



Variable Uninsured Life (Value) Annuities:
Theory, Practice and Country Cases
Appendix 4: Illustrations for India






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Appendix 4: Illustrations for India


AUTHORS	William Price	Evan Inglis	Darren Ryder
	CEO	Associate Director	President
	D3P Global	D3P Global	D3P Global



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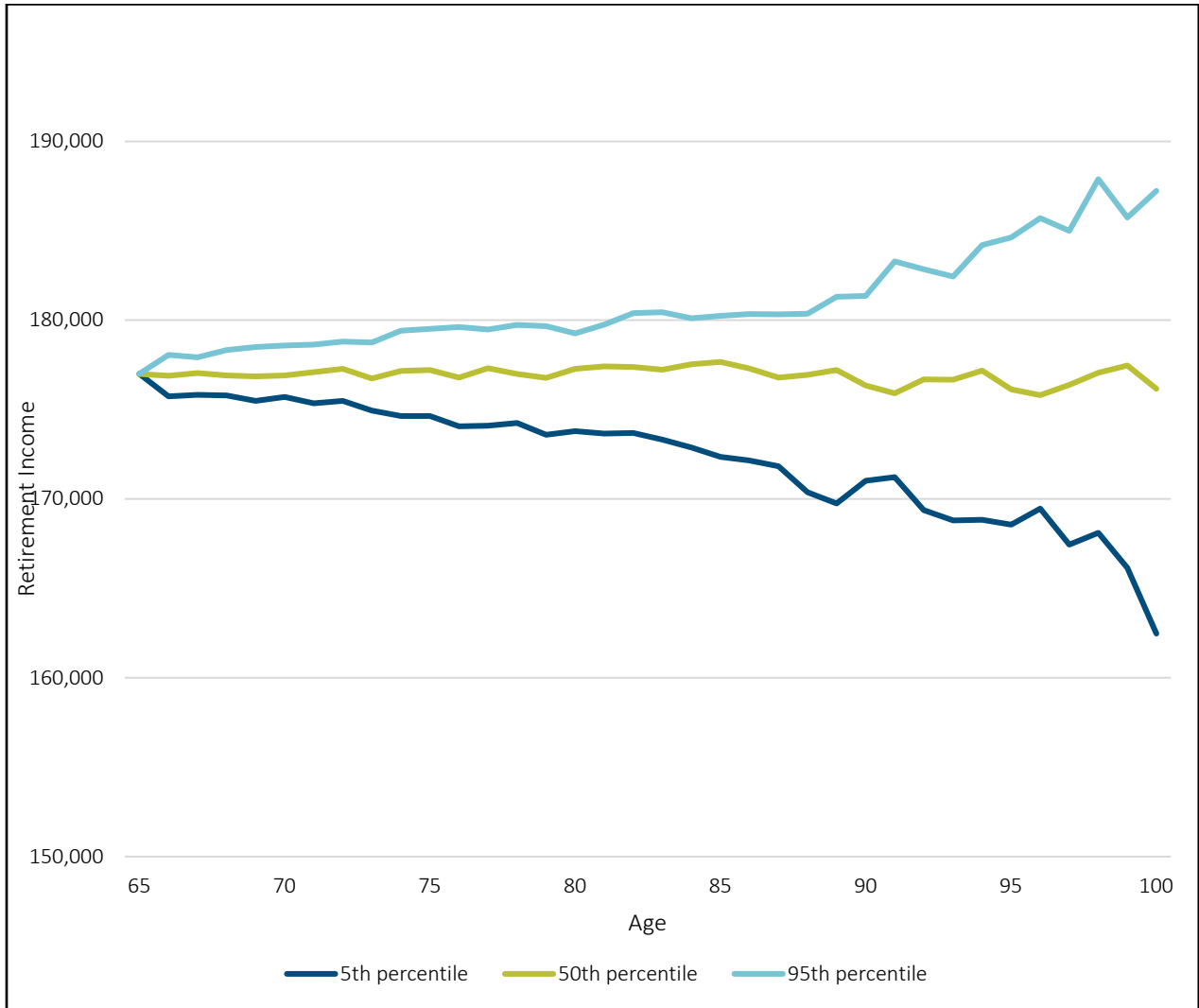
Appendix 4: Dispersion of Outcome Illustrations for India

This appendix provides additional scenarios for India to illustrate how the Value payouts would adjust with different assumptions. The first eight illustrations have a deterministic investment assumption with no volatility to focus on the impact of mortality volatility and different mortality assumptions as well as the impact of various changes such as the rate of improvement, sample sizes or the impact of a Covid-like event on two different cohorts. The final two illustrations show the impact of investment returns and volatility. A new mortality table would be used each year, which is explained in the workbook instructions.

