# Caribbean Pension Mortality Study Report

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## Executive Summary

The Society of Actuaries and the Caribbean Actuarial Association carried out this joint initiative in order to provide further research on the mortality experience of the Caribbean. The Society of Actuaries carried out the technical analysis of the data that was provided by the Caribbean Actuarial Association. The Caribbean Actuarial Association also reviewed the report and provided input into the final results and analyses presented.

The Society of Actuaries and the Caribbean Actuarial Association would like to thank the Directors and staff of the social schemes in The Bahamas, St. Christopher and Nevis, St. Vincent and the Grenadines, and Turks and Caicos for their efforts in providing the information to ensure the completion of the one of the first studies of its kind in the Caribbean.

This report presents an experience study of pension mortality for national pension systems for four Caribbean countries. The countries have not been individually identified and will be referred to for the duration of the study as Country 1, Country 2, Country 3, and Country 4. Across all four countries, the experience data include over 230,000 life-years of exposure and over 7,500 deaths. The experience period spans the calendar years 2011-2018 though, as described in Section 1, not all countries provided data for all eight of these years, so the period studied varies by country. The period under measurement is prior to the COVID-19 pandemic, and there is no data available that includes COVID-19 mortality.

Section 2 of this report summarizes the aggregate mortality experience for each country by sex and pensioner type and compares this experience to several previously established 'expected' bases for mortality. Section 3 breaks down detailed results for Retirement mortality by age group. Due to the small sizes of the datasets, results may not be indicative of true mortality rates in the countries studied.

Key study conclusions include:

- Generally, the highest actual-to-expected (A/E) mortality ratios are seen for Country 1, followed by Country 2, Country 3, and Country 4. While that is typically the pattern observed, there are exceptions for some combinations of sex and expected basis.
- Consistent with other SOA studies, actual-to-expected (A/E) mortality ratios tend to be lower on an amount-weighted basis than a headcount-weighted basis.
- Invalidity mortality is very high for all countries, even substantially exceeding 100% A/E ratios when compared to other tables built from disability experience. However, the volume of invalidity data is very small.
- For males, Country 4 had Retirement A/E ratios that were under 100% on both an amount- and headcount-weighted basis for all expected bases studied.
- For Country 3, an analysis of mortality by pension income quartile was performed, revealing that the lowest income quartile experienced much higher mortality than the other three quartiles.

# Section 1: Study Methods

## 1.1 DATA COLLECTION AND VALIDATION

The experience period for study data collected varied by country. Table 1.1 shows the time period for which mortality experience was studied for each country, with the aqua-shaded cells indicating the years for which each country's study data were made available. This study focuses on years prior to the COVID-19 pandemic, and may not be indicative of post-pandemic mortality.

Table 1.1
YEARS STUDIED FOR EACH COUNTRY

|  | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|
| Country 1 | ■ | ■ | ■ | ■ | ■ | ■ |  |  |
| Country 2 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Country 3 | ■ | ■ | ■ | ■ | ■ |  |  |  |
| Country 4 | ■ | ■ | ■ | ■ | ■ | ■ | ■ |  |

Data elements collected varied slightly by country, but generally consisted of the following:

- Participant ID
- Sex
- Date of birth
- Benefit commencement date
- Status (receiving payment, deceased, or payment stopped for non-death reason)
- Pensioner type (e.g., retirement pension, invalidity pension, survivor pension)
- Monthly pension amount
- Date of death
- Date of termination
- Type of pension (benefit vs. assistance)
- Type of beneficiary (parent vs. spouse)

With the exception of Country 1, which provided a single longitudinal register of data for the full study period, each country provided data as census snapshots as of December 31 of each year, with December 31, 2010 serving as the first snapshot date for each country. Data were linked across years using a combination of a consistent participant ID, pensioner type, and the type of benefit. There were duplicate records in the data, and these duplicates were resolved with the contributors via a review of specific records.

A detailed review of the data was performed, which resulted in questions being sent to the contributor for resolution. Many of the data questions pertained to inconsistencies between the status codes provided as of each December 31st and the various dates (Date of Retirement, Date of Death, etc.) describing each participant's experience. Another important data question for Countries 2, 3, and 4 was regarding disappearing annuitants. These were participants who were indicated as actively receiving payment at one census date, but not provided in the data at the ensuing census date. The purposes of this question were to confirm whether their omission from the subsequent census was due to a death and to confirm the date at which their payments stopped, if applicable.

## 1.2 EXPERIENCE TABULATION

Exposures were determined on an age-last-birthday basis using the actuarial method in which exposure for a deceased person is counted through the birthday following their death. The resultant mortality experience is most

appropriately compared to mortality tables constructed as one-year probabilities of death as of each integral age. Such mortality tables are typically applied on an age-nearest-birthday basis, despite being built from experience tabulated on an age-last-birthday basis. Subsection 13.3 of the Pri-2012 Mortality Tables Report[1] describes this concept in detail.

Exposures and deaths were measured using the final dates determined after resolution of all data questions. Because dates were provided with only month and year, exposures were tabulated on a monthly basis. Exposure was assumed to begin (i) on the first of the month following a provided date of retirement or (ii) at the beginning of the study period, if the provided dates and statuses indicated that the participant was in payment at that time. Exposure was assumed to stop (i) at the end of the month of the participant's birthday following their death, (ii) at the end of the month during which a date of termination is provided, or (iii) at the end of the study period (except when death occurred between the participant's last birthday during the study period and the end of the study period, in which case exposure continued until their next birthday).

Using the previously defined start and stop dates for exposure, a flag was set up to indicate whether to count exposure for each month of the study period. This allowed exposure to be tabulated by both individual age and calendar year.

Deaths were tabulated on an age-last-birthday basis. Because dates were provided with only month and year, it was not possible to know whether a death in the same month as a participant's birthday took place before or after the birthday. The initial resolution to this issue was to defer the increment to a participant's age to the beginning of the month following the month of their birthday. However, this caused the population to be treated, on average, as half of a month younger than their actual age. To adjust for this bias, half of the participants were selected randomly, and the birthdays of these participants were adjusted to be earlier by one month, making them one month older.

Experience was computed on a pension amount-weighted basis in addition to a headcount-weighted basis. Amount-weighted exposures and deaths were calculated by multiplying these values for a particular participant by their monthly pension amount. Monthly pension amounts were provided as of December 31st of each year. The monthly pension as of the preceding December 31st was used for the younger of two ages-last-birthday during a particular calendar year, and the monthly pension as of the following December 31st was used for the older of two ages-last-birthday during that calendar year.

## 1.3 DETERMINATION OF EXPECTED DEATHS AND ACTUAL-TO-EXPECTED RATIOS

For the purposes of evaluating the study experience, the following mortality bases were considered for comparison:

- RP-2006[2], projected with Scale MP-2014 to measurement year
- RP-2014, no projection
- Pri-2012, projected with Scale MP-2020 to measurement year
- GAM94, no projection
- GAM94, projected with Scale AA to measurement year
- GAM94, projected with Scale AA to study midpoint
- UP94, projected with Scale AA to measurement year
- PA80c2020, no projection

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[1] https://www.soa.org/resources/experience-studies/2019/pri-2012-private-mortality-tables/
[2] In 2014, the SOA published the RP-2014 mortality tables, which were built from experience with a central year of 2006, projected forward to the year 2014 using Scale MP-2014. The RP-2006 mortality tables are the experience rates from the RP-2014 study as of 2006, with no projection.

