New York City Retirement Systems Part I Experience Study Report - POLICE and FIRE

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Issued November 29, 2023

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November 29, 2023

Ms. Krista Olson
Deputy Comptroller for Budget
New York City Comptroller's Office
1 Centre Street, 8th Floor
New York, NY 10007

Re: Part I Experience Study Report – POLICE and FIRE

Dear Ms. Olson:

We are pleased to present the enclosed report, along with the Milliman Experience Study Tool, of our observations of the Part I Experience Study for the five New York City Retirement Systems ("NYCRS"):

- New York City Employees' Retirement System ("NYCERS")
- Teachers' Retirement System of the City of New York ("TRS")
- Board of Education Retirement System of the City of New York ("BERS")
- **New York City Police Pension Fund ("POLICE")**
- **New York City Fire Pension Fund ("FIRE")**

This report includes Sections IV and V for POLICE and FIRE.

The purpose of the Part I Experience Study report is to provide high-level observations of the demographic assumptions used in the actuarial valuations performed by the Office of the Actuary (OA) for these systems compared to the experience. The experience includes data from 2012 – 2017 used in prior experience studies, along with updates for the 4-year period ending June 30, 2021.

The Part II Experience Study report will incorporate recommendations for changes to the actuarial assumptions reviewed.

This report incorporates analysis performed with the Milliman Experience Study Tool (MEST). MEST enables examination of the experience of the systems using many data elements such as age, service, plan, employee group, etc. The observations included in this report are based on the charts produced by the MEST.

In preparing this report, we relied, without audit, on information (some oral and some in writing) supplied by staffs of Office of the Comptroller and the OA. This information includes, but is not limited to, statutory provisions, employee data, administrative policies, and financial information. Since the results are dependent on the integrity of the data supplied, the results can be expected to differ if the underlying data is incomplete or missing. It should be noted that if any data or other information is inaccurate or incomplete, our calculations may need to be revised.

Milliman's work product was prepared exclusively for the New York City Office of the Comptroller, for a specific and limited purpose. It is a complex, technical analysis that requires a high-level of knowledge concerning NYCRS' operations, and is based on NYCRS' data, which Milliman has not audited. Milliman's work product is not intended to be used by, or for the benefit of, any third party for any purpose. Any third-party recipient of Milliman's work product who desires professional guidance should not rely upon Milliman's work product, but should engage qualified professionals for advice appropriate to its specific needs.

On the basis of the foregoing, we hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices which are consistent with the Actuarial Standards of Practice promulgated by the Actuarial Standards Board and the applicable Code of Professional Conduct, amplifying Opinions, and supporting Recommendations of the American Academy of Actuaries.

We are members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

The consultants who worked on this assignment are actuaries. Milliman's advice is not intended to be a substitute for qualified legal or accounting counsel. The signing actuaries are independent of NYCRS. We are not aware of any relationship that would impair the objectivity of our work.

We would like to thank the staffs of the Office of the Comptroller and the Office of the Actuary (OA) for their cooperation. Their prompt and courteous responses to our questions and requests for information were of valuable assistance to us and are greatly appreciated.

Respectfully submitted,

Glenn D. Bowen, FSA, EA, MAAA

Scott Porter, FSA, EA, MAAA

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Executive Summary

This report summarizes the Part I Experience Study performed by Milliman of the five New York City Retirement Systems ("NYCRS"):

- Section I - New York City Employees' Retirement System (NYCERS)
- Section II - Teachers' Retirement System of the City of New York (TRS)
- Section III - Board of Education Retirement System of the City of New York (BERS)
- **Section IV - New York City Police Pension Fund (POLICE)**
- **Section V - New York City Fire Pension Fund (FIRE)**

This report includes Sections IV and V for POLICE and FIRE.

The primary purposes of the Part I Experience Study Report are to provide high-level observations of the experience for the indicated systems:

- This report provides information on key preretirement demographic assumptions - withdrawal, retirement and disability – used in the actuarial valuations performed by the OA.
- This report provides information on the pre-retirement and postretirement mortality assumptions used in the actuarial valuations performed by the OA.

The Part II Experience Study report will incorporate recommendations for changes to the actuarial assumptions reviewed.

The experience study includes information for the 10-year period ending June 30, 2021 as provided by the OA. This includes data from 2012 – 2017 contained in the historical database along with updates for the 4-year period ending June 30, 2021 completed by Milliman.

POLICE

The following is a summary of our observations regarding the experience of POLICE.

Summary of Police Observations		
Decrement	Observation	Potential Impact
Withdrawal	Fewer withdrawals than expected after 5 years of service.	Reducing withdrawal rates generally results in higher liabilities.
Retirement	Fewer retirements than expected overall, although more retirements than expected for those not eligible for WTC benefits.	How should retirement rates and disability rates be adjusted to account for impact of WTC benefits?
Ordinary Disability	Eligibility for retirement impacts rates of disability; nearly none occurred for members with at least 20 years of service, but greater than expected for those with less than 20 years.	Modifying rates of disability based on eligibility for retirement generally results in higher liabilities.
Accidental Disability	If eligible for WTC benefits, fewer accidental disability retirements occurred than expected.	How should retirement rates and disability rates be adjusted

Summary of Police Observations		
Decrement	Observation	Potential Impact
	If not eligible for WTC benefits, experience was similar to expectations.	to account for impact of WTC benefits?
Ordinary Death	Fewer deaths than expected but not enough data for experience to be considered fully credible.	Reductions in rates of mortality generally results in higher liabilities.
Accidental Death	Actual deaths were less than half that expected.	Reductions in rates of accidental death would generally result in lower liabilities.
Post Retirement Mortality		
Service Retirees	Actual number of deaths was similar to expectations.	Further review required to compare experience to the most recent published mortality tables.
Disabled Retirees	Actual number of deaths was relatively similar to expectations but will need to review amount-weighting factor.	
Contingent Beneficiaries	Not enough data for experience to be considered credible.	

FIRE

The following is a summary of our observations regarding the experience of FIRE.

Summary of Fire Observations		
Decrement	Observation	Potential Impact
Withdrawal	Fewer withdrawals than expected after 1 year of service. Unsure of impact hiring freeze from 2017 – 2013 on experience.	Reducing withdrawal rates generally results in higher liabilities.
Retirement	Fewer retirements than expected overall, although more retirements than expected for those not eligible for WTC benefits.	How should retirement rates and disability rates be adjusted to account for impact of WTC benefits?
Ordinary Disability	Eligibility for retirement impacts rates of disability; nearly none occurred for members with at least 20 years of service or age 55 and older, but greater than expected for those with less than 20 years.	Modifying rates of disability based on eligibility for retirement would generally results in higher liabilities.
Accidental Disability	Greater number of accidental disability retirements than expected, although less at ages 55 and older.	Increasing accidental disability rates generally results in higher liabilities.
Ordinary Death	Less deaths than expected but data is not fully credible.	Reductions in rates of mortality generally results in higher liabilities.
Accidental Death	Actual deaths were less than expected.	Reductions in rates of accidental death would generally result in lower liabilities.

Summary of Fire Observations		
Decrement	Observation	Potential Impact
Post Retirement Mortality		
Service Retirees	Actual number of deaths was greater than expected.	Further review required to compare experience to the most recent published mortality tables.
Disabled Retirees	Actual number of deaths was relatively similar to expectations.	
Contingent Beneficiaries	Not enough data for experience to be considered credible.	

Introduction

Part I Experience Study Introduction

Milliman's focus for Part I of the experience study is to provide high-level observations of the experience during the 10-year study period July 1, 2011 – June 30, 2021. Our review splits this study period into three periods:

- Prior period: July 1, 2011 – June 30, 2017 (2012 – 2017), which includes updates made by Milliman to the historical data, primarily in 2017.
- Two-year period July 1, 2017 – June 30, 2019 (2018 – 2019)
- Two-year period July 1, 2019 – June 30, 2021 (2020 – 2021)

Throughout this report we refer to plan years by the end of the plan year. For example, 2012 refers to the period July 1, 2011 to June 30, 2012; 2021 refers to the period July 1, 2020 to June 30, 2021.

Our observations are based on analysis performed with the Milliman Experience Study Tool (MEST) which creates customized experience summaries for the chosen study periods. This report includes various graphs and charts produced by MEST.

This report focuses on key preretirement decrements – withdrawal, retirement and disability – and the mortality assumptions – pre-retirement and postretirement.

An Appendix (to be provided subsequently) describes the data processing in detail. The following sections briefly describe this process.

Selection of Actuarial Assumptions

The purpose of the actuarial valuation is to analyze the resources needed to meet the current and future obligations of the System. To provide the best estimate of the long-term funded status of the System, the actuarial valuation should be predicated on methods and assumptions that will estimate the future obligations of the System in a reasonable manner.

An actuarial valuation uses various methods and two different types of assumptions: economic and demographic. Economic assumptions are related to the general economy and its long-term impact on the System, or to the operation of the System itself. Demographic assumptions are based on the specific experience of the System's members.

Actuarial Standard of Practice (ASOP) No. 35 governs the selection of demographic and other noneconomic assumptions for measuring pension obligations. ASOP 35 states that the actuary should use professional judgment to estimate possible future outcomes based on past experience and future expectations, and select assumptions based upon application of that professional judgment. The actuary should select reasonable demographic assumptions in light of the particular characteristics of the defined benefit plan that is the subject of the measurement. A reasonable assumption is one that is appropriate for the purpose of the measurement reflecting historical and current demographic data, that reflects the actuary's professional judgment and estimate of future experience, and that contains no significant bias, i.e., it is not significantly optimistic or pessimistic.

Choosing actuarial assumptions requires the application of actuarial judgment. It is unlikely that any two actuaries, given the same set of experience statistics, would arrive at exactly the same

set of actuarial assumptions for any system as complex as NYCRS. Even allowing for minor variations that occur because of the variability of the underlying statistics and possible data anomalies, differences among actuarial approaches will occur in analyzing trends. Some actuaries prefer to match the results of recent experience very closely in setting future assumptions, while other actuaries will use recent experience as a guide but tend to change existing assumptions gradually over time. Valid arguments can be made for either approach.

Experience Analysis Process

The general procedure in a study of demographic experience is to first determine the number of participants who were exposed to the possibility of retirement, withdrawal, disability, etc. We refer to these events as decrements. The next step is to determine how many actually retired, withdrew, became disabled, etc. Dividing the number of terminations in each age and service cell by the number exposed to the possibility of termination in that cell produces the rate of decrement.

In reviewing the actual rates of decrement, we compare them to the current assumed rates used in the actuarial valuations. For this purpose, the assumed rates are those used in the most recent actuarial valuation report, the June 30, 2020 lag actuarial valuation. For example, the assumed rates of withdrawal that apply in 2016 in this analysis are based on the assumptions from the 2020 lag actuarial valuation, not the assumptions in effect in 2016.

To compare actual rates of decrement to assumed rates of decrement, we produce actual to expected ratios ("A/E" ratio). These ratios compare actual decrements (one set due to retirement, a different set due to withdrawal, a different set due to disability, etc.) with expected decrements based on the actuarial assumptions. An A/E ratio that is greater than one indicates that there were more actual decrements than expected and a ratio that is less than one indicates that there were fewer actual decrements than expected. For example, a ratio of 1.5 means that 50% more members left the plan for that cause than expected. A ratio of 0.8 means that 20% fewer members left the plan for that cause than expected.