Basic Assumptions (unless adjusted for scenario shown)

- **New cohort** of age 65-year-old retirees is added to pool each year
- **Account balance** at retirement = Rs 2,500,000 (US\$37,313)
- **Interest rate** for actuarial factors = 3.0%
- **Mortality base table** is the Indian Individual Annuitants Mortality Table (2012–15) published March 31, 2021
- **Mortality improvement** is 1.0% per year
- **Mortality uncertainty:**
 - Mortality volatility is based on random variation from the binomial distribution with a standard error of $\sqrt{pq \times N}$ where N is the number of participants at each age in a particular year.
 - In addition, population mortality is assumed to have a standard error of 2.5% per year. In other words, in about two out of three years, actual population mortality would be between 97.5% and 102.5% of mortality predicted by the mortality table with the variation due to things like bad flu seasons or natural disasters. The impact of the mortality assumption being an inaccurate representation of actual mortality is shown in Example 4.
- **Investment returns (real)** are 3.0%, except for the examples with diversified portfolios.
- **Investment returns for the diversified portfolios** are based on economic conditions in the country as of June 2021. The parameters are not determined precisely since the information is only illustrative. The following information describes the stochastic investment return assumptions:
 - **Aggressive portfolio:**
50% growth-oriented assets/50% fixed income
Arithmetic mean of real investment return of 3.32% with volatility of 8%, producing a 3.0% geometric average.
 - **Conservative portfolio:**
25% growth-oriented assets/75% fixed income
Investment returns (real) for the alternative, more conservative, portfolio have an arithmetic mean of 2.08% with volatility of 4%. Some mean reversion in returns is assumed when asset prices get very high or very low.

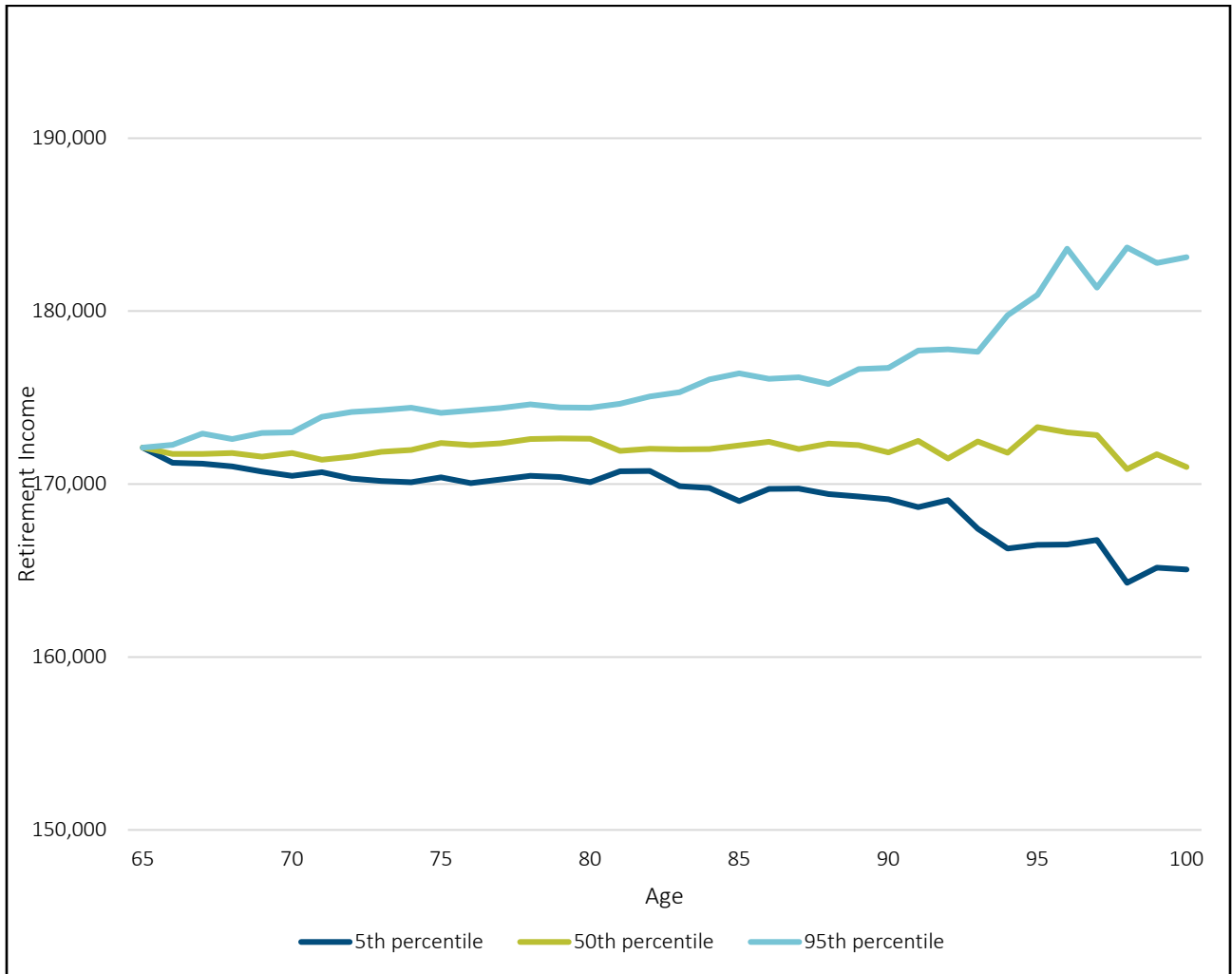
Example 1
INDIA: COHORT NO. 1—NO MORTALITY IMPROVEMENT



