

Comparative Analysis of Vital Statistics Among Four Provinces in Pakistan

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Abstract

Vital statistics are essential indicators and reflect a nation's health status and social well-being. It plays a crucial role in finding the demographic structure, health conditions, development level and planning needs. This research examines provincial disparities in Pakistan's key demographic indicators, including the crude birth rate, death rate, infant mortality rate, and life expectancy, utilising data from the Pakistan Demographic Survey (2020). Research findings show significant provincial disparities. Baluchistan exhibits the highest birth rate (29 per 1000) compared to Punjab's lowest rate (26 per 1000). Mortality patterns indicate that Punjab and Balochistan exhibit peak mortality rates of 7 per 1,000, while Khyber Pakhtunkhwa reports the lowest rate at 4 per 1,000. Sindh has the highest infant mortality rate (58/1000 births), whereas Khyber Pakhtunkhwa has a better outcome (53/1000). Life expectancy follows a comparable pattern of regional disparities, with Khyber Pakhtunkhwa leading (men: 66.4 years, women: 68 years) and Baluchistan trailing (men: 62.6 years, women: 64.3 years). These gaps reflect persistent differences in health infrastructure and development between provinces, which serve as key markers for targeted policy interventions.

Keywords: Birth Rate, Death Rate, Infant Mortality Rate, Life Expectancy.

Introduction

The term vital statistics refers to either the data or the method used in data analysis to describe critical events occurring in specific communities. Vital statistics, including births, deaths, marriages, divorces, and migration, have a profound impact on a country's demographic health and socioeconomic development. This information can aid in planning public health services, infrastructure development, educational initiatives, and resource allocation. Understanding and assessing vital data is crucial for effective governance in Pakistan, a country with a population exceeding 240 million and significant geographical diversity. Pakistan consists of four central provinces: Khyber Pakhtunkhwa, Baluchistan, Sindh, and Punjab. Each province is a distinct entity characterised by its unique economic systems, healthcare systems, cultural norms, demographic profiles, and development challenges. Despite national statistical efforts, there are a limited number of empirical and comparative studies on provincial disparities available in the literature.

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This gap needs to be bridged to improve public service delivery, promote equitable development, and provide guidelines for policy solutions.

Basic statistics are handy for better management of specific operating organisations, general administrations, and investigative research. Provinces are distinguished by their economic systems, healthcare systems, cultural norms, demography, and development concerns. Despite national statistics efforts, empirical and comparative examinations of provincial differences in vital events are sometimes lacking. In study of Hafiz et al. (2023) understanding health trends helps leaders to measure progress and find health gaps. The Global Burden of Disease Study 2019 gives complete data for Pakistan from 1990 to 2019. It demonstrates Pakistan's progress in improving healthcare, reducing inequality, supporting women and children, and advancing global health objectives. The study in Jabeen et al. (2024) shows Pakistan has a high under-five years mortality rate, while using 2017–18 Punjab (Multiple Indicator Cluster Survey) MICS data, it is revealed that higher maternal education and access to clean drinking water significantly reduce child deaths. Improving these factors can help lower mortality, especially in low-income areas.