To assist reviewers in assessing whether an assumption may need to be modified or not, we incorporated a color-coded metric to indicate how far the actual experience is from that expected:

- A green circle indicates that the experience is within 10% of that assumed, that is, the A/E ratio is in the range 0.9 – 1.1.
- An orange triangle indicates that the experience is within 50% of that assumed, but not within 10%, that is, the A/E ratio is in the range 0.5 – 0.9 or 1.1 to 1.5.
- A red diamond indicates that the experience is outside 50% of what was assumed, that is, the A/E ratio is smaller than 0.5 or greater than 1.5.

Please note that the color-coded symbols are meant to assist the reader to determine how far the actual experience is from that expected. Many factors are used to determine if an assumption should be modified – reason for the deviation, credibility of the data, anticipation that experience in the future would be consistent with the prior experience, actuarial judgment, etc.

Historical Database Update

The OA provided separate historical databases with experience from 2001 to 2017 for each of the systems, the valuation files for the four-year period 2018 – 2021, detailed descriptions of the

various codes contained in the data, and year by year status reconciliations or flow of lives. Milliman reviewed and updated the historical database to ensure completeness and consistency. We verified that the member valuation data provided to us was consistent with the flow of lives and updated the historical database accordingly. The historical database was imported into the MEST and we reviewed to ensure that the number of exposures and actual decrements were captured reasonably. In our review, we noticed that the 2017 status distribution in the historical database did not match the flow of lives or was inconsistent with information contained in the 2018 data. We updated the 2017 status for consistency with the 2018 data.

While the Historical Database contains the status used in each actuarial valuation, there are situations in which this status may not indicate the actual cause of decrement. Two such situations relate to disability retirements and members on leave of absence.

Disability Retirements

There are instances in which members may have applied for disability retirement, but the application had not been approved by the time the data was provided for the annual actuarial valuation. In this situation, a member status could be classified as a termination, leave of absence, etc. in one valuation file but as a disability retirement in a subsequent valuation file. In these situations, we modified the status in the historical database to reflect the eventual approval of the disability retirement. For any record who was active during the study period (2011 or later) and had a subsequent inactive status followed by a disability retirement, the years with an inactive status code were changed to the indicated disability retirement status. These adjustments are applied after any adjustments for leave of absence noted in the following section.

Please note that approvals for disability retirement that took place after June 30, 2021 for members who are indicated as terminated in the experience data are not reflected in this analysis which, consequently, underestimates the number of disability retirements, especially in the latter years of the study.

Leave of Absence

During the study period, the OA used different terminology for identifying members on leave of absence such as active off payroll, nonvested terminated, etc. In the prior experience study, records with a status code of leave of absence had this status code modified to reflect a subsequent event as if that subsequent event occurred when the leave of absence (LOA) occurred. We applied similar adjustments to the status codes in the historical database. LOA status codes exist for years 2016 and 2017 where the prior actuary did not have sufficient information to make an adjustment as well as on the valuation data added for years 2018 – 2021. The following summarizes the adjustments made when a record has a LOA code (“C”):

- If the status code in the year before the LOA code is an “F”, the LOA code was changed to a termination code (“F”).
- If the record has three consecutive LOA codes, then all LOA codes are changed to a termination code (“F”).
- If the record has an active status within 2 years after the first LOA code, then the LOA codes are changed to a rehire status code (“B”).
- If the record has an inactive status within 2 years after the first LOA code, then the LOA codes are changed to that inactive status code.

Due to this methodology, records will retain a LOA status code if:

- It first occurred in 2020 and remained a LOA status code in 2021.
- It first occurred in 2021.

Consistent with past practice, any member with a LOA status code was not included as a decrement because some of these members subsequently returned to active status. Furthermore, all remaining LOA status codes in 2020 are counted as exposures for withdrawal purposes. Therefore, all else being equal, the overall rates of termination are smaller during the two-year period 2020 – 2021 than in other years. Due to this situation, these years are primarily excluded from the analysis. We do note that the vast majority of records with a LOA status code do terminate employment (withdrawal, retire, become disabled, etc.).

Exposures and Decrements

An exposure is a member who is subject to the particular contingency being studied. For example, an active member who has met the conditions for retirement is a retirement exposure. If they have not met that condition, then they are a withdrawal exposure. The following section describes the rules used to determine exposures and decrements in this analysis:

- Any record considered an active employee in the indicated actuarial valuation is considered an exposure for preretirement decrements. This includes status codes of "A" and "B". For withdrawal purposes, records with a LOA status code of "C" are also included as exposures.
- Members indicated as terminations during the year who do not meet the conditions for retirement are reflected in the termination decrement.
- Members indicated as retirements during the year, or members indicated as terminations who do meet the conditions for retirement, are reflected in the retirement decrement.
- Police and Fire members who retired, but were indicated with 19 years of service, are deemed to have 20 years of service upon retirement.
- Exposures for ordinary disability exclude service periods prior to the eligibility conditions. For example, if 10 years of service is required to receive an ordinary disability benefit, the exposures exclude all members prior to 10 years of service.

Age and Service Calculations

Age was determined as age nearest on July 1 based on the date of birth and the indicated valuation year. Service is based on the service field contained in each year's valuation data as imported into the Historical Database and rounded to the nearest integer.

Due to the rounding of ages and service calculations, it may appear that some members retire before they are eligible. For example, POLICE and FIRE records may appear to retire with 19 years of service, but in fact, they have retired once they attained 20 years of service. We made an adjustment for these members in this situation. In subsequent analyses, we will review other similar members for the other systems and decrements to determine if any additional adjustments should be considered.

Milliman Experience Study Tool (MEST)

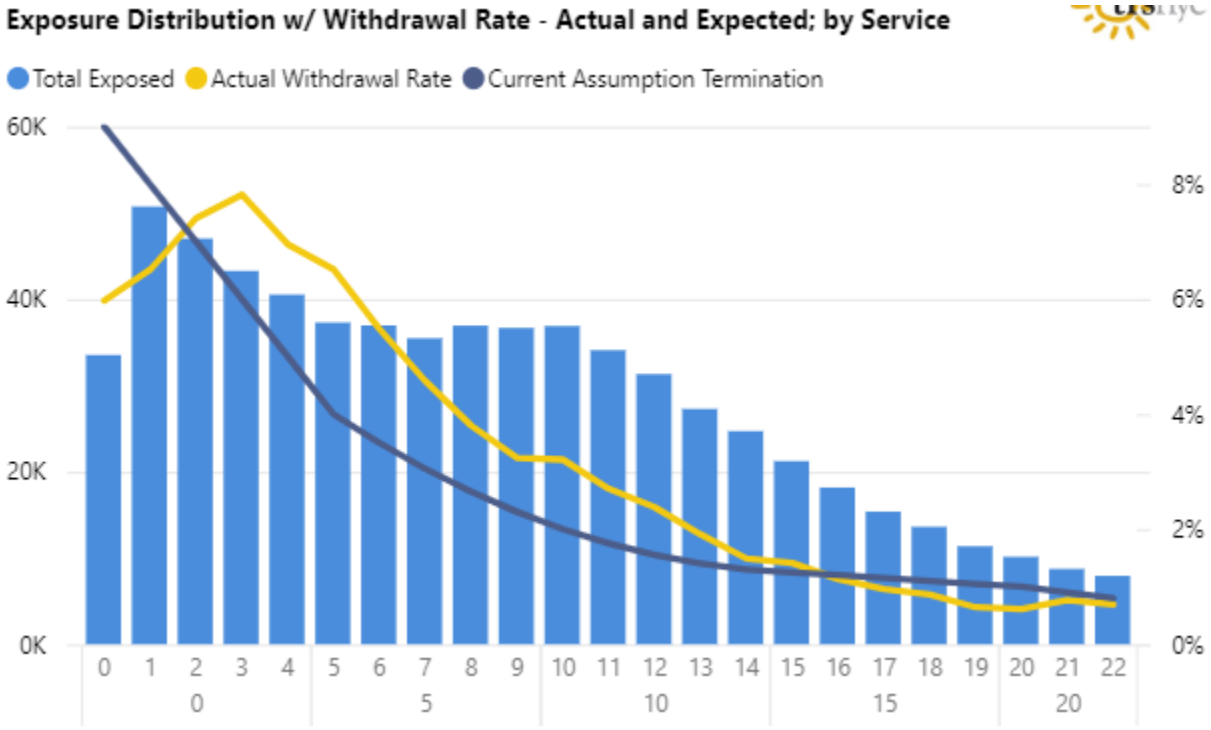
The purpose of the MEST is to analyze the experience by System using the status codes in the historical database. The MEST allows easy review of the experience by plan or other parameters for each System.

There are four primary charts in MEST for each decrement page. In addition, each of the four charts can be displayed on a service basis, age basis or year-by-year basis. A tool bar at the top of page allows the user to select how the information is displayed. A walkthrough of these charts in MEST has been described below using the withdrawal decrement tab as an example.

The following chart shows withdrawal decrements based on service. The chart includes the actual number of withdrawals, expected number, and the total number. An actual withdrawal rate is computed and compared to the assumption.