Example 2

INDIA: COHORT NO. 1—ASSUMED MORTALITY IMPROVEMENT = 0.75% PER YEAR

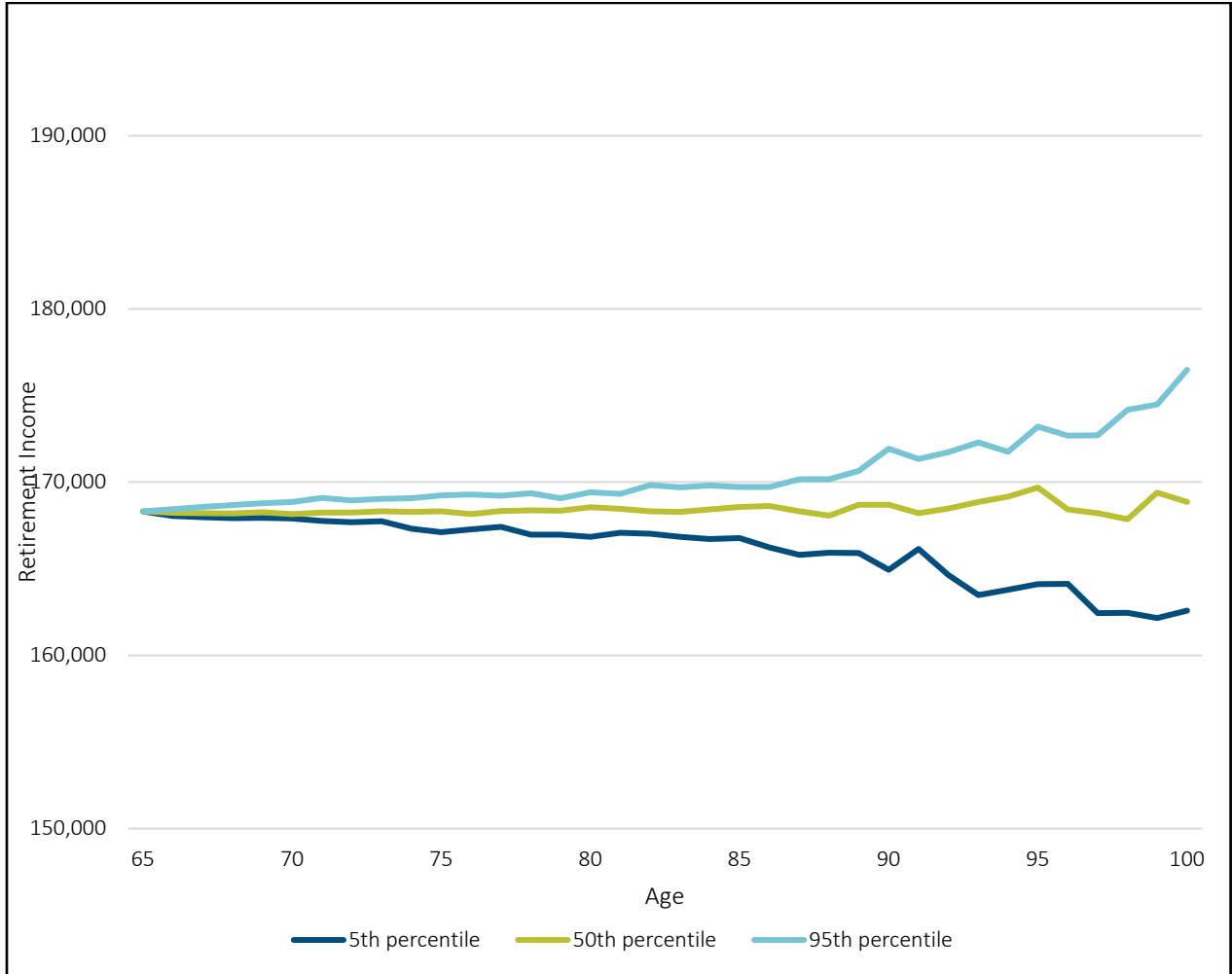
Benefit amounts are lower due to assumed longer life expectancy.