Pakistan's 2017 census, the first since 1998, has raised concerns about various reported numbers due to the lack of a post-enumeration survey. The study in Wazir and Goujon (2021) employed demographic analysis and the cohort-component method, using the 1998 census and other surveys, to assess its accuracy across six subnational regions. While the national estimate of 212.4 million was close to the official estimate of 207.7 million (a 2.3% difference), greater discrepancies were found at the sub-national level. In the study Wazir and Goujon (2019), Pakistan's 2017 census, the first since 1998, faced accuracy concerns due to the lack of a post-enumeration survey. Using older census and survey data, this study estimated a population of 210 million, compared to the official estimate of 207.8 million (1.1% difference). While the national figures were close, significant regional differences highlight the need for regular data checks in future censuses. In study Gill and Saqib (2019), Pakistan faces high population growth due to a high birth rate and fertility rate, while its death rate is below the global average. If current trends continue, the population is expected to double by 2046 and reach 405 million by 2093. With only one-third of the population urbanised and nearly half living in slums, this study compares Pakistan's demographic, fertility, and urban trends (1951–2017) with those of selected countries to assess its progress in transition. The study Rabbani and Quyyum (2017) looks at child deaths in Pakistan using data from 2006–07. Findings of this study show that many babies die soon after birth. Important reasons include the mother's education, family income, and access to media. Knowing these helps make better plans to reduce child deaths. The study Nasir et al. (2021) analyses Pakistan's infant mortality rate from 1960 to 2017 using World Bank data and time series methods in R. Despite global progress, Pakistan still faces high child mortality due to poor health policies and socioeconomic challenges. In a study Gill and Saqib (2019), Pakistan experiences rapid population expansion due to a higher Crude Birth Rate (28.7) and Total Fertility Rate (3.6) compared to the worldwide averages. Urbanisation remains low (approximately one-third of the population), with 45.5% of urban residents living in slums. This study examines Pakistan's demographic, fertility, and urban trends from 1951 to 2017, comparing them with those of selected countries and global averages. The study Ahmad et al. (2016) demonstrates that rural infrastructure contributes to increased income in Pakistan. Still, its impact is smaller than factors like household size, livestock, and the education or gender of the household head. Development is uneven, with Punjab better served than Baluchistan. Energy access is the most important infrastructure need, though regional needs vary. The study Khan et al. (2024) found that about 52% of women in Pakistan use birth control. Women in cities and those with more education use it more often. Use is highest in Punjab and lowest in Balochistan. Young

and uneducated women are less likely to use birth control. The study highlights the need for improved education, guidance, and easier access to family planning services. In Aziz et al. (2020), Pakistan has worse pregnancy outcomes than other low-resource countries, with higher maternal and neonatal deaths and stillbirths. From 2010 to 2018, poor care, low maternal education, undernutrition, and anaemia contributed to these outcomes. Improving healthcare and maternal conditions could greatly reduce these risks. The study Majumder (2011) shows that, according to World Health Statistics 2011, Bangladesh has made notable health progress but still faces significant challenges. The country falls behind in terms of life expectancy, healthcare professionals, and health spending, but adolescent fertility and underweight children remain high. Despite advances in vaccines, poor prenatal care and health disparities continue. Most MDG health targets, except infant mortality, may not be met. A range of recent studies and reports provides a comprehensive basis for analysing provincial disparities in Pakistan's vital statistics. The Pakistan Demographic and Health Survey (PDHS) 2017–18 (National Institute of Population Studies, 2019) and the Pakistan Demographic Survey (PDS) 2020 (Pakistan Bureau of Statistics, 2021) offer nationally representative estimates of fertility, mortality, and life expectancy, disaggregated by provinces and urban–rural divisions. Building on these, Tharwani et al. (2023) and Memon et al. (2023) identify socioeconomic and maternal factors—such as education, antenatal care, and household characteristics—as central to explaining the differentials in infant and child mortality across regions. Complementary insights are provided by UNICEF's Situation Analysis Update (2020), which highlights child survival and nutrition gaps with provincial implications. In contrast, Muhammad et al. (2024) employ spatial inequality measures to map maternal and child health disparities across districts. For demographic context, Goujon (2020) examines Pakistan's fertility transition and its varied provincial trajectories, while Muzzamil (2022) highlights the challenges to neonatal survival linked to health system capacity. Data quality concerns are addressed in the UNESCAP (2020) case study on birth registration inequalities, stressing how under-registration distorts provincial statistics. Finally, Khan et al. (2024) provide a comparative analysis of fertility patterns, underscoring how differences in total fertility rates shape provincial birth rates. Collectively, these studies underscore significant demographic, health, and registration disparities among Pakistan's provinces, making them essential references for comparative vital statistics research.

Methodology

This section describes the data sources, research design, and the variables that are used for analysis, the systematic techniques employed to achieve the objective of this research, and the methodological outline used to conduct the comparative study of vital statistics between four provinces of Pakistan based on the Pakistan Demographic Survey (PDS) 2020.

