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The Role of Socio-Economic Development and Higher Education in Fertility Decline in Turkiye*

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ABSTRACT

This study analyzes fertility decline (crude birth rate) in Turkiye by focusing on education expansion, marriage behavior, and socio-economic development, situating the country within the broader Asian and European low-fertility literature. Using a two-stage quantitative design, it combines national time series data (2009-2024) with province-level cross-sectional data for 2024. Pearson correlation analyses show a strong negative relationship between fertility rates and rising marriage ages for both women and men, with female university enrollment playing a key role in marriage postponement and fertility decline. Provincial regression analyses reveal that higher university graduation rates significantly reduce fertility. Although socio-economic development is negatively associated with fertility when examined alone, this association becomes statistically insignificant once education is included. Mediation analyses further indicate that university graduation rates significantly mediate the relationship between socio-economic development and fertility. Overall, the findings indicate that fertility decline in Turkiye is driven primarily by educational expansion rather than socio-economic development itself. The Turkish case mirrors patterns observed in East Asia, Iran and Europe, while also reflecting a regionally uneven fertility transition within a middle-income society positioned between Europe and Asia. The study contributes to low-fertility theory and policy discussions.

Keywords: Fertility Decline, Higher Education, Socio-Economic Development, Marriage Age, Turkiye.

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Türkiye'de Doğurganlık Düşüşünde Sosyo-Ekonomik Gelişmişlik ve Yükseköğretimin Rolü

ÖZ

Bu çalışma, Türkiye'de doğurganlıktaki düşüşü (kaba doğum hızı) eğitim yaygınlaşması, evlilik davranışları ve sosyoekonomik gelişmişlik bağlamında incelemekte ve Türkiye örneğini Asya ve Avrupa'daki düşük doğurganlık literatürü içine yerleştirmektedir. İki aşamalı nicel bir araştırma deseni kullanılan çalışmada, 2009–2024 dönemine ait ulusal düzeyde zaman serisine ait veriler ile 2024 yılına ait il düzeyinde kesitsel veriler bir arada analiz edilmiştir. Pearson korelasyon analizleri, doğurganlık oranları ile kadın ve erkeklerde artan ortalama evlenme yaşı arasında güçlü ve negatif bir ilişki olduğunu; özellikle kadınların üniversiteye katılımının evliliğin ertelenmesi ve doğurganlığın düşüşünde belirleyici bir rol oynadığını göstermektedir. İl düzeyindeki regresyon analizleri, yükseköğretim mezuniyet oranlarının doğurganlığı anlamlı biçimde azalttığını ortaya koymaktadır. Sosyoekonomik gelişmişlik tek başına ele alındığında doğurganlıkla negatif ilişkilidir; ancak modele eğitim değişkeni dâhil edildiğinde bu etki istatistiksel olarak anlamsızlaşmaktadır. Aracılık analizleri, üniversite mezuniyet oranlarının sosyoekonomik gelişmişlik ile doğurganlık arasındaki ilişkide anlamlı bir aracı değişken olduğunu doğrulamaktadır. Bulgular, Türkiye'de doğurganlık düşüşünün esas olarak sosyoekonomik gelişmeden

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ziyade eğitim yaygınlaşması tarafından yönlendirildiğini göstermektedir. Türkiye örneği, Doğu Asya ülkeleri ve İran'da gözlenen örüntülerle benzerlik taşırken, Avrupa ile Asya arasında konumlanan orta gelirli bir toplumda doğurganlık düşüşünün bölgesel olarak eşitsiz seyrini de ortaya koymaktadır. Çalışma, düşük doğurganlık bağlamında demografik kuram ve politika tartışmalarına önemli katkılar sunmaktadır.

Anahtar Kelimeler: Doğurganlık Düşüşü, Yükseköğretim, Sosyoekonomik Gelişmişlik, Evlilik Yaşı, Türkiye.

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INTRODUCTION

The decline in fertility rates has become one of the most critical demographic challenges facing both developed and developing countries today. Prolonged periods of low fertility directly affect population replacement capacity, labor supply, the sustainability of social security systems, and economic growth potential (Sultana et al., 2022, p. 14-15). In Turkiye, which has traditionally been characterized by relatively high fertility rates, a marked and persistent decline in birth rates has been observed over the past two decades. This trend has generated significant debates regarding population aging and the future of the socio-economic structure (Yılmaz, 2023, p. 98-99).

In the literature, fertility decline is commonly associated with structural transformations such as rising levels of education, increasing age at marriage, greater female labor force participation, and urbanization. In particular, women's educational attainment emerges as a strong determinant of fertility through mechanisms such as the postponement of marriage and first birth, changes in preferences regarding family size, and the rising opportunity costs of childbearing (Sobotka et al., 2017, p. 1-4). Similarly, socio-economic development reshapes fertility behavior by transforming individuals' living standards, expectations, and life-course decisions (Audi, 2019, p. 85).

A large proportion of studies focusing on Turkiye examine fertility primarily through individual or household-level variables or analyze regional differences using descriptive approaches. However, studies that address the joint and indirect effects of education and socio-economic development on fertility remain limited. Moreover, the existing literature offers relatively few comprehensive analyses that simultaneously examine national-level transformations over time and spatial variations at the provincial level within a single analytical framework.

