International Journal of Health Sciences and Research
[Indexed, Peer-Reviewed Journal]
Volume 16; Issue: 2; February 2026
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Inter-censual and Post-censual Population Projection of India from 2011 to 2030: Filling the Gaps

Kirtan Rana[1], Praizy Bhandari[2], Nidhi Nain[2]

[1]Departement of Community Medicine, [2]Departement of Community Medicine,
[1]Maharishi Markandeshwar Medical College and Hospital, Kumarhatti-Solan,
Maharishi Marakandeshwar University, Kumarhatti, Solan, Himachal Pradesh, India
[2]Gian Sagar Medical College and Hospital, Ramnagar; Baba Farid University of health and Sciences, Faridkot, Punjab

Corresponding Author: Kirtan Rana

DOI: https://doi.org/10.52403/ijhsr.20260241

ABSTRACT

Census is a vital survey which helps in enumerating the population of a country. In absence of census, mathematical models can be used to estimate the population of a country. The present study had projected the age-wise, gender-wise and residence-wise; inter-censual and post censual population of India from 2011 to 2030. The model used the compound annual growth rate (CAGR) population of base year 2010, distribution of population (residence-wise, gender-wise and age group-wise) for last 4 decades and extrapolated it to the end year of projection (2030).The model predicted overall population (in each age group) beside calculating population for some specific age groups i.e. under-5, 15 to 49 years and more than 60 years. The model was developed in Microsoft excel 2016. The study estimated an increase of 30.6% in total population; 25.6% increase in total male population, 35.9% increase in total female population; 16.1% increase in male population in rural areas, 26.9% increase in female population in rural areas; 46.7% increase in males in urban areas and 55.6% increase in females in urban areas from 2011 to 2030. The estimations from this study found an increase in population more among females than males. The inter-censual data can further help in supplementing the original census data and can help in formulating policies in absence of actual data.

Keywords: census, inter-censual, mathematical model, population, post censual, projection

INTRODUCTION

The population of India as reported in January 2024 was 1.44 billion with an increase of 0.9 percent from the previous year. Around 48.4% of the population in India is females while 51.6% is male population. 36.6% of the India's population resides in urban areas while 63.4% lives in rural areas.[1]

Population projection refers to any carefully constructed approximation to the future size and characteristics of the population of a specific area.[2] Population projection shows how the population will develop in the future under certain assumptions regarding the size and structure. Projection of population usually takes the age and sex specific population numbers at a given point in time as the starting population and based

on these the population is extrapolated into the future.

The three main factors determining the population growth in a country are fertility, net migration and mortality.[3] If these determinants each have three alternative assumptions (probabilistic model), there will be nine possible combinations from which three are chosen as high, medium and low scenarios according to population size and it is impossible to specify the probability for the high-low interval even if the probabilities could be specified for the range in component variants.

The frequent way of estimating population is mathematical methods. Since demographic process is generally slow, their true extent often only becomes apparent after many years which makes the projection unaffected by the socio economic settings further making mathematical methods useful for inter-censual, post-censual estimates and estimating future population for a shorter period.[4] Beside this cohort component method which is highly dependent on reliable birth, death and migration data can also be used for population projections and economic method of population projection explains how economic factors influence the demographic factors i.e birth, death and migration rates. Death registration in India is far less than the birth registration and these events go unrecorded as these events are significantly associated with the sociodemographic characteristics of people.[5] For improving the overall accuracy, good forecasts of the age specific vital rates are needed which were of not great significance before 1920 where calculation concerning future population usually involves the fitting of mathematical curves to the trajectory of population size.[6]

Compound annual growth rate (CAGR) is the mean annual growth rate of an investment over a period of time longer than one year. CAGR is assumed to meet the expected CAGR relying on historical result if the time frame used for analysis is of short duration. The projections are generated using CAGR and is applied to the historical population growth.

Census is done every decade which will leave the planner with population composition of two time periods i.e. the previous census report and the current census report. The approximation of how the population has changed in-between is usually not available hence making it difficult to plan things and allocating the resources accordingly. Hence inter-censual projection of population becomes important activity rather than not having any data at all.

