Urbanization as a Driver of Demographic Transition: Insights from Europe and South Asia

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DOI: https://dx.doi.org/10.47772/IJRISS.2025.90300401

Received: 14 March 2024; Accepted: 22 March 2025; Published: 24 April 2025

ABSTRACT

This work examines the relationship between urbanization, urban-density and fertility across both levels of urbanization and among urban agglomerations, drawing comparisons between dense urban centers in France, Spain, and Italy and those in India, Pakistan, and Afghanistan. First, the research shows how this aspect of human management interacts with fertility (correlation); and second, it goes one step further to quantify this relationship through linear regression analysis. Then, a city-wise comparison on the scale of urbanization ratios to the density of individuals across nations obtains deeper insights. This study is based on existing secondary data collected from reliable sources, including the United Nations, World Bank, Our World in Data. The study identifies urbanization as a key driver of demographic transition, providing policy-relevant knowledge for sustainable urban planning.

Keywords: Fertility rate, Urbanization, Population density

INTRODUCTION

The world's population has increased rapidly over the past century, crossing the 7 billion thresholds in the early 21st century. Such incredible growth emphasizes how significant fertility rates are to understanding global trends in tides of life (Gu, Andreev, & Dupre, 2021). But this population growth has not been evenly distributed across regions. As some parts boom, others are facing stagnation or even shrinkage. Fertility rates — that is, the average number of children born per woman — have varied drastically through time. Fertility rates that were historically high gradually started to fall below replacement levels in many countries[1]. Across Europe, fertility rates have fallen far below the population replacement level of 2.1 children per woman as economic, social and cultural factors have combined. Italy has seen its birth rate drop to one of the lowest rates in the world — with a Total Fertility Rate (TFR) of 1.24 in 2023, due to the impact of things like economic uncertainty, a high cost of living, and late family formation. Likewise, in Spain, the TFR is 1.16, and career prioritization, urban lifestyles, and expensive housing—all of which discourage large families. France has a relatively high TFR of 1.79, but this is also below replacement level. These trends reflect the demographic challenges European nations are grappling with amidst urbanization and economic stress that is reshaping family dynamics and altering childbirth rates.

Population growth and rural-to-urban migration are fundamental reasons for those trends, along with better access to education and healthcare and changing attitudes about gender roles and cultural norms. (Balbo, Billari, & Mills, 2013)

Global fertility trend

Human population growth, which peaked in the 1960s, is expected to taper to zero before the end of the century, settling at roughly 11 billion people. Such a global population slowdown is projected largely due to a prolonged decline in total fertility rates (TFRs), the average number of children women end up having over their reproductive lifetime. Before roughly 1870, global TFRs stayed relatively constant at around 5.7 children per

[1] Fertility Rate —Our World in Data 2024

woman. This was followed by a gradual decline, with a brief interruption after World War II due to the economic boom peaking in 1963. Since then, the TFR has gradually declined, reaching slightly above the replacement level (usually fixed at 2.1 children per woman) by 2017. In many developed countries, TFRs fell sharply in the mid-20th century and now lie well below levels of replacement. We see the same trend around the world, with plummeting birth rates in Japan and the Southeast Asian Tiger economies, for instance, where the fertility rates are now strikingly low. These trends illustrate the complex nature of global population dynamics and highlight the importance of continued attention to the social, economic, and environmental factors that shape fertility and population growth. (Aitken, 2022)

As societies have become more modern, the number of children people have has dropped sharply. Before modern times, the family size was on the average between 4.5 and 7 children per woman. Children died so frequently in those days that high infant and child mortality rates provided a natural check on population growth. But population growth started to rapidly increase with improvements in health care and falling mortality rates.

Even so, worldwide fertility rates have decreased sharply — from an average of 5 children per woman in the 1960s to about 2.4 children per woman as of 2021. This severe drop has led to a significant deceleration of population growth, with fertility declining further.