East Asian countries such as South Korea and China, as well as non-East Asian cases like Iran, have experienced rapid fertility decline associated with education expansion, delayed marriage, and changing life-course expectations (Wang & Li, 2025, p. 2010-2012;

Abbasi-Shavazi et al., 2009). However, middle-income countries at the crossroads of Europe and Asia remain underexplored. Turkiye provides a critical comparative case for extending the Asian low-fertility literature beyond East Asia.

This study aims to fill this gap by examining the relationships between fertility rates, educational indicators, and socio-economic development in Turkiye through a two-stage quantitative research design. In the first stage, national-level data for the period 2009–2024, obtained from the Turkish Statistical Institute (TurkStat) and the Higher Education Council (YOK), are used to multivariate time series analyze the relationships among birth rates, ages at marriage, numbers of university students, and female employment. In the second stage, provincial-level data for 2024 from TurkStat, YÖK, and the Socio-Economic Development Index (SEGE) are employed to assess, in a cross-sectional framework, the effects of the university graduate rate and socio-economic development on the crude birth rate. Within this framework, the study tests whether the university graduate rate functions as a mediating mechanism in the relationship between socio-economic development and fertility. This multi-dimensional analytical approach is consistent with Thompson's (1936) emphasis on the systematic consideration of variables such as age at marriage, socio-economic status, and place of residence in order to understand demographic change.

The study makes three main contributions. First, by using up-to-date official data, it provides comprehensive and current empirical evidence on fertility decline (Crude Birth Rate) in Turkiye. Second, it analyzes higher education not only in terms of its direct effect on fertility but also as an indirect channel through which the effects of socio-economic development are transmitted. Finally, the findings offer important implications for policymakers in the areas of population policy, higher education planning, and regional development strategies. To explain these relationships and situate them within a theoretical framework, the following section discusses the main approaches to demographic transition. The study seeks to answer the following research questions, namely how higher education and socio-economic development influence fertility rates in Turkiye and through which channels these effects are transmitted.

Literature Review

Fertility decline has long been examined within the framework of "*Demographic Transition Theory*". This theory explains transformations in societies' population structures through

changes in birth and death rates (Kirk, 1996, p. 361). In the third stage of the theory, improvements in health services and living conditions lead to low mortality levels, while fertility rates also exhibit a marked decline. At this stage, rising levels of education, increasing urbanization, and transformations in family structures result in changing preferences regarding the number of children (Davis, 1945, p. 5). Turkiye's current demographic profile largely corresponds to this stage, as it is characterized by low mortality rates alongside rapidly declining fertility levels (Can & Avcı, 2021, p. 246-247).

However, explanations based solely on structural and economic modernization have been increasingly questioned, giving rise to the "*Second Demographic Transition*" (SDT) perspective. The theory explains fertility decline in modern societies not only through economic and structural changes but also through transformations in value systems (Van De Kaa, 1987, p. 5-7). Within this framework, increasing individualization, the weakening of traditional family norms, the spread of non-marital unions, and the perception of parenthood as no longer a mandatory life stage become prominent (Zaidi & Morgan, 2017, p. 2-3). In this process, fertility shifts from being a social expectation to becoming an individual choice. This transformation represents a decision-making process in which socially shared norms dissolve and individuals reassess their preferences through new forms of social interaction (Lesthaeghe, 2014, p. 18112-18114). In Turkiye, especially in large metropolitan areas, observed changes in family structures and lifestyles present patterns that can be explained through the Second Demographic Transition approach (Yolcu, 2025, p. 347-352).

Persistently low fertility levels are further addressed by the 'Low-Fertility Trap Hypothesis'. This hypothesis posits that once fertility falls below a critical threshold, a self-reinforcing process may begin. According to the hypothesis, low fertility leads to population ageing, a shrinking working-age population, and increasing economic uncertainties, which further weaken individuals' willingness to have children (Lutz & Skirbekk, 2005, p. 702-703). At the same time, generations raised under low-fertility conditions may no longer perceive childbearing as a normative expectation, thereby reinforcing the process at the cultural level. In this context, fertility decline represents not merely a temporary behavioral change but carries the risk of turning into a permanent demographic equilibrium (Lutz et al., 2006, p. 175-176).

Finally, the concept of "*Voluntary Childlessness*" highlights the growing importance of individual values and lifestyle orientations in fertility behavior. Voluntary childlessness refers to individuals' conscious decision to remain childless in the absence of any biological

necessity (Veevers, 1979). This phenomenon has become increasingly prevalent, particularly among highly educated, urban populations who prioritize individual life goals. Career plans, the desire to maintain quality of life, economic concerns, and the pursuit of personal freedom are among the key factors influencing the decision to remain voluntarily childless (Bloom & Pebley, 1982, p. 214-215). This perspective indicates that fertility behaviors are closely linked not only to economic or structural conditions but also to values and lifestyles (Ramu, 1985, p. 143-144).

Research Design and Methodology

This study was designed within the framework of a quantitative research approach and is based on the analysis of secondary data. It examines the demographic, educational, and socio-economic factors affecting fertility rates in Turkiye. The research employs two complementary analyses consisting of multivariate time series and cross-sectional analyses.