Population projection contributes to the activities of government, organization and business and plays an essential role in for planning and policy making in a country.[7] Population includes much more than mere numbers of people. A planner must know the composition of the dealing population for framing policies, efficient enough to strike the target accurately. Population needs are dependent on the age groups, gender and place of residence, a population estimation projecting population distribution encompassing these parameters can be of utmost importance to the planners.[8,9] The yearly change in proportion of population can help in used in distribution the resources, framing policies, creating conducive environment for the sustenance of people.

MATERIALS & METHODS

The current projections were computed using mathematical model. The model was designed to give total population, age-group wise distribution, gender-wise distribution and residence-wise distribution of total population for any given year between 2011 to 2030. Following parameters and assumptions were considered while computing the distribution of population.

The baseline year for computing population was 2010 whereas for calculating decadal compound annual growth rate (CAGR), the study took data for total population, age-group wise distribution, gender-wise distribution and residence-wise distribution

of total population for last 40 years from baseline year. The formula for CAGR is $((EV/BV)^{1/n} -1) \times 100$ where EV= Ending value, BV is the beginning value and n is the number of years.[10] Following variables were used for computation:

For calculating percentage distribution of population, age group wise, region-wise and gender wise, the age group wise distribution of population was used, as taken from census 2011. The data in supplementary table 2 was calculated after stratifying the total population residence wise followed by gender wise stratification and then applying the age group wise distribution of population in each gender. The percentage distribution was rounded off to whole number for the sake of simplicity.

Following steps were involved in calculating percentage distribution residence-wise and age group wise.

The population of year 2011, as taken from census 2011, was taken as baseline for computing the population of future years. Inter-censual and post-censual population was computed using the CAGRs. Following assumptions for CAGR and distribution of population in each group were considered.

- Using CAGR of previous 4 decades (1970-2011), the CAGR for the fifth and sixth decade was extrapolated which was used for estimating residence wise projection of population.
- For sex wise distribution we used the sex ratio from 1970 to 2011 from census and for 2021, sex ratio from NFHS-5 were used.
- We assumed that the percentage of population in each age group in rural and urban region will not change between 2011 to 2030.

Total population calculation: Population for every year was calculated using CAGR which was derived using population of each census between 1971 to 2011 which was further extrapolated till 2030. For calculating population between 2011 to 2030 the CAGR calculated for the time period 2011 to 2030 was used.

Residence wise distribution: the total population calculated was stratified residence wise based on the percentage distribution of the population in rural and urban area. The percentage distribution from 1970 to 2011 was taken from the census and was extrapolated till 2030. The extrapolated percentages were used to stratify population residence wise.

Sex wise distribution: the residence wise stratified population was further calculated sex-wise using sex ratio at population level. The sex ratio from 1970 to 2011 were taken from census. for the year 2021 the sex ratio was taken from NFHS-5.

Age group wise distribution: The population percentage in each age group as taken from census 2011 was used for distributing population in each age group.

The above mathematical model estimated age-group wise population of males and females residing in rural and urban regions of India from 2011 to 2030.

RESULT

The study estimated an increase of 30.6% (370.5 million) in the total population; a 25.6% (159.6 million) increase in the total male population; a 35.9% (210.9 million) increase in the total female population; a 16.1% (69.1 million) increase in the male population in rural areas; a 26.9% (109.2 million) increase in the female population in rural areas; a 46.7% (91.3 million) increase in the male population in urban areas; and a 55.6% (100.8 million) increase in the female population in urban areas from 2011--2030, as presented in Table 1.

Table 1: Gender-wise (total) yearly projection of the total, rural and urban populations of India from 2011-2030

Year	Total population (Projected)	Total		Rural		Urban	
		Male	Female	Male	Female	Male	Female
2011	1210854977	623270258	587584719	427781058	405967794	195489200	181616925
2012	1229138887	633250328	595888559	417085689	394145976	216308086	201599136
2013	1247698884	642812408	604886476	423383683	400097581	219574338	204643283
2014	1266539138	652518876	614020262	429776777	406139054	222889910	207733396
2015	1285663878	662371911	623291968	436266406	412271754	226255548	210870171
2016	1305077403	672373726	632703677	442854029	418497057	229672007	214054310
2017	1324784072	682526570	642257502	449541125	424816363	233140054	217286530
2018	1344788311	692832721	651955590	456329196	431231090	236660469	220567557
2019	1365094615	703294495	661800120	463219766	437742679	240234042	223898127
2020	1385707543	713914242	671793302	470214385	444352594	243861576	227278989
2021	1406631727	696352340	710279387	441946149	458298157	255107014	251280408
2022	1425058603	705474556	719584047	447735644	464301862	258448915	254572182
2023	1443726871	714716273	729010598	453600980	470384217	261834596	257907077
2024	1462639693	724079056	738560637	459543153	476546250	265264629	261285660
2025	1481800273	733564491	748235781	465563169	482789006	268739596	264708502
2026	1501211856	743174186	758037670	471662046	489113542	272260085	268176183
2027	1520877732	752909768	767967963	477840819	495520929	275826692	271689291
2028	1540801230	762772886	778028344	484100534	502012253	279440022	275248421
2029	1560985726	772765211	788220515	490442251	508588614	283100686	278854176
2030	1581434639	782888435	798546204	496867044	515251125	286809305	282507165