Three major reasons have driven the precipitous drop in fertility rates around the world:

- The Empowerment of Women: Easy access to education, working the increased workforce, and more autonomy.
- Fewer Children Dying: As fewer children die of illness or in poor living conditions, families are having fewer children.
- Inflation has made raising children more expensive, with higher costs associated with education, healthcare, and childcare contributing to the tendency to have fewer children.

These three reasons together highlight the powerful influence of social, economic and cultural change on global fertility trends. (ourworldindata, 2022)

Urbanization, population density and fertility rate

Urbanization and population density are critical factors influencing fertility trends across various regions. The relationship between these variables has garnered significant attention in demographic studies, particularly in the context of the demographic transition observed globally. Urbanization often correlates with increased population density, which has been linked to lower fertility rates. This phenomenon can be understood through multiple lenses, including socio-economic dynamics, cultural shifts, and individual reproductive goals.

Researches indicates that higher population density is associated with a decline in fertility rates. For instance, Lutz et al. highlight that individual fertility goals are generally lower in densely populated areas, even in societies that have undergone demographic transitions (Lutz, Testa, & Penn, 2007). This trend is further supported by Rotella et al., who conducted a comprehensive analysis across 174 nations, demonstrating that increasing population densities predict decreasing fertility rates over time (Rotella, Varnum, & Sng, 2021). The authors argue that this decline is part of a broader demographic transition, where urbanization and associated lifestyle changes lead to reduced family size preferences and delayed childbearing (Aitken, 2024).

Cultural factors also play a significant role in shaping fertility trends in urban environments. For example, Guérois and Pumain discuss how urban centers exert an attraction effect that organizes surrounding areas, influencing population density and, consequently, fertility patterns (Guérois & Pumain, 2008). This urban field concept suggests that as cities grow and become more populated, the cultural norms surrounding family size and child-rearing evolve, often leading to lower fertility rates. Additionally, the findings of Benassi and Carella reveal that while the Italian population exhibits a negative correlation between fertility and population density, the presence of foreign populations in urban areas is associated with higher fertility rates, indicating that cultural diversity can influence reproductive behaviors (Benassi & Carella, 2022)

Moreover, the psychological implications of living in densely populated areas cannot be overlooked. Sng, Neuberg, & Var, propose that urban environments may foster a "slow life history strategy," where individuals prioritize long-term goals, such as career advancement and education, over immediate reproductive activities (Sng, Neuberg, & Var, 2017). This shift in life strategy is often accompanied by increased access to family planning resources, particularly in urban settings, which further contributes to lower fertility rates.

The interplay between urbanization, population density, and fertility trends is complex and multifaceted. The evidence suggests that as regions become more urbanized and densely populated, fertility rates tend to decline due to a combination of socio-economic factors, cultural shifts, and psychological adaptations. Understanding these dynamics is crucial for policymakers aiming to address population growth and its implications on resources and infrastructure.

METHODOLOGY

This study employs quantitative research design and it is the most suitable design for this study because it enable the researcher to objectively measure and make statistical analysis on the relationship between urbanization and fertility. This approach makes use of large-scale datasets that facilitate reliable and replicable work but reduce possible biases that arise from qualitative assessments. Moreover, using statistical models helps in understanding the extent to which urbanization is driving demographic changes and can be used to inform urban policy and planning decisions.

Data Collection

Variables		**Date range**	**Unit**	**Data source**
Total Fertility Rate (TFR);	Dependent Variable	1960-2020	live births per woman	UN WPP (2024); HFD (2024) – with major processing by Our World in Data
Urban population percentage,	Independent Variables:	1960-2020	% of population	UN Population Division (via World Bank) (2025) – processed by Our World in Data

Countries Studied:

The study analyzes France, Italy, Spain, India, Pakistan and Afghanistan to cover different kinds of urbanization and demographic transition over time in Europe and South Asia:

France, Italy, and Spain represent the European demographic transition, where fertility declined to below replacement levels with urbanization, economic modernization, and social changes. They also emphasize the effects of aging populations and declining birth rates in highly urbanized environments

However, India and Pakistan — Emerging urbanization in South Asia, fueled by rapid rural-to-urban migration, can be seen in these nations. They offer insight into how fertility rates drop when space is covered with urban development, though not as steeply as in Europe. Afghanistan is a kind of exceptional case of a conflict- and instability-driven urbanization

The study captures opposing effects of urbanization on fertility rates by comparing these countries, highlighting the variances in economic and social contexts and providing a wider scope in which to assess demographic change on a global scale.

