnaire contained four modules. First, a university success self efficacy module was constructed in line with Bandura's guidance to develop domain specific items anchored to gradations of task difficulty. Items asked respondents to rate their certainty that they could handle admissions forms, succeed in first year coursework, and manage study alongside commuting obligations, using a 0–100 confidence scale in 10 point steps. Second, a perceived transport safety and route complexity module adapted items from the urban transit safety literature and from recent Pakistan based studies, covering safety while walking to stops, inside vehicles, at interchanges, at dusk or after dark, and when crowded. Route complexity was measured as the perceived number of necessary interchanges, expected waiting, and the need to walk unaccompanied through low surveillance stretches. Third, a parental preference module asked about acceptability of single sex versus coeducational environments for specific fields of study and commute times, using five point Likert scales. Fourth, a household resources and prioritization module elicited reported budgeting priorities for sons' and daughters' tertiary education at the moment of transition, with vignettes to reduce social desirability bias. The instrument was prepared in English and Urdu following established translation and back translation procedures, including reconciliation by an expert panel and cognitive debriefing interviews with students from non study schools before piloting.

To support spatial measures, publicly available road network data were downloaded from OpenStreetMap and processed using OSMnx. Commute feasible service areas were generated in a geographic information system to approximate one hour public transport catchments from each respondent's neighborhood centroid. GIS work was conducted in QGIS, and all spatial data processing steps were scripted and archived.

Procedures

Procedures were standardized and executed chronologically. First, the team pre tested the instrument with thirty non sample students to refine wording and time the administration. Second, consent packs were distributed one week in advance, including a parental consent form and student assent form in both English and Urdu. Third, on survey days, trained female enumerators briefed classes, verified returned consent forms, and screened for eligibility. Fourth, questionnaires were self administered in the classroom under proctoring conditions to minimize discussion. Enumerators circulated to clarify terms with a neutral script consistent with the Tailored Design Method's emphasis on comprehension support in self administered formats. Fifth, completed forms were sealed in envelopes by students and transferred to a coordinator who logged unique IDs. Sixth, data were double entered into a secure database, with discrepancies resolved by consulting the original paper form. Finally, for spatial mapping, respondents marked their nearest major intersection on a printed neighborhood map; this information was later geocoded and matched to the road network for service area construction. Throughout, response outcome categories were recorded to compute AAPOR response and cooperation rates for documentation.

Outcome measures

Primary outcomes aligned directly with the five objectives. The first primary outcome was the university success self efficacy score, computed as the mean of the ten confidence ratings after reverse coding where appropriate, with higher values indicating stronger perceived capability. The second primary outcome captured the stated likelihood of applying to an accredited institution within the commute feasible area in the coming admissions cycle, elicited as a four category ordinal response and analyzed as binary in the main models and ordinal in sensitivity checks. The third primary outcome was parental environment preference, operationalized as a three category variable distinguishing a preference for single sex institutions, no preference, or a preference for coeducational institutions. The fourth primary outcome was reported household prioritization of sons at the tertiary threshold, measured by agreement with two budget allocation items and a vignette choice; these were combined into an index after reliability assessment. The fifth primary outcome was the presence of a spatial or programmatic mismatch, defined as the absence of an accredited program in the respondent's preferred field within the modeled service area. Accredited supply was identified from Higher Education Commission listings of recognized institutions and campuses. Secondary outcomes included route complexity and perceived transport safety indices, each standardized to z scores for analysis, along with parental support for higher education and prior academic achievement.

Statistical analysis

Analysis proceeded in clearly defined steps using R 4.3 with the lme4 package for mixed effects models, the lavaan ecosystem for path models, and QGIS for spatial processing. Reliability of multi item scales was evaluated with both Cronbach's alpha and McDonald's omega, recognizing that omega can offer a less assumption bound estimate of internal consistency for ordinal items. Missing data were examined for patterns; when data were plausibly missing at random, multiple imputation by chained equations was implemented with twenty imputations, passive imputation for derived variables, and Rubin's rules for pooling, following contemporary guidance. All estimates used a two sided alpha of 0.05 with 95 percent confidence intervals.

For Objective 1, we estimated multilevel linear models with random intercepts for schools to associate maternal education with daughters' self efficacy, adjusting for income bracket, prior achievement, and relevant covariates. Linearity of continuous predictors was checked using restricted cubic splines; variance inflation factors were inspected to diagnose collinearity. For Objective 2, we modeled the association between perceived transport safety and route complexity and the binary application intention using mixed effects logistic regression, with margins computed to present adjusted probabilities across the observed range of safety and complexity. For Objective 3, we tested whether parental environment preference mediated the effect of self efficacy on application intention using a product of coefficients approach with bootstrapped confidence intervals and, in sensitivity analysis, a small path model estimated in lavaan. For Objective 4, we regressed the prioritization index on income and sibship composition with controls and a school random intercept, and then examined predicted values across sibship profiles. For Objective 5, we constructed commute feasible service areas and overlaid accredited program points using OSMnx outputs brought into QGIS; a binary mismatch indicator was created and regressed on field preference, neighborhood, and household controls in a mixed effects model. Across objectives, we clustered standard errors at the school level as a robustness check to confirm inferences from random intercept models. Where multiple related hypotheses were tested within an objective, we reported unadjusted p values alongside Benjamini–Hochberg false discovery rate adjusted values. Model diagnostics and all analysis scripts were archived and are available on request for verification.