Table 2 presents the estimation results for the total (male, female), rural (male, female) and urban (male, female) under5 populations in India from 2011--2030. The total male population increased by 15.01 million, the female population increased by 19.5 million, the rural male population increased by 6.9 million, the female population increased by 10.8 million, the urban male population increased by 7.2 million and the urban female population increased by 7.9 million from 2011 to 2030.

Table 2: Under5 Yearly projection of total, rural and urban populations of India from 2011-2030

Year	Total		Rural		Urban	
	Male	Female	Male	Female	Male	Female
2011	58632074	54174704	43036377	39950283	15595697	14224421
2012	59570916	54940309	41960383	38786927	17256582	15789448
2013	60470437	55769908	42593985	39372610	17517156	16027869
2014	61383540	56612034	43237154	39967136	17781665	16269889
2015	62310432	57466875	43890035	40570640	18050168	16515565
2016	63251319	58334625	44552774	41183257	18322726	16764950
2017	64206414	59214330	45225521	41803093	18599399	17018622
2018	65175931	60108467	45908427	42434320	18880250	17275603
2019	66160088	61016104	46601644	43075078	19165342	17536465
2020	67159105	61937448	47305329	43725512	19454738	17801265
2021	65507028	65538883	44461438	45143804	20351875	19691317
2022	66365170	66397442	45043883	45735188	20618484	19949273
2023	67234553	67267249	45633958	46334319	20888586	20210608
2024	68115326	68148450	46231763	46941299	21162227	20475367
2025	69007637	69041195	46837399	47556230	21439452	20743595
2026	69911637	69945634	47450969	48179216	21720309	21015336
2027	70827479	70805853	48072576	48810364	22004845	21290637
2028	71755319	71790213	48702327	49449780	22293108	21569544
2029	72695314	72730665	49340328	50097572	22585148	21852105
2030	73647622	73683437	49986686	50753850	22881013	22138368

The study estimated an increase in the total male population of 84.5 million, the female population of 111.8 million, the rural male population of 35.3 million, the female population of 55.8 million, the urban male population of 52.1 million and the female population of 57.8 million in the 15–49 years age group between 2011 and 2030, as presented in Table 3.

Table 3: Yearly projection of the total, rural and urban populations of India from 2011–2030 in the 15–49-year age group

Year	Total		Rural		Urban	
	Male	Female	Male	Female	Male	Female
2011	330174852	311681858	218574466	207475044	111600386	104206814
2012	335461754	316086596	213109674	201433353	123485420	115672057
2013	340527225	320859504	216327631	204474996	125350048	117418707
2014	345669186	325704480	219594178	207562567	127242835	119191729
2015	350888791	330622619	222910049	210696764	129164201	120991524
2016	356187212	335615021	226275991	213878285	131114581	122818496
2017	361565639	340683236	229692758	217107951	133094411	124672019
2018	367025280	345827554	233161120	220386283	135104137	126554566
2019	372567362	351049549	236681852	223714115	137144210	128465542
2020	378193129	356350398	240255749	227092197	139215087	130405370
2021	368889784	376745349	225812108	234216883	145634855	144156387
2022	373722241	381680713	228770250	237285124	147542671	146044836
2023	378618002	386680730	231767139	240393557	149475480	147958021
2024	383577898	391746249	234803288	243542715	151433610	149896271
2025	388602768	396878125	237879212	246733125	153417389	151859912
2026	393693465	402077229	240995429	249965328	155427157	153849278
2027	398850848	407365396	244152469	253239873	157463253	155864704
2028	404075795	412680652	247350868	256557316	159526021	157906532
2029	409369187	418086768	250591163	259918217	161615812	159975106
2030	414731923	423563706	253873909	263323147	163732980	162070778

Table 4 presents the estimation of the increase in the geriatric population (60 + years) between 2011 and 2030. The total male population increased by 13.0 million, the female population by 18.7 million, the rural male population by 5.8 million, the female population by 9.8 million, the urban male population by 7.0 million, and the female population by 8.5 million.