In the first stage, relationships among variables were analyzed using time series analysis based on national-level data covering the period 2009–2024. At this stage, the associations between fertility rates and marriage ages, the number of university students, and female employment rates were examined using annual data for Turkiye as a whole. In the second stage, cross-sectional analyses were conducted at the provincial level using data from 2024 for all 81 provinces, as the Ministry of Industry and Technology releases the SEGE data only for specific years, and 2024 represents the most recent available data. Within this scope, the relationships between crude birth rates, university graduate rates, and socio-economic levels of cities were analyzed.

The data used in the study were obtained from reports published by the Turkish Statistical Institute (Turkstat, 2025), the Council of Higher Education (YÖK, 2026), and the Socio-Economic Development Index (SEGE, 2025) released by the Ministry of Industry and Technology, which provides city-level socio-economic indicators for 2024. In the multivariate time series analyses, annual data for the 2009–2024 period were used, while the cross-sectional analyses included all 81 provinces for the year 2024. In this respect, no sampling was conducted, and the entire population was analyzed.

The dependent variable in the study is the fertility rate. In the multivariate time series analyses relationships among variables were analyzed over time using national-level annual data for the period 2009–2024, and the independent variables were defined as average female

age at marriage, average male age at marriage, the number of female university students, the number of male university students, and the female employment rate. In the cross-sectional analyses, the independent variables were the university graduate rate and the socio-economic index value. In addition, the university graduate rate was included in the model as a mediating variable in the relationship between the socio-economic index and fertility rates.

Statistical methods were used in the data analysis. In the multivariate time series analyses, Pearson correlation analysis was employed to assess relationships among variables due to the insufficient number of annual observations for regression analysis. Since the variables examined in this study are macro-level indicators that evolve over time, the correlations reported in the analysis should be interpreted cautiously. The aim of the correlation analysis is not to establish causal relationships but to explore the extent to which these demographic indicators move together over time**.** In the cross-sectional analyses, simple linear regression and multiple linear regression analyses were conducted to examine the effects on fertility rates. Mediation analysis was performed to test the mediating role of the university graduate rate in the relationship between the socio-economic index and fertility rates, and the significance of the mediation effect was assessed using the Sobel test. Statistical analyses were conducted using the SPSS software package. For the Sobel test, Calculation for The Sobel Test (Quantpsy, 2026) was used.

Data Analysis and Findings

The findings of the study were derived from data published by the Turkish Statistical Institute (TurkStat, 2025), the Council of Higher Education (YOK, 2025), and the Ministry of Industry and Technology (SEGE, 2025). The findings collected for Turkiye were examined in two stages. In the first stage, year-to-year changes were analyzed using time series analysis. In the second stage, data for the year 2024 were examined cross-sectionally across all 81 provinces.

Within this framework, the hypotheses developed in the study were tested by considering the relationships among the relevant variables. In the multivariate time series analyses, relationships among changes over time were examined using correlation analyses; in the cross-sectional analyses, causal relationships among the university graduate rate, socio-economic index, and fertility rate were evaluated using regression and mediation analyses. The findings obtained were systematically analyzed and reported within the framework of the research hypotheses. The hypotheses developed in the study are as follows:

H_{1a}: The fertility rate has a significant and negative relationship with the average male age at marriage.

H_{1b}: The fertility rate has a significant and negative relationship with the average female age at marriage.

H_{1c}: The fertility rate has a significant and negative relationship with the number of female university students.

H_{1d}: The fertility rate has a significant and negative relationship with the number of male university students.

H_{1e}: The fertility rate has a significant and negative relationship with female employment.

H_{1f}: The average female age at marriage has a significant and positive relationship with female employment.

H_{1g}: The average female age at marriage has a significant and positive relationship with the number of female university students.

H_{1h}: The average male age at marriage has a significant and positive relationship with the number of female university students.

H_{1i}: The average male age at marriage has a significant and positive relationship with the number of male university students.

H_{1j}: The average male age at marriage has a significant and positive relationship with female employment.

H_{2a}: As the proportion of university graduates living in cities increases, fertility rates decrease.

H_{2b}: As the socio-economic level of cities increases, fertility rates decrease.

H_{2c}: When both the proportion of university graduates and the socio-economic level of cities increase simultaneously, fertility rates decrease.

Multivariate Time Series Results

The table below presents demographic and educational indicators for the years covered in the study. Crude birth rate refers to the number of live births per thousand individuals. Average marriage age indicates the mean age at which men and women enter into their first marriage. University student numbers are provided by gender and as totals, revealing the gender distribution in higher education. Female employment rate represents the percentage of women of working age who are actively employed. Data on female employment are not available for the years 2009–2013.

Table: 1. Statistical Data of the Research

Years	Crude Birth Rate (per thousand)	Average Male Marriage Age	Average Female Marriage Age	Number of Male University Students	Number of Female University Students	Total Number of University Students	Female Employment Rate