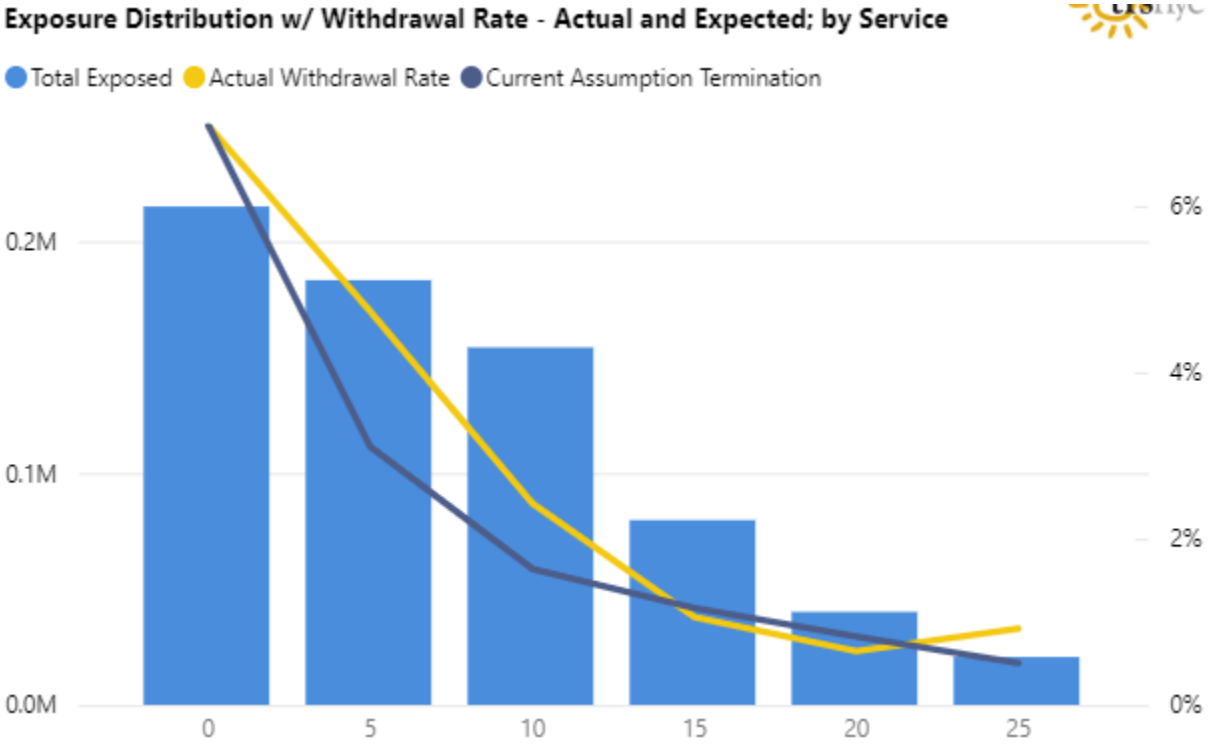
Service	Actual Withdrawals	Expected Withdrawals	Total Exposed	Actual Withdrawal Rate	Current Assumption Termination	Ratio Act/Exp Term
0	2,003	3,017.7	33,530	5.97%	9.00%	0.66
1	3,302	4,058.2	50,727	6.51%	8.00%	0.81
2	3,482	3,291.5	47,021	7.41%	7.00%	1.06
3	3,382	2,596.4	43,273	7.82%	6.00%	1.30
4	2,818	2,026.3	40,525	6.95%	5.00%	1.39
5	2,431	1,491.4	37,286	6.52%	4.00%	1.63
6	2,026	1,293.4	36,954	5.48%	3.50%	1.57
7	1,623	1,081.7	35,466	4.58%	3.05%	1.50
8	1,404	978.7	36,931	3.80%	2.65%	1.43
9	1,189	843.2	36,663	3.24%	2.30%	1.41
10	1,184	737.7	36,886	3.21%	2.00%	1.60
11	921	596.5	34,088	2.70%	1.75%	1.54
12	746	485.3	31,310	2.38%	1.55%	1.54
13	521	381.9	27,279	1.91%	1.40%	1.36
14	368	321.2	24,704	1.49%	1.30%	1.15
15	300	265.4	21,229	1.41%	1.25%	1.13
16	206	218.0	18,166	1.13%	1.20%	0.94
17	147	176.8	15,377	0.96%	1.15%	0.83
18	118	149.8	13,618	0.87%	1.10%	0.79
19	73	119.2	11,357	0.64%	1.05%	0.61
20	62	101.4	10,137	0.61%	1.00%	0.61
Total	**28,693**	**24,564.3**	**693,237**	**4.14%**	**3.54%**	**1.17**

The following chart compares the actual withdrawal rate (yellow line) to the current assumption (blue line) by service (or by age or plan year depending on selection). The blue bars show the number of exposures allowing the user to identify situations where there are relatively few exposures for that bucket and that the data may not be fully credible.

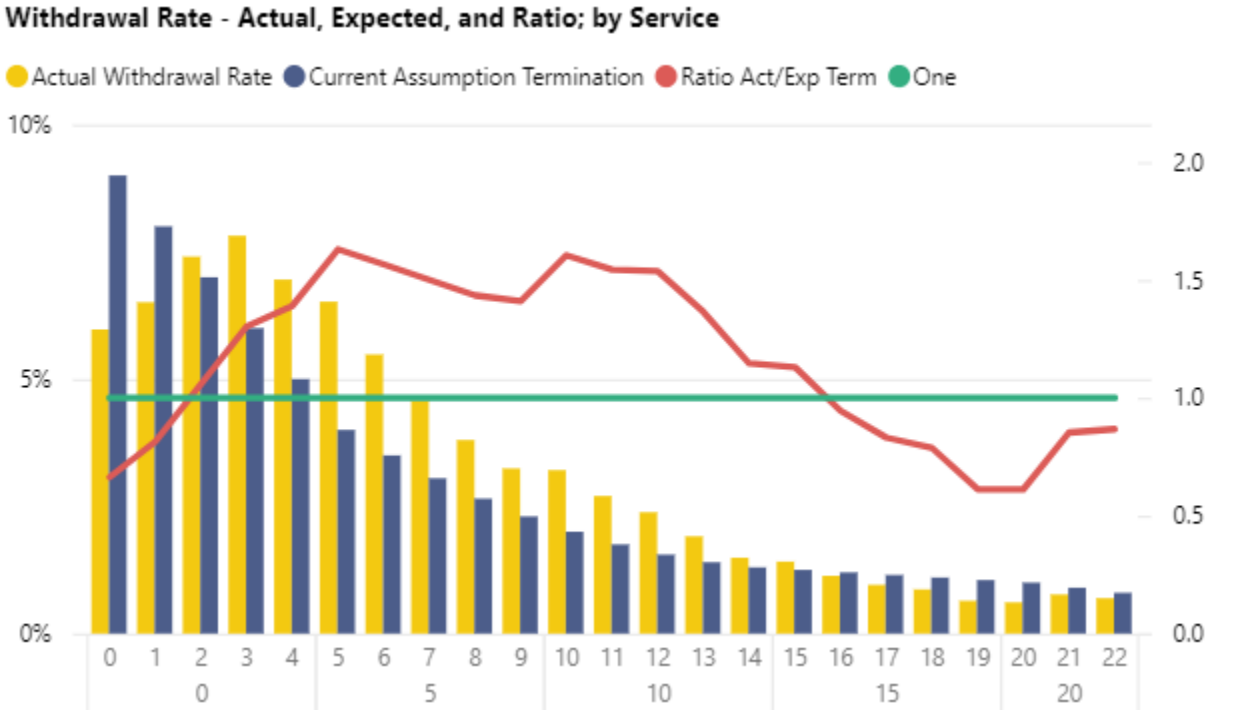


Also, this chart can be used to review the experience in 5-year service or age bins. In the chart above, the second row in the x-axis shows 0, 5, 10, etc. indicating the service bin from 0-4 years, 5-9 years, 10-14 years, etc.

The following chart shows the results based on service bins.

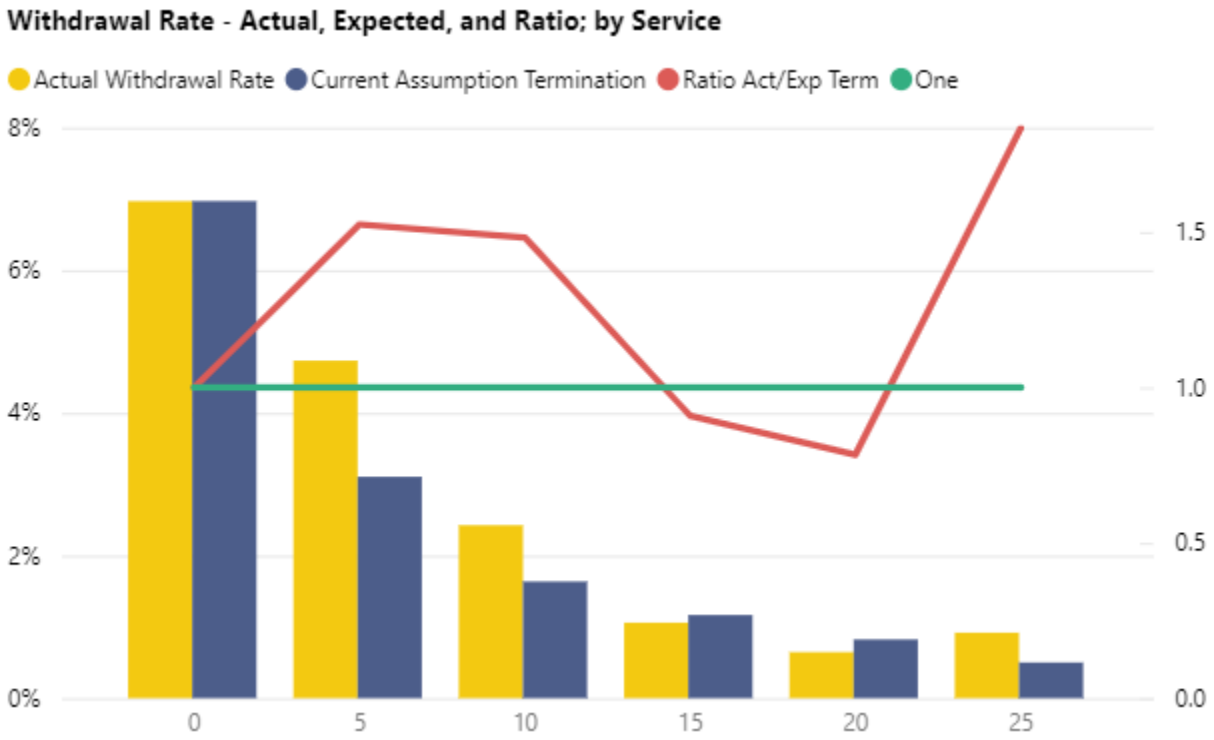


In the next chart, the A/E ratio is graphed as the red line and compared to the green line which is the 1.0 baseline (meaning that the actual experience is equal to that assumed). This provides the user with a different viewpoint in comparing the results of the study. The actual withdrawal rate and the current assumption are shown on the graph in the yellow and blue bars, respectively.

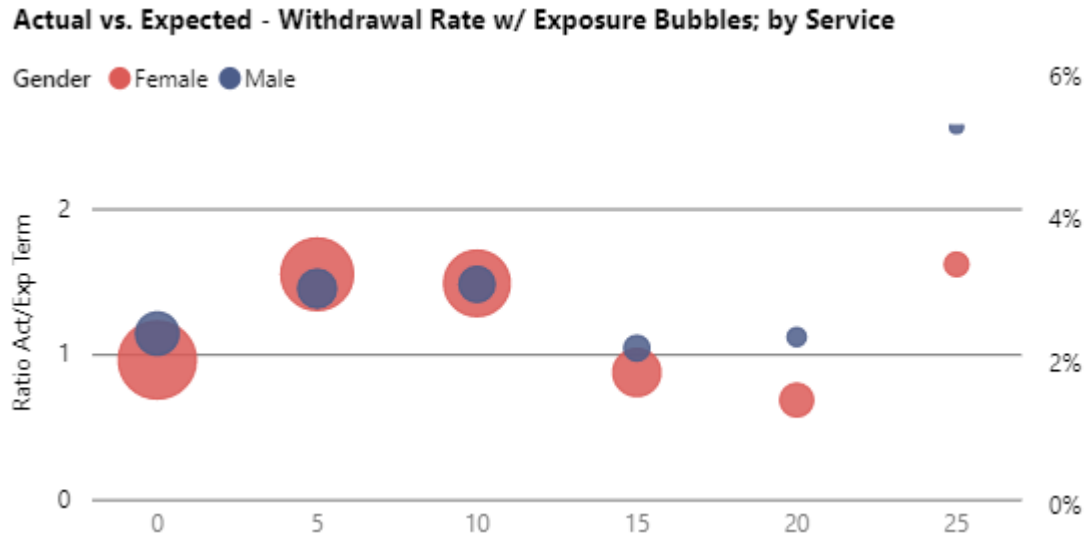


Also, this chart can be used to review the experience in 5-year service or age bins. In the chart above, the second row in the x-axis shows 0, 5, 10, etc. indicating the service bin from 0-4 years, 5-9 years, 10-14 years, etc.