Research Design

This research assumes a quantitative comparative research design focusing on the analysis of secondary data obtained from the Pakistan demographic survey (2020) and the Pakistan Bureau of Statistics. It prioritises numerical analysis and statistical techniques to search for trends, variations, and relations in demographic indicators across Punjab, Sindh, KPK, and Balochistan.

Data Source

The primary data source for this study is the Pakistan Demographic Survey (PDS), published by the Pakistan Bureau of Statistics (PBS). The Pakistan Bureau of Statistics provides additional

socio-economic indicators and historical trends. The PDS 2020 is a nationally representative survey designed to collect information on various demographic measures, including fertility, mortality, infant mortality, and migration patterns. The survey encompasses both rural and urban areas across the four provinces.

Statistical tools

Birth Rates

Birth rate is defined as the number of live births in each population during a particular period and expressed as per thousand people (1000). It is a crucial demographic metric used in vital statistics to estimate the number of live births in a community.

$$\text{Birth Rate} = \frac{\text{Number of live births}}{\text{total population}} \times 1000 \quad (1)$$

Crude Birth Rate

The Crude Birth Rate (CBR) is a fundamental metric in vital statistics that shows how many live births there are in a population. The number of live births per thousand people in a particular year is known as the total birth rate.

$$\text{Crude birth rate} = \frac{\text{number of live births in a year}}{\text{total mid_year population}} \times 1000 \quad (2)$$

Crude Death Rate

The crude death rate is introduced as the number of deaths per thousand half-year population of an area during a year. It is the ratio of deaths registered in an area during a year to the mid-year estimated population of the same area during the same year, expressed per 1,000 population.

$$\text{Crude death rate} = \frac{\text{number of deaths in a year}}{\text{total mid_year population}} \times 1000 \quad (3)$$

Infant Mortality Rate

Infant mortality rate is the ratio of registered deaths of infants (under one year of age) in an area during a calendar year to the total number of births registered in the same area during the same year and is expressed per 1000.

$$\text{IMR} = \frac{\text{number of infant deaths}}{\text{number of live births}} \times 1000 \quad (4)$$

Results and Discussion

This chapter analyzes essential demographic indicators such as the Crude Birth Rate (CBR), Crude Death Rate (CDR), Infant Mortality Rate (IMR), and life expectancy. It aims to interpret these calculated figures within the context of the study region, highlighting designs, differences, and their wider impact on population trends and dynamics.

Table 1: Population, Live Births, and Crude Birth Rate (CBR) in Pakistan and Provinces

Region	Population	Live Births	Crude Birth Rate (CBR)
Pakistan (Total)	220,425,254	5,937,007	27
Punjab	118,365,259	3,120,781	26
Sindh	52,076,552	1,443,350	28
Khyber Pakhtunkhwa	36,901,290	995,506	27
Baluchistan	13,082,155	377,368	29