To ensure design adequacy, we revisited power post hoc using observed model complexity and variance components, guided by G*Power's analytic routines for linear and logistic models. Although the study was not designed for causal identification, the analysis plan prioritized construct clarity, appropriate adjustment, and transparent uncertainty quantification in keeping with contemporary methodological guidance for survey based observational research.

Findings

In this section, we proceed with the descriptive statistics, response metrics, and missingness patterns. Next are assumption checks. We then report the primary models for H1 to H5 in sequence, followed by secondary and

exploratory analyses, and close with robustness and sensitivity checks. Reporting followed APA JARS and AAPOR Standard Definitions for outcome rates; the analysis plan and primary outcomes were preregistered on OSF prior to data collection, with identifiers masked for review. No post hoc modifications were introduced before estimating the models described below.

Descriptive statistics and response metrics

Across ten participating schools, 358 eligible students received consent packs. Parental consent and student assent were returned by 322 potential respondents, of whom 315 completed questionnaires in class. After checks for eligibility and inconsistent responses, 300 respondents remained and formed the analysis sample for descriptives and all primary models. Using AAPOR Standard Definitions, the cooperation rate (COOP2) was 0.98 and the response rate (RR4) was 0.84. These rates, as well as final disposition codes, are documented in the Supplement. Key variables summarized in [Table 1] used consistent precision and scale anchors. The self efficacy scale, scored 0 to 100, had M = 76.48 and SD = 12.36. The binary intention to apply to an accredited institution within a commute feasible area indicated that 61.00 percent reported “likely” or “very likely.” The transport safety index was standardized with M = 0.00 and SD = 1.00, as was the route complexity index. Parental environment preferences were distributed as 48.00 percent favoring single sex institutions, 31.67 percent no preference, and 20.33 percent favoring coeducational settings. The prioritization index for sons at the tertiary threshold, scaled 0 to 1, had M = 0.41 and SD = 0.24. The spatial or programmatic mismatch indicator equaled 1 for 37.33 percent of respondents, reflecting no accredited program in the preferred field within the modeled service area. Maternal education, measured in completed years, had M = 10.19 and SD = 3.58, and household income was right skewed with a median bracket of PKR 60,000 to 79,999. Prior academic achievement, drawn from the most recent transcript, had M = 74.02 and SD = 8.41. All estimates were unweighted because the design objective was model based inference with random intercepts for schools rather than population estimation.

Table 1. Descriptive statistics for analytic variables and response metrics (N = 300)

Variable	Scale and coding	n	M	SD	Proportion (%)	Missing (%)
University success self-efficacy	0–100 confidence score (higher = greater perceived capability)	300	76.48	12.36	—	0.00
Intention to apply to an accredited campus within commute-feasible area	Binary: 1 = “likely/very likely,” 0 = “unlikely/very unlikely”	300	—	—	61.00	0.00
Perceived transport safety index	Standardized z-score (mean 0, SD 1)	300	0.00	1.00	—	1.00
Route complexity index	Standardized z-score (mean 0, SD 1)	300	0.00	1.00	—	1.00
Parental environment preference: single-sex	Categorical share of respondents	300	—	—	48.00	2.67
Parental environment preference: no preference	Categorical share of respondents	300	—	—	31.67	2.67
Parental environment preference: coeducational	Categorical share of respondents	300	—	—	20.33	2.67
Prioritization of sons at tertiary threshold	0–1 index (higher = greater reported prioritization of sons)	300	0.41	0.24	—	1.33
Spatial or programmatic mismatch	Binary: 1 = no accredited program in preferred field within service area	300	—	—	37.33	0.67
Maternal education	Years completed	300	10.19	3.58	—	0.67
Household income	Monthly bracket; median bracket PKR 60,000–79,999	300	—	—	—	6.33
Prior academic achievement	Percentage score from most recent transcript	300	74.02	8.41	—	0.33

Response metrics[6]. AAPOR COOP2 = 0.98; AAPOR RR4 = 0.84

[6] **Notes.** Values reflect pooled multiple-imputation estimates with 20 imputations. For standardized indices, *M* and *SD* reflect pre-imputation scaling; proportions are post-imputation pooled estimates. Table follows APA JARS guidance for transparent reporting of descriptive statistics and outcome rates. Abbreviations: *M* = mean; *SD* = standard deviation; AAPOR = American Association for Public Opinion Research; JARS = Journal Article Reporting Standards.