2009	17,60	28,8	23,5	1917899	1549951	3467850	No Data
2010	17,20	28,9	23,7	2047316	1705598	3752914	No Data
2011	16,90	29,1	23,8	2329255	1961463	4290718	No Data
2012	17,20	29,3	23,9	2666039	2257901	4923940	No Data
2013	17,00	29,4	24,1	3075444	2543635	5619079	No Data
2014	17,50	29,4	24,2	3276658	2786228	6062886	29,5
2015	17,10	29,6	24,4	3621517	3067668	6689185	30,5
2016	16,60	29,8	24,5	3886107	3312880	7198987	31,2
2017	16,20	29,9	24,6	4047302	3513069	7560371	32,2
2018	15,40	30,2	24,8	4064516	3675986	7740502	32,9
2019	14,40	30,3	25	4108571	3831562	7940133	32,2
2020	13,40	30,4	25,1	4191572	4049425	8240997	29,7
2021	12,90	30,6	25,4	4172147	4124812	8296959	31,7
2022	12,20	30,9	25,6	3416976	3533166	6950142	34,5
2023	11,30	31,1	25,7	3395767	3685522	7081289	35,6
2024	11,00	31,2	25,8	3201895	3633220	6835115	37

Source: *Turkish Statistical Institute (TurkStat) – National Statistics Database (2009–2024); Higher Education Council (2009-2024 YOK) – University Graduate Data*

Due to the insufficient number of observations for regression analysis, the relationships between the variables were examined using correlation analysis. Accordingly, the Pearson correlation results are presented in Table 2.

Table: 2. Pearson Correlation Coefficients of the Variables

Variable	N	X	SD	1	2	3	4	5	6	7
1- Crude Birth Rate	16	15,2438	2,34918	1						
2- Average Female Marriage Age	16	24,631	0,7454	-,948**	1					
3- Number of Female University Students	16	3077005,38	840726,385	-,727*	,881**	1				
4- Female Employment Rate	11	84,3182	6,00364	-,765**	,799**	0,258	1			
5- Average Male Marriage Age	16	29,931	0,7709	-,953**	,996**	,868**	,835**	1		
6- Number of Male University Students	16	3338686,31	760804,132	-0,428	,655**	,930**	-0,474	,636*	1	
7- Total Number of University Students	16	6415691,69	1573387,409	-0,595*	,787**	,984**	-0,115	,771*	,981**	1

*P<0.05 ve **P<0.01

When Table 2 is examined, the crude birth rate shows a negative and statistically significant relationship with both the average age at marriage for women and the average age at marriage for men ($p < 0.01$). The crude birth rate also has a negative and statistically significant relationship with the number of female university students and the female

employment rate ($p < 0.05$). Based on these findings, it can be stated that rising marriage age and declining fertility appear to move together over time. In other words, delayed marriage among women and men is associated with lower fertility levels. In interpreting these findings, it should be considered that these variables inherently contain strong trend components and move together over the long term. It should also be noted that the effects of these variables may not be observed in the same year, but tend to manifest over subsequent years. This situation, frequently encountered in time series data, may cause the correlation coefficients to be high. However, this co-movement should be evaluated as a reflection of a structural transformation predicted by the Demographic Transition Theory. According to the theory, in the process of socio-economic development, the increase in women's education levels and labor force participation raises the age at marriage, which in turn results in declining fertility rates. In this context, the negative relationships identified in our findings are broadly in line with this theoretical framework.

While a negative and statistically significant relationship is found between the number of female university students and the crude birth rate ($p < 0.05$), no statistically significant relationship is identified between the number of male university students and the crude birth rate. There is a positive and statistically significant relationship between the average age at marriage for women and the number of female university students ($p < 0.01$), as well as between the average age at marriage for women and female employment ($p < 0.05$). The average age at marriage for men is positively and significantly related to the number of female university students ($p < 0.01$) and to the number of male university students ($p < 0.01$). In addition, the average age at marriage for men has a positive and statistically significant relationship with female employment ($p < 0.05$). The correlation coefficients indicate that both female and male ages at marriage are strongly and positively associated with the number of female university students.

Moreover, a very strong and positive relationship is observed between the average age at marriage for men and the number of female university students ($r = .996$; $p < 0.01$), which is even stronger than the relationship between men’s average age at marriage and the number of male university students ($r = .636$; $p < 0.01$). Taken together, these findings suggest a co-varying pattern between the increase in marriage age among women attending university, the postponement of parenthood, and the decline in birth rates.