Figure 1: Comparison of crude birth rate in four provinces of Pakistan

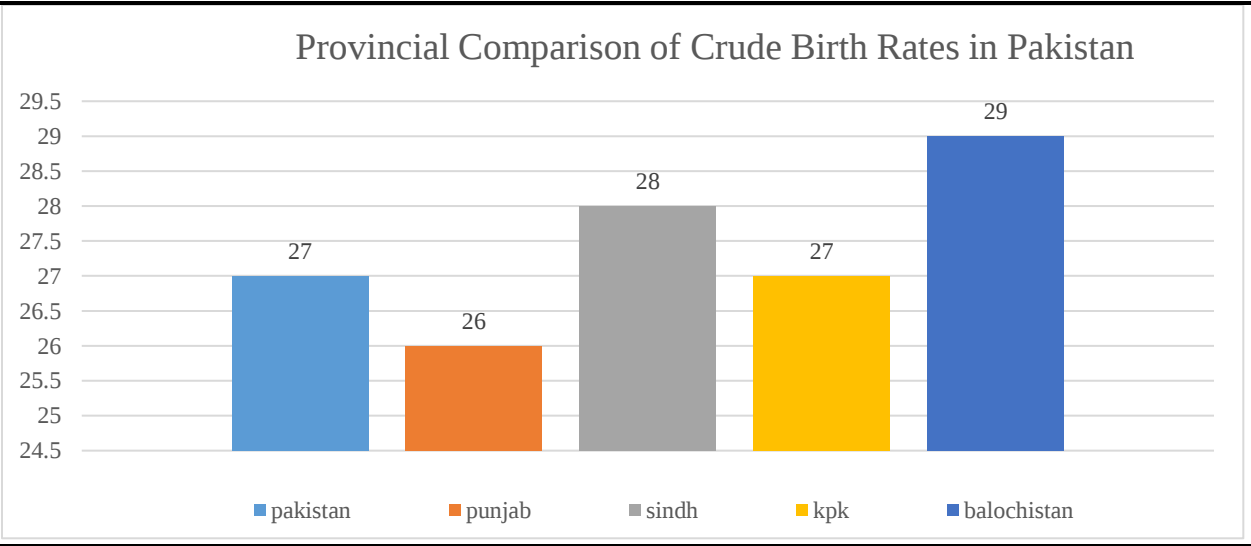


Figure 1 indicates that Pakistan has a total population of 220,425,254, with 5,937,007 live births, resulting in a national crude birth rate of 27. When analyzing the provinces individually, Punjab has the highest population at 118,365,259 and reported 3,120,781 live births, giving it a crude birth rate of 26. Khyber Pakhtunkhwa has a population of 36,901,290, with 995,506 live births, resulting in a crude birth rate of 27. Sindh, with a population of 52,076,552 and 1,443,350 live births, records a slightly higher crude birth rate of 28. Baluchistan, although the least populated amongst these provinces with 13,082,155 people and 377,368 live births, has the highest crude birth rate at 29. When compared to other provinces, Baluchistan has the highest crude birth rate, while Punjab has the lowest. The variation can be ascribed to several factors. The rural lifestyle, restricted access to family planning facilities, and social standards that support superior families may all affect Baluchistan's higher birth rate. In contrast, Punjab, which is more urbanized and developed, is expected to gain from better healthcare facilities, more knowledge of family planning, and higher educational attainment, all of which led to lower birth rates. Khyber Pakhtunkhwa and Sindh sit somewhere in the middle, with a combination of rural and urban factors influencing their birth rates.

To control the high crude birth rate in Baluchistan, access to helpful family planning services must be increased. Public consciousness efforts about reproductive health and the advantages of smaller families should be encouraged. Improving female education can result in delayed marriages and fewer births.

Table 2: Population, Recorded Deaths, and Crude Death Rate (CDR) in Pakistan and Provinces

Region	Population	Recorded Deaths	(CDR)
Pakistan (total)	220425254	1453055	7
Punjab	118365259	885112	7
Sindh	52076552	308966	6
KPK	36901290	169083	4
Baluchistan	13082155	89893	7

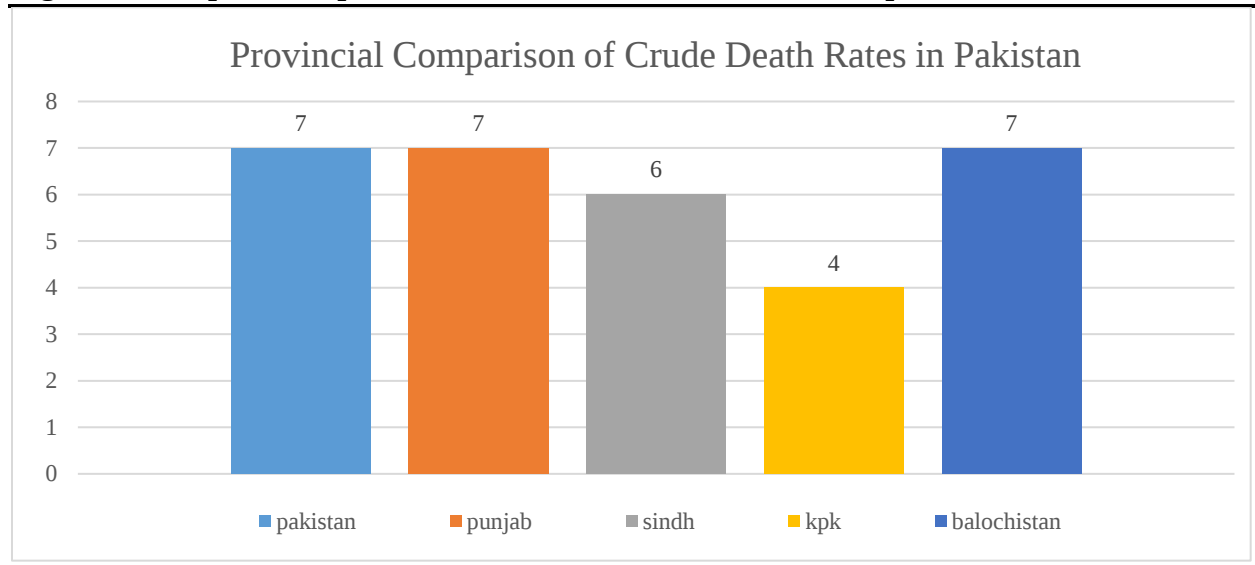
Figure 2: Graphical Representation of crude death rate in four provinces of Pakistan