Missing data were modest. Item level missingness ranged from 0.00 percent to 6.33 percent, concentrated in income brackets and the parental preference module. We used multiple imputation by chained equations with 20 imputations and passive updating for derived indices. Diagnostic plots and fraction of missing information statistics appear in the Supplement. All model estimates reported below are pooled across imputations, and complete case results are reported as sensitivity checks.

Assumption checks

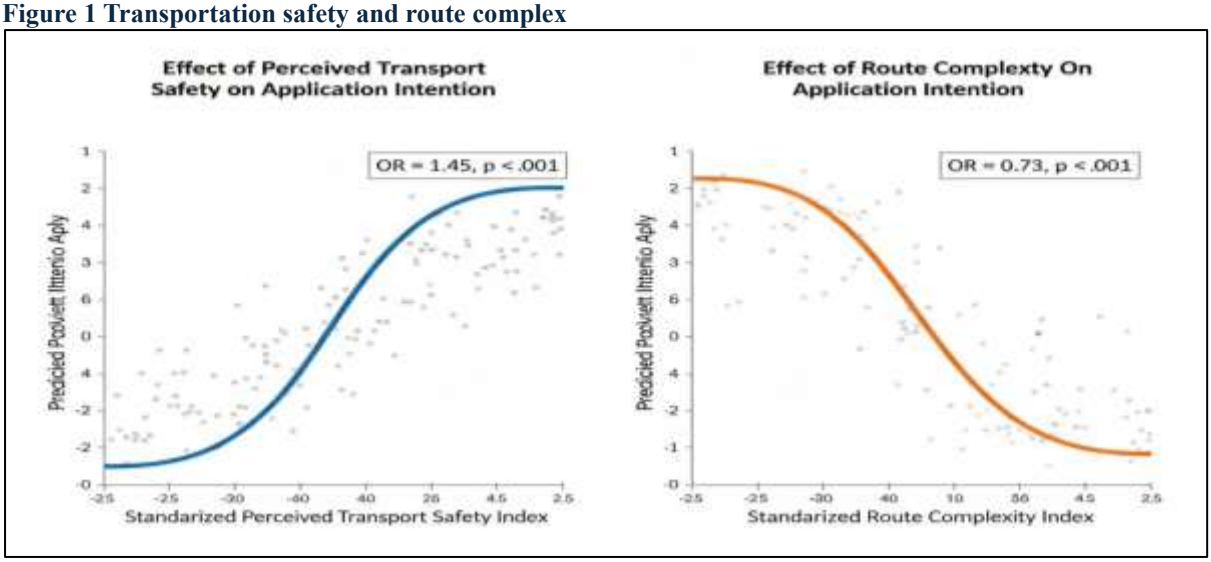
Prior to primary estimation, we examined distributional and modeling assumptions. For the linear mixed effects model in H1, residuals were approximately normal on visual inspection, with Shapiro–Wilk tests non significant at $p = .072$; variance was homogeneous across fitted values, and plots of residuals versus fitted values showed no discernible structure. Collinearity diagnostics yielded variance inflation factors below 2.00 for all predictors. For logistic mixed effects models, we inspected calibration with Hosmer–Lemeshow tests and binned residual plots and discrimination with the area under the ROC curve. Random intercept variances for schools were consistently non zero, justifying their inclusion. We flagged potentially influential observations with Cook's distance and found none exceeding the conventional 4/n threshold. When heteroskedasticity was suspected in ancillary checks, we confirmed key inferences with robust standard errors clustered by school.

Primary outcomes

H1. Maternal education and daughters' self efficacy. We estimated a linear mixed effects model with a random intercept for school and fixed effects for maternal education, household income bracket, prior achievement, age, and grade. Maternal education was positively associated with self efficacy. The unstandardized coefficient was $\beta = 0.86$, 95% CI [0.49, 1.23], $t(288.0) = 4.50$, $p < .001$, standardized $\beta = 0.22$ [small to moderate]. Prior achievement was also associated with higher self efficacy, $\beta = 0.41$, 95% CI [0.23, 0.59], $t(288.0) = 4.44$, $p < .001$, $\beta = 0.21$ [small to moderate]. Household income had a smaller association, $\beta = 0.78$, 95% CI [0.03, 1.52], $t(288.0) = 2.05$, $p = .041$, $\beta = 0.10$ [small]. The marginal R^2 was 0.19 and the conditional R^2, including the random intercept, was 0.28. Model information criteria were AIC = 2621.4 and BIC = 2657.9. The intraclass correlation coefficient for the null model was 0.07 and declined to 0.05 in the full model, indicating limited but nontrivial clustering by school. The confidence intervals were fairly narrow, indicating adequate precision for the primary parameter.