Cross-sectional Findings

Table: 3. Cross-Sectional Provincial Data for 2024

City	Crude Birth Rate (per thousand)	Population	Number of Living University Graduates	University Graduate Rate (%)	Socio-Economic Index Value
Şanlıurfa	24,90	2237745	171457	7,66	-1,53
Şırnak	21,50	570826	56065	9,82	-1,50
Mardin	18,70	895911	91699	10,24	-1,17
Muş	17,90	392301	35489	9,05	-1,80
Diyarbakır	17,70	1833684	215340	11,74	-,88
Batman	17,60	654528	77403	11,83	-,93
Siirt	17,50	336453	38218	11,36	-1,35
Bitlis	17,40	359808	39396	10,95	-1,35
Ağr	17,40	499801	43673	8,74	-1,83
Van	16,70	1118087	117737	10,53	-1,35
Gaziantep	16,40	2193363	262142	11,95	,15
Kilis	16,20	156739	21645	13,81	-,28
Hakkari	15,10	282191	33694	11,94	-1,47
Adıyaman	14,00	611037	77750	12,72	-,94
Bingöl-	13,10	283276	37781	13,34	-,99
Iğdır	13,10	206857	25145	12,16	-1,18
Hatay	12,80	1562185	206881	13,24	-,25
Kahramanmaraş	12,60	1134105	145724	12,85	-,58
Kars	12,60	272300	34281	12,59	-1,12
Osmaniye	12,40	561061	84676	15,09	-,38
Aksaray	12,10	439474	53763	12,23	-,18
Erzurum	12,00	745005	112945	15,16	-,35
Konya	11,80	2330024	353399	15,17	,68
Adana	11,50	2280484	363240	15,93	,44
Kocaeli	11,10	2130006	396764	18,63	1,78
Niğde	10,90	372708	49175	13,19	-,47
Kayseri	10,60	1452458	243060	16,73	,62
Mersin	10,50	1954279	319457	16,35	,69
Sakarya	10,50	1110735	175342	15,79	,73
Tekirdağ	10,30	1187162	185483	15,62	,88
Afyonkarahisar	10,30	750193	97378	12,98	-,15
Elazığ	10,20	603941	101954	16,88	-,17
Düzce	10,20	412344	62484	15,15	,17
Karaman	10,20	262791	39545	15,05	,06
Ardahan	10,20	91354	11759	12,87	-,94
Nevşehir	10,10	317952	47134	14,82	,11
Malatya	10,00	750491	125791	16,76	-,16
İstanbul	9,90	15701602	3358187	21,39	4,42
Bursa	9,90	3238618	562215	17,36	1,36
Erzincan	9,80	241239	42790	17,74	-,17
Manisa	9,80	1475353	211314	14,32	,51
Bayburt	9,70	83676	13303	15,9	-,52
Bilecik	9,60	228495	36875	16,14	,32
Sivas	9,50	637007	98544	15,47	-,16
Yalova	9,40	307882	56374	18,31	,98
Yozgat	9,40	413161	50946	12,33	-,60

Denizli	9,30	1061371	178797	16,85	,82
Samsun	9,10	1382376	235714	17,05	,32
Antalya	9,00	2722103	510753	18,76	1,72
Ankara	8,90	5864049	1521475	25,95	2,84
Gümüşhane	8,90	142617	21977	15,41	-,87
Çankırı	8,90	199981	27777	13,89	-,28
Trabzon	8,80	822270	152667	18,57	,42
Rize	8,80	346977	60491	17,43	,12
Aydın	8,80	1165943	198245	17	,50
Tunceli	8,70	86612	17722	20,46	-,38
Bolu	8,60	326409	56849	17,42	,62
Burdur	8,60	275826	47765	17,32	,08
Isparta	8,50	446409	84970	19,03	,42
Uşak	8,50	375310	56179	14,97	,11
Kırşehir	8,40	244546	39129	16	-,13
Ordu	8,40	770711	111216	14,43	-,31
Tokat	8,40	612674	87160	14,23	-,48
Kırıkkale	8,30	283053	45390	16,04	-,03
Kütahya	8,30	571078	84082	14,72	,13
İzmir	8,20	4493242	968457	21,55	1,81
Çorum	8,10	521335	73160	14,03	-,16
Eskişehir	8,00	921630	197705	21,45	1,30
Muğla	8,00	1081867	228197	21,09	1,25
Balıkesir	8,00	1276096	232588	18,23	,60
Artvin	8,00	169280	30154	17,81	-,14
Kırklareli	7,90	379031	66262	17,48	,43
Edirne	7,90	421247	72456	17,2	,56
Kastamonu	7,90	381991	53912	14,11	-,19
Çanakkale	7,70	568966	116157	20,42	,63
Karabük	7,70	250478	44542	17,78	,18
Amasya	7,70	342378	58371	17,05	-,07
Giresun	7,60	455922	73717	16,17	-,26
Sinop	7,50	226957	32159	14,17	-,38
Bartın	7,10	206715	28427	13,75	-,36
Zonguldak	6,90	586802	87595	14,93	,06

Source: *Data obtained from the TurkStat Central Distribution System (2024), the Higher Education Council (YÖK, 2024), and the Socio-Economic Development Index (SEGE, 2024).*

Table: 4. Descriptive Analysis of the Data

Variable	N	X	SD	Min.	Max.
City	81	-	-	-	-
Crude Birth Rate (per thousand)	81	10,9198	3,629	6,90	24,90
Population	81	1.057.591	1.910.439,432	83.676	15.701.602
Number of Living University Graduates	81	183797,95	415337,669	11759	3357187
University Graduate Rate (%)	81	15,3412	3,227	7,66	25,95

Socio-Economic Index Value	81	0,000	1,000	-1,83	4,42

Regression analysis was conducted to examine the effects of the variables on the crude birth rate. This analysis was conducted using cross-sectional data from a single year at the province level. The results of the regression analysis in which the university graduate rate is included as the independent variable are presented in Table 5, while the results of the regression analysis in which the Socio-Economic Index is included as the independent variable are shown in Table 6. The results of the model in which both variables are simultaneously included as independent variables are presented in Table 7.