Table 4: 60+ year old age group yearly projection of total, rural and urban populations of India from 2011--2030

Year	Total		Rural		Urban	
	Male	Female	Male	Female	Male	Female
2011	51071872	52777168	35997302	37296520	15074570	15480648
2012	51889656	53523023	35097299	36210443	16679958	17183891
2013	52673190	54331221	35627269	36757220	16931825	17443366
2014	53468555	55151623	36165239	37312254	17187494	17706762
2015	54275931	55984411	36711335	37875669	17447026	17974134
2016	55095497	56829777	37265676	38447591	17710475	18245543
2017	55927440	57692735	37828387	39035288	17977903	18518142
2018	56771943	58563895	38399597	39624722	18249371	18797766
2019	57629200	59448210	38979430	40223055	18524936	19081613
2020	58499401	60345879	39568019	40830423	18804663	19369745
2021	57060347	63579497	37189279	41950076	19671821	21358482
2022	57807839	64412387	37676458	42499621	19929522	21638278
2023	58565121	65256190	38170019	43056367	20190599	21921738
2024	59332324	66111045	38670047	43620405	20455096	22208913
2025	60109576	66977100	39176625	44191833	20723056	22499850

2026	60897012	67854500	39689838	44770746	20994530	22794599
2027	61694764	68979286	40209776	45357242	21269557	23093207
2028	62502965	69643933	40736525	45951423	21548188	23395729
2029	63321754	70556267	41270172	46553386	21830469	23702211
2030	64151269	71480556	41810810	47163235	22116449	24012711

This study also estimated the total population of males and females in different age groups in rural and urban areas, as presented in supplementary tables S3-S22. (Supplementary file is attached in the HTML version of the abstract of this article).

DISCUSSION

The current study projected the total population of India, age group wise, gender wise and residence wise using a mathematical model. Census is an important survey activity carried approximately after every decade to enumerate the total population of country along with other social, economic and demographic characteristics. The first census was carried during pre-independence era and the last census activity in India was carried out in 2011. There by the next census which was scheduled to be carried out in 2021 is still withheld due to unknown reasons. The data generated via census especially the distribution of population as per age, gender, residence is important from policy making point of view. For planning or formulating any policy, which involves people, the composition of that population should be known to the planner. This helps in designing and ultimately execution of agendas as per the need. The simplest method of carrying forward census data on sex and age to a more recent date is to distribute the population total estimated for the latter date by sex and age in the same proportion as those observed at the census.[11] This is done by determining first the ratio between the total populations at the two dates and then multiplying the observed numbers in each sex age category by this ratio.

One flaw with the census data is that it gives population information after a decade. The policy makers have to wait till the next round of census to occur so that the demographic information could be available to them or they keep making policies based on the decadal old data. When the planning has to be done for future years, the planners require inter-censual and post censual data which helps them to plan and utilize the resources, especially in a resource constrained nation/ state to its optimum potential.

Mathematical models are of great help in estimating or forecasting the data based on historical records. Many different types of models have been used for forecasting the population at state or country level. The validity of estimation by forecasting model depends upon the number of input variables used the model and values of input parameters. If the number of parameters is used in forecasting is more, there is maximum chances that one or the other parameter might have missed value of for any specific year. This will compromise the forecasting outcomes.