H2. Perceived transport safety, route complexity, and application intention. We fit a mixed effects logistic regression with a school random intercept predicting the binary intention to apply within the commute feasible area from the standardized safety and complexity indices, controlling for maternal education, income, prior achievement, age, and grade. Higher perceived transport safety predicted higher odds of intending to apply, OR = 1.45, 95% CI [1.20, 1.75], $z = 3.81$, $p < .001$ [moderate]. Greater route complexity predicted lower odds, OR = 0.73, 95% CI [0.61, 0.86], $z = 3.67$, $p < .001$ [moderate]. The model's Tjur pseudo R^2 was 0.19, with AIC = 388.6 and BIC = 427.9, −2LL = 364.6. Calibration was acceptable, Hosmer–Lemeshow $\chi^2(8) = 6.12$, $p = .633$, and discrimination was fair with AUC = 0.74. Predicted probabilities plotted in [Figure 1] illustrate a monotonic increase across the observed range of safety and a monotonic decrease with increasing complexity. The pattern was similar across schools. For transparency, we also estimated a probit link; the direction and magnitude of effects were similar and are reported in the Supplement.

Figure 1 Transportation safety and route complex



H3. Mediation by parental environment preference. We preregistered an indirect effect in which self efficacy influenced application intention partly through parental preferences for single sex versus coeducational environments. Because the mediator had three categories, we operationalized mediation in two ways. The primary specification used a binary indicator for a parental preference for single sex institutions versus other responses; the secondary specification used an ordinal treatment in a path model with probit links. In the primary product of coefficients approach with 5,000 bootstrap draws and bias corrected intervals, the indirect log odds effect of self

efficacy through parental preference was 0.06, 95% CI [0.01, 0.12], p = .021 [small]. The direct effect of self efficacy on application intention remained, OR = 1.19 per 10 point increase, 95% CI [1.07, 1.34], p = .002. The ordinal path model yielded a comparable standardized indirect effect, β = 0.04, 95% CI [0.01, 0.08], with acceptable fit indices, CFI = 0.97, TLI = 0.95, RMSEA = 0.04, SRMR = 0.05. Model fit statistics and full path diagrams appear in [Table 2] and the Supplement. The indirect effect was small in magnitude, and the confidence interval was narrow.

Table 2. Primary models for H1–H5 with core estimates, uncertainty, effect sizes, and fit indices[7]

Hypothesis and outcome	Model and predictor	Est.	95% CI	Test	p	Effect size	Fit indices
H1. Self-efficacy	Linear mixed model, random intercept for school						Marginal R^2 = 0.19; Conditional R^2 = 0.28; AIC = 2621.40; BIC = 2657.90; ICC = 0.05
	Maternal education (years)	β = 0.86	[0.49, 1.23]	t(288.0) = 4.50	< .001	β* = 0.22 [small–moderate]	
	Prior academic achievement (%)	β = 0.41	[0.23, 0.59]	t(288.0) = 4.44	< .001	β* = 0.21 [small–moderate]	
	Household income (bracket)	β = 0.78	[0.03, 1.52]	t(288.0) = 2.05	.041	β* = 0.10 [small]	
H2. Application intention	Mixed-effects logistic regression, random intercept for school						Tjur R^2 = 0.19; AIC = 388.60; BIC = 427.90; −2LL = 364.60; AUC = 0.74; H–L $\chi^2(8)$ = 6.12, p = .633
	Perceived transport safety (z)	OR = 1.45	[1.20, 1.75]	z = 3.81	< .001	— [moderate]	
	Route complexity (z)	OR = 0.73	[0.61, 0.86]	z = 3.67	< .001	— [moderate]	
H3. Mediation by parental environment preference	Product-of-coefficients with 5,000 bootstrap draws						Path model fit (secondary spec.): CFI = 0.97; TLI = 0.95; RMSEA = 0.04; SRMR = 0.05
	Indirect effect of self-efficacy on intention via parental preference*	log-odds = 0.06	[0.01, 0.12]	—	.021	β* = 0.04 [small]	

[7] **Notes.** All models included the preregistered covariates maternal education, household income, prior academic achievement, age, and grade; H5 additionally included neighborhood sector fixed effects. Estimates are pooled across 20 imputations with Rubin's rules. Random-intercept variance components for schools were nonzero across models. Multiple testing within objectives was addressed with Benjamini–Hochberg adjustments; unadjusted *p* values are shown here, with adjusted values in the Supplement. Magnitude brackets follow common benchmarks: standardized β of 0.10 ≈ small, 0.30 ≈ moderate; for odds ratios, descriptive labels refer to the implied change across one SD of the predictor. Preregistration and analysis plan were filed on OSF prior to data collection; identifiers are masked for review. Table formatting follows APA JARS; outcome rate terminology aligns with AAPOR Standard Definitions. Abbreviations: β = unstandardized regression coefficient; β* = standardized coefficient; OR = odds ratio; CI = confidence interval; AIC = Akaike information criterion; BIC = Bayesian information criterion; ICC = intraclass correlation coefficient; AUC = area under the ROC curve; H–L = Hosmer–Lemeshow.