Table: 5. Regression Analysis Results of the Effect of University Graduate Rate on Crude Birth Rate (Model 1)

Independent Variable	**B[1]**	**SE**	**t**	**P**	**VIF**
University Graduate Rate	-0,809	0,88	-9,203	,000	1,000
Model F value: 84,703 (p=,00)				Adjusted R^2: ,511	

Table: 6. Regression Analysis Results of the Effect of Socio-Economic Index on Crude Birth Rate (Model 2)

Independent Variable	**B[1]**	**SE**	**t**	**P**	**VIF**
Socio-Economic Index Value	-1,981	,342	-5,790	,000	1,000
Model F value: 33,520 (p=,00)				Adjusted R^2: ,289	

Table: 7. Regression Analysis Results of the Effect of Both Factors on Crude Birth Rate (Model 3)

Independent Variable	**B[1]**	**SE**	**t**	**P**	**VIF**
University Graduate Rate	-0,952	,156	-6,106	,000	3,158
Socio-Economic Index Value	,560	,503	1,112	,270	3,158
Model F value: 43,096 (p=,00)				Adjusted R^2: ,513	

In the analyses, the presence of a multicollinearity problem was first examined. To identify this issue, Variance Inflation Factor (VIF) values were assessed. For the absence of multicollinearity, VIF values should not exceed 10 (Albayrak, 2005, p. 110). In all cases, VIF values were found to be below 10, indicating that there is no multicollinearity problem.

According to Tables 5 and 6, when the independent variables are included in the analysis separately, both have negative and statistically significant effects on the dependent variable (crude birth rate). In Table 7, both variables are included in the analysis simultaneously. In this model, while the university graduate rate has a negative and statistically significant effect on the dependent variable (crude birth rate), the socio-economic

index has a positive but statistically insignificant effect. The patterns observed across these three models suggest that the university graduate rate has a direct effect, whereas the effect of socio-economic development may operate through the mediating role of the university graduate rate. To test the presence of this mechanism, Model 4 was constructed and is presented in Figure 1. To examine this relationship, the following hypothesis was developed:

> **H_{2d}:** In the decline of the crude birth rate, the urban university graduate rate has a mediating effect on the relationship between the socio-economic development index and fertility.

Figure: 1. Mediating Effect of University Graduate Rate on Socio-Economic Impact (Model 4)

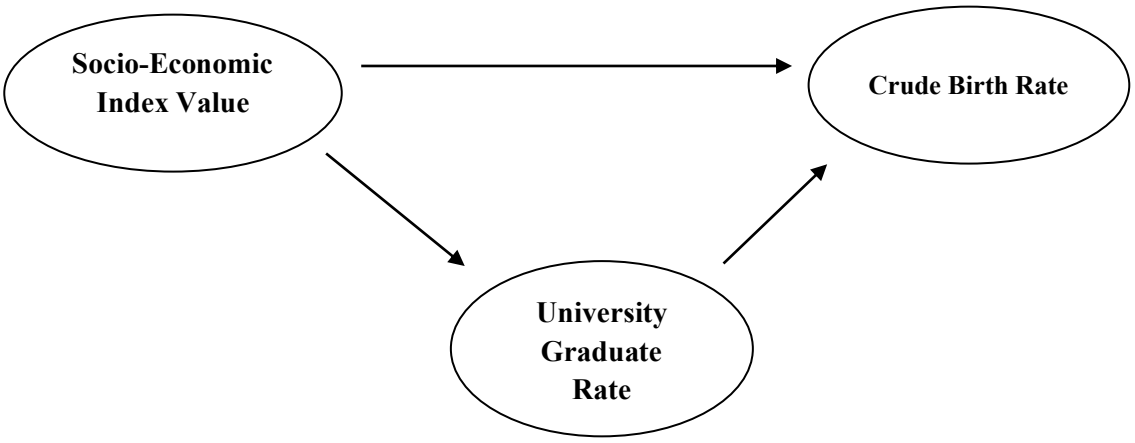

Table: 8. Regression Analysis of the Effect of Socio-Economic Index on University Graduate Rate (Model 5)

Independent Variable	B[1]	SE	t	P	VIF
Socio-Economic Index Value	2,668	,204	13,058	,000	1,000
Model F value: 170,509 (p=,00)				Adjusted R^2: ,679	

Table: 9. Sobel Test Results

Test	Z value	Std. Error	p
Sobel	-5,53	0,459	< .001

As shown in Table 9, the result of the Sobel Test is statistically significant. This finding indicates that a substantial part of the association between the socio-economic development index and fertility is transmitted through the variance shared with the university graduate rate.

According to Table 5, in the regression model examining the effect of the university graduate rate on the crude birth rate, the adjusted R^2 value is calculated as 0.511. This

indicates that the university graduate rate explains approximately 51.1% of the variation in the birth rate. The model is highly significant, with an F value of 84.703 ($p = 0.000$). The standardized regression coefficient (β^1) of the university graduate rate is -0.809 and statistically significant ($p = 0.000$). This result demonstrates that as the university graduate rate increases, the birth rate decreases significantly.

Table 6 examines the effect of the socio-economic development index on the birth rate when included as the sole independent variable. The adjusted R^2 value is 0.289, indicating that the socio-economic index explains approximately 28.9% of the variation in the birth rate. The model is significant ($F = 33.520$; $p = 0.000$), and the coefficient of the socio-economic index is -1.981, which is negative and statistically significant ($p = 0.000$). In other words, as socio-economic development increases, the birth rate declines.

In Table 7, when both the university graduate rate and the socio-economic development index are included simultaneously in the model, the adjusted R^2 value increases slightly to 0.513. This means that both variables together explain approximately 51.3% of the variation in the birth rate. However, while the coefficient of the university graduate rate remains negative and significant (-0.952; $p = 0.000$), the coefficient of the socio-economic development index becomes positive but statistically insignificant (0.560; $p = 0.270$). This finding suggests that the apparent effect of socio-economic development on the birth rate is largely transmitted through the university graduate rate, indicating a mediating effect.