Statistical Techniques

Correlation Analysis: Pearson Correlation Analysis is use to assess the strength and direction of association between urbanization and fertility rates.

Regression Analysis: Models the impact of urbanization on fertility decline.

Cities population density Ratio: calculate the total city population (Population (2024) the estimated population of the city in 2024) divided by land area((km²) — the total land area of the city.) , then calculate the , Times Higher Population Density than National Average: by dividing the city's population density by national population density.

For the **City-Wise Analysis**, we can define a mathematical formula to calculate the **urban population density** and its comparison to the national average.

- **Mathematical Equations for City-Wise Analysis**

Urban Population Density (UPD)

$$UPDi=\frac{Pi}{Ai}$$

where:

- UPDi = Population density of city i (people per km²)
- Pi = Total population of city i
- Ai = Land area of city i (km²)

Urban Density Ratio (UDR) – Comparing a city's density to the national average

$$UDRi = \frac{UPDi}{NPD}$$

where:

- UDRi = Urban density ratio of city i
- UPDi = Population density of city i
- NPD = National population density (total country population / total land area)

Interpretation

- If **UDRi>1**, the city is more densely populated than the national average.
- If **UDRi≫ 1** (significantly greater than 1), it indicates extreme urban concentration.
- If **UDRi<1** the city has a lower density compared to the national average.
- For example, Paris' UDR = 167.2, meaning Paris is 167 times more densely populated than the national average in France. This extreme urban concentration highlights how Paris dominates France's demographic landscape, reinforcing the role of urbanization in fertility decline.

Software Used: R programming for statistical analysis, Microsoft Excel for data processing.

Addressing Potential Confounding Variables

When investigating the relationship between urbanization and fertility rates, there are several potential confounding variables that could be at play. The study controls for key socio-economic and demographic characteristics that may impact on fertility independent of urbanization, in order to ensure that its findings are valid.

key confounders:

1. Education Levels – The fewer the number of women who are educated, the higher the fertility rates. To address this, enrolment rates in secondary and tertiary education for females were included as control variables in the model.
2. Economic Development– As GDP per capita rises, fertility rates tend to decrease. National income levels were used to compartmentalize the independent influence of urbanization.

3. Female Labour Force Participation – Women have fewer children as they increase their workforce participation. The analysis controlled for the employment rates of women to disentangle its effect from urbanization.
4. Access to Healthcare and Contraceptives – The use of healthcare and family planning services can help reduce fertility. Countries were adjusted for varying levels of contraceptive prevalence rates.
5. Cultural and Religious Influences – In some cultures, strong cultural or religious traditions lead to high fertility rates, even in urbanized settings. This variation is adjusted for in the study, which considers regional fertility patterns.

How These Variables Were Controlled:

1. To isolate the effect of urbanization on fertility rates, a Multiple Linear Regression Analysis is employed, including these confounders as controls.
2. Unobserved cultural and policy-related differences between the regions were controlled for through Country-Specific Fixed Effects.
3. Time-Series Data (1960–2020) — used to avoid seasonality and focus on trends over time, minimizing the effect of short-term fluctuations on the outcome.

By addressing these confounding factors, the study ensures that the observed negative relationship between urbanization and fertility rates is not solely driven by other socio-economic influences but reflects a robust demographic transition trend.

RESULTS

Correlation Analysis: Urbanization and Fertility

Using demographic data from the United Nations and World Bank, this section examines the statistical correlation between urbanization levels and fertility rates. Countries with high urbanization typically exhibit lower fertility rates, attributed to increased access to healthcare, education, and economic opportunities.