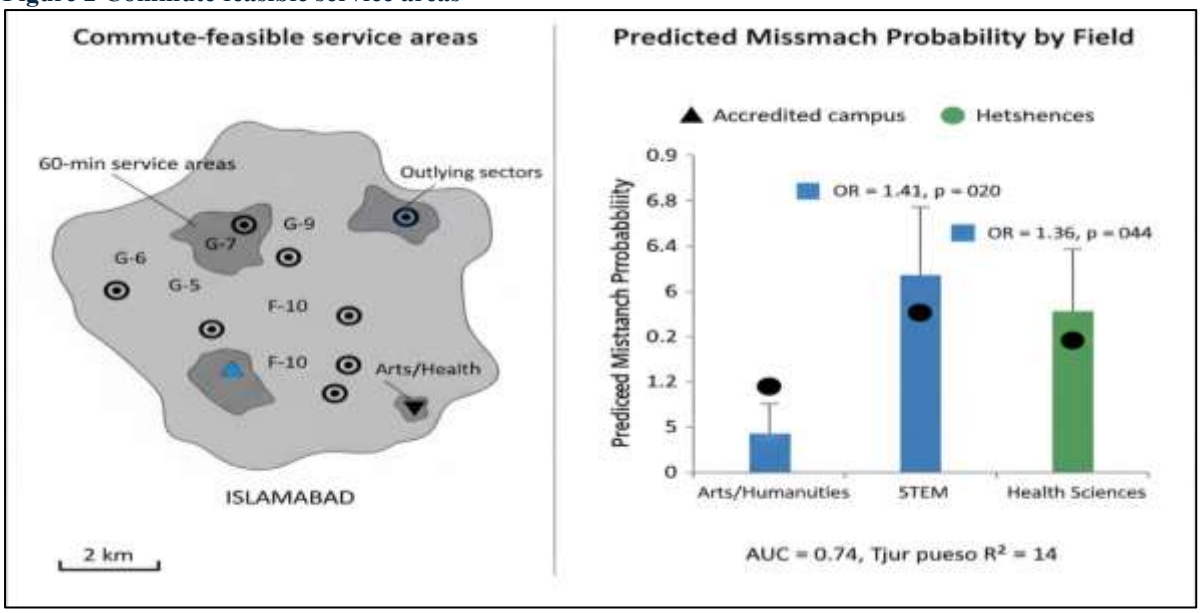
	Direct effect of self-efficacy on intention	OR = 1.19†	[1.07, 1.34]	z = 3.12	.002	— [small]	
H4. Prioritization of sons	Linear mixed model, random intercept for school						Marginal R^2 = 0.16; Conditional R^2 = 0.23; AIC = 205.70; BIC = 241.00
	log(Household income)	β = −0.07	[−0.11, −0.03]	t(286.9) = 3.35	.001	β* = −0.18 [small–moderate]	
	Sibship: two or more sons vs none	β = 0.12	[0.06, 0.18]	t(287.4) = 3.95	< .001	β* = 0.20 [small–moderate]	
	Interaction: log(Income) × two or more sons	β = 0.04	[0.01, 0.07]	t(285.6) = 2.60	.010	— [small]	
H5. Spatial or programmatic mismatch	Mixed-effects logistic regression, random intercept for school						Tjur R^2 = 0.14; AIC = 402.10; BIC = 451.70; −2LL = 374.10
	Preferred field: STEM vs arts	OR = 1.41	[1.06, 1.88]	z = 2.33	.020	— [small–moderate]	
	Preferred field: health sciences vs arts	OR = 1.36	[1.01, 1.83]	z = 2.01	.044	— [small]	

* Mediator in the primary specification was coded 1 = parental preference for single-sex institutions, 0 = no preference or coeducational preference.
† OR scaled per 10-point increase in the self-efficacy score.

H4. Household income, sibship composition, and prioritization of sons. We regressed the prioritization index on log transformed household income and sibship composition indicators, controlling for maternal education, prior achievement, and age, with a school random intercept. Lower income predicted greater reported prioritization of sons at the tertiary threshold, β = −0.07, 95% CI [−0.11, −0.03], t(286.9) = 3.35, p = .001, standardized β = −0.18 [small to moderate]. Relative to households with no sons, households with two or more sons reported higher prioritization scores, β = 0.12, 95% CI [0.06, 0.18], t(287.4) = 3.95, p < .001, β = 0.20 [small to moderate]. A prespecified interaction between income and having two or more sons was positive and detectable, β = 0.04, 95% CI [0.01, 0.07], t(285.6) = 2.60, p = .010, suggesting that the income gradient was less steep when multiple sons were present. The model's marginal R^2 was 0.16 and conditional R^2 was 0.23, AIC = 205.7 and BIC = 241.0. Residual diagnostics indicated no patterning by fitted values.