The following chart shows the results based on service bins.

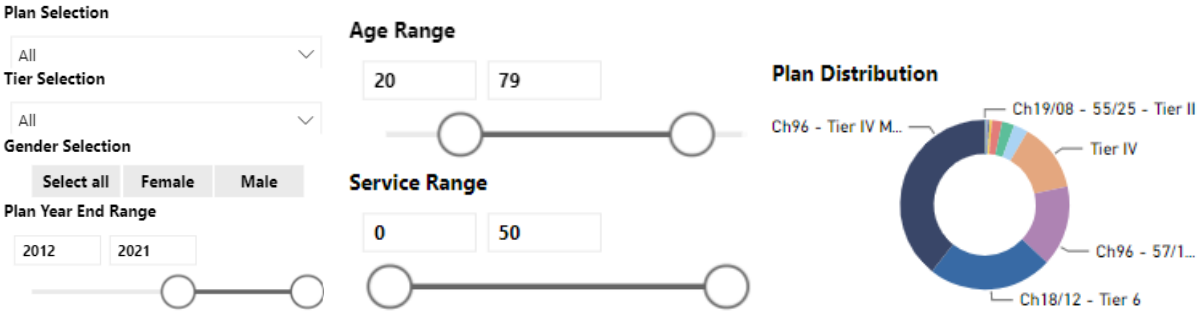


Finally, a bubble chart displaying the A/E ratios by gender is shown. The size of the bubble reflects the number of exposures. The following chart shows the results based on service bins.



In MEST, there are various items that the user can select. Once a selection is made, the charts update in real time and the totals are based on the selections.

- Plan selections – a drop-down box allows the user to select the available plan codes for that system (the options in the drop-down box depend on the selected system).
- Tier selections – a drop-down box allows the user to select the available tier codes for that system.
- Gender – male or female or both can be selected.
- Plan Year End Range – the user can select the specific years (years selected must be consecutive). Plan year 2021 contains the experience from July 1, 2020 to June 30, 2021.
- Age and Service Ranges – can be adjusted and combined with the different displays to delve deeper into the experience. For example, if a user wants to view the results by age for those who terminated with 10 or more years of service, the user can select the service range from 10 years to up to the maximum contained in the data and view results by age.
- Plan and Tier distributions provide the user with the number of exposures in each bucket (hover over the indicated cell). The user can select a specific plan or tier to see how those results differ from the totals, but we recommend using the drop-down boxes above.



Section IV –New York City Police Pension Fund (POLICE)

Exposures and Decrements

To set the exposures and actual decrements for POLICE, the eligibility criteria for retirement is 20 years of service. Thus, if a member has not accrued less 20 years of service, the member would be considered a withdrawal exposure whereas a member with 20 or more years of service is considered a retirement exposure. Members with 19 years of service in their last active record with a status code of retirement the following year were included as retirements with 20 years of service.

Tier 3 was effective for new hires beginning no earlier than July 1, 2009. All retirement data is for Tier 2 members, except for a few exposures under Tier 1.

Using the age and service slider tools, a user can drill down to view the results that reflect a variety of conditions such as retirement at first eligibility.

OA's retirement assumptions depend on whether the member retires at first eligibility (20 years of service) or later.

Withdrawal

The current withdrawal assumption varies by service.

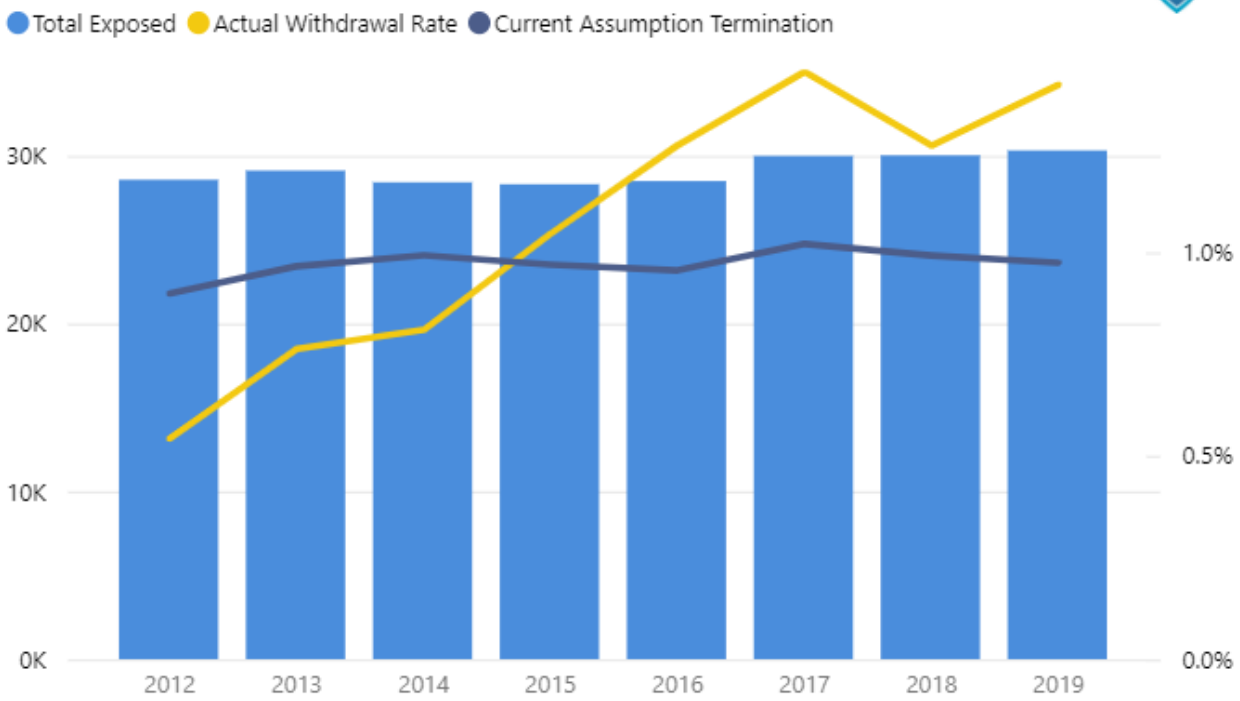
The following table shows the experience of withdrawal by year for the age range (22 to 59) and service range (0 to 19 years). Based on the current assumptions, the overall expected rate of withdrawal averaged 0.97% whereas the actual rate was 1.09%.

Plan Year	Actual Withdrawals	Expected Withdrawals	Total Exposed	Actual Withdrawal Rate	Current Assumption Termination	Ratio Act/Exp Term
2012	155	256.8	28,573	0.54%	0.90%	0.60
2013	222	281.3	29,116	0.76%	0.97%	0.79
2014	230	282.1	28,418	0.81%	0.99%	0.82
2015	296	274.6	28,303	1.05%	0.97%	1.08
2016	360	272.3	28,493	1.26%	0.96%	1.32
2017	433	306.2	29,991	1.44%	1.02%	1.41
2018	379	297.8	30,024	1.26%	0.99%	1.27
2019	428	295.4	30,315	1.41%	0.97%	1.45
2020	292	290.3	30,441	0.96%	0.95%	1.01
2021	408	286.1	30,331	1.35%	0.94%	1.43
Total	**3,203**	**2,842.8**	**294,005**	**1.09%**	**0.97%**	**1.13**

The rate of termination during 2020 and 2021 may be artificially low due to the treatment of members with a LOA status code. A record with a LOA status code is included as an exposure and not a decrement. Note that from 2016 to 2020, between 2% and 15% of the records with a status code of LOA were changed to a rehire code. Hence, between 85% and 98% of the LOA records are eventually coded as terminated, retired, disabled or death. Surprisingly, 2021 had one of the largest termination rates during the study period. Excluding 2020 and 2021, the actual rate of termination decreased slightly to 1.07% for an A/E ratio of 1.10 as shown in the following charts.

Plan Year	Actual Withdrawals	Expected Withdrawals	Total Exposed	Actual Withdrawal Rate	Current Assumption Termination	Ratio Act/Exp Term
2012	155	256.8	28,573	0.54%	0.90%	0.60
2013	222	281.3	29,116	0.76%	0.97%	0.79
2014	230	282.1	28,418	0.81%	0.99%	0.82
2015	296	274.6	28,303	1.05%	0.97%	1.08
2016	360	272.3	28,493	1.26%	0.96%	1.32
2017	433	306.2	29,991	1.44%	1.02%	1.41
2018	379	297.8	30,024	1.26%	0.99%	1.27
2019	428	295.4	30,315	1.41%	0.97%	1.45
Total	**2,503**	**2,266.4**	**233,233**	**1.07%**	**0.97%**	**1.10**

Exposure Distribution w/ Withdrawal Rate - Actual and Expected; by Year



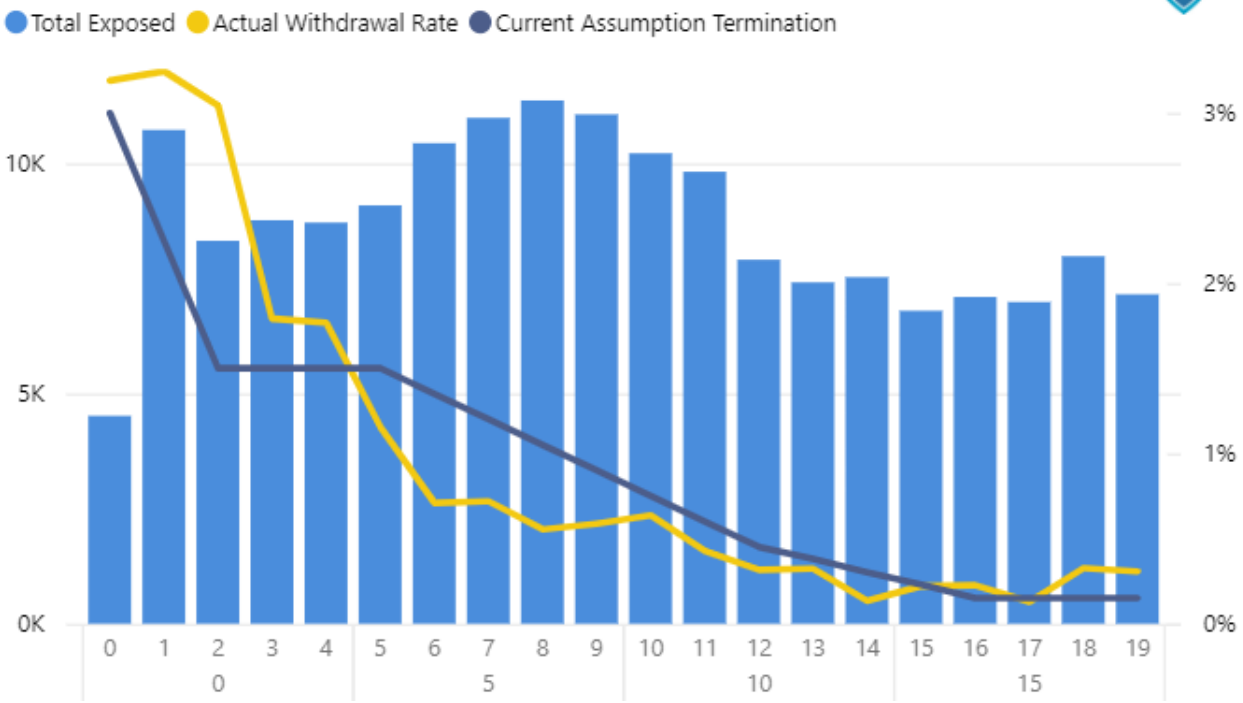
Specific observations on results through 2019:

- The actual rate of withdrawal has generally increased during the study period.
- The highest rates and the largest number of withdrawals occurred during 2017 and 2019, as well as 2021.