- NIST2012, no projection
- GAM83, no projection

For each basis, expected deaths were computed by multiplying the tabulated exposure for each age, sex, and calendar year by the mortality rate for that age, sex, and calendar year. The RP-2006, RP-2014, and Pri-2012 tables each have amount-weighted and headcount-weighted versions. The headcount-weighted tables were used to compute headcount-weighted expected deaths and the amount-weighted tables were used to compute amount-weighted expected deaths. For the remaining mortality tables, the same rates were used to compute expected deaths on a headcount-weighted basis and an amount-weighted basis.

GAM94, UP94, PA80c2020, NIST2012, and GAM83 include just one table of rates by age for males and females, and these were used for expected mortality for all status groups in the study. The RP-2006 and RP-2014 tables include a separate set of mortality rates for disabled annuitants. The Pri-2012 tables include separate sets of mortality rates for disabled annuitants and contingent survivors.

Using the actual deaths observed and the expected deaths under each basis, actual-to-expected (A/E) mortality ratios were developed to assess the level of mortality observed in the study data relative to the above established bases.

# Section 2: Summary of Results

The results presented in this report include experience totals and actual-to-expected ratios by sex and pensioner type. The three primary pensioner types studied in this report are Retirement, Invalidity, and Survivor, which were included for all four countries. The "Retirement" group was not labeled uniformly by country. Below are the labels used in the data for each country to designate the pensioner type referred to by "Retirement" for the duration of this report.

- Country 1: "Old Age Pension"
- Country 2: "Age"
- Country 3: "Age/Retirement"
- Country 4: "Retirement Pension"

As detailed in Section 1, the RP-2006 and RP-2014 tables have separate mortality rates for disabled annuitants; these rates are used for Invalidity A/E ratios in this section. The Pri-2012 tables have separate mortality rates for disabled annuitants and contingent survivors, which are used for Invalidity and Survivor A/E ratios, respectively, in this section. The "Total" A/E ratio for these bases are, therefore, derived from a mix of tables for the different pensioner types.

## 2.1 COUNTRY 1 RESULTS

Table 2.1 displays a summary of life-years of exposure and deaths for Country 1 by sex and pensioner type.

Table 2.1
COUNTRY 1 LIFE YEARS OF EXPOSURE AND DEATHS BY SEX AND PENSIONER TYPE

| Sex | Statistic | Retirement | Survivor | Invalidity | Total |
|---|---|---|---|---|---|
| Females | Life Years | 11,298 | 2,716 | 207 | 14,221 |
| | Deaths | 198 | 47 | 28 | 273 |
| Males | Life Years | 13,517 | 659 | 300 | 14,476 |
| | Deaths | 404 | 10 | 38 | 452 |

Tables 2.2 and 2.3 show actual-to-expected ratios by sex and pensioner type for each of the mortality bases being used for comparison in this study. For Table 2.2, the experience is weighted by headcount. For Table 2.3, the experience is weighted by pension amount.

Table 2.2
COUNTRY 1 HEADCOUNT-WEIGHTED A/E RATIOS BY SEX AND PENSIONER TYPE

| | Expected Basis | Retirement | Survivor | Invalidity | Total |
|---|---|---|---|---|---|
| Females | RPH-2006 / MP-2014 | 136.4% | 137.5% | 1074.2% | 150.1% |
| | RPH-2014 | 137.2% | 138.0% | 1078.8% | 150.9% |
| | Pri.H-2012 / MP-2020 | 127.3% | 96.5% | 858.1% | 131.5% |
| | GAM94 | 136.9% | 138.6% | 6137.1% | 152.5% |
| | GAM94 / AA | 154.6% | 156.2% | 7138.9% | 172.2% |
| | GAM94 / AA Midpoint | 154.7% | 156.3% | 7169.6% | 172.3% |
| | UP94 / AA | 143.8% | 145.3% | 6639.3% | 160.1% |
| | PA80c2020 | 143.3% | 137.8% | 6643.6% | 158.0% |
| | NIST2012 | 121.4% | 127.7% | 5426.6% | 136.2% |
| | GAM83 | 141.7% | 137.6% | 5833.2% | 156.6% |
| Males | RPH-2006 / MP-2014 | 159.5% | 80.3% | 577.0% | 165.9% |
| | RPH-2014 | 160.4% | 80.6% | 581.5% | 166.9% |
| | Pri.H-2012 / MP-2020 | 146.2% | 50.7% | 547.8% | 149.2% |
| | GAM94 | 135.8% | 69.8% | 3063.5% | 144.3% |
| | GAM94 / AA | 176.1% | 87.2% | 4272.9% | 187.0% |
| | GAM94 / AA Midpoint | 176.8% | 87.4% | 4311.7% | 187.7% |
| | UP94 / AA | 163.8% | 81.1% | 3973.9% | 173.9% |
| | PA80c2020 | 133.1% | 65.1% | 3583.4% | 141.3% |
| | NIST2012 | 100.5% | 54.3% | 2082.8% | 107.1% |
| | GAM83 | 117.6% | 59.2% | 2338.8% | 124.9% |

Table 2.3
COUNTRY 1 AMOUNT-WEIGHTED A/E RATIOS BY SEX AND PENSIONER TYPE

| | Expected Basis | Retirement | Survivor | Invalidity | Total |
|---|---|---|---|---|---|
| Females | RP-2006 / MP-2014 | 119.6% | 132.0% | 1006.6% | 137.7% |
| | RP-2014 | 120.1% | 132.2% | 1010.4% | 138.2% |
| | Pri-2012 / MP-2020 | 113.0% | 90.1% | 931.3% | 124.0% |
| | GAM94 | 114.6% | 126.5% | 5891.2% | 134.1% |
| | GAM94 / AA | 128.8% | 143.0% | 6863.4% | 150.8% |
| | GAM94 / AA Midpoint | 128.9% | 143.1% | 6892.4% | 150.9% |
| | UP94 / AA | 119.8% | 133.0% | 6383.0% | 140.2% |
| | PA80c2020 | 124.6% | 127.8% | 6328.8% | 144.4% |
| | NIST2012 | 99.9% | 115.1% | 5217.1% | 117.5% |
| | GAM83 | 121.6% | 127.6% | 5567.5% | 141.3% |
| Males | RP-2006 / MP-2014 | 160.5% | 75.8% | 605.1% | 169.3% |
| | RP-2014 | 161.1% | 76.0% | 609.2% | 169.9% |
| | Pri-2012 / MP-2020 | 154.5% | 40.4% | 631.9% | 159.8% |
| | GAM94 | 123.1% | 60.2% | 3146.1% | 132.8% |
| | GAM94 / AA | 161.3% | 76.3% | 4405.8% | 173.9% |
| | GAM94 / AA Midpoint | 161.8% | 76.5% | 4434.5% | 174.4% |
| | UP94 / AA | 150.0% | 71.0% | 4097.5% | 161.7% |
| | PA80c2020 | 125.2% | 57.3% | 3672.3% | 134.9% |
| | NIST2012 | 88.9% | 46.1% | 2141.7% | 96.0% |
| | GAM83 | 107.9% | 50.9% | 2407.5% | 116.2% |

The study data produces Total A/E ratios of over 100% on most of the expected bases shown. However, on an amount-weighted basis, the NIST2012 expected basis for males produces an aggregate A/E ratio below 100%. For expected bases other than NIST2012, aggregate A/E ratios by sex range between 120% and 190% on a headcount-weighted basis and between 115% and 175% on an amount-weighted basis. In general, lower mortality rates are observed on an amount-weighted basis than a headcount-weighted basis. This observation is consistent with other SOA pension studies and is believed to be due to the general trend of individuals with higher income experiencing lower mortality rates.