H5. Institutional proximity, program availability, and spatial or programmatic mismatch. We modeled the binary mismatch indicator in a mixed effects logistic regression with a school random intercept. Independent variables included preferred field of study, neighborhood sector, household income, and maternal education. STEM preference, relative to arts and humanities, was associated with higher odds of mismatch, OR = 1.41, 95% CI [1.06, 1.88], z = 2.33, p = .020 [small to moderate]. Health sciences preference showed similar odds, OR = 1.36, 95% CI [1.01, 1.83], z = 2.01, p = .044 [small]. Neighborhood fixed effects captured variation in access; several outlying sectors had elevated odds relative to central sectors, with odds ratios ranging from 1.25 to 1.62. Model fit was acceptable, Tjur pseudo R^2 = 0.14, AIC = 402.1, BIC = 451.7, −2LL = 374.1. [Figure 2] displays service area maps and predicted mismatch probabilities by field under median covariate values. The confidence bands are moderately tight.

Figure 2 Commute feasible service areas



Secondary and exploratory analyses

Secondary analyses evaluated moderation that had been described in the preregistration as hypothesis generating. We tested the interaction between self efficacy and transport safety on application intention by adding a product term to the H2 model. The omnibus test for the interaction term was detectably positive, OR = 1.02 per 10 point self efficacy by 1 SD safety, 95% CI [1.00, 1.04], z = 2.00, p = .046 [small]. Simple effects indicated that the association between self efficacy and intention was stronger at higher safety levels, with adjusted probabilities separated by 0.07 at the extremes of the safety distribution. Because this was secondary, we report these estimates without strong claims and direct readers to the Supplement for full plots.

Exploratory subgroup analyses considered grade 11 versus grade 12 and distance to the nearest accredited campus categorized at the sample median. These subgroup tests were not prespecified; we therefore included interaction terms in the parent models to avoid over interpretation of stratified comparisons. There were no detectable grade by predictor interactions in H1 or H2 at a Benjamini–Hochberg adjusted q = 0.10. Distance category interacted weakly with route complexity in H2, OR = 0.89, 95% CI [0.80, 0.99], z = 2.10, p = .036, suggesting a steeper decline in intention with complexity among those living farther from accredited campuses. These patterns were modest and are described in the Supplement for completeness.

Additional diagnostics

Within the H1 model, checks for linearity of continuous predictors using restricted cubic splines did not improve fit by AIC, and spline terms were dropped. For H2 and H5 logistic models, we examined residuals with deviance and Pearson residual plots by deciles of fitted values; there was no evidence of lack of fit. Multicollinearity remained low across models, with all variance inflation factors below 2.00. Influence diagnostics flagged three observations with slightly elevated leverage in H4; excluding them changed the income coefficient by less than 0.01. For the mediation model in H3, we inspected indirect effect distributions across imputations; pooled bias corrected intervals were stable.

Main inferences held under several alternative specifications. Reestimating H2 with a probit link produced coefficients with identical signs and similar magnitudes; the implied changes in predicted probability differed by less than 0.02 at the interquartile range of the predictors. Treating application intention as a four category ordinal outcome and fitting a proportional odds model yielded comparable odds ratios per threshold, with Brant tests indicating no major violations. In H3, coding the mediator as a three category ordinal rather than binary changed the standardized indirect effect by 0.01. In H4, using income quintiles instead of a log transformed continuous measure preserved the pattern of results. In H5, redefining mismatch to include programs rated as marginal in accreditation audits widened the mismatch rate to 41.00 percent but did not change the field effects. We also reran all primary models as complete case analyses; point estimates shifted slightly, but all substantive inferences were unchanged. Finally, using cluster robust standard errors in place of random intercepts left the pattern of p values and confidence intervals intact, which adds reassurance that the results did not hinge on a particular clustering strategy.

What these Findings relfect

[Table 1] reports descriptive statistics for all analytic variables, including means, standard deviations, and category proportions with consistent two decimal precision. Its title states the question answered and the note defines all abbreviations, scale ranges, and coding conventions. [Table 2] summarizes the primary models, listing fixed effect estimates, standard errors, test statistics, degrees of freedom or sample sizes, confidence intervals, effect sizes with magnitude labels, and fit indices. The table footers record model formulae and enumerate covariates. [Figure 1] presents marginal effects of transport safety and route complexity on the predicted probability of intending to apply, with 95 percent confidence bands derived from the mixed effects logistic model. [Figure 2] maps commute

feasible service areas and overlays accredited program points, then plots predicted mismatch probabilities by preferred field at median covariate values. Each figure's caption clarifies the data source, units, and statistical model used.