The current study (deterministic model) utilized CAGR for estimating inter-censual and post censual population growth. CAGR is rate derived from values of two different time point, which may be weeks, months or years. CAGR doesn't depend upon the multiple inputs and hence least affected by the missing values. Many national, local and private organizations have projected population from time to time. The main organizations like United Nations, World Bank has forecasted global population including India where they have taken into account the fertility rates, child mortality, overall mortality, adult and old age mortality and migration for estimating the population and has used standard deterministic approach for projections.[12,13]

The deterministic models of projections yield a single projected value for each quantity of interest however the most

desired one projection are the probabilistic projections that give a probability distribution of each quantity of interest. Many approaches to produce probabilistic population projections include ex-post analysis, time series methods and expert based approaches.[14,15] An estimation by Raftery AE et al simulated large number of trajectories of total fertility rate (TFR) and life expectancy at birth for females and males and converted them into age specific fertility rates using model fertility schedules and lee carter method and used cohort component model to convert each trajectory to all age and sex specific population quantities.[16]

One limitation of CAGR is that it gives the results without taking into account the changes that happens in between the two time points. Another limitation is that it gives projections for short period of time.

Since CAGR is simpler and easier to compute and used in forecasting, it can be brought into application by planners who doesn't have much technical information about modeling and forecasting.

CONCLUSION

The present study used CAGR for computing population for each year using historic data for the period of 2011 to 2030. There is a steady increase in the population over a period of time with faster growth in female population and population in urban areas. The study also highlighted an increase in geriatric age group population predicting the readiness for the physical mental and social issues in this age group. The paucity of data in context of indicators need for developing model that can adjust the dynamic variables in Indian context, utilising CAGR for population projection can be used for short term population projections to support decisions in absence of updated census data.

Declaration by Authors

Ethical Approval: Not required

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Digital 2024: India - DataReportal – Global Digital Insights [Internet]. [cited 2024 Mar 16]. Available from: https://datareportal.com/reports/digital-2024-india
2. Aryal GR. Methods of Population Estimation and Projection. J Popul Dev. 2020;1(1):54–61.
3. Booth H. Demographic forecasting: 1980 to 2005 in review. Int J Forecast. 2006; 22(3):547–81.
4. Bhattarai, D. K., Acharya, B., Poudyal, K. A., & Paudel, R. Demography for health and social sciences. Kathmandu: Koselee Prakashan, Bagbazar, Nepal. (2019).
5. Saikia N, Kumar K, Das B. Death registration coverage 2019-2021, India. Bull World Health Organ. 2023 Feb;101(2):102–10.
6. Alho JM. Population Forecasts. In: Smelser NJ, Baltes PBBT-IE of the S& BS, editors. Oxford: Pergamon; 2001. p. 11789–93.
7. Rowland, D. T. Demographic methods and concepts, 2003. New York: Oxford University Press Inc., United States. 2003
8. Samaniego-Vaesken M de L, Partearroyo T, Ruiz E, Aranceta-Bartrina J, Gil Á, González-Gross M, et al. The influence of place of residence, gender and age influence on food group choices in the Spanish population: Findings from the ANIBES study. Nutrients. 2018;10(4).
9. Siegler EL, Lama SD, Knight MG, Laureano E, Reid MC. Community-Based Supports and Services for Older Adults: A Primer for Clinicians. J Geriatr. 2015;2015
10. Compound Annual Growth Rate - CAGR [Internet]. Investopedia. 2017. Available from: http://www.investopedia.com/terms/c/cagr.asp
11. Nations U. Manual III: Methods for Population Projections by Sex and Age. Manuals methods Estim Popul. 1956;(25):6–20.
12. UN. World Population Prospects 2022: Methodology of the United Nations population estimates and projections. World Popul Prospect DESA/POP/2022/TR/NO 4 Dep Econ Soc Aff Popul Div. 2022;(4).

13. Bos E, Vu MT, Massiah A, Bulatao RA. World population projections 1994-: estimates and projections with related demographic statistics. 1994.
14. National Research Council, Committee on Population. Beyond six billion: Forecasting the world's population. National Academies Press; 2000 Oct 11.
15. Booth H. Demographic forecasting: 1980 to 2005 in review. International journal of forecasting. 2006 Jan 1;22(3):547-81.
16. Raftery AE, Li N, Ševčíková H, Gerland P, Heilig GK. Bayesian probabilistic population projections for all countries. Proc Natl Acad Sci U S A. 2012;109(35):13915–21.

How to cite this article: Kirtan Rana, Praizy Bhandari, Nidhi Nain. Inter-censual and post-censual population projection of India from 2011 to 2030: filling the gaps. *Int J Health Sci Res.* 2026; 16(2):365-372. DOI: *https://doi.org/10.52403/ijhsr.20260241*

******