In particular, the invalidity A/E ratios are very high, though the sample of data contributing to them is very small. It should be noted that, for RP-2006 and Pri-2012, the basis of comparison for Invalidity is a disability mortality table, so the A/E ratios are significantly lower (though still quite high) on these bases than the others. Although the number of life-years of exposure for Invalidity is small, aggregating the Invalidity experience with the Retirement and Survivor experience significantly raises the A/E ratios from what they would be excluding Invalidity.

Table 2.4 displays 95% confidence intervals[3] for the above headcount-weighted A/E ratios on the PA80c2020 basis.

Table 2.4
COUNTRY 1 HEADCOUNT-WEIGHTED 95% CONFIDENCE INTERVALS ON THE PA80C2020 BASIS

|  | Measure | Retirement | Survivor | Invalidity | Total |
|---|---|---|---|---|---|
| Females | A/E Ratio | 143.3% | 137.8% | 6643.6% | **158.0%** |
|  | A/E – 95% CI Lower Bound | 124.0% | 101.2% | 4413.6% | **139.8%** |
|  | A/E – 95% CI Upper Bound | 164.7% | 183.2% | 9602.2% | **177.9%** |
| Males | A/E Ratio | 133.1% | 65.1% | 3583.4% | **141.3%** |
|  | A/E – 95% CI Lower Bound | 120.4% | 31.2% | 2535.5% | **128.5%** |
|  | A/E – 95% CI Upper Bound | 146.7% | 119.7% | 4918.6% | **154.9%** |

## 2.2 COUNTRY 2 RESULTS

Table 2.5 displays a summary of life-years of exposure and deaths for Country 2 by sex and pensioner type.

Table 2.5
COUNTRY 2 LIFE YEARS OF EXPOSURE AND DEATHS BY SEX AND PENSIONER TYPE

| Sex | Statistic | Retirement | Survivor | Invalidity | Total |
|---|---|---|---|---|---|
| Females | Life Years | 12,368 | 3,921 | 1,512 | 17,801 |
|  | Deaths | 280 | 106 | 71 | 457 |
| Males | Life Years | 12,029 | 839 | 1,219 | 14,086 |
|  | Deaths | 455 | 25 | 65 | 545 |

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[3] Confidence intervals in this report were computed using Byar's approximation for confidence limits around a Poisson mean. See *Breslow NE, Day NE. Statistical methods in cancer research. Volume II--The design and analysis of cohort studies. IARC Sci Publ. 1987;(82):1-406. PMID: 3329634, pg 69.*

Tables 2.6 and 2.7 show actual-to-expected ratios by sex and pensioner type for each of the mortality bases being used for comparison in this study. For Table 2.6, the experience is weighted by headcount. For Table 2.7, the experience is weighted by pension amount.

Table 2.6
COUNTRY 2 HEADCOUNT-WEIGHTED A/E RATIOS BY SEX AND PENSIONER TYPE

| | Expected Basis | Retirement | Survivor | Invalidity | Total |
|---|---|---|---|---|---|
| Females | RPH-2006 / MP-2014 | 126.5% | 102.7% | 353.8% | 132.6% |
| | RPH-2014 | 124.5% | 101.4% | 344.6% | 130.6% |
| | Pri.H-2012 / MP-2020 | 114.6% | 79.0% | 279.8% | 113.2% |
| | GAM94 | 119.8% | 97.5% | 1804.0% | 131.9% |
| | GAM94 / AA | 135.0% | 108.4% | 2093.6% | 148.1% |
| | GAM94 / AA Midpoint | 134.3% | 108.0% | 2082.8% | 147.4% |
| | UP94 / AA | 125.5% | 100.8% | 1947.1% | 137.7% |
| | PA80c2020 | 118.9% | 91.6% | 1999.2% | 128.8% |
| | NIST2012 | 109.0% | 91.6% | 1560.1% | 121.2% |
| | GAM83 | 122.7% | 96.8% | 1764.5% | 133.7% |
| Males | RPH-2006 / MP-2014 | 158.9% | 143.0% | 248.9% | 165.2% |
| | RPH-2014 | 157.2% | 140.6% | 247.1% | 163.4% |
| | Pri.H-2012 / MP-2020 | 142.8% | 87.6% | 232.1% | 145.3% |
| | GAM94 | 132.3% | 124.3% | 1220.4% | 147.5% |
| | GAM94 / AA | 167.6% | 156.5% | 1725.2% | 187.1% |
| | GAM94 / AA Midpoint | 166.1% | 154.7% | 1704.2% | 185.4% |
| | UP94 / AA | 155.9% | 145.6% | 1604.5% | 174.0% |
| | PA80c2020 | 126.3% | 118.7% | 1436.3% | 141.3% |
| | NIST2012 | 101.3% | 97.3% | 820.6% | 112.9% |
| | GAM83 | 115.3% | 108.1% | 958.9% | 128.4% |

Table 2.7
COUNTRY 2 AMOUNT-WEIGHTED A/E RATIOS BY SEX AND PENSIONER TYPE

| | Expected Basis | Retirement | Survivor | Invalidity | Total |
|---|---|---|---|---|---|
| Females | RP-2006 / MP-2014 | 117.0% | 109.4% | 342.7% | 131.6% |
| | RP-2014 | 114.7% | 107.8% | 339.1% | 129.1% |
| | Pri-2012 / MP-2020 | 101.3% | 77.9% | 277.1% | 110.2% |
| | GAM94 | 106.3% | 100.5% | 1739.3% | 126.9% |
| | GAM94 / AA | 120.1% | 112.4% | 2014.2% | 143.2% |
| | GAM94 / AA Midpoint | 119.3% | 111.9% | 2000.9% | 142.3% |
| | UP94 / AA | 111.7% | 104.5% | 1873.3% | 133.2% |
| | PA80c2020 | 109.5% | 94.9% | 1931.1% | 129.2% |
| | NIST2012 | 95.2% | 93.8% | 1498.1% | 114.2% |
| | GAM83 | 111.0% | 99.8% | 1707.1% | 131.5% |
| Males | RP-2006 / MP-2014 | 154.3% | 148.4% | 242.0% | 160.2% |
| | RP-2014 | 152.0% | 145.8% | 239.3% | 157.9% |
| | Pri-2012 / MP-2020 | 124.9% | 77.5% | 226.5% | 130.0% |
| | GAM94 | 114.5% | 118.4% | 1143.9% | 126.2% |
| | GAM94 / AA | 148.4% | 151.1% | 1623.0% | 163.7% |
| | GAM94 / AA Midpoint | 146.5% | 149.2% | 1598.5% | 161.7% |
| | UP94 / AA | 138.0% | 140.6% | 1509.4% | 152.3% |
| | PA80c2020 | 112.0% | 115.4% | 1342.4% | 123.8% |
| | NIST2012 | 85.7% | 90.9% | 769.5% | 94.4% |
| | GAM83 | 100.1% | 102.7% | 902.9% | 110.2% |

