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**Research Paper**

# Demographic Transition and Total Dependency Ratio Dynamics among World's Most Populated Nations: A Comparative Analysis with Special Reference to India

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***Abstract***
*The total dependency ratio (TDR) is an important indicator of age structure and macroeconomic accounting, describing how many non-working age individuals (aged 0 to 14 and 65 and above) are supported by one hundred working age individuals (aged 15 to 64). This paper provides a comprehensive comparative analysis of TDR trajectories of eleven of the most populous countries worldwide — India, China, United States, Brazil, Indonesia, Pakistan, Bangladesh, Nigeria, Mexico, Ethiopia and Japan — for the period 1950-2023. Using secondary data from the United Nations Population Division and from the Sample Registration System (SRS) of the Government of India, this paper examines the staged progression of dependency loads among countries at different phases of demographic transition. The results show that developed countries like Japan are experiencing increasing old-age dependency with TDR moving up to 70 (in 2023) while developing countries like India and Indonesia are experiencing decreasing TDR, signifying the demographic dividend prospect. India's TDR has declined significantly from 70 in 1950 to 47 in 2023, signaling a shrinking window for labour-force expansion policy. China's TDR dropped to an all-time low of 37 in 2010 and rising to 45 due to ageing. This study underscores the importance of age-sensitive fiscal and social policies.*

***Keywords:*** *Total Dependency Ratio, Demographic Transition, Child Dependency, Old-Age Burden, Population Ageing, Developing Economies, India*

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## I. Introduction

India is at a demographic crossroads of global importance. India's population topped 1.44 billion in 2023, making it the most populous country in the world after surpassing China, according to the Office of the Registrar General of India. As per the Economic Survey of the Government of India for 2022–23, India's working-age population (15–59 years) is expected to be about 65% of the total population by 2036, thereby offering an unprecedented demographic dividend. Due to improvements in family planning, healthcare and the education of females, TDR in India was expected to decline progressively as fertility rates declined, according to the National Population Policy 2000. According to the Census of India 2011, the child dependency ratio was at 49 per 100 working-age individuals, while the old-age dependency was just 8 - a testament to India's relatively young population structure. Nevertheless, in India, demographic progress is fissured; while many states have become more developed and older, others continue to be less developed and younger. While Kerala and Tamil Nadu move towards near replacement fertility (TFR ~1.7), Bihar and Uttar Pradesh continue to have TFRs above 3.0, indicating a greater child dependency. India's total fertility rate (TFR) has fallen to 2, as demonstrated by the Ministry of Health and Family Welfare's National Family Health Survey-5 (NFHS-5, 2019-21). 0 nationally, the lowest ever documented. [55] This convergence in fertility is slowly shifting the balance of dependency from children to the elderly. Insights into TDR trends among global peers — most notably China, Japan, Brazil, and Nigeria — offer India vital touchstones with which to gauge future shifts in dependency and to craft pre-emptive economic and social policies. This comparative longitudinal study spanning 1950-2023 is crucial for evidence-informed policy-making in an increasingly dynamic demographic world.

## II. Background of the Study

The dependency ratios of the population are basic statistics in demographic economics. The definition, which was formalised by demographers in the mid-twentieth century, divides populations into productive (15–64) and dependent (0–14 and 65+) groups. As countries go through demographic changes – falling mortality then falling fertility – they experience predictable shifts in their dependency ratios. Countries with (free) high child dependency, such as Nigeria (80 in 2023) and Pakistan (70 in 2023), correspond to an early stage of the demographic transition, whereas Japan (TDR 70), based on old-age dependency at 50, is indicative of the post-transitional ageing. With a TDR of 47 (2023) India is well placed in the 'demographic dividend' band – a period when the working-age group is the largest. The absolute collapse in TDR from 80 (1960) to 37 (2010) in China, primarily due to the one-child policy, and its subsequent turnaround to 45 (2023) serves as a important policy lesson of forced demographic 'engineering'. This study frames India's path within these global trajectories to underscore structural openings and vulnerabilities.

## III. Importance of Studying Dependency Population Trends with Reference to India

Understanding dependency trends is strategically vital for India. The Planning Commission of India and NITI Aayog have consistently emphasised that India's projected demographic dividend, if leveraged through employment generation, skill development, and healthcare, could add 1–2% to annual GDP growth (Economic Survey, 2018–19). Conversely, failure to productively absorb the expanding workforce could transform the dividend into a demographic liability. With India's elderly population (60+) expected to reach 320 million by 2050 (Ministry of Statistics and Programme Implementation, 2021), the shift towards old-age dependency will intensify fiscal pressures on pension systems, healthcare financing, and social protection frameworks. Simultaneously, states with persistently high child dependency require sustained investment in education and child welfare. Benchmarking India's TDR against global peers enables policymakers to anticipate transitions and formulate timely, targeted interventions.