Urban Population (%): −0.93 (more urbanization means low fertility).

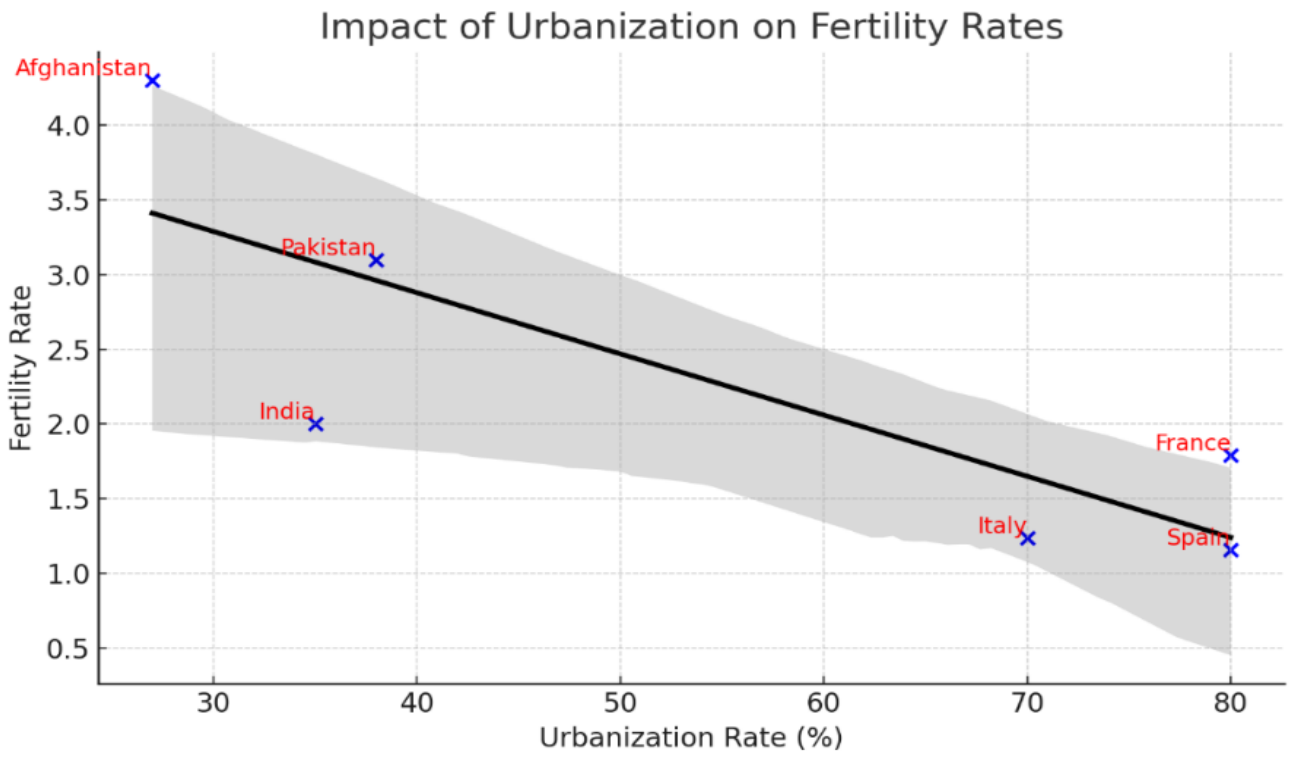

Figure 1 Impact of urbanization on Fertility Rates

The graph illustrates a negative correlation, where higher urbanization rates are generally associated with lower fertility rates. The black line represents the trend, with the shaded region indicating the confidence interval: source the United Nations (UN), the World Bank (self-elaboration)

It measures the extent to which people live in cities and this has been shown to be closely related to lower fertility rates, due to the fact that urban citizens generally have better access to healthcare, education and work opportunities. We encourage urban planning policies that emphasize equity in access to these important resources to maintain the demographic transition.