Example 3

INDIA: COHORT NO. 10—ASSUMED MORTALITY IMPROVEMENT = 0.75% PER YEAR

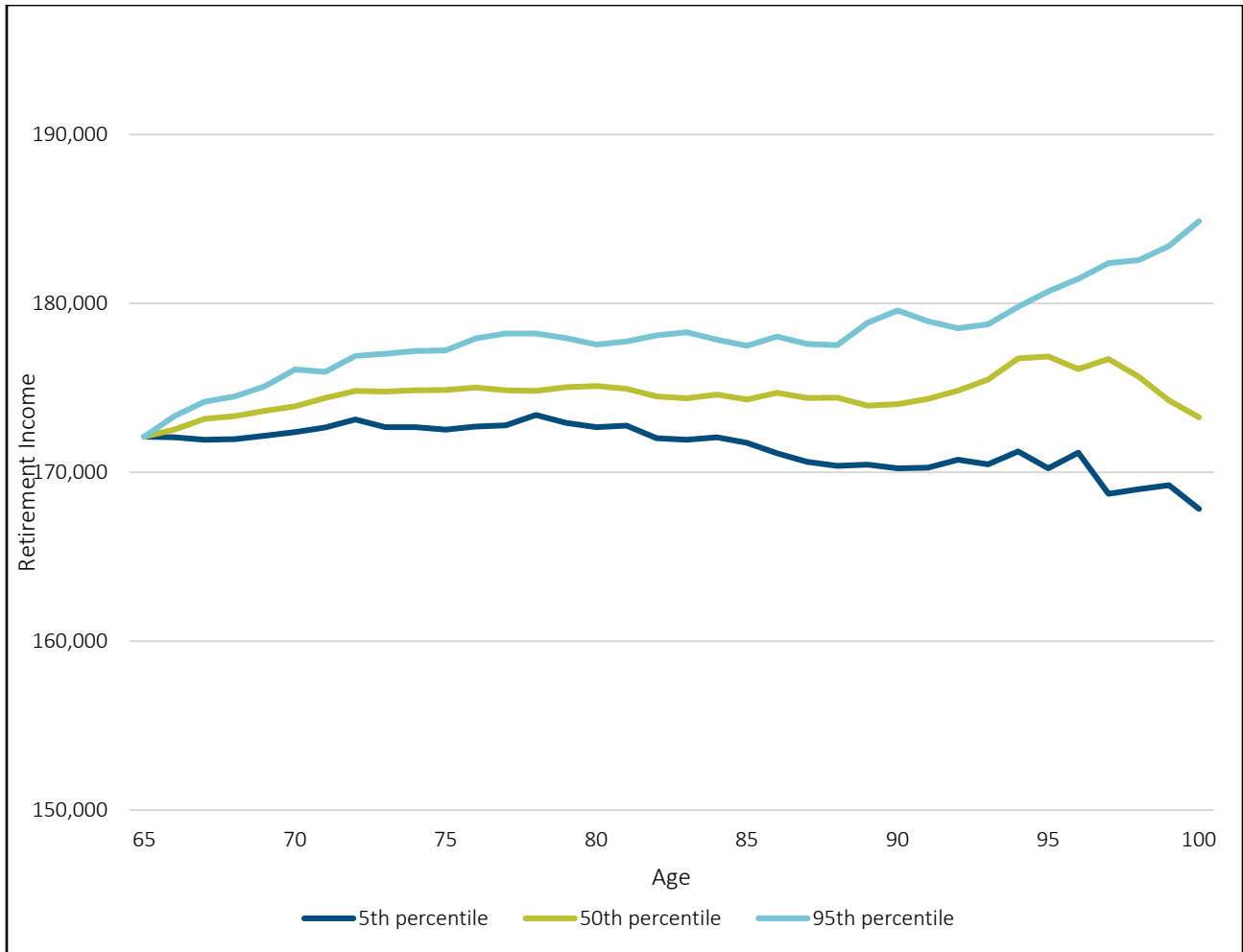
Lower benefit amounts for a given level of savings for later cohorts that have longer life expectancy as longevity improves.



Example 4

INDIA: COHORT NO. 1—MORTALITY ASSUMPTION 20% TOO LOW IN YEAR 1, CORRECTING 2% PER YEAR UNTIL YEAR 10

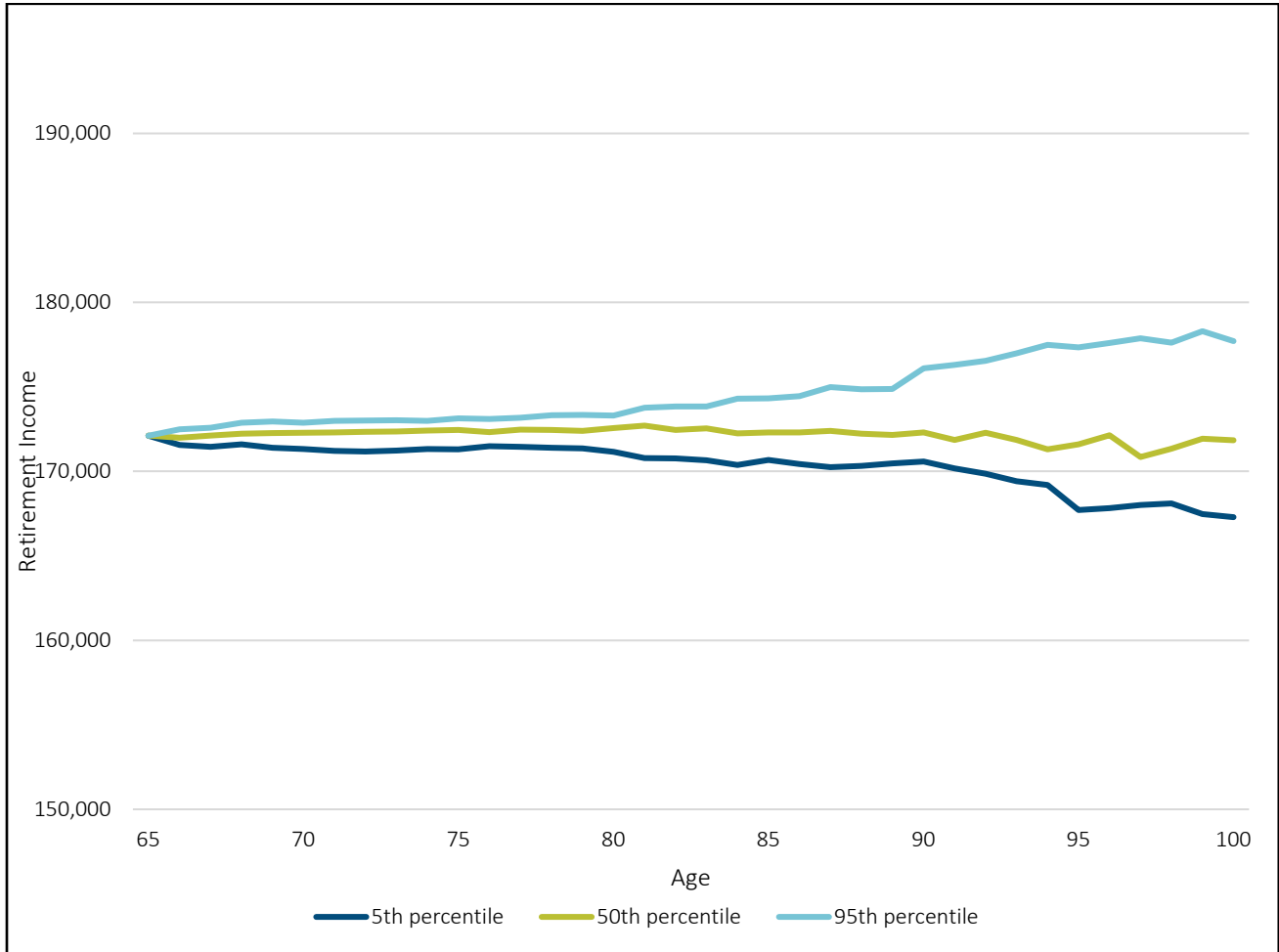
Benefit amounts increase in the early years when mortality risk has been estimated too low and actual mortality is higher, producing bigger mortality gains.