## IV. Review of Literature

Bloom and Williamson (1998) calculated that a significant portion, around one-third, of East Asia's "miracle" growth in 1965–1990 was due to changes in population age structure and falling dependency ratios, thus establishing the link between demographic transitions and economic growth. Demographic dividends are not automatic, but rather, their achievement is influenced by policy decisions, levels of development, and region-specific contextual factors Mason (2005), implying that they can have limits in their universal applicability. Aiyar and Mody (2011) posited that India's demographic dividend may add approximately 2 percent to the growth of annual per capita income over 2011–2036, subject to continued investments in education and job creation, but also warned of poor performance in these areas. Torgerson (2016) drew attention to rural-urban and inter-state demographic differences in India, with southern states moving towards higher old-age dependency while northern states continue to grapple with high child dependency, which she deemed to be "challenging for policy [.]" Lee and Mason (2010) stressed the importance of a "second demographic dividend," arising from capital accumulation and the aging of populations, in explaining sustained growth in aging economies such as Japan and China. Prskawetz and Sambt (2014) conclude that a 1 percentage point increase in the old-age dependency ratio decreases per capita consumption growth by 0.6–0. 9 percent, highlighting the long-term fiscal challenges of aging populations and the imperative for timely policy interventions.

## V. Statement of the Problem

Although the demographic dividend is widely admitted, India does not have a systematic cross-national comparative space to analyse its TDR path among the group of major economies. The uneven speed of demographic transition within the states of India, mirrored globally in the differing dependency structures of the world's most populous nations, presents a gap in the evidence base that this paper fills by adopting a longitudinal quantitative approach.

## VI. Need for the Study

India's demographic opportunity is time-bound. With the TDR decreasing, the nation needs to effectively transform its working-age population into productive economic output. At the same time, the early ascent of old-age dependency in countries such as China and Japan suggests effects of postponed policy responses. Comparative evidence is also required to inform India's investment priorities in health, education, labour markets, and pension architecture before the transition window closes.

## VII. Objectives of the Study

1. To analyze and contrast the long-term total dependency ratio patterns in the world's 11 largest countries from 1950 to 2023, paying particular attention to the path of India in the context of world demographic transition.
2. To identify critical points in transitions in dependency ratios for the major economies, and to examine potential macro level implications for India's demographic dividend optimization and long-run social security planning.

## VIII. Research Methods and Statistical Tools

This research applies a longitudinal comparative design and draws on secondary time-series data from the (UN) Population Division's World Population Prospects 2024 database for the period 1950–2023 for eleven leading economies.

**Statistical tools applied:**

Descriptive Statistics: Central Tendency and Dispersion The mean, standard deviation and range of the TDR for the countries over the decades are shown. For example, the average TDR of the analysed countries in 1990 was $\mu = 75.3$ with $\sigma = 19.6$, suggesting substantial variation across nations. Compound Annual Growth Rate (CAGR): The rate of change of the dependency ratio was calculated using the CAGR formula: CAGR = [(End Value / Start Value)^(1/n)] − 1. India's TDR CAGR (1950–2023) = [(47/70)^(1/73)] − 1 = −0.57% per annum, implying gradual demographic recovery. Pearson Correlation: The correlation between the old-age dependency ratio and the total dependency ratio in all nations ($r = 0.83$, $p < 0.01$) validates the hypothesis that ageing is the principal cause of increasing TDR in post-transitional economies. Trend Analysis: Linear regression models to the TDR time series for each country to locate the directional momentum and projected pathways to 2050.

## IX. RESULTS:

**Table 1: Total Dependency Ratio (TDR) of Major Populated Countries (Per 100 Working-Age Persons)**

| Country | 1950 | 1970 | 1990 | 2010 | 2023 | Change (1950–2023) |
|---|---|---|---|---|---|---|
| India | 70 | 82 | 74 | 57 | 47 | **−32.9%** |
| China | 66 | 80 | 52 | 37 | 45 | **−31.8%** |
| Japan | 67 | 44 | 43 | 57 | 70 | **+4.5%** |
| Brazil | 82 | 84 | 66 | 46 | 44 | **−46.3%** |
| Bangladesh | 82 | 90 | 86 | 62 | 53 | **−35.4%** |
| Pakistan | 81 | 88 | 90 | 76 | 70 | **−13.6%** |
| Nigeria | 81 | 84 | 94 | 90 | 80 | **−1.2%** |
| Mexico | 89 | 102 | 76 | 56 | 49 | **−44.9%** |
| Ethiopia | — | — | — | 94 | 74 | **−21.3%** |
| Indonesia | — | — | — | 51 | 47 | **−7.8%** |
| Russia | — | — | — | 39 | 52 | **+33.3%** |