Figure 2 shows that Pakistan's total population is 220425254 with 1453055 recorded deaths, resulting in a national crude death rate of 7. In Punjab, with a population of 118365259 and 885112 deaths, the crude death rate is also 7. Khyber Pakhtunkhwa, with a population of 36901290 and 169083 deaths, has a lower crude death rate of 4. Sindh, having a population of 52076552 and 308966 deaths, records a crude death rate of 6. Meanwhile, Baluchistan, with a population of 13082155 and 89893 deaths, also has a crude death rate of 7. When comparing crude death rates among the provinces, it is observed that Punjab and Baluchistan have the highest crude death rate at 7, equal to the national average. Sindh follows with a slightly lower rate of 6, while Khyber Pakhtunkhwa has the lowest at 4. These differences may be influenced by factors such as healthcare access, quality of medical services, nutritional standards, and overall living conditions. Khyber Pakhtunkhwa's lower crude death rate may reflect better health outcomes or a younger population, while the higher rates in Punjab and Baluchistan could be linked to larger elderly populations, limited healthcare in rural areas, or socioeconomic differences. To minimize the high death rate in Punjab and Baluchistan, healthcare services must be enhanced, particularly in rural areas. Protective health measures and instant healthcare should be expanded. Furthermore, public health education may help lower disease-related mortality.

Table 3: Infant Mortality rates in four provinces of Pakistan

Province	Live Births	Infant Deaths	Infant Mortality Rate (per 1,000 live births)
Total (P)	5937007	330775	55
Punjab	3120781	172727	55
KPK	995506	52982	53
Sindh	1443350	83962	58
Baluchistan	377368	21103	56