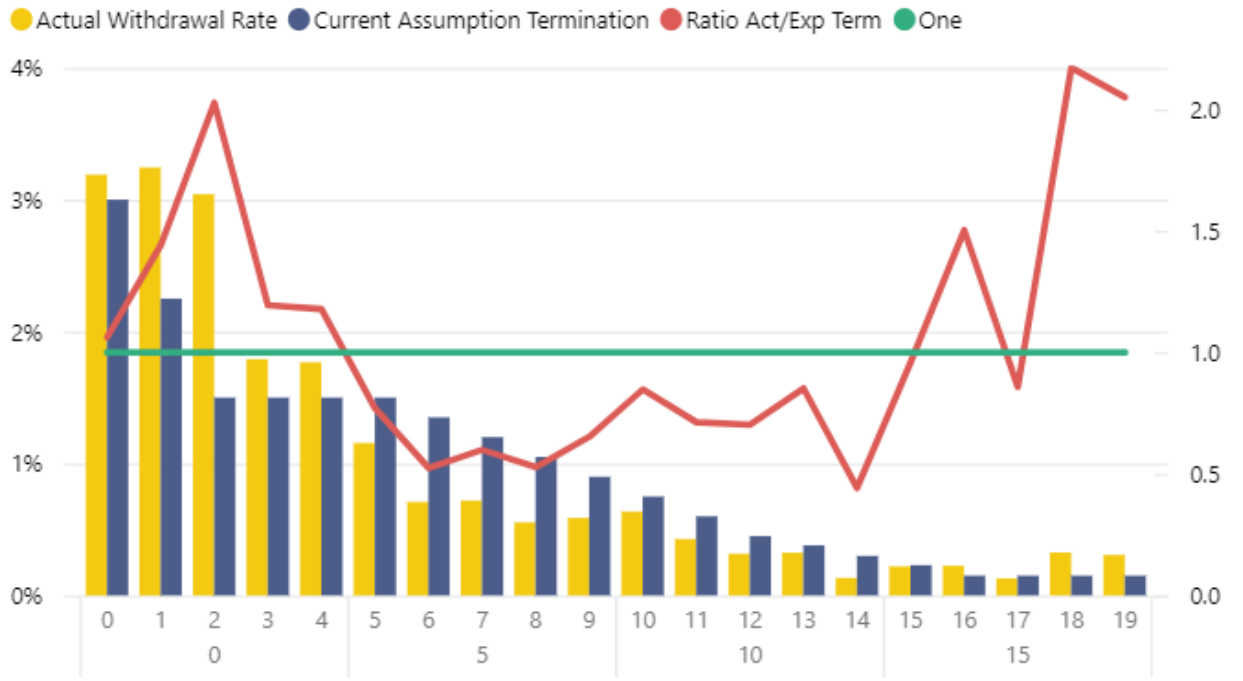
The following charts show the experience by service for the age range (22 to 59) and service range (0 to 19 years) with data through 2017, prior to the addition of data.

Service	Actual Withdrawals	Expected Withdrawals	Total Exposed	Actual Withdrawal Rate	Current Assumption Termination	Ratio Act/Exp Term
0	144	135.5	4,515	3.19%	3.00%	1.06
1	348	241.4	10,727	3.24%	2.25%	1.44
2	253	124.8	8,318	3.04%	1.50%	2.03
3	157	131.5	8,765	1.79%	1.50%	1.19
4	154	130.7	8,714	1.77%	1.50%	1.18
5	105	136.3	9,087	1.16%	1.50%	0.77
6	74	140.9	10,439	0.71%	1.35%	0.53
7	79	131.9	10,989	0.72%	1.20%	0.60
8	63	119.4	11,367	0.55%	1.05%	0.53
9	65	99.6	11,064	0.59%	0.90%	0.65
10	65	76.6	10,219	0.64%	0.75%	0.85
11	42	58.9	9,818	0.43%	0.60%	0.71
12	25	35.6	7,906	0.32%	0.45%	0.70
13	24	28.2	7,415	0.32%	0.38%	0.85
14	10	22.6	7,529	0.13%	0.30%	0.44
15	15	15.6	6,798	0.22%	0.23%	0.96
16	16	10.6	7,098	0.23%	0.15%	1.50
17	9	10.5	6,988	0.13%	0.15%	0.86
18	26	12.0	7,983	0.33%	0.15%	2.17
19	22	10.7	7,155	0.31%	0.15%	2.05
Total	**1,696**	**1,673.2**	**172,894**	**0.98%**	**0.97%**	**1.01**

Exposure Distribution w/ Withdrawal Rate - Actual and Expected; by Service



Withdrawal Rate - Actual, Expected, and Ratio; by Service



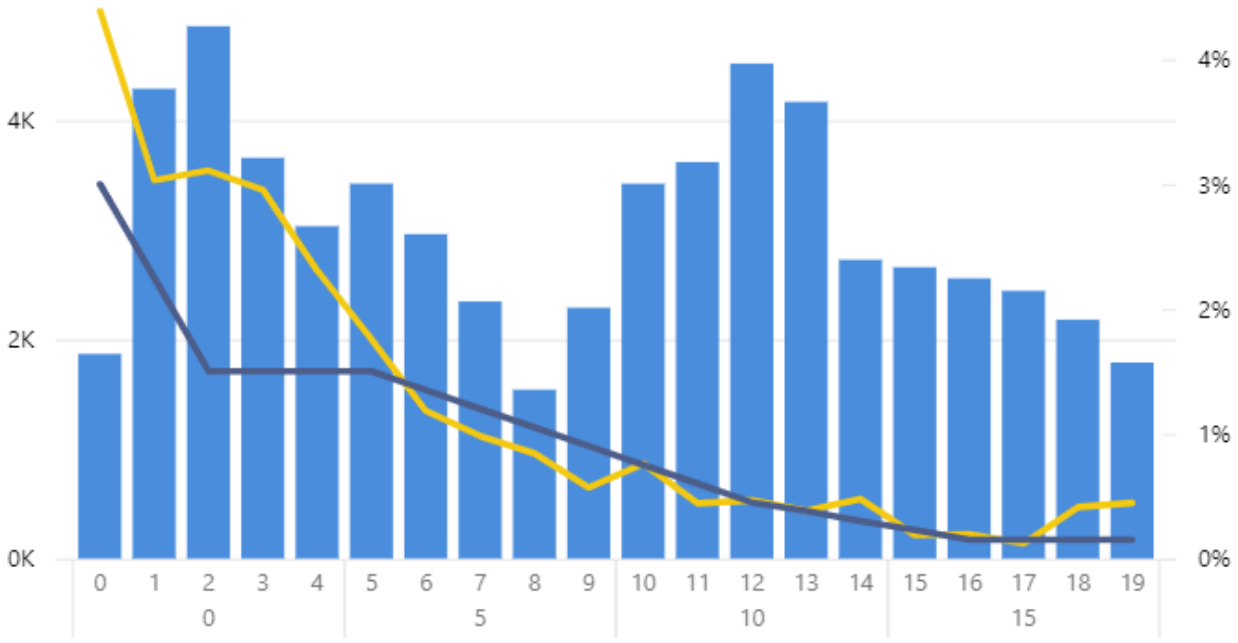
Specific observations:

- While the overall actual rate of withdrawal is very similar to the assumption, results varied by years of service.
- Actual withdrawals were larger than assumed for periods of service less than 5 years.
- Actual withdrawals were smaller than assumed for periods of service between 5 and 14 years.
- More withdrawals occurred than expected for periods of service of 18 and 19 years.

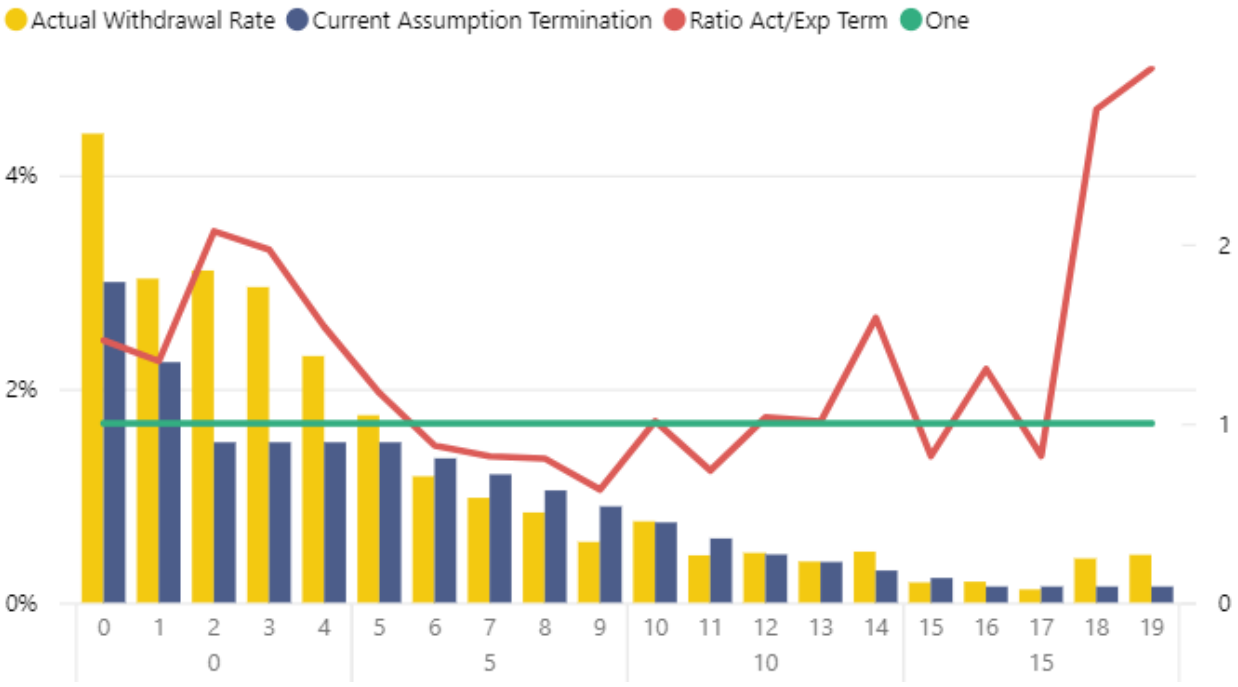
The following charts show the experience by service, for the age range (22 to 59) and service range (0 to 19 years), during the two-year period July 1, 2017 – June 30, 2019 (2018 and 2019). While the overall rates of withdrawal are greater in the two-year period than in the 2012 – 2017 experience period, they exhibit similar patterns such as relatively decreasing rates of withdrawal by service with very few withdrawals after 15 years of service, and higher rates at 18 – 19 years of service.