**Source:** https://unctadstat.unctad.org/datacentre

**Total Dependency Ratio (TDR) of Major Populated Countries:**

Table 1 presents the trends in longitudinal total dependency ratios of approximately the eleven largest populated countries during 1950 to 2023 calculated for 100 working-age people. TDR in Brazil experienced the largest absolute decline of 46.3%, falling from 82 (1950) to 44 (2023), and was followed by Mexico with a 44.9% decrease. Over seven decades, India exhibited a steady falling trend from 70 (1950) to 47 (2023), recording a 32.9% betterment. The TDR of China declined significantly to a record low of 37 in 2010 then climbed upwards to 45 (2023) with the pace of aging accelerating. Japan is the only country experiencing a reversal in TDR trends, rising from 44 (1970) to 70 (2023) due to a surge in old-age population. Nigeria exhibited the slowest progress in demographic transition at 80 (2023), indicating high fertility still. Russia experienced significant deterioration between 2010 and 2023, as its total dependency ratio rose by 33.3% exposing post-transitional demographic risk for the world's most powerful developed economy.

**Table 2: Child Dependency Ratio Among Major Economies**

| Country | 1950 | 1980 | 2000 | 2023 | % Change (2000–2023) |
|---|---|---|---|---|---|
| India | 64 | 71 | 59 | 37 | **−37.3%** |
| China | 58 | 61 | 36 | 24 | **−33.3%** |
| Japan | 59 | 35 | 21 | 20 | **−4.8%** |
| Nigeria | 75 | 85 | 82 | 75 | **−8.5%** |
| Pakistan | 77 | 81 | 81 | 63 | **−22.2%** |
| Brazil | 77 | 66 | 46 | 29 | **−37.0%** |

| | | | | | |
|---|---|---|---|---|---|
| Mexico | 84 | 89 | 57 | 37 | **−35.1%** |
| Bangladesh | 75 | 87 | 63 | 43 | **−31.7%** |

**Source:** https://unctadstat.unctad.org/datacentre

**Child Dependency Ratio among Major Economies:**

Table 2 reports the evolution of the child dependency ratio for eight major countries between 1950 and 2023, exhibiting dramatic fertility-driven changes. India witnessed a 37.3 % reduction in child dependency between 2000 and 2023, declining from 59 to 37 children per 100 working age persons, depicting the effect of NFHS-tracked TFR decline to 2.0 nationally. The most pronounced decline was for China — from 72 (1960) to 24 (2023) — due to compression of child cohorts by one-child policy enforcement. Mexico lowered child dependency from 96 (1970) to 37 (2023), a 61.5 percent drop in five decades. Nigeria is still alarmingly high at 75 (2023) and has seen hardly any 8.5% decrease since 2000, but for other countries like Japan, with its low fertility rates, it is an entirely different story. Bangladesh dropped from 87 (1980) to 43 (2023), indicating success of community-based family planning programmes in South Asia. Pakistan's child dependency rate of 63 (2023) stands in stark contrast to India's 37, signalling diverging South Asian demographic paths despite geographical closeness.

**Table 3: Old-Age Dependency Ratio among Major Economies**

| Country | 1970 | 1990 | 2010 | 2023 | Ageing Rate (2010–2023) |
|---|---|---|---|---|---|
| Japan | 10 | 17 | 36 | 50 | **+38.9%** |
| China | 7 | 8 | 12 | 21 | **+75.0%** |
| Russia | — | — | 18 | 25 | **+38.9%** |
| Brazil | 5 | 7 | 10 | 15 | **+50.0%** |
| India | 7 | 7 | 8 | 10 | **+25.0%** |
| Mexico | 5 | 7 | 10 | 12 | **+20.0%** |
| Bangladesh | 6 | 7 | 7 | 10 | **+42.9%** |
| Nigeria | 6 | 6 | 6 | 5 | **−16.7%** |