Example 5

INDIA: COHORT NO. 1—5000 NEW MEMBERS EACH YEAR

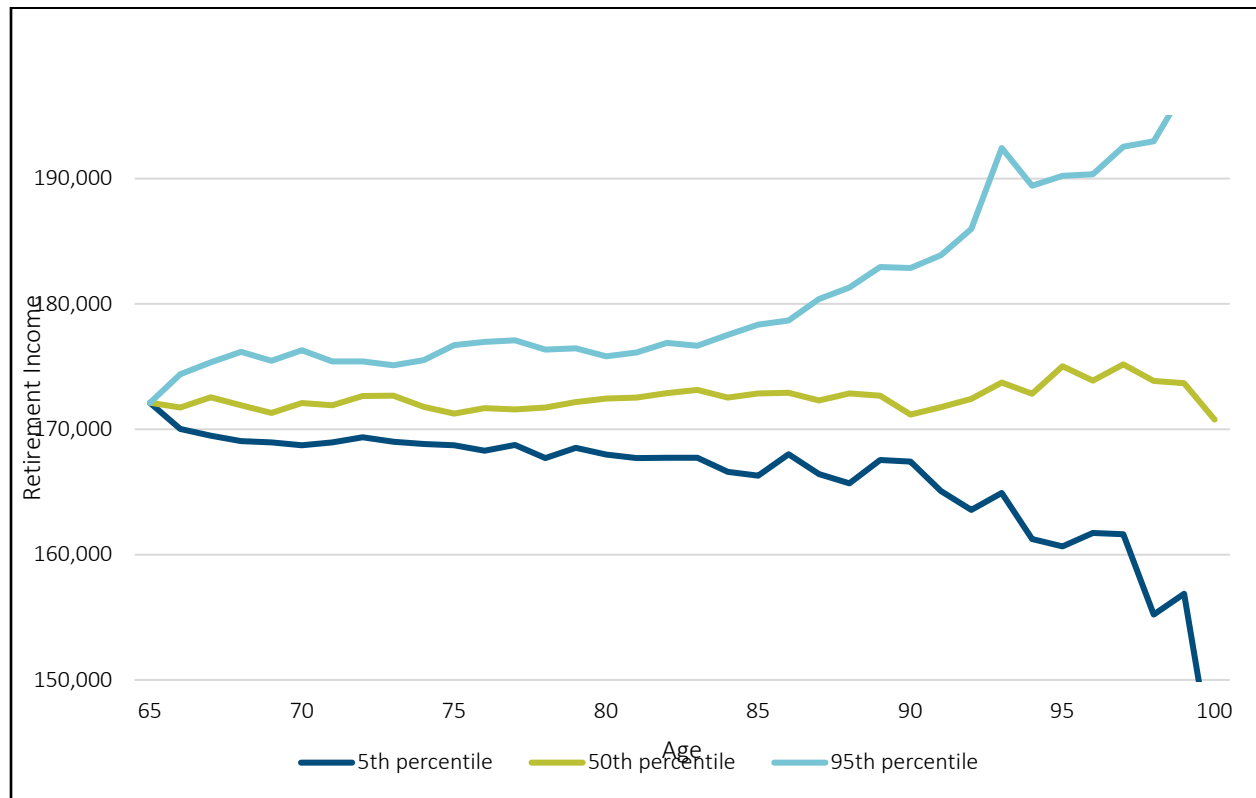
Benefit amounts are less variable since risk is spread among more participants.