Most A/E ratios are substantially higher than 100%. Among the Total A/E ratios, only the ratio for amount-weighted males under the NIST2012 basis is below 100%. For expected bases other than NIST2012, A/E ratios on a headcount basis range for females between 110% and 150% and for males between 125% and 190%. On an amount-weighted basis, these ranges are 110% to 145% and 110% to 165% for females and males, respectively.

Similar to Country 1, the A/E ratios for Invalidity are very high under all bases, though lower for the RP-2006 and Pri-2012 bases due to the use of disability-specific tables. Survivor mortality for Country        2 was lower than Retirement mortality for both females and males during the study period on a headcount basis. The A/E ratios for Survivors are significantly lower under the Pri-2012 basis because the Pri-2012 basis includes an assumption of survivor-specific tables to develop expected mortality, and the U.S. pension data upon which the Pri-2012 study was built exhibited significantly higher mortality for survivors than healthy retirees.

Table 2.8 displays 95% confidence intervals for the above headcount-weighted A/E ratios on the PA80c2020 basis.

Table 2.8
COUNTRY 2 HEADCOUNT-WEIGHTED 95% CONFIDENCE INTERVALS ON THE PA80C2020 BASIS

|  | Measure | Retirement | Survivor | Invalidity | Total |
|---|---|---|---|---|---|
| Females | A/E Ratio | 118.9% | 91.6% | 1999.2% | **128.8%** |
|  | A/E − 95% CI Lower Bound | 105.4% | 75.0% | 1561.3% | **117.3%** |
|  | A/E − 95% CI Upper Bound | 133.6% | 110.8% | 2521.7% | **141.2%** |
| Males | A/E Ratio | 126.3% | 118.7% | 1436.3% | **141.3%** |
|  | A/E − 95% CI Lower Bound | 115.0% | 76.8% | 1108.4% | **129.6%** |
|  | A/E − 95% CI Upper Bound | 138.5% | 175.2% | 1830.7% | **153.6%** |

## 2.3 COUNTRY 3 RESULTS

Table 2.9 displays a summary of life-years of exposure and deaths for Country 3 by sex and pensioner type. In addition to the Retirement, Survivor, and Invalidity pensioner types, Country 3 also reported experience for Industrial Death (labeled "Ind. Death" in the tables in this subsection).

Table 2.9
COUNTRY 3 LIFE YEARS OF EXPOSURE AND DEATHS BY SEX AND PENSIONER TYPE

| Sex | Statistic | Retirement | Survivor | Invalidity | Ind. Death | Total |
|---|---|---|---|---|---|---|
| Females | Life Years | 63,467 | 17,475 | 13,920 | 239 | 95,101 |
|  | Deaths | 1,938 | 470 | 543 | 0 | 2,951 |
| Males | Life Years | 50,976 | 1,859 | 12,657 | 1 | 65,493 |
|  | Deaths | 2,020 | 41 | 541 | 0 | 2,602 |

Tables 2.10 and 2.11 show actual-to-expected ratios by sex and pensioner type for each of the mortality bases being used for comparison in this study. For Table 2.10, the experience is weighted by headcount. For Table 2.11, the experience is weighted by pension amount.

Table 2.10
COUNTRY 3 HEADCOUNT-WEIGHTED A/E RATIOS BY SEX AND PENSIONER TYPE

| | Expected Basis | Retirement | Survivor | Invalidity | Ind. Death | Total |
|---|---|---|---|---|---|---|
| Females | RPH-2006 / MP-2014 | 116.7% | 133.0% | 195.3% | 0.0% | 128.6% |
| | RPH-2014 | 119.2% | 135.3% | 198.9% | 0.0% | 131.2% |
| | Pri.H-2012 / MP-2020 | 108.5% | 102.3% | 169.9% | 0.0% | 114.9% |
| | GAM94 | 113.8% | 131.1% | 454.4% | 0.0% | 135.1% |
| | GAM94 / AA | 125.6% | 145.9% | 513.9% | 0.0% | 149.6% |
| | GAM94 / AA Midpoint | 125.6% | 145.7% | 513.7% | 0.0% | 149.5% |
| | UP94 / AA | 116.8% | 135.5% | 478.2% | 0.0% | 139.0% |
| | PA80c2020 | 110.7% | 124.1% | 457.0% | 0.0% | 131.1% |
| | NIST2012 | 105.9% | 122.7% | 414.8% | 0.0% | 125.7% |
| | GAM83 | 113.9% | 129.5% | 451.6% | 0.0% | 134.9% |
| Males | RPH-2006 / MP-2014 | 126.7% | 118.5% | 184.6% | 0.0% | 135.4% |
| | RPH-2014 | 129.2% | 119.5% | 187.7% | 0.0% | 138.0% |
| | Pri.H-2012 / MP-2020 | 115.7% | 77.7% | 170.7% | 0.0% | 123.0% |
| | GAM94 | 107.6% | 103.1% | 523.8% | 0.0% | 128.8% |
| | GAM94 / AA | 132.0% | 127.0% | 677.5% | 0.0% | 158.4% |
| | GAM94 / AA Midpoint | 131.9% | 126.3% | 676.9% | 0.0% | 158.3% |
| | UP94 / AA | 122.6% | 117.4% | 629.6% | 0.0% | 147.2% |
| | PA80c2020 | 99.9% | 95.5% | 533.1% | 0.0% | 120.1% |
| | NIST2012 | 85.2% | 81.1% | 381.3% | 0.0% | 101.5% |
| | GAM83 | 93.3% | 87.6% | 443.3% | 0.0% | 111.4% |