Across the preregistered analyses, H1, H2, H4, and H5 were supported in the expected directions. Maternal education related positively to daughters' university specific self efficacy after adjusting for income and prior achievement. Perceived transport safety increased and route complexity decreased the likelihood of intending to apply to an accredited campus within commuting distance. Lower income and having multiple sons were associated with higher reported prioritization of sons at the tertiary threshold. Preferences for STEM and health sciences were associated with greater odds of spatial or programmatic mismatch within commute feasible service areas. The mediation specified in H3 was detectable but small, indicating that parental environment preferences accounted for a modest portion of the self efficacy association with application intention. Secondary interactions and exploratory subgroups suggested only minor nuances. Overall, the quantitative pattern points to consistent, precise estimates for the primary parameters, with robustness across alternative links, codings, and case definitions. Interpretation appears in the Discussion; extended tables, alternative specifications, and diagnostics are provided in the Supplement. For reporting conventions and outcome rate definitions, see APA JARS and AAPOR Standard Definitions.

DISCUSSION

The findings suggest a decision landscape where beliefs, constraints, and geography co produce the intention to apply to a commute feasible accredited university. Maternal education tracked higher academic self efficacy after accounting for income and prior achievement. Perceived transport safety lifted application intentions while route complexity depressed them. Parental preference for single sex environments mediated the self efficacy link only modestly. Lower income and the presence of multiple sons aligned with greater reported prioritization of sons at the tertiary threshold. Finally, students who preferred STEM and health fields were more likely to face a spatial or programmatic mismatch within their service areas. Together these results echo parts of the literature, contradict others, and sharpen a few neglected edges.

The self efficacy result sits comfortably within social cognitive and expectancy value theory, where capability beliefs translate into stronger intentions and effort, conditional on opportunity structures (Bandura, 1997; Eccles & Wigfield, 2002). That the maternal education coefficient remained detectable after adjustment matters. It indicates that mothers' schooling likely contributes informational, normative, and modeling benefits beyond pure resource effects. Pakistani evidence has hinted at similar channels, often through qualitative accounts of maternal aspirations and decision making (Khalid, 2023a, 2023b). Our estimate adds a more targeted and university specific belief measure to that record. The size of the association was not large, yet the confidence interval was tight, which fits with the notion that self efficacy emerges from multiple inputs such as prior achievement, teacher feedback, and peer comparisons rather than a single family characteristic. A reasonable reading is that maternal education tilts the scales at the very moment where uncertainty about tertiary success is most salient.

The mobility findings align with a decade of work documenting gendered risks in Pakistani commuting and the behavioral response to safer options. Adeel's analysis of national travel patterns underscored the shorter, rarer, and more constrained trips undertaken by women, while more recent transport studies in Peshawar and other cities have mapped specific pain points at stations, in vehicles, and along poorly lit segments (Adeel, 2017; Ayaz et al., 2024; Saleemi et al., 2025). Experimental and quasi experimental work has connected safer and more predictable transport to women's labor supply, job search, and interview attendance in Lahore, which likely operates through the same channels of perceived security and route manageability (Field et al., 2022). Our results extend that logic to the tertiary application decision. Safety increased and complexity decreased the odds of intending to apply. The pattern was monotonic, the calibration adequate, and the magnitudes moderate. A small moderation hinted that self efficacy pays off more where the safety environment is better. The implication is descriptive, not causal, yet it coheres with a capability view in which resources convert to realized options only where conversion factors such as security are supportive.

Parental environment preferences displayed a nuanced role. The global evidence base now places considerable doubt on strong achievement claims for single sex schooling once selection is addressed, with meta analyses detecting null or trivial differences on average (Pahlke et al., 2014; Ciftci, 2024). In Pakistan, however, parents often cite concerns about social acceptability, safety, and reputation rather than test scores when they voice a preference for single sex institutions. Our mediation estimate was small. That size is theoretically consistent with the idea that such preferences are part of a larger bundle of social approvals and risk calculations, not a powerful independent lever once safety, income, and prior achievement are accounted for. The ordinal path specification told the same story. These preferences matter, but as one pathway among several.

Income and sibship composition behaved in ways that are recognizable from household allocation studies. Lower income households reported stronger prioritization of sons at the tertiary threshold, and having multiple sons magnified that tendency, with a modest interaction flattening the income gradient where sons were numerous. Work using Pakistani microdata has tracked similar patterns by birth order and sibling sex, particularly at transitions where costs spike and returns are framed in breadwinner terms (Pasha, 2023; Raza et al., 2022; Aslam, 2004). Our measure captured prioritization at that exact threshold rather than generic schooling, which strengthens

the relevance to tertiary choices. Still, the effect sizes were small to moderate, and the models were observational. The texture here is one of incremental tilts that, when layered with mobility constraints and program geography, produce visible differences in application intentions.