Example 6

INDIA: COHORT NO. 1—200 NEW MEMBERS EACH YEAR

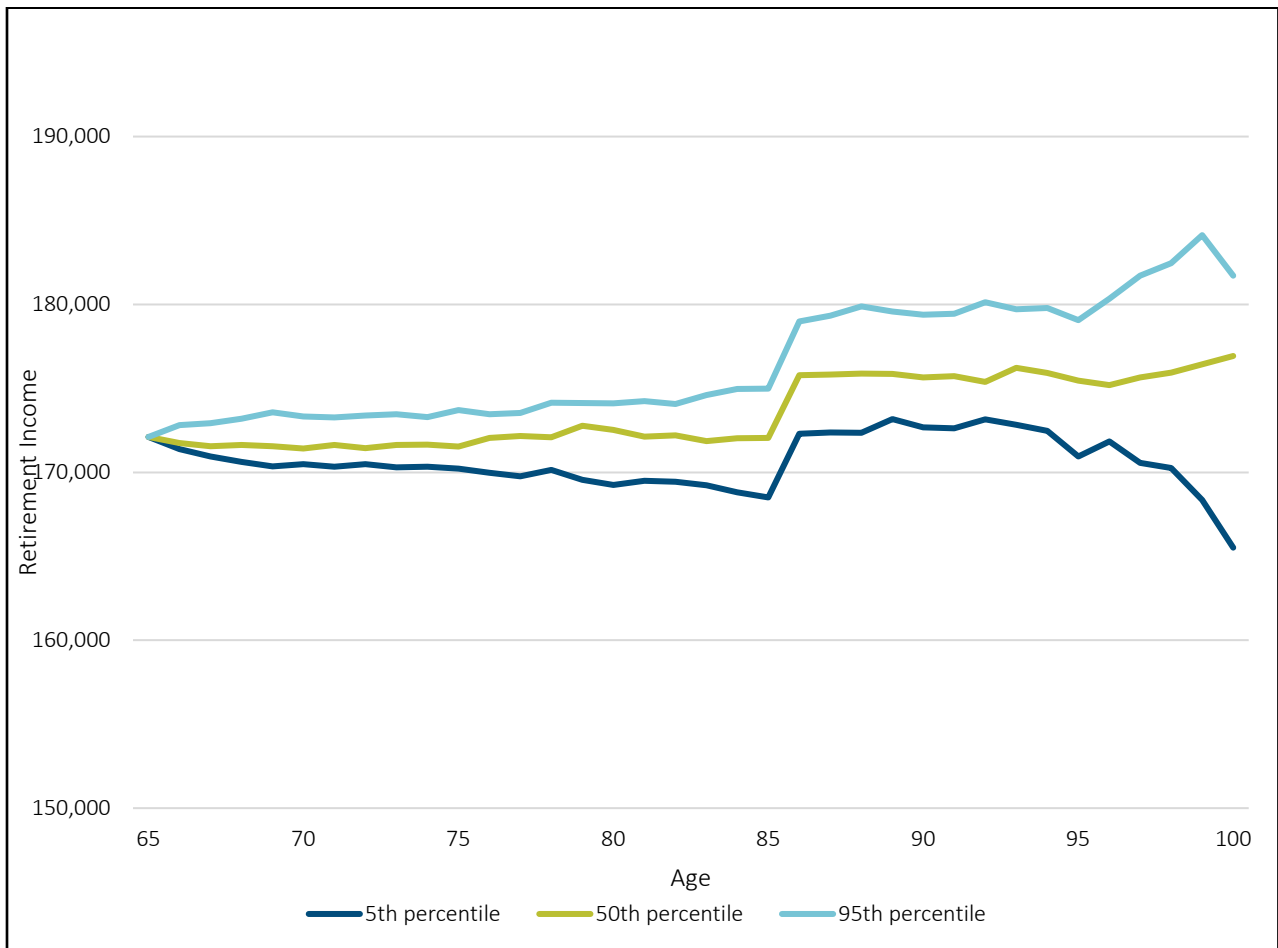
Benefit amounts are more variable since risk is spread among fewer participants.