Table 2.11
COUNTRY 3 AMOUNT-WEIGHTED A/E RATIOS BY SEX AND PENSIONER TYPE

| | Expected Basis | Retirement | Survivor | Invalidity | Ind. Death | Total |
|---|---|---|---|---|---|---|
| Females | RP-2006 / MP-2014 | 117.6% | 132.7% | 203.1% | 0.0% | 129.7% |
| | RP-2014 | 119.9% | 135.1% | 206.7% | 0.0% | 132.2% |
| | Pri-2012 / MP-2020 | 109.3% | 103.3% | 197.5% | 0.0% | 118.6% |
| | GAM94 | 110.3% | 125.5% | 478.9% | 0.0% | 131.5% |
| | GAM94 / AA | 122.2% | 139.4% | 541.2% | 0.0% | 145.9% |
| | GAM94 / AA Midpoint | 113.6% | 129.5% | 503.3% | 0.0% | 135.6% |
| | UP94 / AA | 122.1% | 139.2% | 540.8% | 0.0% | 145.8% |
| | PA80c2020 | 107.8% | 118.8% | 486.8% | 0.0% | 128.3% |
| | NIST2012 | 102.1% | 117.7% | 434.0% | 0.0% | 121.9% |
| | GAM83 | 110.9% | 124.1% | 481.1% | 0.0% | 132.0% |
| Males | RP-2006 / MP-2014 | 130.6% | 128.1% | 200.0% | 0.0% | 139.7% |
| | RP-2014 | 133.1% | 129.3% | 203.2% | 0.0% | 142.3% |
| | Pri-2012 / MP-2020 | 123.1% | 72.5% | 198.7% | 0.0% | 131.8% |
| | GAM94 | 101.1% | 102.5% | 530.2% | 0.0% | 119.2% |
| | GAM94 / AA | 124.4% | 127.1% | 687.6% | 0.0% | 147.0% |
| | GAM94 / AA Midpoint | 115.5% | 117.6% | 638.5% | 0.0% | 136.5% |
| | UP94 / AA | 124.2% | 126.4% | 686.6% | 0.0% | 146.8% |
| | PA80c2020 | 94.1% | 96.8% | 540.0% | 0.0% | 111.4% |
| | NIST2012 | 79.7% | 79.5% | 385.4% | 0.0% | 93.7% |
| | GAM83 | 87.6% | 87.0% | 450.4% | 0.0% | 103.2% |

A relatively small amount of exposures were provided for Industrial Death, but no deaths were observed among this pensioner type. While most A/E ratios are over 100% compared to the various U.S. expected bases, the A/E ratios are below 100% for males for the Retirement and Survivor pensioner types for the PA80c2020, NIST2012, and GAM83 bases. Invalidity mortality remains very high compared to all expected bases, though less so than for Country 2 and Country 1. A/E ratios on a headcount basis range for females between 110% and 150% and for males between 100% and 160%. On an amount-weighted basis, these ranges are 115% to 150% and 90% to 150% for females and males, respectively.

Table 2.12 displays 95% confidence intervals for the above headcount-weighted A/E ratios on the PA80c2020 basis.

Table 2.12
COUNTRY 3 HEADCOUNT-WEIGHTED 95% CONFIDENCE INTERVALS ON THE PA80C2020 BASIS

|  | Measure | Retirement | Survivor | Invalidity | Ind. Death | Total |
|---|---|---|---|---|---|---|
| Females | A/E Ratio | 110.7% | 124.1% | 457.0% | 0.0% | 131.1% |
|  | A/E – 95% CI Lower Bound | 105.8% | 113.2% | 419.4% | N/A | 126.4% |
|  | A/E – 95% CI Upper Bound | 115.7% | 135.9% | 497.1% | N/A | 135.9% |
| Males | A/E Ratio | 99.9% | 95.5% | 533.1% | 0.0% | 120.1% |
|  | A/E – 95% CI Lower Bound | 95.6% | 68.5% | 489.1% | N/A | 115.5% |
|  | A/E – 95% CI Upper Bound | 104.3% | 129.6% | 580.0% | N/A | 124.8% |

Subsection 2.1 discusses the observation that amount-weighted A/E ratios tend to be lower than their headcount-weighted counterparts when using the same mortality basis[4]. The general reason ascribed to this is that pensioners with lower income tend to exhibit higher mortality characteristics. Country 3's Retirement population is the largest subgroup in the study, which makes it the most credible to split into quartiles. To do this, separate quartile breakpoints were created for males and females based on the average benefit amount for each pensioner across the study period. Table 2.13 displays these breakpoints.

Table 2.13
COUNTRY 3 RETIREMENT INCOME QUARTILE BREAKPOINTS

|  | 25th Percentile | 50th Percentile | 75th Percentile |
|---|---|---|---|
| Females | 276.81 | 303.65 | 531.09 |
| Males | 285.85 | 418.37 | 688.78 |

Table 2.14 displays the difference in headcount-weighted A/E ratios on the PA80C2020 basis by income quartiles, with Quartile 1 representing the group with the highest pension amounts.

Table 2.14
COUNTRY 3 RETIREMENT HEADCOUNT-WEIGHTED A/E RATIOS BY INCOME QUARTILE ON THE PA80C2020 BASIS

|  | Quartile 1 | Quartile 2 | Quartile 3 | Quartile 4 | Total |
|---|---|---|---|---|---|
| Females | 90.9% | 109.9% | 78.2% | 171.3% | 110.7% |
| Males | 85.5% | 97.2% | 88.4% | 131.1% | 99.9% |

For both males and females, the A/E ratios for Quartile 1, Quartile 2, and Quartile 3 are lower than the aggregate Retirement A/E ratio, with the lowest income group, Quartile 4, having substantially higher A/E ratios. Because there

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[4] Note again that the RP-2006, RP-2014, and Pri-2012 tables have headcount-weighted versions. The mortality bases using these tables are not consistent between the tables displaying headcount-weighted and the tables displaying amount-weighted results.

is a higher concentration of deaths among pensioners with the lowest benefit amounts, it is observed that amount-weighted A/E ratios are smaller than headcount-weighted A/E ratios for Country 3 Retirement experience when the same set of mortality rates are used as the expected basis.

## 2.4 COUNTRY 4 RESULTS

Table 2.15 displays a summary of life-years of exposure and deaths for Country 4 by sex and pensioner type. In addition to the Retirement, Survivor, and Invalidity pensioner types, Country 4 also reported experience for Non-Contributory Old Age Pension (labeled "Non-Contrib" in the tables in this subsection).

Table 2.15
COUNTRY 4 LIFE YEARS OF EXPOSURE AND DEATHS BY SEX AND PENSIONER TYPE

| Sex | Statistic | Retirement | Survivor | Invalidity | Non-Contrib | Total |
|---|---|---|---|---|---|---|
| Females | Life Years | 2,765 | 654 | 332 | 1,295 | 5,046 |
|  | Deaths | 46 | 0 | 9 | 90 | 145 |
| Males | Life Years | 3,314 | 94 | 357 | 529 | 4,294 |
|  | Deaths | 65 | 0 | 9 | 47 | 121 |

Tables 2.16 and 2.17 show actual-to-expected ratios by sex and pensioner type for each of the mortality bases being used for comparison in this study. For Table 2.16, the experience is weighted by headcount. For Table 2.17, the experience is weighted by pension amount.