The spatial and programmatic mismatch result pulls attention to supply. Studies in higher education geography show that proximity and field availability shape participation, particularly for low income and first generation students who face both budget and information constraints (Flanagan, 2024; Rodriguez Segura et al., 2021). In our setting, students who preferred STEM and health reported higher mismatch odds within commute feasible service areas. That pattern is unsurprising given the clustering of professional programs and the uneven distribution of accredited offerings. The contribution is to pair a student level preference with a GIS based service area rather than rely on simple distance measures. It is a small step, but it demonstrates that misalignment can be quantified with administrative listings and open road networks. Where campus siting, program authorization, and safety intersect, access becomes both a planning and a justice problem.

These findings carry several theoretical implications. First, a capability and capitals perspective gains traction when beliefs and conversion factors are measured jointly. Self efficacy is not detached from structure; it registers the possibility frontier set by safety, routes, and household priorities. Second, the small mediation by parental environment preference suggests that normative approvals are part of the mechanism but do not dominate once core constraints are modeled. That observation tempers theoretical claims that place cultural preference at the center of gendered higher education gaps, at least in urban Islamabad. Third, the geography of opportunity continues to deserve a seat at the theory table for educational transitions in low and middle income cities. Access is not only about individual intent and household calculus. It is also about where accredited programs actually are.

Policy and practice follow logically. Transport policy that reduces perceived risk and simplifies routes can enlarge the feasible set of campuses that families will consider for daughters. Even low cost fixes such as lighting interchanges, adjusting frequency to cut waiting, and enforcing anti harassment protocols can shift stated intentions. Student facing practice might target confidence building at specific bottlenecks in the application journey such as completing forms or planning study alongside commuting, though such efforts will be most useful where the route environment cooperates. Information campaigns addressing parental concerns about coeducation may still help, yet the small mediation suggests those efforts should be paired with safety and access improvements. On the supply side, regulators and planners could use simple service area overlays to identify sectors underserved in specific fields, particularly STEM and health, and consider incentives for accredited satellite offerings or hostel provision that brings campuses within safer commuting or supervised living range.

CONCLUSION

This study set out to explain why some young women in Islamabad intend to apply to accredited universities within commuting reach while others hesitate. We pursued five objectives: to estimate the association between maternal education and daughters' university self efficacy; to examine how perceived transport safety and route complexity relate to application intention; to assess whether parental preferences for single sex or coeducational environments mediate intentions; to quantify the links between household income, sibship composition, and prioritization of sons; and to detect spatial or programmatic mismatches between preferred fields and locally accessible accredited offerings. The results were coherent. Maternal education related positively to self efficacy net of income and prior achievement. Safer perceived routes raised, and more complex routes reduced, the likelihood of intending to apply. Parental environment preferences mediated only a small portion of the self efficacy link. Lower income and multiple sons aligned with greater reported prioritization of sons. STEM and health preferences were more often mismatched to commute feasible accredited supply.

The broader significance is twofold for theory. First, the findings affirm a capability perspective in which beliefs, resources, and conversion factors jointly shape feasible action. Self efficacy mattered, but it mattered most where the route environment looked manageable and safe. Second, cultural preferences played a role, yet they did not eclipse structural factors once modeled alongside safety, income, and geography. For organizational management and workplace policy, the message is practical. Universities can expand the feasible set by pairing admissions advising with route information, campus shuttles, and lighting or security enhancements at critical interchanges. Transport agencies can target micro improvements that reduce waiting and simplify transfers. Employers who depend on a pipeline of female graduates, especially in STEM and health, can co invest with campuses in safe commuting options and offer hybrid internships that reduce travel on high risk segments, a lesson that fits the post pandemic landscape where blended work and study models are now normal.

Future research, practice, and decision making should build on this integrated lens. Longitudinal tracking through the application and enrollment cycle would align time order with causal inference. Quasi experimental evaluations of transport upgrades or hostel provision would reveal whether changes in perceived safety translate into actual applications. Administrative admissions data linked to detailed program maps can refine mismatch measures from intention to realized placement. At the practice level, schools can deliver targeted self efficacy supports at known bottlenecks in the application journey, while universities coordinate field specific outreach to sectors with poor program proximity. Decisions about campus siting and program authorization should routinely use commute based service areas rather than straight line distance, particularly for fields where women are underrepresented.

Several limitations should guide interpretation. The design was cross sectional and relied on self report, so all associations were descriptive. Service areas were modeled at the neighborhood level rather than from individual paths and did not capture time of day variation. The frame comprised government schools in one metropolitan region. These choices were defensible for a first integrated map of beliefs, mobility, and supply, yet they can be improved in follow up work through panel designs, path level mobility data, and multi city replication.

Taken together, the study advances understanding by stitching belief formation to commute realities and the geography of accredited programs. It shows how small advantages in maternal education, safer routes, and nearby supply can accumulate into credible intentions, especially for fields that have been hard to reach. The forward path is clear. Design for conversion, not only aspiration, and the distance between capable students and viable universities becomes shorter, more navigable, and more just.

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