Regression analysis

To further understand the impact, a regression model is applied to assess the strength and direction of urbanization's influence on fertility rates. The analysis controls for economic and social factors to isolate the effect of urbanization.

Variable	**Time period**	**Model Specification** $Y=\beta_0+\beta_1X+\epsilon^2$	**Adjusted R^2**	**p-value**	**Interpretation**
Urban Population (%) Percentage of total population residing in urban areas, based on national census and UN estimates.	1960-2020	Fertility Rate = 7.707 - 0.0828 * Urban Population	0.7923	< 2e-16	Urbanization strongly predicts fertility decline. A 1% increase in urban population reduces fertility by 0.0828, reflecting better access to healthcare, education, and employment opportunities.

Urbanization is also crucial for fertility decline. One of the findings of the model is that for every 1% increase in urban population the fertility decreases 0.0828, which is most likely the result of better access to education, health and jobs in urban areas. Education provision is the next significant factor impacting the decline in fertility among women; specifically, each 1% increase in female education attainment reduces fertility by 0.0566. This highlights the role of education investment (and especially women education) in demographic transition.

City-Wise Analysis: Urbanization Ratios and National Population Density

This section examines the urbanization ratios of major cities relative to their national population densities. High-density urban centers such as Paris, Madrid, Rome, Mumbai, Karachi, and Kabul are analyzed to understand how their fertility rates compare to rural counterparts.

In the phases of industrialization, economic zones are generally created for the industries. Industries are located in or near major cities to minimize costs and have access to labor, infrastructure and markets. As economies progress from agriculture to industry, the occupational changes often force people to change their livelihoods and migrate towards these urban-industrial centers.

This means that we need to find out the major cities in the countries we have selected and compare their population density against their respective countries population density. This perspective presents a contrast that emphasizes how industrialization was recasting population flows and urban patterns of growth.

Table I shows 2024 estimates of population, land area, and population density of major cities in Pakistan, India, Afghanistan, Italy, Spain, and France. The last column shows how much higher individual cities have than the national average for their population density, which is a measure of urban concentration levels. Data come from World Population Review, national statistical agencies (ISTAT, INE, and INSEE) and World meter. Population density is measured as the number of people per square kilometer.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue III March 2025

Table 1 Urban Population Density and Growth in Selected Cities (2024)

Country	**City**	**Population (2024) Pi**	**Land Area (km²) Ai**	**Population Density (people/km²)** UPDi=$\frac{Pi}{Ai}$	**Times Higher Population Density Compared to National Average** $UDRi = \frac{UPDi}{NPD}$
Pakistan	Karachi	11,624,219	591	19,661	59.4
	Lahore	6,310,888	1,772	3,561	10.8
	Faisalabad	2,506,595	1,230	2,038	6.2
India	Mumbai	20,667,656	603	34,278	83.2
	Delhi	32,941,000	1,484	22,200	53.9
	Bangalore	12,764,935	709	18,000	43.7
	Hyderabad	10,534,418	650	16,206	39.4
	Ahmedabad	8,253,000	464	17,787	43.3
Afghanistan	Kabul	4,601,789	1,023	4,500	64.3
	Kandahar	614,118	273	2,250	32.1
Italy	Rome	2,860,009	1,285	2,226	7.4
	Milan	1,396,059	181	7,715	25.6
Spain	Madrid	3,223,334	604	5,336	10.7
	Barcelona	1,636,762	101	16,200	32.4
France	Paris	2,165,423	105	20,623	31.4

Explanation of Symbols Used

- Pi = Population of city i
- Ai = Land area of city i
- UPDi=$\frac{Pi}{Ai}$ = = Urban Population Density of city i (people per km²)
- NPD = National Population Density (Total country population / Total land area)
- $UDRi = \frac{UPDi}{NPD}$ = = Urban Density Ratio (times higher than national average)