Table 2.16
COUNTRY 4 HEADCOUNT-WEIGHTED A/E RATIOS BY SEX AND PENSIONER TYPE

|  | Expected Basis | Retirement | Survivor | Invalidity | Non-Contrib | Total |
|---|---|---|---|---|---|---|
| Females | RPH-2006 / MP-2014 | 114.1% | 0.0% | 223.1% | 107.0% | 108.9% |
|  | RPH-2014 | 113.3% | 0.0% | 221.1% | 107.5% | 108.9% |
|  | Pri.H-2012 / MP-2020 | 105.2% | 0.0% | 175.1% | 96.4% | 97.2% |
|  | GAM94 | 110.5% | 0.0% | 1277.9% | 101.2% | 106.7% |
|  | GAM94 / AA | 125.4% | 0.0% | 1505.8% | 109.7% | 117.5% |
|  | GAM94 / AA Midpoint | 125.0% | 0.0% | 1506.8% | 109.8% | 117.4% |
|  | UP94 / AA | 116.3% | 0.0% | 1401.4% | 102.1% | 109.2% |
|  | PA80c2020 | 112.8% | 0.0% | 1403.1% | 95.2% | 103.1% |
|  | NIST2012 | 99.1% | 0.0% | 1132.6% | 97.4% | 100.2% |
|  | GAM83 | 113.6% | 0.0% | 1227.4% | 99.8% | 106.6% |
| Males | RPH-2006 / MP-2014 | 92.0% | 0.0% | 131.9% | 123.6% | 104.2% |
|  | RPH-2014 | 91.5% | 0.0% | 130.2% | 124.3% | 104.0% |
|  | Pri.H-2012 / MP-2020 | 83.8% | 0.0% | 118.4% | 109.7% | 93.5% |
|  | GAM94 | 75.4% | 0.0% | 715.7% | 108.3% | 92.1% |
|  | GAM94 / AA | 97.6% | 0.0% | 996.2% | 123.3% | 114.2% |
|  | GAM94 / AA Midpoint | 97.2% | 0.0% | 994.6% | 123.6% | 113.9% |
|  | UP94 / AA | 90.8% | 0.0% | 926.4% | 114.7% | 106.2% |
|  | PA80c2020 | 72.7% | 0.0% | 853.1% | 97.4% | 86.9% |
|  | NIST2012 | 56.6% | 0.0% | 481.4% | 93.2% | 72.1% |
|  | GAM83 | 65.1% | 0.0% | 554.7% | 96.6% | 80.3% |

Table 2.17
COUNTRY 4 AMOUNT-WEIGHTED A/E RATIOS BY SEX AND PENSIONER TYPE

|  | Expected Basis | Retirement | Survivor | Invalidity | Non-Contrib | Total |
|---|---|---|---|---|---|---|
| Females | RP-2006 | 107.4% | 0.0% | 265.1% | 109.1% | 112.2% |
|  | RP-2006 / MP-2014 | 106.4% | 0.0% | 264.8% | 109.6% | 111.9% |
|  | Pri-2012 / MP-2020 | 100.7% | 0.0% | 233.5% | 97.4% | 100.9% |
|  | GAM94 | 99.5% | 0.0% | 1613.4% | 101.1% | 108.9% |
|  | GAM94 / AA | 112.3% | 0.0% | 1930.6% | 109.6% | 120.6% |
|  | GAM94 / AA Midpoint | 111.9% | 0.0% | 1929.1% | 109.7% | 120.4% |
|  | UP94 / AA | 104.1% | 0.0% | 1794.1% | 102.0% | 112.0% |
|  | PA80c2020 | 106.5% | 0.0% | 1762.9% | 95.2% | 109.1% |
|  | NIST2012 | 87.6% | 0.0% | 1450.7% | 97.4% | 100.1% |
|  | GAM83 | 105.5% | 0.0% | 1533.8% | 99.7% | 111.2% |
| Males | RP-2006 | 97.3% | 0.0% | 132.0% | 128.9% | 105.1% |
|  | RP-2006 / MP-2014 | 96.6% | 0.0% | 131.4% | 129.5% | 104.6% |
|  | Pri-2012 / MP-2020 | 93.0% | 0.0% | 130.4% | 116.3% | 99.1% |
|  | GAM94 | 71.3% | 0.0% | 729.2% | 107.2% | 85.2% |
|  | GAM94 / AA | 93.5% | 0.0% | 1023.1% | 122.1% | 109.0% |
|  | GAM94 / AA Midpoint | 92.9% | 0.0% | 1019.5% | 122.3% | 108.5% |
|  | UP94 / AA | 86.9% | 0.0% | 951.4% | 113.6% | 101.4% |
|  | PA80c2020 | 70.6% | 0.0% | 864.6% | 96.4% | 83.1% |
|  | NIST2012 | 52.6% | 0.0% | 492.7% | 92.3% | 64.2% |
|  | GAM83 | 62.1% | 0.0% | 559.1% | 95.6% | 74.3% |

In contrast with the other countries, Country 4 Retirement A/E ratios are lower than 100% for males for all experience bases on both headcount and amount bases. On a headcount basis, female mortality was higher than that implied by all bases except NIST2012. No deaths were reported for Survivor pensioners, though these groups were relatively young, averaging 52 years of age for males and females. A/E ratios on a headcount basis range for females between 95% and 120% and for males between 70% and 115%. On an amount-weighted basis, these ranges are 100% to 125% and 60% to 110% for females and males, respectively. In aggregate, Country 4 exhibited the lowest mortality of all four countries studied.

Table 2.18 displays 95% confidence intervals for the above headcount-weighted A/E ratios on the PA80c2020 basis.

Table 2.18
COUNTRY 4 HEADCOUNT-WEIGHTED 95% CONFIDENCE INTERVALS ON THE PA80C2020 BASIS

| | Measure | Retirement | Survivor | Invalidity | Non-Contrib | Total |
|---|---|---|---|---|---|---|
| Females | A/E Ratio | 112.8% | 0.0% | 1403.1% | 95.2% | 103.1% |
| | A/E – 95% CI Lower Bound | 82.6% | N/A | 640.3% | 76.6% | 87.0% |
| | A/E – 95% CI Upper Bound | 150.5% | N/A | 2663.7% | 117.0% | 121.4% |
| Males | A/E Ratio | 72.7% | 0.0% | 853.1% | 97.4% | 86.9% |
| | A/E – 95% CI Lower Bound | 56.1% | N/A | 389.3% | 71.5% | 72.1% |
| | A/E – 95% CI Upper Bound | 92.7% | N/A | 1619.5% | 129.5% | 103.9% |

## Section 3: Detailed Results by Age Group

Table 3.1 shows a summary of Retirement exposures and deaths by age group for each of the four countries.