Figure 3: Comparison of infant mortality rates in four provinces of Pakistan

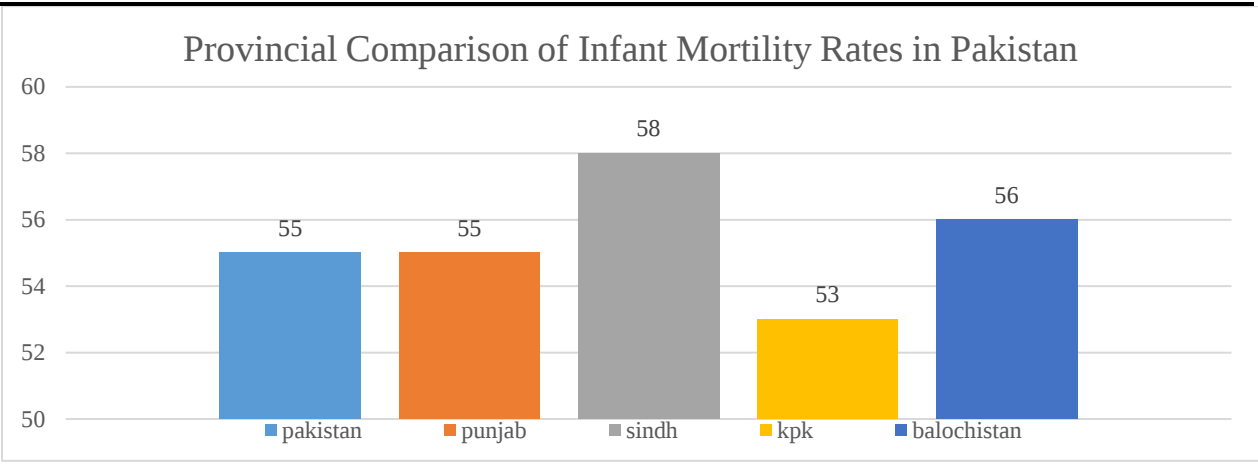
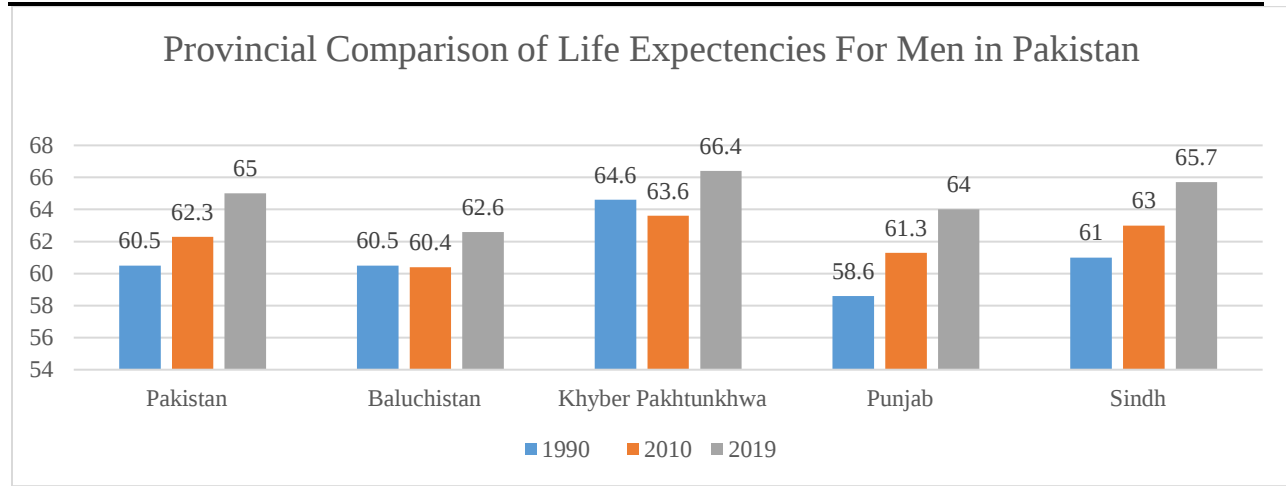


Figure 3, data reveals that the total number of live births in Pakistan is 5,937,007, with 330,775 infant deaths, resulting in a national infant mortality rate of 55 per 1,000 live births. Among the provinces, Punjab recorded the highest number of live births at 3,120,781 and reported 172,727 infant deaths, yielding an infant mortality rate of 55, equal to the national average. Khyber Pakhtunkhwa reported 995,506 live births and 52,982 infant deaths, resulting in the lowest infant mortality rate among the provinces at 53. Sindh recorded 1,443,350 live births with 83,962 infant deaths, leading to the highest provincial infant mortality rate of 58. Meanwhile, Baluchistan reported 377,368 live births and 21,103 infant deaths, with an infant mortality rate of 56. In comparison, Sindh has the highest infant mortality rate, suggesting that there are more newborn deaths than live births. Khyber Pakhtunkhwa, on the other hand, has the lowest infant mortality rate, indicating higher infant health outcomes. Punjab and Baluchistan fall in the middle, with infant mortality rates like the national average. This analysis reveals considerable geographical discrepancies in newborn survival rates among Pakistan's provinces. Sindh has the highest infant death rate due to poor living conditions in urban slums, limited access to healthcare in rural regions, and a lack of maternal and child health knowledge. In contrast, Khyber Pakhtunkhwa has the lowest incidence, thanks to more effective healthcare initiatives, improved rural outreach, and increased community trust in health services.