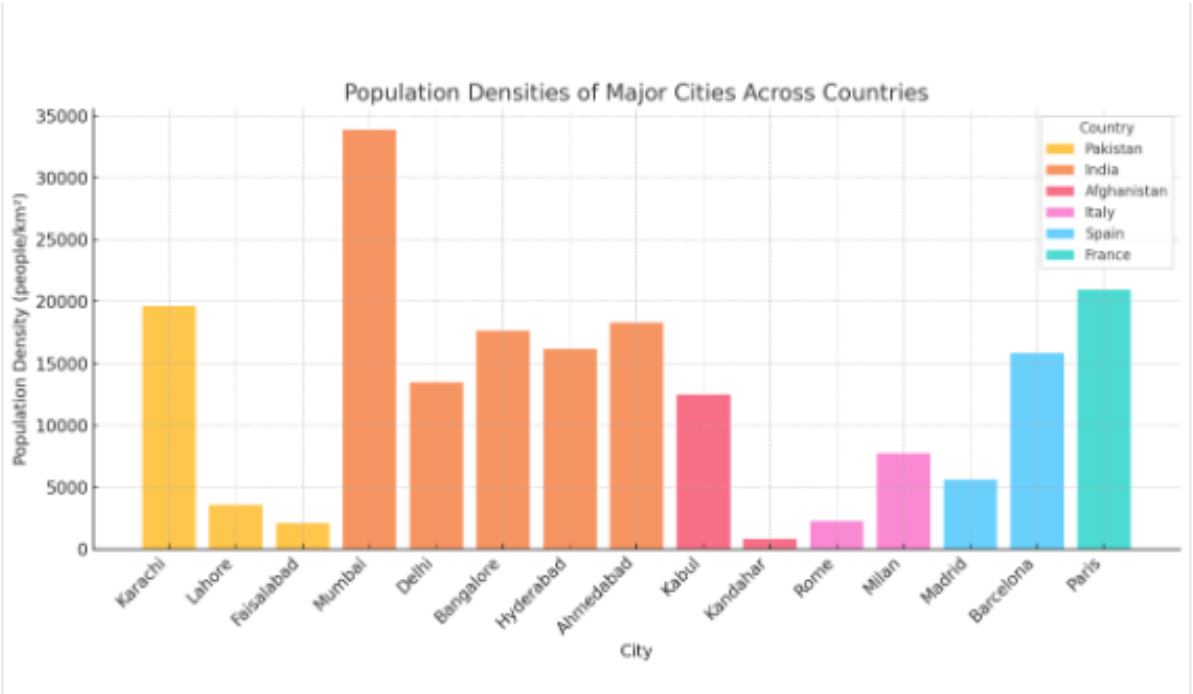

Figure 2 Population Densities of Major Cities across Countries (2024) (self elaboration)