As the socio-economic development index increases, urban birth rates tend to decline. This relationship can be explained by the mediating role of the university graduate rate. As socio-economic development rises, the proportion of university graduates living in cities also increases. This allows for the interpretation that individuals with higher educational attainment are more likely to reside in cities with higher socio-economic development levels. Taken together, these findings indicate that increases in socio-economic development lead to higher university graduate rates, and the greater presence of university-educated individuals, in turn, exerts a negative effect on urban birth rates. Through this mediating mechanism, the lower fertility levels observed in socio-economically developed cities can be explained by their hosting a larger population of university graduates.

DISCUSSION

This study aimed to provide a comprehensive assessment of the decline in fertility rates in Turkiye by examining education, marriage behaviors, and socio-economic development from

both temporal and spatial perspectives. By jointly analyzing time series data covering the period 2009–2024 and province-level cross-sectional data for 2024, the structural dynamics underlying transformations in fertility behavior were examined in a multidimensional manner.

The time series findings reveal that the decline in fertility rates is strongly and negatively associated with increases in both female and male ages at marriage. Growth in the number of female university students and in female employment rates contributes to rising marriage ages, which in turn indirectly suppresses fertility levels. The results indicate that higher education plays a central role in shaping fertility behavior, particularly for women, and that men's marriage timing is also largely influenced by women's educational attainment. These findings are consistent with both the third stage of the Demographic Transition Theory and the Second Demographic Transition framework.

The cross-sectional analyses demonstrate that, at the provincial level, the university graduate rate has a strong, negative, and direct effect on fertility rates. When entered alone into the model, the socio-economic development index significantly reduces fertility; however, when included together with the university graduate rate, its effect loses statistical significance. Sobel test results confirm that the university graduate rate functions as a significant mediating variable in the relationship between socio-economic development and fertility. This finding suggests that socio-economic development affects fertility not directly, but largely through educational attainment.

The results further indicate that Turkiye is increasingly approaching the risk of a Low Fertility Trap. Persistently low fertility levels in socio-economically developed cities with high proportions of university graduates suggest that fertility decline may evolve from a temporary trend into a self-reinforcing demographic equilibrium. In cities where educated individuals are concentrated, the rising economic, social, and time-related costs of childbearing may lead younger cohorts who grow up in low-fertility contexts to internalize low fertility as a "normal" life pattern.

These findings show important parallels with patterns observed in East Asian countries and non–East Asian cases such as Iran (Abbasi-Shavazi et al., 2009), where rapid fertility decline has been associated with education expansion, delayed marriage, and transformations in life-course expectations. At the same time, the Turkish case demonstrates that in middle-income countries this process may unfold more gradually, shaped by

pronounced regional disparities and spatial This pattern aligns with broader European experiences, where the relationship between education and fertility is mediated by institutional and labor market contexts. In Germany, for instance, while stable employment is often seen as a prerequisite for family formation among highly educated women, a significant minority still opt to have children despite precarious working conditions, highlighting the complexity of fertility decisions (Schaeper et al., 2017, p. 209-232). Similarly, in the United Kingdom, although childlessness rates have historically been higher among university-educated women, recent cohorts show a reversal of this trend, suggesting that the postponement of childbearing does not necessarily lead to permanent childlessness (Berrington, 2017, p. 57-76). These European examples underscore that the fertility decline among educated women is not a linear or deterministic process, but one that is shaped by policy, economic conditions, and changing social norms. In this respect, Turkiye offers a critical comparative case that extends the Asian low-fertility literature beyond East Asia (Wang & Li, 2025, p. 2010-2012).

The findings are also consistent with the Voluntary Childlessness perspective. The strong effect of the university graduate rate on fertility suggests that decisions to remain childless or to limit the number of children are not driven solely by economic constraints, but also by individual life goals, career aspirations, and the desire to maintain quality of life. Although the study does not directly measure individual choices, this pattern may indicate that fertility behavior is increasingly influenced by personal preferences, as suggested by existing literature. From a broader sociological perspective, such preferences can also be understood as being shaped by cultural norms, everyday life practices, and processes of social memory (Akbaş, 2025, p. 250-252). At the micro level, recent evidence from Turkiye also suggests that marriage is increasingly perceived by young adults as a flexible and negotiable life choice shaped by economic conditions, cultural norms, and individual life projects (Güneş & Bilek, 2026).

Accordingly, it is evident that policies aimed at increasing fertility cannot rely solely on economic incentives. Instead, comprehensive policy frameworks are required that ensure compatibility between education, labor markets, and family life. Flexible working arrangements, accessible childcare services, and social policies that prioritize quality of life-particularly for highly educated individuals are becoming increasingly important. Otherwise, the transformation of fertility decline into a stable demographic equilibrium in Turkiye appears inevitable.

In conclusion, this study highlights the central role of education in the transformation of fertility behavior in Turkiye and demonstrates that higher education constitutes the primary mechanism through which socio-economic development influences fertility. The findings underscore the need to conceptualize education not merely as an outcome, but as a direct and decisive process in the design of demographic policies.