Service	Actual Withdrawals	Expected Withdrawals	Total Exposed	Actual Withdrawal Rate	Current Assumption Termination	Ratio Act/Exp Term
0	82	56.0	1,868	4.39%	3.00%	1.46
1	130	96.5	4,287	3.03%	2.25%	1.35
2	151	72.9	4,858	3.11%	1.50%	2.07
3	108	54.9	3,657	2.95%	1.50%	1.97
4	70	45.5	3,033	2.31%	1.50%	1.54
5	60	51.3	3,422	1.75%	1.50%	1.17
6	35	40.0	2,961	1.18%	1.35%	0.88
7	23	28.2	2,346	0.98%	1.20%	0.82
8	13	16.2	1,541	0.84%	1.05%	0.80
9	13	20.6	2,289	0.57%	0.90%	0.63
10	26	25.7	3,421	0.76%	0.75%	1.01
11	16	21.7	3,618	0.44%	0.60%	0.74
12	21	20.3	4,517	0.46%	0.45%	1.03
13	16	15.8	4,167	0.38%	0.38%	1.01
14	13	8.2	2,727	0.48%	0.30%	1.59
15	5	6.1	2,658	0.19%	0.23%	0.82
16	5	3.8	2,557	0.20%	0.15%	1.30
17	3	3.7	2,443	0.12%	0.15%	0.82
18	9	3.3	2,180	0.41%	0.15%	2.75
19	8	2.7	1,789	0.45%	0.15%	2.98
Total	**807**	**593.2**	**60,339**	**1.34%**	**0.98%**	**1.36**

Exposure Distribution w/ Withdrawal Rate - Actual and Expected; by Service



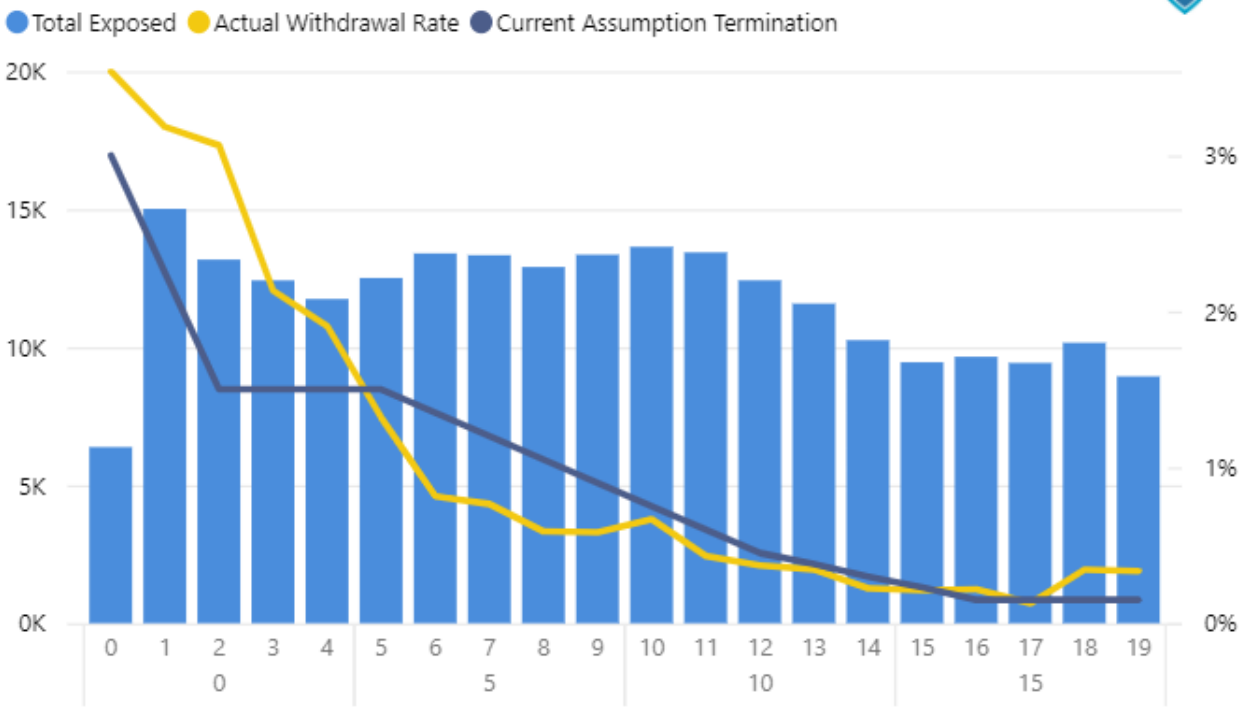
Withdrawal Rate - Actual, Expected, and Ratio; by Service



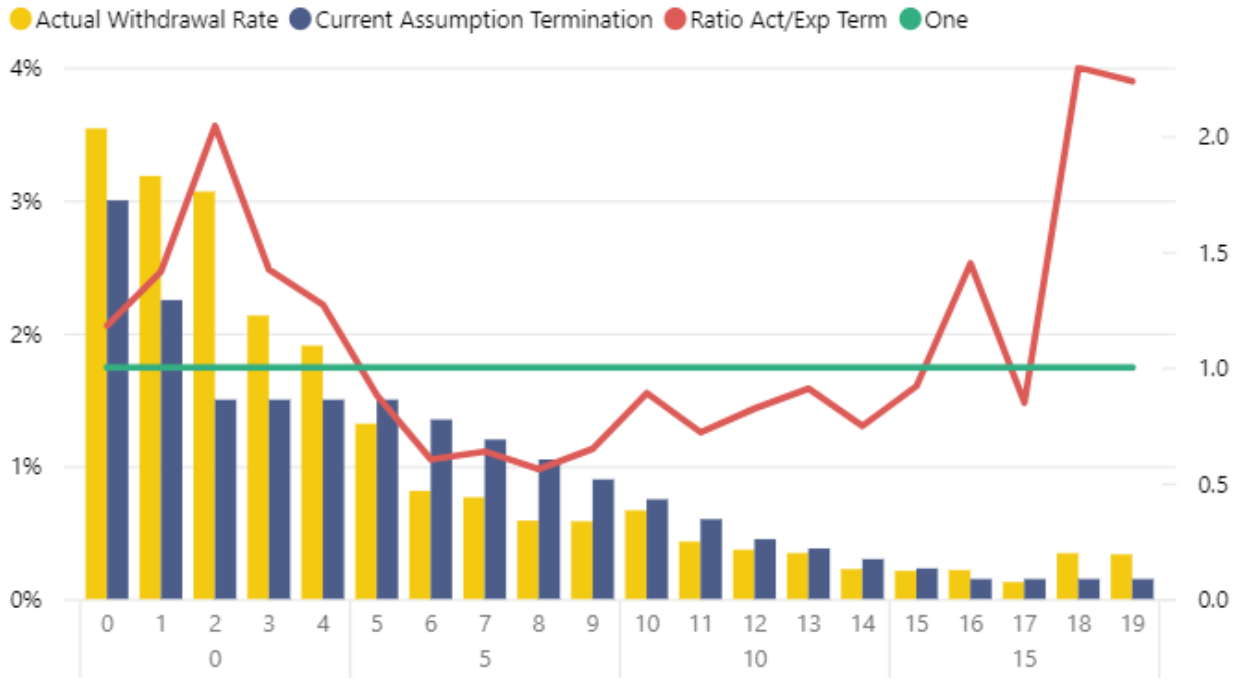
The following charts show the experience by service, for the age range (22 to 59) and service range (0 to 19 years), during the period 2012 – 2019.

Service	Actual Withdrawals	Expected Withdrawals	Total Exposed	Actual Withdrawal Rate	Current Assumption Termination	Ratio Act/Exp Term
0	226	191.5	6,383	3.54%	3.00%	1.18
1	478	337.8	15,014	3.18%	2.25%	1.41
2	404	197.6	13,176	3.07%	1.50%	2.04
3	265	186.3	12,422	2.13%	1.50%	1.42
4	224	176.2	11,747	1.91%	1.50%	1.27
5	165	187.6	12,509	1.32%	1.50%	0.88
6	109	180.9	13,400	0.81%	1.35%	0.60
7	102	160.0	13,335	0.76%	1.20%	0.64
8	76	135.5	12,908	0.59%	1.05%	0.56
9	78	120.2	13,353	0.58%	0.90%	0.65
10	91	102.3	13,640	0.67%	0.75%	0.89
11	58	80.6	13,436	0.43%	0.60%	0.72
12	46	55.9	12,423	0.37%	0.45%	0.82
13	40	44.0	11,582	0.35%	0.38%	0.91
14	23	30.8	10,256	0.22%	0.30%	0.75
15	20	21.7	9,456	0.21%	0.23%	0.92
16	21	14.5	9,655	0.22%	0.15%	1.45
17	12	14.1	9,431	0.13%	0.15%	0.85
18	35	15.2	10,163	0.34%	0.15%	2.30
19	30	13.4	8,944	0.34%	0.15%	2.24
Total	**2,503**	**2,266.4**	**233,233**	**1.07%**	**0.97%**	**1.10**

Exposure Distribution w/ Withdrawal Rate - Actual and Expected; by Service



Withdrawal Rate - Actual, Expected, and Ratio; by Service



Specific observations based on the period 2012 - 2019:

- Overall, the actual rate of withdrawal is somewhat greater than expected (the A/E ratio is 1.10), but the actual rates of withdrawal vary by length of service.
- The actual withdrawal rate is greater than expected for the service period of up to 4 years (A/E ratio of 1.47).
- The actual withdrawal rate is smaller for the service periods of 5 - 14 years of service (A/E ratio of 0.72).
- Actual withdrawal rates are much greater than expected for members near retirement with 18 and 19 years of service (A/E ratio of 2.27).
    - We believe this may be due to officers ability to commence receiving pension benefits once they would have accrued 20 years of service.

Summary

We find that the actual withdrawal experience is higher than expected for short service members up to 4 years, less than expected for service periods of 5 to 17 years and then higher than expected for members with 18 to 19 years.