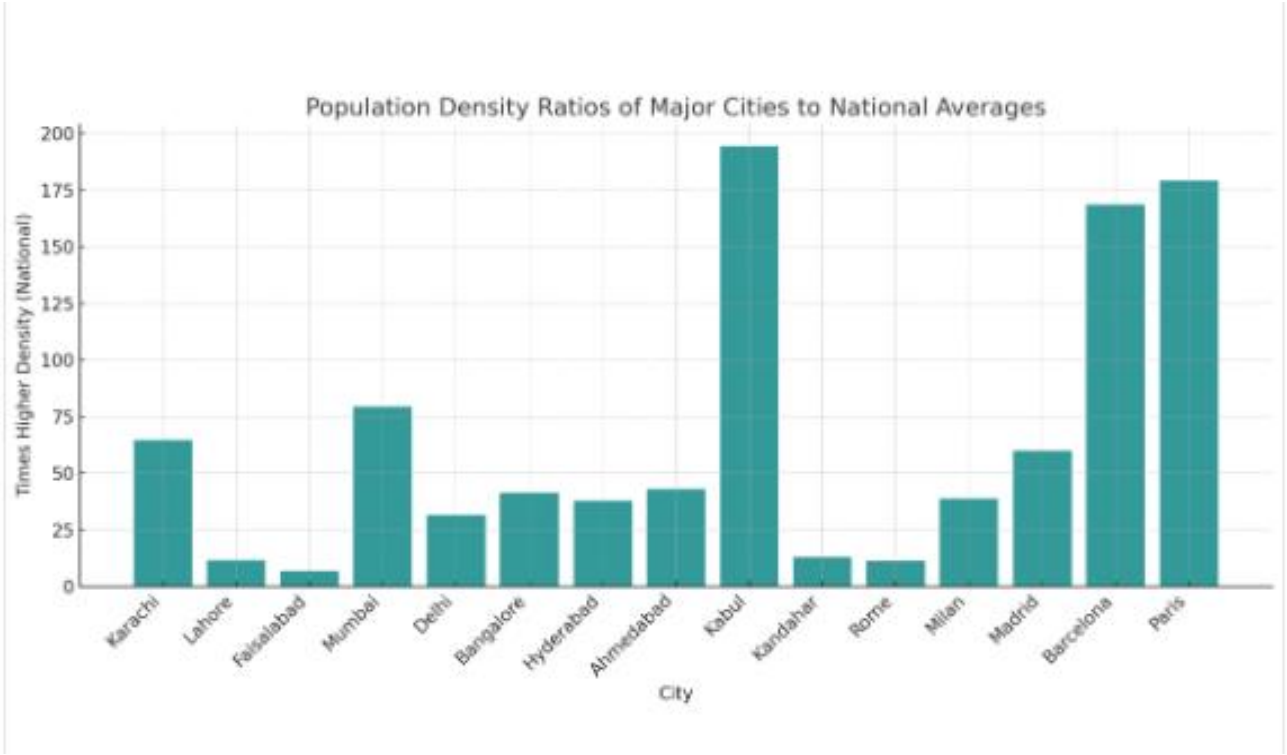

Figure 3 Population Density Ratios of Major Cities to National Averages (2024)

This bar chart shows the population densities (people per square kilometer) of major cities in six countries: Pakistan, India, Afghanistan, Italy, Spain, and France. The color-coded legend shows the cities by country. This table of data illustrates the density levels of the most populated cities there. Data is based on World Population Review, national statistical agencies (ISTAT, INE, and INSEE) and World meter estimates for 2024.Population Density: Ratios of Population Density per Major City to National Average (bar chart) the numbers express how many times denser a city is relative to the overall population density of the country. In Kabul, Paris, and Barcelona, the ratios are the most extreme, showing a concentration (urban) in its extreme. The data is from World Population Review, national statistical agencies (ISTAT, INE, INSEE), and estimates from World meter for 2024.