Table 3.1
RETIREMENT EXPOSURES AND DEATHS BY AGE GROUP AND COUNTRY

| | Age Group | Statistic | Country 1 | Country 2 | Country 3 | Country 4 |
|---|---|---|---|---|---|---|
| Females | < 65 | Life Years | 4,932 | 3,547 | 9,422 | 832 |
| | | Deaths | 29 | 30 | 88 | 7 |
| | 65 – 74 | Life Years | 4,652 | 5,976 | 32,228 | 1,408 |
| | | Deaths | 94 | 91 | 520 | 21 |
| | 75 – 84 | Life Years | 1,698 | 2,315 | 16,494 | 508 |
| | | Deaths | 73 | 115 | 686 | 17 |
| | >= 85 | Life Years | 17 | 530 | 5,324 | 18 |
| | | Deaths | 2 | 44 | 644 | 1 |
| Males | < 65 | Life Years | 5,563 | 3,620 | 6,891 | 714 |
| | | Deaths | 72 | 43 | 117 | 8 |
| | 65 – 74 | Life Years | 5,750 | 5,833 | 27,470 | 1,922 |
| | | Deaths | 182 | 155 | 705 | 28 |
| | 75 – 84 | Life Years | 2,176 | 2,118 | 13,621 | 661 |
| | | Deaths | 147 | 169 | 766 | 28 |
| | >= 85 | Life Years | 28 | 458 | 2,994 | 16 |
| | | Deaths | 3 | 88 | 432 | 1 |

For completeness, the figures in this section include A/E results for all combinations of country, sex, and age group of the Retirement subset of experience. However, it should be noted that several such categories, most notably the 85-and-up age groups for Country 1 and Country 4, contain a very small amount of data. Users of this report should reference Table 3.1 to understand the credibility of the results shown.

This section will focus on comparisons to the PA80c2020 basis and the Pri-2012 / MP-2020 basis to show A/E patterns by age for two different sets of benchmark mortality rates.

**3.1 RESULTS BY AGE GROUP FOR MALES**

Figure 3.1 and Table 3.2 display male headcount-weighted A/E mortality ratios by age group for the PA80c2020 basis.

**Figure 3.1**
RETIREMENT PA80C2020 HEADCOUNT A/E MORTALITY RATIOS BY AGE GROUP AND COUNTRY, MALES
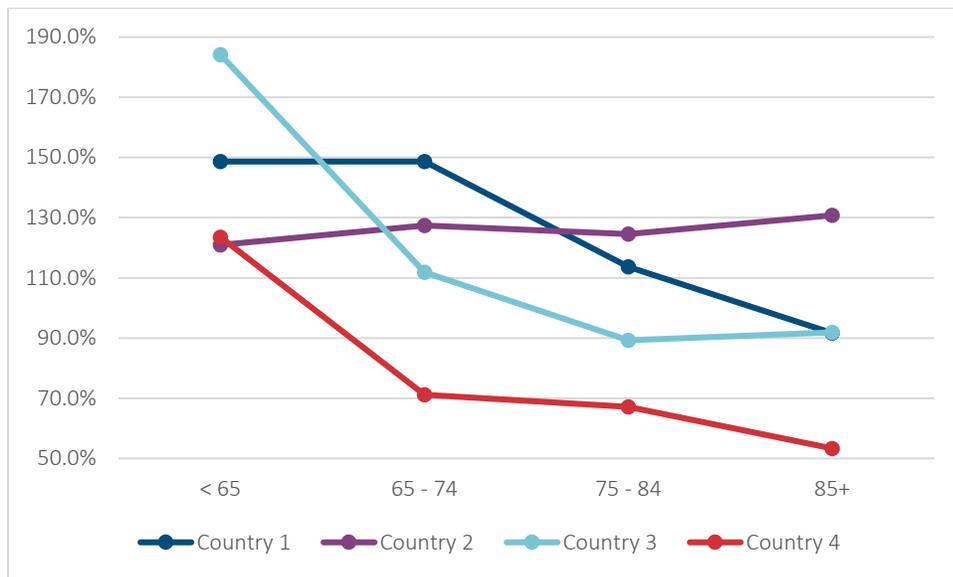


**Table 3.2**
RETIREMENT PA80C2020 HEADCOUNT A/E MORTALITY RATIOS BY AGE GROUP AND COUNTRY, MALES

| Age Group | Country 1 | Country 2 | Country 3 | Country 4 |
|---|---|---|---|---|
| < 65 | 148.6% | 120.9% | 184.1% | 123.5% |
| 65 - 74 | 148.7% | 127.4% | 111.8% | 71.2% |
| 75 - 84 | 113.6% | 124.5% | 89.3% | 67.1% |
| 85+ | 91.6% | 130.8% | 91.8% | 53.3% |

On the PA80c2020 basis, all countries except Country 2 exhibit a general pattern of decreasing A/E ratios with increasing age for males. Country 4 had an A/E ratio higher than 100% only for the under-65 age group, with a steep drop-off in mortality relative to the PA80c2020 basis above age 65. Country 3's mortality experience for the under-65 age group was particularly high.

Figure 3.2 and Table 3.3 display male headcount-weighted A/E mortality ratios by age group for the Pri.H-2012 / MP-2020 basis.

**Figure 3.2**
RETIREMENT PRI.H-2012 / MP-2020 A/E MORTALITY RATIOS BY AGE GROUP AND COUNTRY, MALES
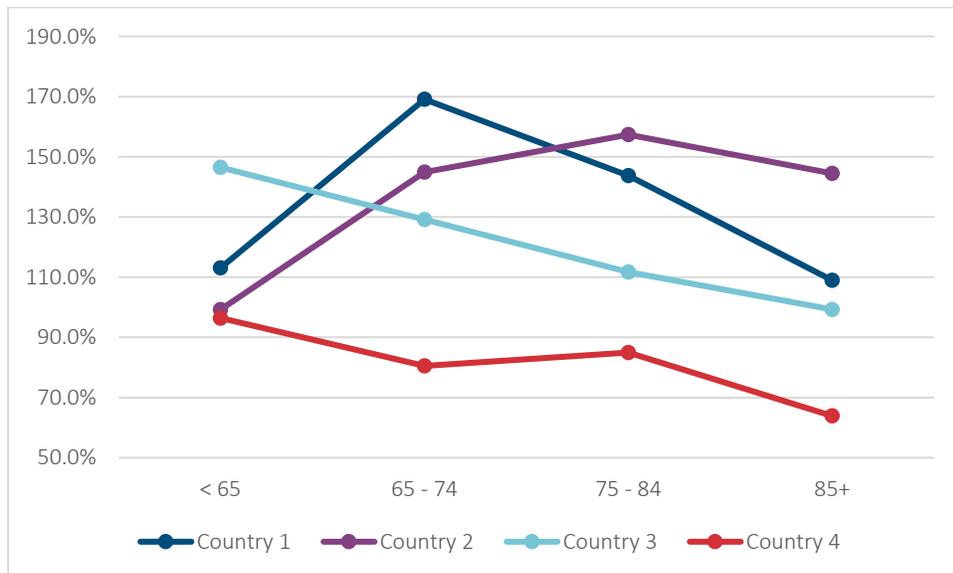


**Table 3.3**
RETIREMENT PRI-2012 / MP-2020 A/E MORTALITY RATIOS BY AGE GROUP AND COUNTRY, MALES

| Age Group | Country 1 | Country 2 | Country 3 | Country 4 |
|-----------|-----------|-----------|-----------|-----------|
| < 65 | 113.0% | 99.2% | 146.5% | 96.4% |
| 65 - 74 | 169.1% | 144.9% | 129.2% | 80.5% |
| 75 - 84 | 143.8% | 157.3% | 111.7% | 84.9% |
| 85+ | 109.0% | 144.5% | 99.3% | 63.9% |

There is a significant difference for males under age 65 between the A/E ratios on the Pri.H-2012 / MP-2020 basis and the A/E ratios on the PA80c2020 basis. This is primarily due to the shape of the base mortality tables. The PA80c2020 rates become substantially lower than the Pri.H-2012 counterparts as age drops below 65. Country 4 has A/E ratios below 100% for all age groups, while Country 1 has A/E ratios above 100% for all age groups. All four countries have higher A/E ratios for the 65-74 and 75-84 age ranges than the 85-and-older range.