EXTENDED ABSTRACT

Over the last two decades, fertility decline has emerged as one of the most pressing demographic challenges in both developed and developing societies. Persistently low fertility rates undermine population replacement, accelerate population ageing, and generate long-term pressures on labor markets, social security systems, and economic growth. Türkiye, historically characterized by relatively high fertility, has experienced a rapid and sustained decline in birth rates since the early 2000s. This transformation has triggered intense public and academic debates regarding demographic sustainability and the future socio-economic structure of the country.

Existing literature commonly links fertility decline to structural factors such as rising educational attainment, delayed marriage, increased female labor force participation, and urbanization. Among these factors, women's education stands out as a particularly influential determinant of fertility behavior, operating through delayed marriage and childbearing, shifts in family-size preferences, and rising opportunity costs associated with motherhood. Socio-economic development is also frequently cited as a driver of fertility decline, as improvements in income levels, living standards, and life expectations reshape reproductive decisions. However, in the Turkish context, empirical studies that jointly examine education and socio-economic development—particularly their indirect and mediating effects on fertility—remain limited. Moreover, few studies combine multivariate time series national-level analyses with cross-sectional regional analyses within a single analytical framework.

Against this background, the present study investigates the role of socio-economic development and higher education in fertility decline in Türkiye by employing a two-stage quantitative research design. The study aims to answer three main questions: (1) How are fertility rates related to changes in marriage behavior, educational expansion, and female employment over time? (2) How do higher education and socio-economic development affect

fertility differences across provinces? (3) Does higher education mediate the relationship between socio-economic development and fertility?

In the first stage, the study uses national-level time series data covering the period 2009–2024 to examine the relationships between fertility rates, average female and male ages at marriage, the number of university students by gender, and female employment rates. Due to the limited number of annual observations, Pearson correlation analysis is employed. In the second stage, province-level cross-sectional data for 2024 are analyzed for all 81 provinces of Türkiye. Crude birth rates are regressed on the university graduate rate and the Socio-Economic Development Index (SEGE) using simple and multiple linear regression models. In addition, mediation analysis is conducted to test whether the university graduate rate mediates the relationship between socio-economic development and fertility, with the significance of the mediation effect assessed using the Sobel test.

The time series findings reveal a strong and statistically significant negative relationship between fertility rates and average ages at marriage for both women and men. Fertility is also negatively associated with the number of female university students and female employment rates. Notably, the number of female university students shows a much stronger association with marriage postponement than the number of male students, suggesting that women's educational expansion plays a central role in shaping marriage timing and fertility decline. These results indicate that delayed marriage functions as a key mechanism linking higher education to lower fertility.

The cross-sectional analyses demonstrate that the university graduate rate has a strong, negative, and statistically significant effect on provincial fertility rates. When included alone in the regression model, socio-economic development also shows a significant negative association with fertility. However, when both variables are entered simultaneously, the effect of socio-economic development becomes statistically insignificant, while the effect of the university graduate rate remains robust. The mediation analysis confirms that higher education significantly mediates the relationship between socio-economic development and fertility. In other words, socio-economic development reduces fertility primarily through its effect on educational attainment rather than through a direct pathway.

These findings suggest that fertility decline in Türkiye is driven more by educational expansion than by socio-economic development per se. The Turkish case closely resembles patterns observed in East Asian countries and Iran, where rapid expansion of higher

education, delayed marriage, and changing life-course expectations have led to sustained low fertility. At the same time, Türkiye exhibits pronounced regional disparities, with low fertility concentrated in socio-economically developed provinces hosting high proportions of university graduates, while higher fertility persists in less developed regions.

From a theoretical perspective, the results are consistent with the Demographic Transition Theory, the Second Demographic Transition framework, and the Low-Fertility Trap Hypothesis. They also align with the voluntary childlessness perspective, highlighting that fertility decisions among highly educated individuals are increasingly shaped by individual preferences, career aspirations, and quality-of-life considerations rather than purely economic constraints.

In conclusion, this study demonstrates that higher education constitutes the primary mechanism through which socio-economic development influences fertility decline in Türkiye. The findings underscore the need for population policies that go beyond financial incentives and instead focus on reconciling education, employment, and family life. Policies such as flexible working arrangements, accessible childcare services, and family-friendly labor market institutions are essential if fertility decline is to be mitigated in an increasingly educated society.

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Makale Bilgileri/Article Information

Etik Beyan:	Bu çalışmanın hazırlanma sürecinde bilimsel ve etik ilkelere uyulduğu ve yararlanılan tüm çalışmaların kaynakçada belirtildiği beyan edilir.	***Ethical Statement:***	It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.
Çıkar Çatışması:	Çalışmada kişiler veya kurumlar arası çıkar çatışması bulunmamaktadır.	***Conflict of Interest:***	The authors declare that declare no conflict of interest.
Yazar Katkı Beyanı:	Çalışmanın tamamı yazar tarafından oluşturulmuştur.	***Author Contribution Declaration:***	The entire study was created by the author.
Mali Destek:	Çalışma için herhangi bir kurum veya projeden mali destek alınmamıştır.	***Financial Support:***	The study received no financial support from any institution or project.
Yapay Zekâ Kullanımı:	Bu çalışmada herhangi bir yapay zekâ tabanlı araç veya uygulama kullanılmamıştır.	***Use of Artificial Intelligence:***	This study did not utilize any artificial intelligence-based tools or applications.
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