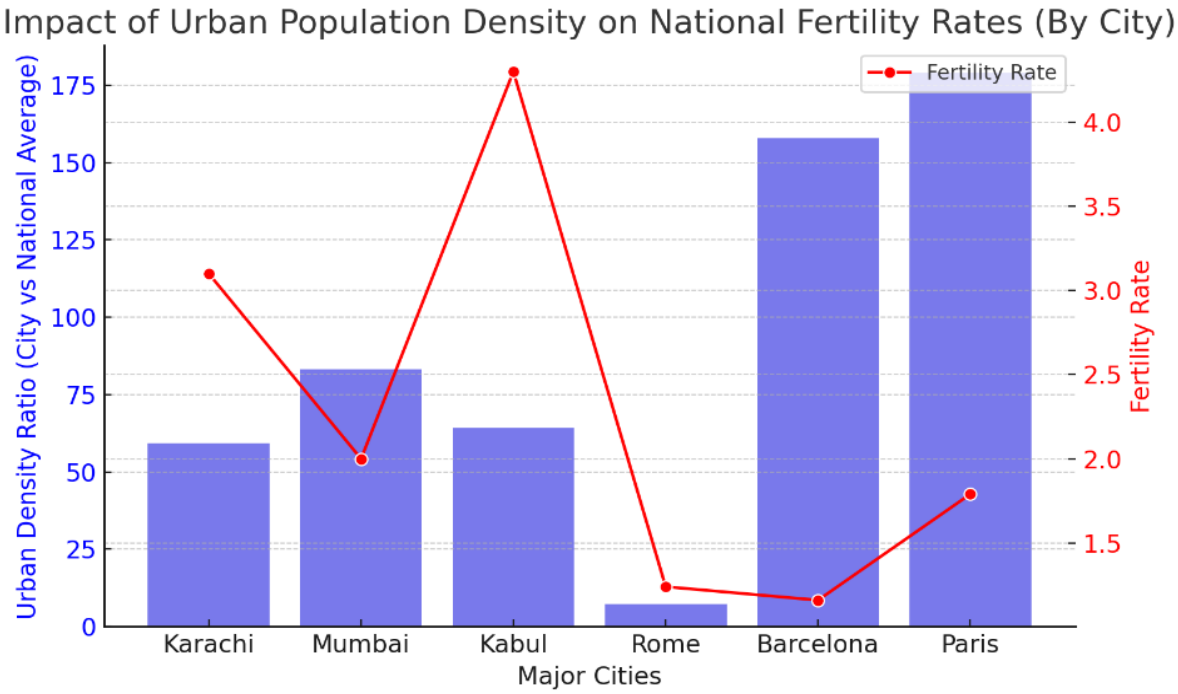

Figure 4 Impact of Urban Population Density on National Fertility Rates

Population Density: Ratios of Population Density per Major City to National Average (bar chart) the numbers express how many times denser a city is relative to the overall population density of the country. In Kabul, Paris, and Barcelona, the ratios are the most extreme, showing a concentration (urban) in its extreme. The data is from World Population Review, national statistical agencies (ISTAT, INE, INSEE), and estimates from World meter for 2024.

Indeed, all major cities boast population densities vastly higher than the national averages. In Paris and Barcelona, for example, population densities are more than 150 times greater than that of the respective country they belong to, indicating a high inflection of urban development. Furthermore, during the transition from an agricultural to an industrial economy, industrialization focused merely on the growth of big cities.

In the case of countries such as India and Pakistan, the dispersion of the rural population among several urban clusters is aided by the plurality of large cities. By contrast, the urban titans in countries like France and Spain are mostly found in one or two major cities.

As for Afghanistan, the country has been marred with political instability and conflict in the recent decades, and millions fled to economic centers in search of decent living standards. Kabul has been especially affected, the city's population exploding over the last few decades due to urbanization. With an estimated population of around 4.7 million as of 2024, Kabul is not only Afghanistan's largest city but also one of the fastest-growing in the world. A high annual migration rate also fuels the growth – around a fifth of new residents are migrants seeking better opportunities. Kabul as the capital pulls citizens from all over the country for its high concentration of services, job opportunities, and educational institutions. It also means that in the most populous province, there would be a greater influx of people than in any other province where they don't have the same resources and comforts.

CONCLUSION

Post Industrial Revolution, a shift was made from agrarian economies to industrial systems where R&D was prioritized, higher education was prioritized and there was a focus on technological advancement. The preference for children evolved from quantity (a labor force for domestic/ agricultural labor) to quality (higher education and quality of life) with this progression. This is why industrialization is correlated with decreased fertility.

Industrialization speeds the movement of people from rural areas to urban centers creating extreme differences in population densities between rural and urban areas. Such migration has resulted in density in population in larger cities. For instance, the population density of Paris is 179 times greater than the population density average of France, demonstrating the demographic and spatial consequences of industrialization.

The urban areas offer better education and health system, either by the intervention of private system or by publicly governed, as according to the Galor's Unified Theory, human capital formation is essential for economic growth to get out of Malthusian trap and seek demographic transition for sustained economic growth. (Galor, 2011) Moreover with the high cost of living and high child bearing cost people preferred to have less children in urban zone. The urban areas also provide better economic and educational opportunities to women also, ad with the more women participation and re- conceptualization of women gender role in the society, the opportunity cost of raise and bear a child is also high in the urban area.

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