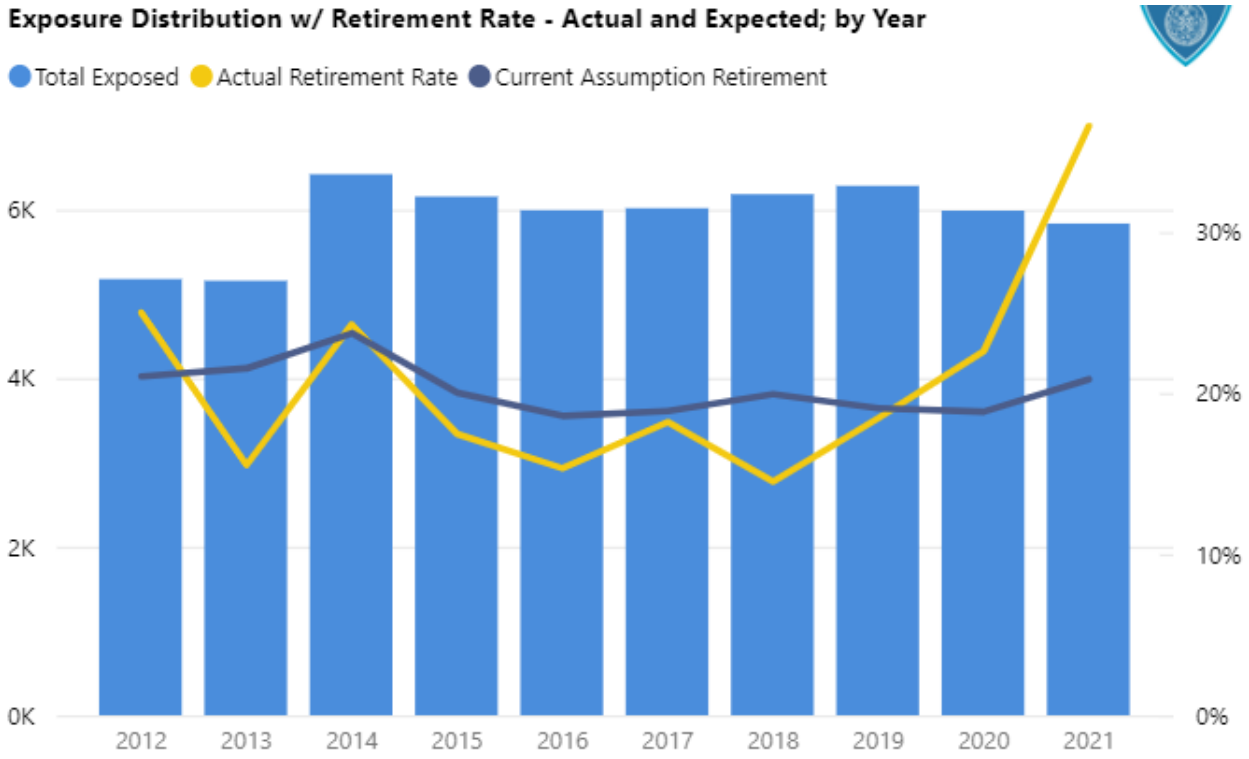
Retirement

The current retirement assumption varies by age and first eligibility for retirement. Since Tier 3 became effective July 1, 2009, and requires 20 years of service to retire, there is no retirement experience associated with this tier.

Please note that members who retired with World Trade Center (WTC) benefits are considered accidental disability retirements for purposes of this analysis, thus potentially reducing the number of service retirements. See the section below for details.

The following table shows the retirement experience by year, for the age range (40 to 62) and service range (20 to 44 years). Based on current assumptions, the overall expected rate of retirement was 20.24%, whereas the actual rate of retirement was slightly higher at 20.76%, for an A/E ratio of 1.03.

Plan Year	Actual Retirements	Expected Retirements	Total Exposed	Actual Retirement Rate	Current Assumption Retirement	Ratio Act/Exp Ret
2012	1,295	1,088.8	5,176	25.02%	21.04%	1.19
2013	800	1,110.4	5,156	15.52%	21.54%	0.72
2014	1,558	1,522.2	6,420	24.27%	23.71%	1.02
2015	1,075	1,232.9	6,155	17.47%	20.03%	0.87
2016	919	1,113.7	5,993	15.33%	18.58%	0.83
2017	1,095	1,136.1	6,017	18.20%	18.88%	0.96
2018	897	1,232.8	6,183	14.51%	19.94%	0.73
2019	1,159	1,198.0	6,283	18.45%	19.07%	0.97
2020	1,354	1,128.3	5,988	22.61%	18.84%	1.20
2021	2,137	1,217.5	5,835	36.62%	20.86%	1.76
Total	**12,289**	**11,980.7**	**59,206**	**20.76%**	**20.24%**	**1.03**



Unlike the other systems, few members with a LOA status code in a given year have a retired status code in the following two years. Consequently, we do not believe LOA status codes have a significant impact on the number of retirements in any year.

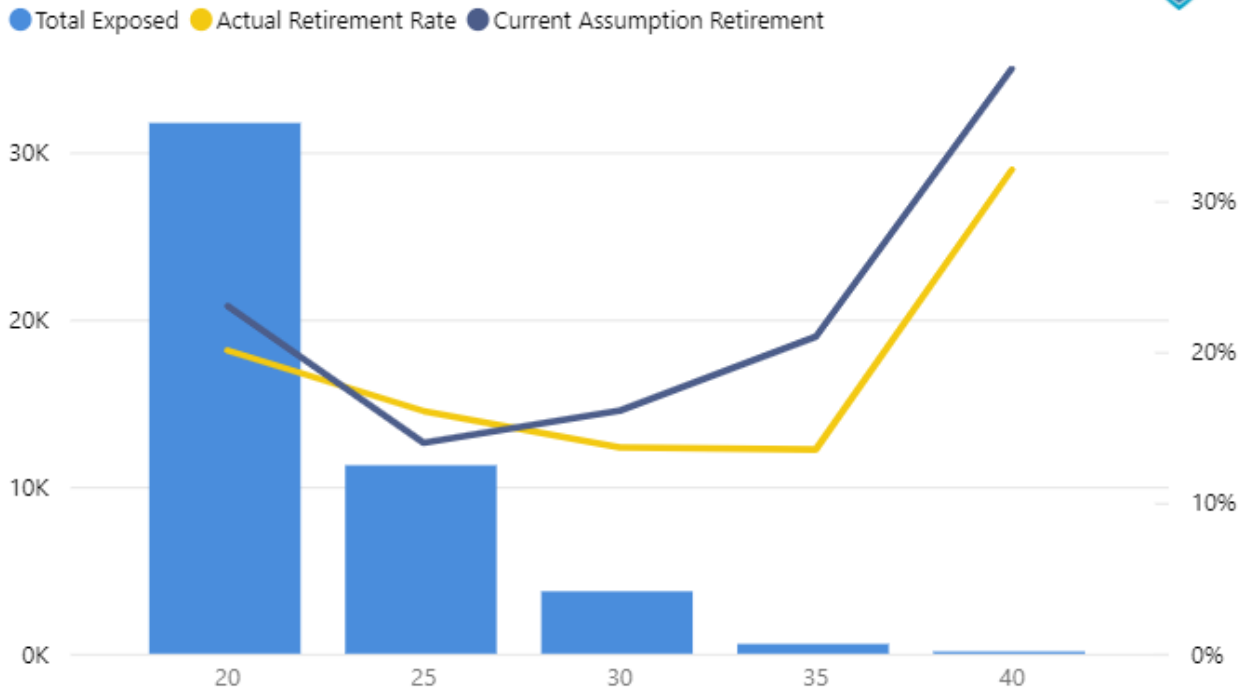
Specific observations:

- The actual rate of retirement was much greater than expected in 2021, when over 36% of eligible officers retired.
- The actual retirement rates were smaller than expected from 2015 to 2019, which may be in part due to the members' ability to elect WTC benefits.

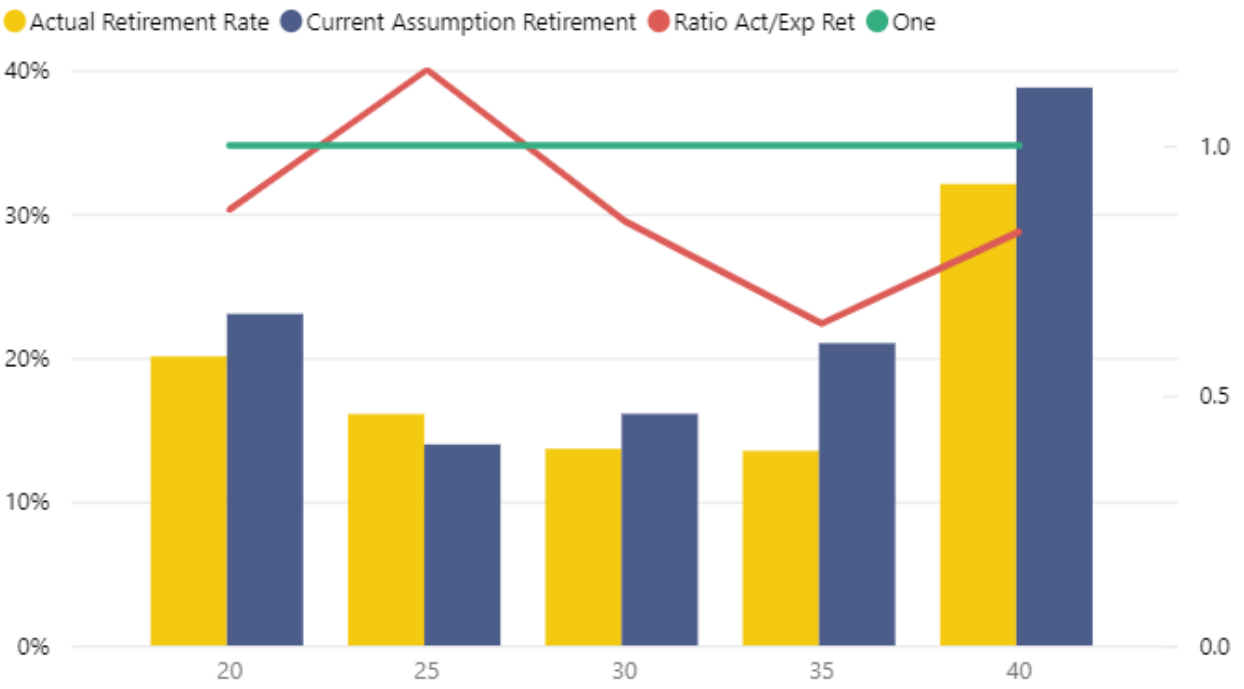
The following charts display the experience by service for the age range (40 to 62) with at least 20 years of service during the period 2012 – 2019.