Table 4: Descriptive Statistics life expectancy for men in four provinces of Pakistan

Province	1990 (years)	2010 (years)	2019 (years)
Total	60.5	62.3	65.00
KPK	64.6	63.6	66.6
Sindh	61.0	63.0	65.7
Punjab	68.6	61.3	64.00
Baluchistan	60.5	60.5	62.5

Figure 4: Comparison of life expectancy for men in four provinces of Pakistan

The graph shows the male life expectancy in Pakistan and its four provinces—Baluchistan, Khyber Pakhtunkhwa, Punjab, and Sindh—for the years 1990, 2010, and 2019. Overall, life expectancy increased in all regions during this period, but the speed of improvement was different in each province. In 1990, the national average life expectancy for males was 60.5. It grew to 62.3 years in 2010 and will reach 65 years by 2019. Khyber Pakhtunkhwa had the greatest male life expectancy during the three years. It began at 64.6 years in 1990, fell slightly to 63.6 in 2010, and then rebounded to 66.4 years in 2019, making it the top province in all three surveys. Sindh also showed steady improvement. In 1990, male life expectancy in Sindh was 61 years. It increased to 63 years in 2010 and reached 65.7 years in 2019, which is very close to the national average and second only to Khyber Pakhtunkhwa in 2019. Punjab had the lowest life expectancy among the provinces in 1990, at 58.6 years. However, it made the most overall development, reaching 61.3 years in 2010 and 64 years in 2019. This cumulative increase is 5.4 years, which exceeds the national average improvement. Baluchistan, on the other hand, confirmed the slowest rate of progress. In 1990, the life expectancy there was 60.5 years. It fell slightly to 60.4 in 2010, but then rose to 62.6 in 2019. Despite the little increase, Baluchistan remained the province with the lowest male life expectancy for all three years. In conclusion, while all areas improved male life expectancy between 1990 and 2019, the rate of improvement differed. Khyber Pakhtunkhwa maintained its lead, Punjab improved the most, Sindh showed a constant rising trend, while Baluchistan lagged the rest.

Table 5: Life expectancy for women in four provinces of Pakistan

Province	1990 (years)	2010 (years)	2019 (years)
Total	61.8	64.4	66.8
KPK	66.0	66.0	68.0
Sindh	63.0	65.0	67.7
Punjab	60.6	64.0	66.3
Baluchistan	62.5	62.5	64.3

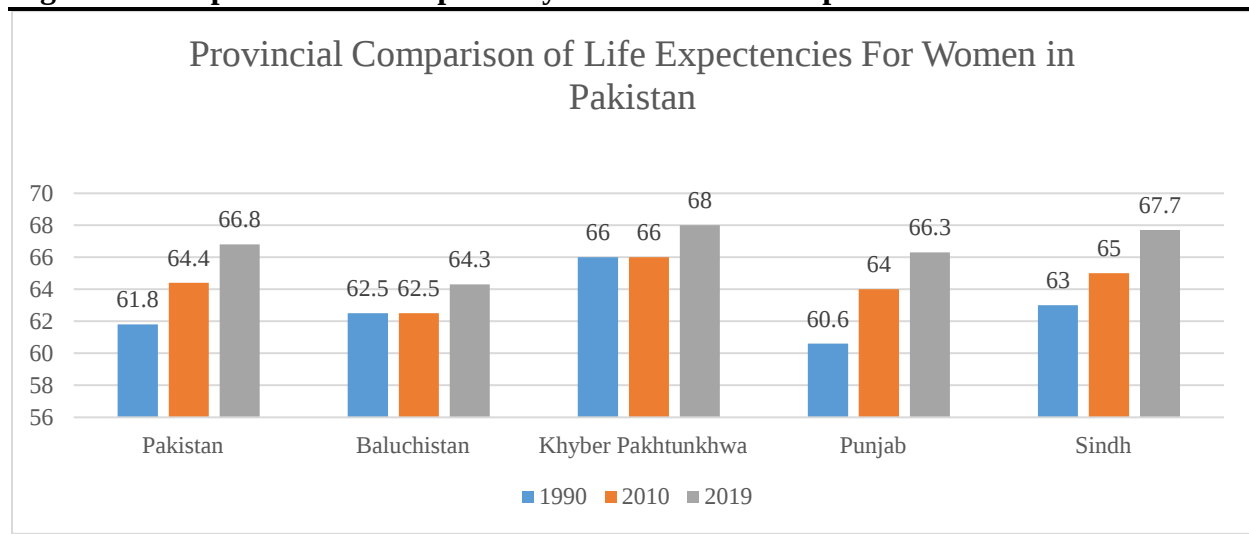
Figure 5: Comparison of life expectancy for women in four provinces of Pakistan