Example 7

INDIA: COHORT NO. 1—COVID-TYPE EVENT: MORTALITY 25% HIGHER IN YEAR 20 OF POOL

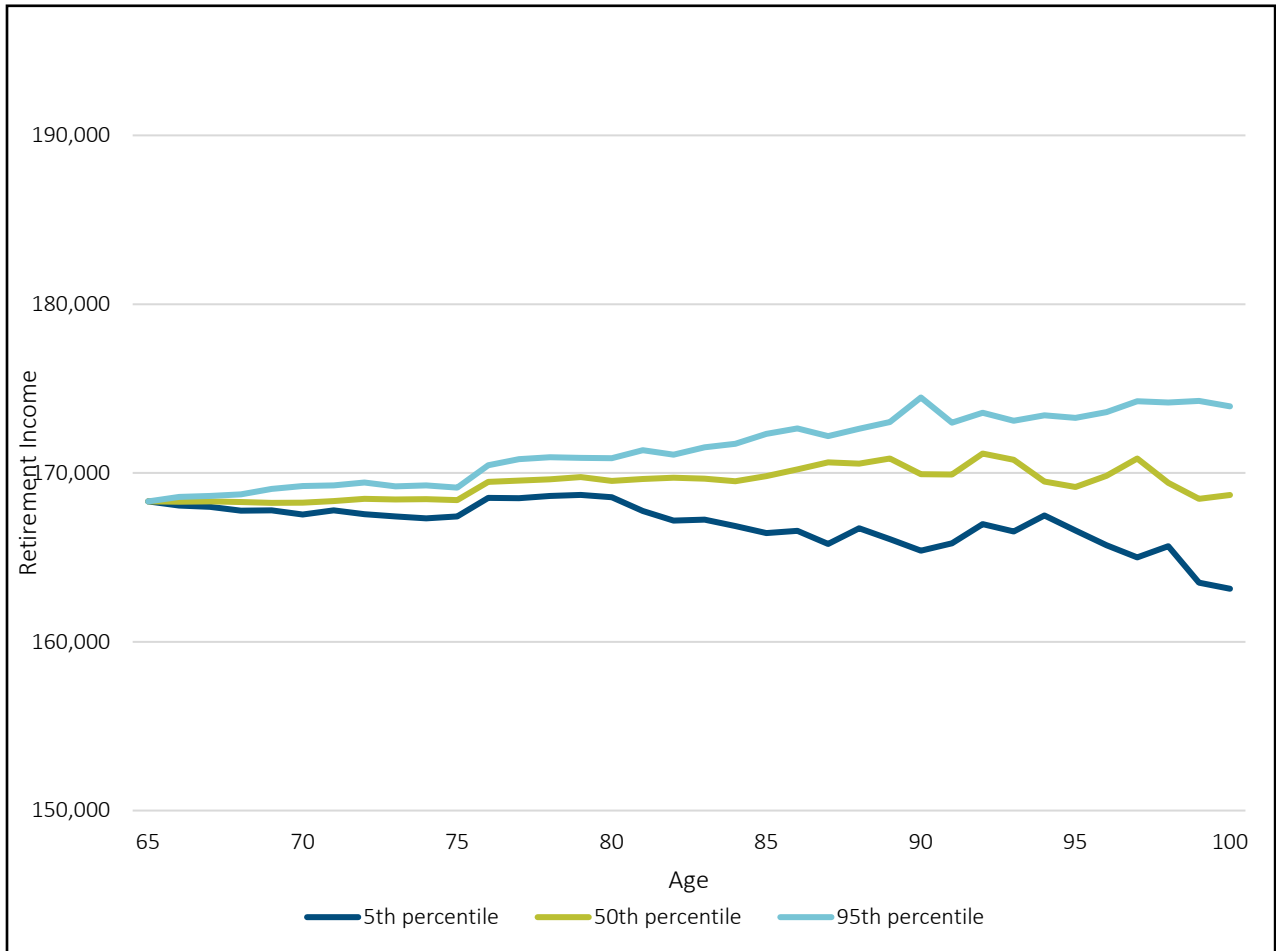
Large mortality gains in the high mortality year.



Example 8

INDIA: COHORT NO. 10—COVID-TYPE EVENT: MORTALITY 25% HIGHER IN YEAR 20 OF POOL, YEAR 10 FOR COHORT

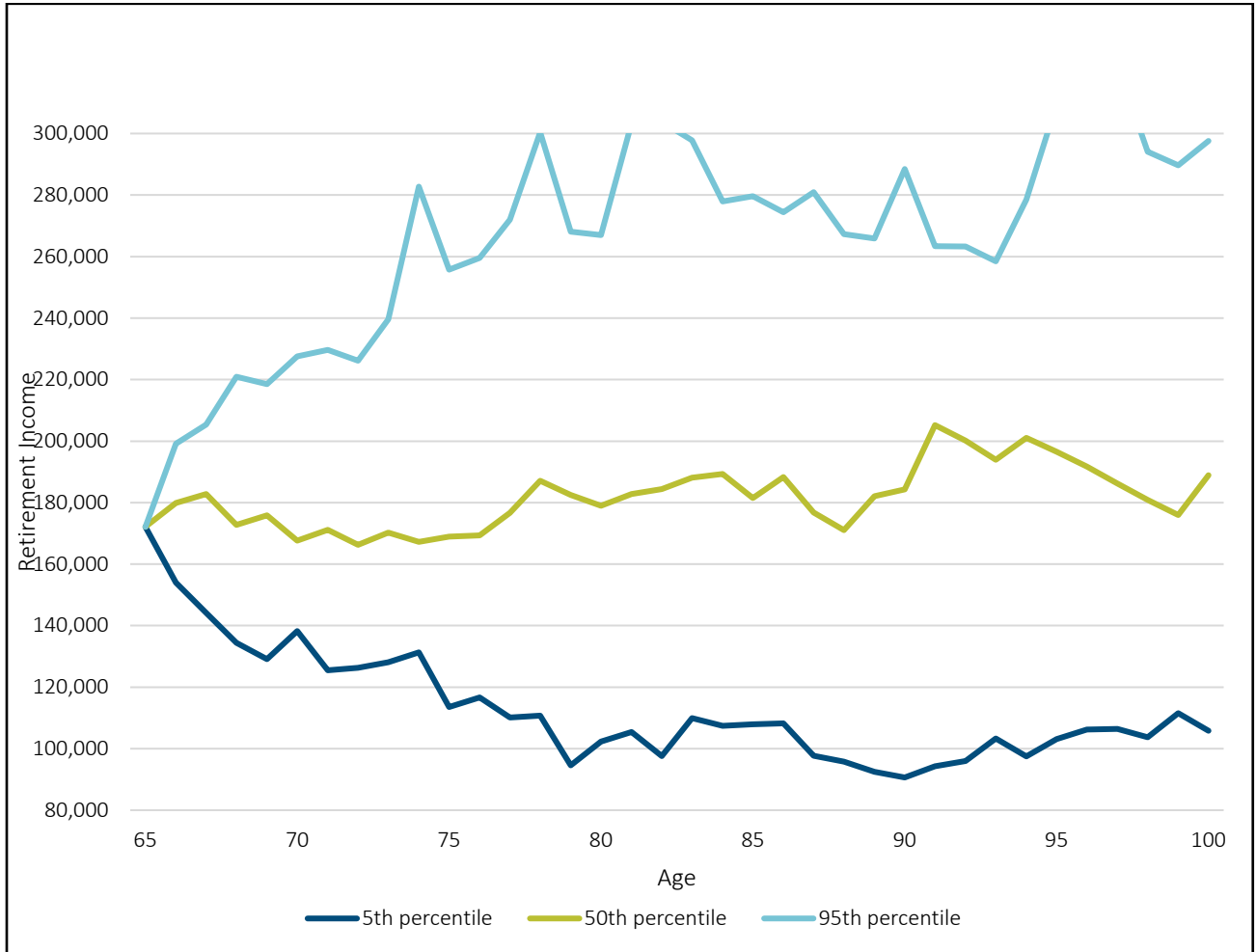
Mortality gains in same year are much smaller for cohort 10 since this group is younger and gets a smaller allocation of the mortality gains.