## 3.2 RESULTS BY AGE GROUP FOR FEMALES

Figure 3.3 and Table 3.4 display female headcount-weighted A/E mortality ratios by age group for the PA80c2020 basis.

Figure 3.3
RETIREMENT PA80C2020 HEADCOUNT A/E MORTALITY RATIOS BY AGE GROUP AND COUNTRY, FEMALES
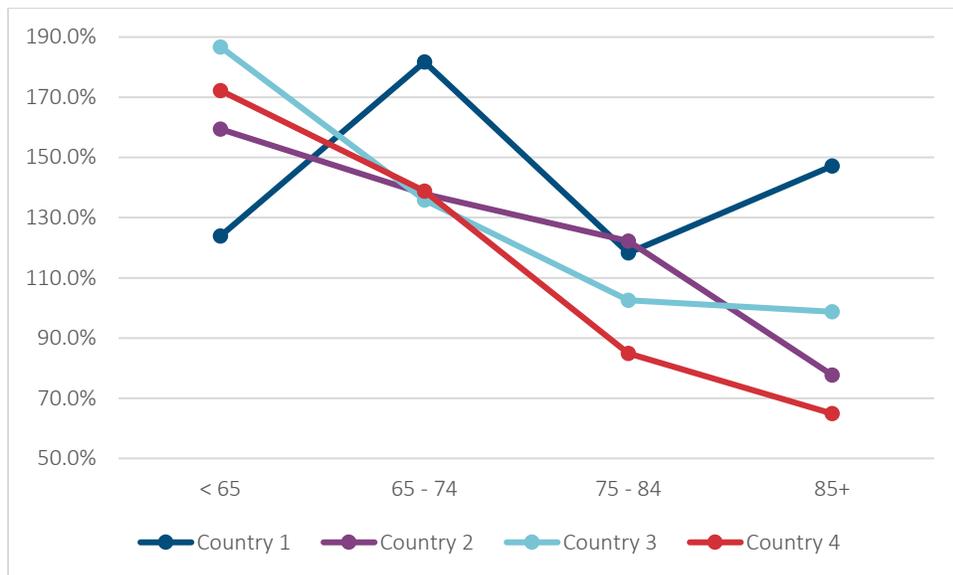


Table 3.4
RETIREMENT PA80C2020 HEADCOUNT A/E MORTALITY RATIOS BY AGE GROUP AND COUNTRY, FEMALES

| Age Group | Country 1 | Country 2 | Country 3 | Country 4 |
|---|---|---|---|---|
| < 65 | 123.9% | 159.4% | 186.7% | 172.2% |
| 65 - 74 | 181.7% | 137.8% | 135.8% | 138.8% |
| 75 - 84 | 118.3% | 122.2% | 102.6% | 84.9% |
| 85+ | 147.2% | 77.7% | 98.7% | 64.9% |

Except for Country 1, there is a clear pattern of decreasing A/E ratios with increasing age. Country 1 displays A/E ratios above 100% for all age groups. Similar to males, the highest A/E ratio is found in Country 3's under-age-65 group.

Figure 3.4 and Table 3.5 display female headcount-weighted A/E mortality ratios by age group for the Pri.H-2012 / MP-2020 basis.

**Figure 3.4**
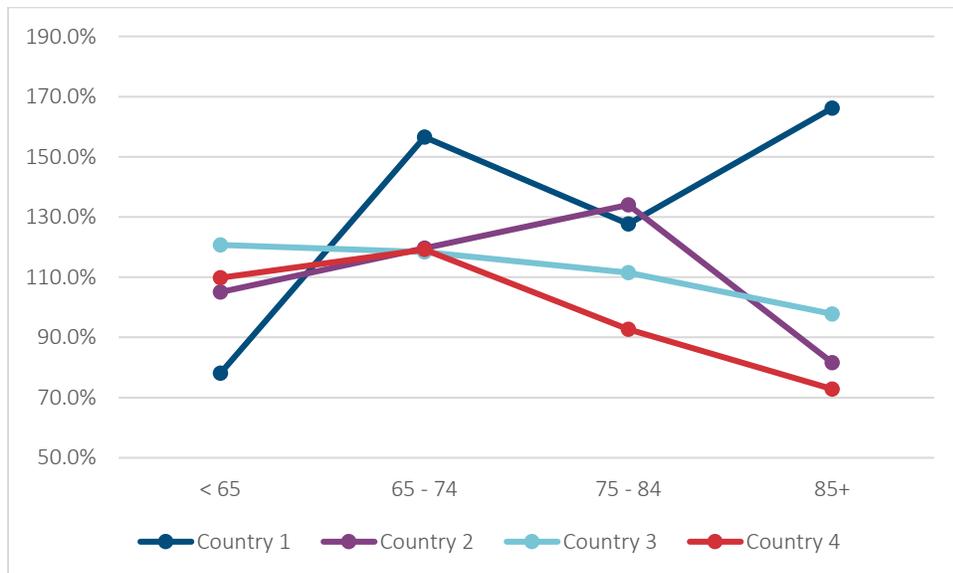RETIREMENT PRI.H-2012 / MP-2020 A/E MORTALITY RATIOS BY AGE GROUP AND COUNTRY, FEMALES



**Table 3.5**
RETIREMENT PRI-2012 / MP-2020 A/E MORTALITY RATIOS BY AGE GROUP AND COUNTRY, FEMALES

| Age Group | Country 1 | Country 2 | Country 3 | Country 4 |
|---|---|---|---|---|
| < 65 | 78.1% | 105.1% | 120.7% | 109.8% |
| 65 - 74 | 156.5% | 119.7% | 118.4% | 119.2% |
| 75 - 84 | 127.6% | 134.0% | 111.5% | 92.6% |
| 85+ | 166.2% | 81.6% | 97.8% | 72.8% |

Similar to males, the Pri.H-2012 mortality rates are much higher than their PA80c2020 counterparts below age 65, contributing to the vast differences in A/E ratios between the two bases in this age group. These differences contribute to the "bump" effect seen in the 65-74 age group in the chart above that does not exist (except for Country 1) in Figure 3.3. The considerable variation by age group for both the PA80c2020 and Pri.H-2012 / MP-2020 bases suggest that the experience differed from these mortality tables in not only level, but shape as well. However, Table 3.1 indicates that some age groups represented in the figures above have a small sample of exposure, so there is low credibility to these results in places.

# Section 4: Reliance and Limitations

The analysis presented in this report relies upon data furnished by the Caribbean Actuarial Association and the social security schemes of the four countries represented in this study.

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