Figure 5 illustrates the life expectancy of women in Pakistan and its four central provinces — Baluchistan, Khyber Pakhtunkhwa, Punjab, and Sindh — for the years 1990, 2010, and 2019. Overall, all regions show a gradual increase in life expectancy over the three decades, although the level of improvement differs among the provinces. In 1990, the average life expectancy for Pakistani women was 61.8 years. It climbed from 64.4 years in 2010 to 66.8 years in 2019, representing a 5-year improvement. This increased trend determines continuous development in healthcare and living situations for women on a nationwide scale. Khyber Pakhtunkhwa has the greatest female life expectancy across all three survey years. It was already 66 years in 1990, remained the same in 2010, and will be 68 years in 2019. Despite insignificant development, it retained its leadership position throughout time. Sindh showed a strong and steady rise. Women's life expectancy was 63 years in 1990, improved to 65 years in 2010, and reached 67.7 years by 2019, just slightly below that of Khyber Pakhtunkhwa. This consistent improvement indicates significant progress in health outcomes for women in Sindh. Punjab also observed substantial growth. It began at 60.6 years in 1990 but increased to 64 years in 2010 and 66.3 years in 2019. The total rise of 5.7 years is among the largest, demonstrating significant advances in public health and women's access to healthcare. Baluchistan saw the poorest improvement among the provinces. Women's life expectancy was 62.5 years in 1990 and 2010, with no change over the two decades. It grew significantly, reaching 64.3 years by 2019. Despite significant development, Baluchistan remained behind neighbouring provinces after the period. Finally, from 1990 to 2019, female life expectancy increased in all provinces. Khyber Pakhtunkhwa maintained the highest figures, followed closely by Sindh, while Punjab gained the most over time, and Baluchistan improved the

least. These variances highlight geographical differences in the consequences of women's health across the country.

Conclusion

In conclusion, this study compared vital statistics—crude birth rate (CBR), crude death rate (CDR), infant mortality rate (IMR), and life expectancy across Pakistan's four provinces (Punjab, Sindh, Khyber Pakhtunkhwa, and Baluchistan) using data from the Pakistan Demographic Survey (2020) and the Global Burden of Disease Study (2019). The findings reveal significant provincial inequalities: Baluchistan had the highest crude birth rate (CBR) (29), while Punjab had the lowest (26). Notably, this aligns with the province's reputation for rural-urban divides in healthcare access, education, and family planning availability. Khyber Pakhtunkhwa recorded the lowest crude death rate (CDR) (4), whereas Punjab and Baluchistan had higher rates (7), linked to healthcare infrastructure and conflict-related mortality in urban Baluchistan. Additionally, the infant mortality rate in Sindh was the highest (58), primarily due to inadequate rural healthcare, whereas Khyber Pakhtunkhwa achieved a better rate (53). Lastly, the life expectancy in Khyber Pakhtunkhwa was higher for both males (66.4 years) and females (68 years), while in Baluchistan, it was affected by weaker health systems, resulting in lower life expectancy for both males (62.6 years) and females (64.3 years), respectively.

Future Research

Recommendations include targeted policies such as expanding rural healthcare, promoting family planning, and improving female education, especially in high-mortality regions like Balochistan and Sindh. Future studies should employ advanced statistical techniques to understand better how socioeconomic factors influence population health outcomes, providing evidence for more equitable policy decisions across Pakistan's provinces. These efforts would help create balanced development by addressing the critical causes of provincial inequalities in vital statistics.

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