Example 9

INDIA: COHORT NO. 1—DIVERSIFIED PORTFOLIO WITH 8.0% VOLATILITY

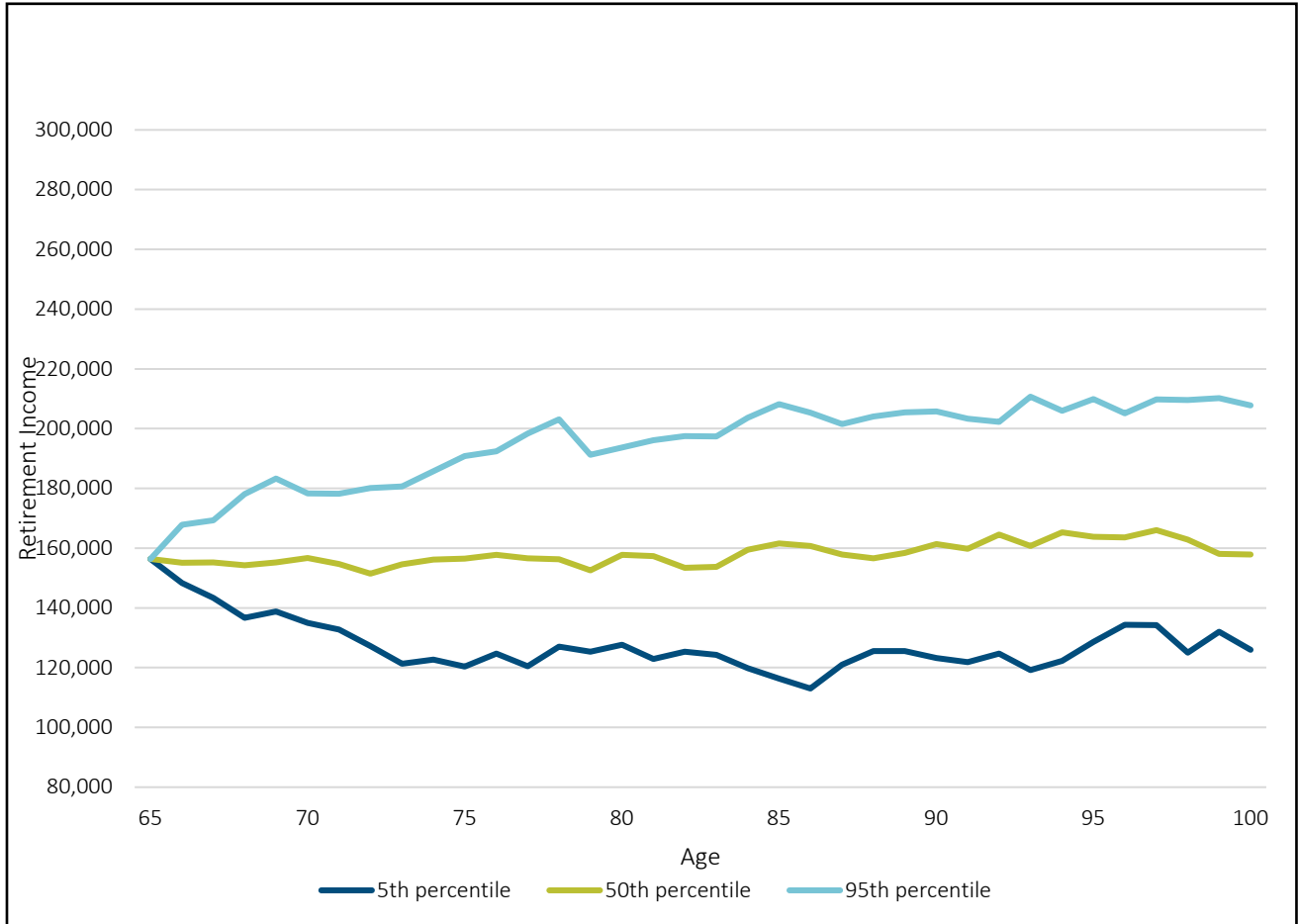
Variability due to investment returns is much greater than variability due to mortality risk. *Note that the scale of the chart is different than the earlier charts.*



Example 10

INDIA: COHORT NO. 1— DIVERSIFIED PORTFOLIO WITH 4.0% VOLATILITY

Lower volatility of investment returns has a significant impact on the dispersion of outcomes for the pool. *Note that the scale of the chart is different than the earlier charts.*



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Society of Actuaries Research Institute
475 N. Martingale Road, Suite 600
Schaumburg, Illinois 60173
www.SOA.org