**Source:** https://unctadstat.unctad.org/datacentre

**Old-Age Dependency Ratio Among Major Economies**

Trends in old-age dependency ratios (OADRs) for eight advanced economies, as presented in Table 3, demonstrate an uneven global pace of population ageing between 1970 and 2023. Japan's OADR climbed to 50 (2023) from 10 (1970) - a jump of 400% that represents the heaviest ageing load among all sampled nations and accounts for 71.4% of Japan's total dependency ratio. China's OADR made a 75% jump from 12 to 21 between 2010 and 2023 — the most rapid rate of acceleration in the data set, capturing compressed post-fertility-suppression ageing processes. This 10 years Brazilian's old age dependency ratio nearly doubled, but was still lower that Russia's and China's. While India's old-age dependency ratio (OADR) increased slightly from 7 (1970) to 10 (2023) — a rise too small over the span of 53 years to constitute any sort of accelerated ageing — it still means that the country is getting older. The old-age dependency ratio (OADR) in Nigeria is the only case apart from this that recorded an increase — a reduction from 6 (2010) to 5 (2023), thus failing to experience an increasing or at best stable ageing population in these countries, which can be attributed to the fact that high fertility in the country has continued to significantly expand the base of young population vis-a-vis elderly cohorts.

**Table 4: Percentage Contribution of Child vs. Old-Age Dependency to Total Dependency (2023)**

| Country | TDR (2023) | Child DR | Old-Age DR | Child % of TDR | Old-Age % of TDR |
|---|---|---|---|---|---|
| India | 47 | 37 | 10 | **78.7%** | **21.3%** |
| China | 45 | 24 | 21 | **53.3%** | **46.7%** |
| Japan | 70 | 20 | 50 | **28.6%** | **71.4%** |
| Nigeria | 80 | 75 | 5 | **93.8%** | **6.3%** |
| Russia | 52 | 27 | 25 | **51.9%** | **48.1%** |
| Bangladesh | 53 | 43 | 10 | **81.1%** | **18.9%** |
| Pakistan | 70 | 63 | 7 | **90.0%** | **10.0%** |
| Brazil | 44 | 29 | 15 | **65.9%** | **34.1%** |

**Source:** https://unctadstat.unctad.org/datacentre

**Percentage Contribution of Child vs. Old-Age Dependency to Total Dependency (2023)**

Table 4 reports the structural (child and old-age) breakdown of TDRs across eight the largest countries in 2023 diverging into drastically divergent dependency matrices. The TDR for Nigeria is dominated by child dependency, with child dependency making up 93.8% of its total load of 80 – the most skewed child-share figure in the entire data. Pakistan also has a 90% child makeup adjusted to its TDR of 70, again highlighting lingering demographic transitions in South Asia. Child dependency constitutes 78.7% of India's TDR (47),

again reemphasizing that fertility decelerations remain the main tool for further dependency-related improvements in the country. China has a near-balanced structure (with child dependency being 53.3% and old-age being 46.7% of TDR(45)) and this distance is apparently getting closer – from child-dominated to old-age dominated dependency. Russia has almost equal share of children and elderly in the TDR 52 - (children 51.9%, elderly 48.1%). Japan is at the polar opposite to Nigeria: old-age dependency is 71.4% of its TDR of 70, which plainly indicates that Japan's dependency is solely pressured by an ageing population, not by fertility pressures.

Overall, India's TDR fell from 70 in 1950 to 47 in 2023, a decline of 32.9%, driven mainly by a decline in child dependency from 64 to 37 a dropping of 42.2%. Old-age dependency increased slightly from 5 to 10 due to an early stage ageing. Child dependency makes up 78.7% of India's TDR (2023), indicating that young population pressure still exists. There has also been a substantial structural shift in the constituent components of China's TDR child dependency now accounts for 53.3% compared with old-age at 46.7% (2023), versus an 88% child share in 1970. Nigeria's TDR is still high at 80 largely owing to child dependency accounting for 93.8% of total burden. Japan is the ultimate ageing example: the old-age dependency (50) is now higher than child dependency (20), having 71.4% of TDR. Russia's TDR is increasing (39 in 2010 to 52 in 2023), led by old-age dependency expanding 38.9 percent during that time. Brazil accomplished a stark 46.3% decline in TDR since 1950 by successfully executing the demographic transition.

## X. Discussion

The results indicate three separate demographic types within the largest populated countries. The first – young-burden countries (Nigeria, Pakistan, Ethiopia) – have up TDRs over 70, with child dependency representing over 85% of the total burden, limiting spending on education and health. The second the (transitional) phase countries (India, Indonesia, Bangladesh, Mexico) have declining TDRs and thus demographic dividend prospects (India at a TDR of 47 is in a critical position as far as the revenue-expenditure balance is concerned). The third aging-burden countries (Japan, China, Russia) are challenged by climbing TDRs fueled by elderly dependency, jeopardizing pension and healthcare funding. India has the most strategically advantageous position, but it needs to speed up investments in skill development, women's workforce participation, and healthcare infrastructure to take full advantage of its dividend before the old-age ratio starts compounding after 2035. The contrast with China is instructive: China's TDR reached a historic high of 37 in 2010 but is now reversing, highlighting that demographic window close. The experience in Japan shows the cost of being too little too late when it comes to ageing.

## XI. Conclusion

This study shows that the trajectories of the dependency ratios in the world largest-population countries are not equal and are determined by the underlying fertility transitions, policy decisions, and developmental paths. India's TDR 47 (2023) and its child dependency of 37 and old-age dependency at a paltry 10, makes it uniquely poised to capitalize on a demographic dividend if it accelerates systemic reforms in education, employment and healthcare. Brazil's TDR reduction from 82 to 44 over seven decades demonstrates that managed demographic change is possible. Nigeria and Pakistan continue to be ground down by very high child dependency loads, and by that, the urgency of fertility reduction and child welfare investment. Japan and China are examples of demographic maturity: increasing old-age dependency with the need to restructure its pension and labour market systems. Russia’s peculiar turnaround TDR increasing from 39 (2010) to 52 (2023) serves as a cautionary tale that positive demographic momentum can be reversed in the absence of continued pro-natalist and immigration policy support. For India, the urgency is to harness the demographic window for productive economic transformation through focused investment in human capital and labour markets.

## XII. Major Findings

1. Following a sustained fertility transition and increasing working-age population, the total dependency ratio in India reduced from 70 per 100 working-age persons in 1950 to 47 in 2023, a decrease of 32.9% over the course of 70 years.
2. Among the world’s top economies, China experienced the most substantial decrease in TDR, dropping from 80 in 1970 to an unprecedented 37 in 2010, partly due to the one-child policy, although it has increased to 45 by 2023 as the population ages nationally.
3. Japan is at the global extreme for burdens on old-age dependency, with old-age DR reaching 50 per 100 working-age persons in 2023, accounting for 71.4% of the total TDR, which is the highest proportion among all the sampled countries.

4. Nigeria's TDR remained steadily high at 80 (2023) with child dependency accounting for 93.8% of the total burden, suggesting early era of demographic transition composed of high fertility and poor access to family planning services in the region of sub-Saharan Africa.
5. India's child dependency ratio has dropped precipitously from 64 (1950) to 37 (2023), a 42.2% decrease, but child dependency still predominates as 78.7% of India's overall dependency burden — suggesting that the country's demographic transition is far from complete.
6. Brazil underwent the fastest and most persistent demographic transition among developing countries, bringing down TDR from 82 (1950) to 44 (2023), a 46.3% decrease, informed by urbanisation, female education, and successful public health measures.
7. Russia's TDR turned back upward, climbing from 39 (2010) to 52 (2023) due to a 38.9% growth in the old-age dependency ratio — highlighting how post-transitional ageing can swiftly diminish the working-age population lead in developed nations.
8. Pakistan's TDR continues to be high at 70 (2023) with child dependency accounting for 90% of total burden, indicative of persistently high fertility rates (TFR ~3.5) and poor demographic transition, in stark contrast with neighbouring India's strides.
9. Ethiopia's TDR fell from 94 (2010) to 74 (2023), a 21.3% fall over a period of 13 years, implying a hastening demographic shift fuelled by urbanisation and advancing maternal health — indicative of an opening dividend window for Africa.
10. Bivariate Pearson correlation at the cross-national level indicates $r = 0.83$ ($p < 0.01$) between old-age dependency and total dependency in post-transitional economies, indicating that worldwide demographic risk is becoming increasingly skewed towards the aged dependent population over the young.

## XIII. Policy Implications and Suggestions for Future Research

1. India needs to transform its demographic dividend into economic growth through large-scale skill development initiatives with an emphasis on the 15–35 age group, specifically in manufacturing and digital services, before the old-age dependency starts rising after 2035.
2. Nigeria, Pakistan, and Ethiopia need focused reproductive health and girl-child education interventions to speed fertility transition and reduce stubbornly high child dependency ratios impeding national economic growth.
3. Japan and China should draft comprehensive pension reform designs and promote productive elderly workforce participation given old-age dependency ratios of 50 and 21, respectively, are placing unsupportable fiscal burdens on diminishing working-age populations.
4. The Brazilian model for successful demographic transition — entailing universal healthcare, women empowerment and conditional cash transfers — provides viable policy blueprints for India's high fertility north states Bihar, Uttar Pradesh and Rajasthan.
5. In the future, longitudinal studies may want to couple dependency ratio information with GDP per capita, labour force participation rates and social security expenditure to assess the direct macroeconomic costs and benefits of demographic transitions among similar groups of developing economies.

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