Service	Actual Retirements	Expected Retirements	Total Exposed	Actual Retirement Rate	Current Assumption Retirement	Ratio Act/Exp Ret
20	3,833	4,756.1	10,570	36.26%	45.00%	0.81
21	942	799.0	6,884	13.68%	11.61%	1.18
22	585	655.5	5,476	10.68%	11.97%	0.89
23	425	582.1	4,705	9.03%	12.37%	0.73
24	594	523.4	4,110	14.45%	12.73%	1.13
25	769	468.2	3,540	21.72%	13.23%	1.64
26	355	351.3	2,558	13.88%	13.73%	1.01
27	280	293.5	2,066	13.55%	14.21%	0.95
28	226	257.8	1,752	12.90%	14.71%	0.88
29	183	204.3	1,355	13.51%	15.08%	0.90
30	190	184.6	1,200	15.83%	15.39%	1.03
31	112	147.6	935	11.98%	15.79%	0.76
32	91	116.2	718	12.67%	16.18%	0.78
33	64	86.5	512	12.50%	16.90%	0.74
34	53	65.5	365	14.52%	17.96%	0.81
35	30	42.6	232	12.93%	18.38%	0.70
36	18	29.0	142	12.68%	20.42%	0.62
37	20	22.7	102	19.61%	22.21%	0.88
38	6	18.1	70	8.57%	25.79%	0.33
39	5	10.4	38	13.16%	27.24%	0.48
40	5	5.9	19	26.32%	30.79%	0.85
41	5	6.0	15	33.33%	40.00%	0.83
42	3	2.6	6	50.00%	43.33%	1.15
43	3	4.6	10	30.00%	46.00%	0.65
44	1	1.5	3	33.33%	50.00%	0.67
Total	**8,798**	**9,634.9**	**47,383**	**18.57%**	**20.33%**	**0.91**

Exposure Distribution w/ Retirement Rate - Actual and Expected; by Service



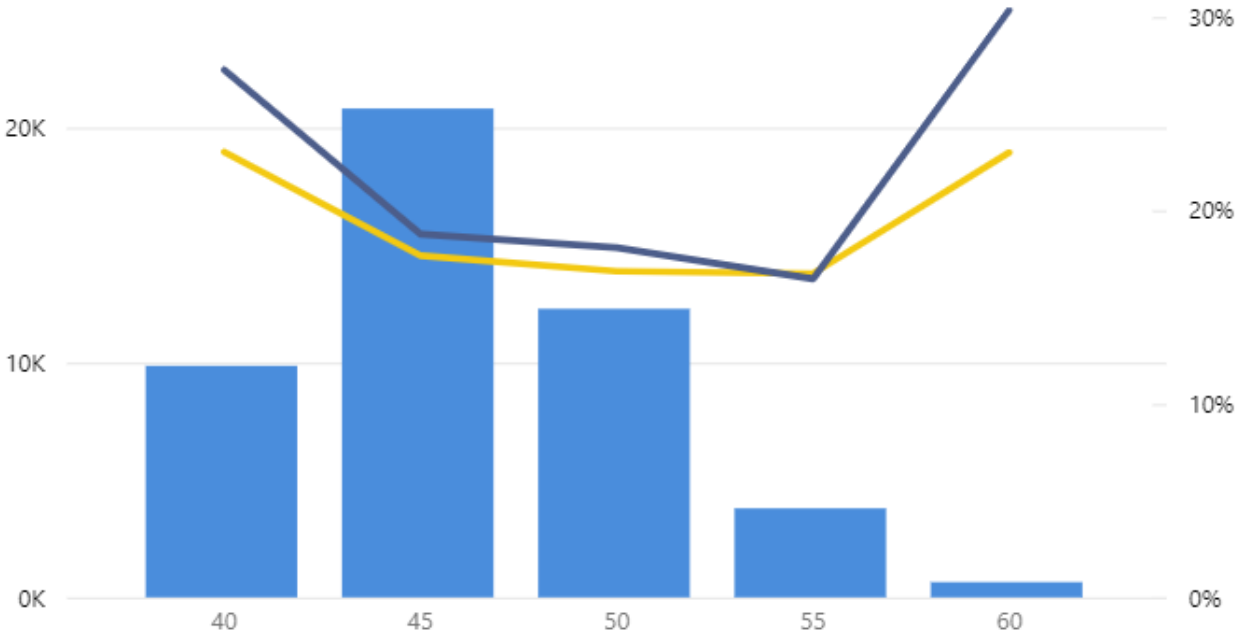
Retirement Rate - Actual, Expected, and Ratio; by Service



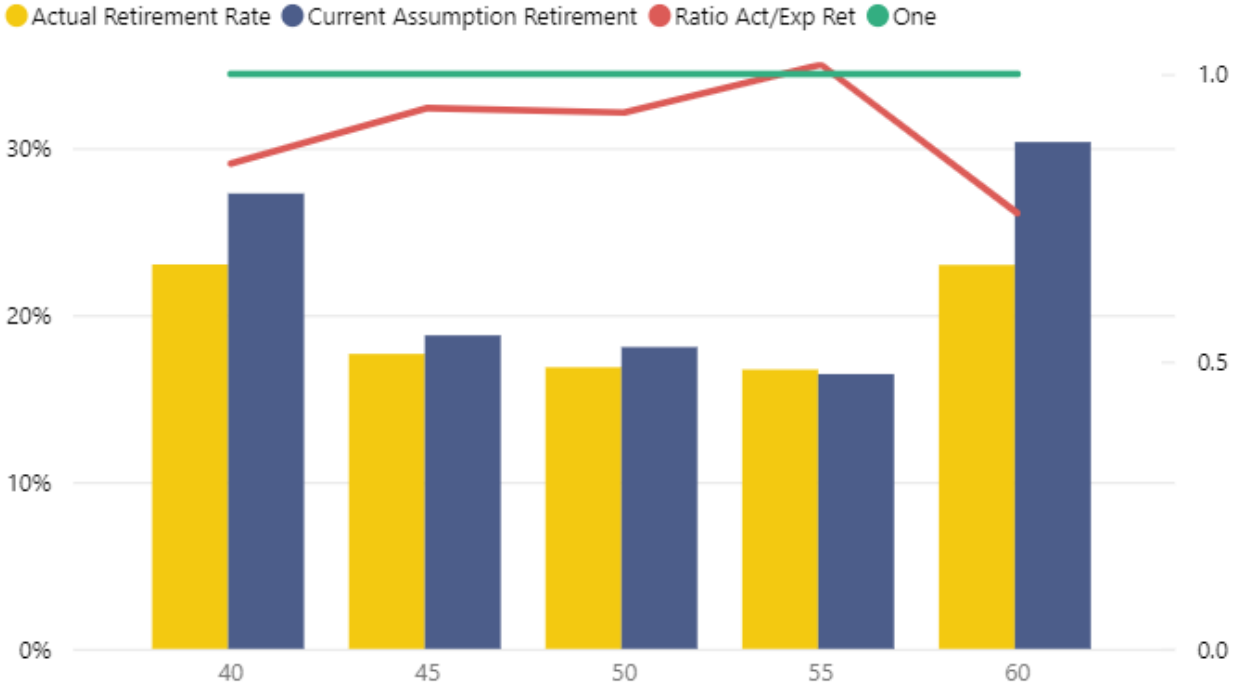
The following charts display the experience by age for the age range (40 to 62) with at least 20 years of service, during the period 2012 – 2019.

Age	Actual Retirements	Expected Retirements	Total Exposed	Actual Retirement Rate	Current Assumption Retirement	Ratio Act/Exp Ret
40	159	116.9	266	59.77%	43.95%	1.36
41	307	375.4	968	31.71%	38.78%	0.82
42	532	638.5	2,038	26.10%	31.33%	0.83
43	625	773.9	2,976	21.00%	26.01%	0.81
44	646	783.1	3,607	17.91%	21.71%	0.82
45	769	823.8	4,147	18.54%	19.87%	0.93
46	780	809.9	4,355	17.91%	18.60%	0.96
47	769	797.3	4,375	17.58%	18.22%	0.96
48	703	755.7	4,120	17.06%	18.34%	0.93
49	654	720.1	3,810	17.17%	18.90%	0.91
50	580	628.1	3,331	17.41%	18.85%	0.92
51	482	532.3	2,905	16.59%	18.32%	0.91
52	402	444.8	2,453	16.39%	18.13%	0.90
53	331	352.8	2,019	16.39%	17.47%	0.94
54	276	262.1	1,575	17.52%	16.64%	1.05
55	207	201.3	1,210	17.11%	16.64%	1.03
56	169	158.1	938	18.02%	16.86%	1.07
57	111	117.3	710	15.63%	16.52%	0.95
58	74	83.7	524	14.12%	15.97%	0.88
59	73	63.3	408	17.89%	15.51%	1.15
60	38	58.2	290	13.10%	20.09%	0.65
61	34	61.5	204	16.67%	30.15%	0.55
62	77	77.0	154	50.00%	49.97%	1.00
Total	**8,798**	**9,634.9**	**47,383**	**18.57%**	**20.33%**	**0.91**

Exposure Distribution w/ Retirement Rate - Actual and Expected; by Age



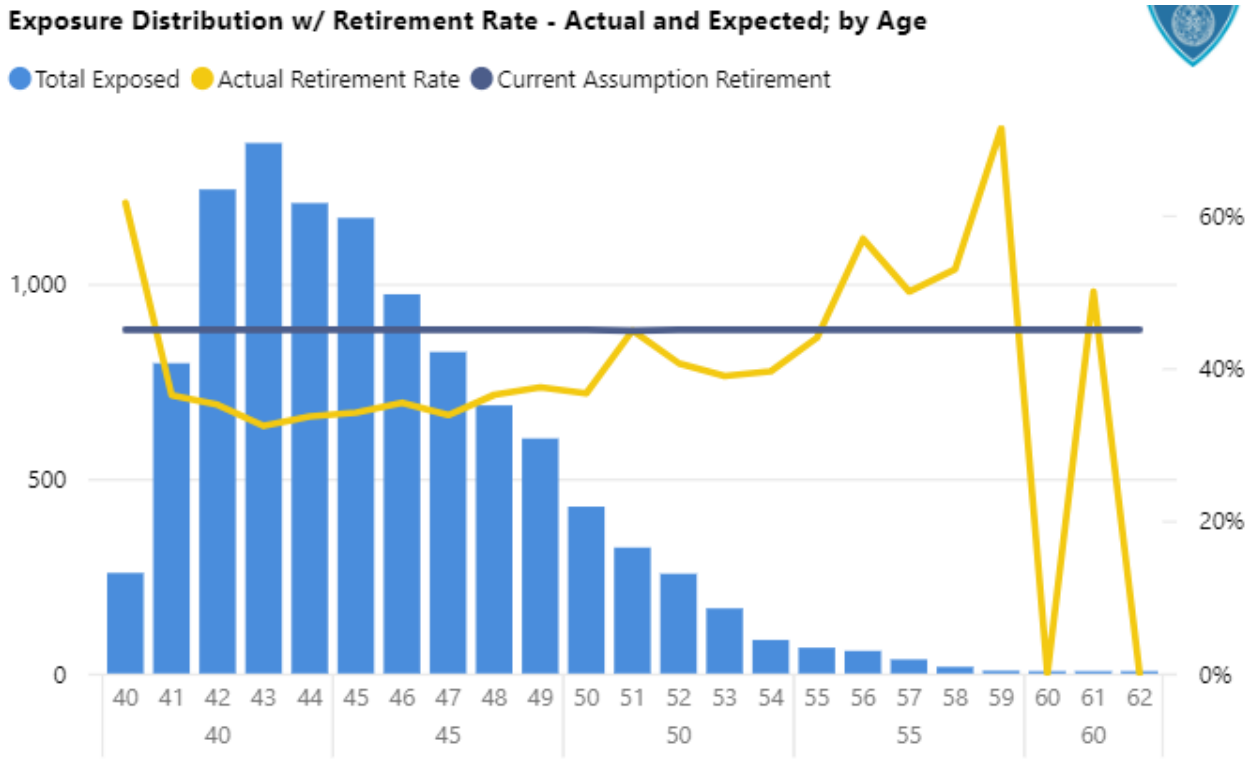
Retirement Rate - Actual, Expected, and Ratio; by Age



Specific observations:

- The actual retirement rate was smaller than expected at first eligibility, that is, when attaining 20 years of service (A/E ratio of 0.81).
- The rate of retirement at 25 years of service is higher than at other service periods.
    - This could be a consequence of the provision under which the member's full longevity salary becomes pensionable earnings after attaining 25 years of service.

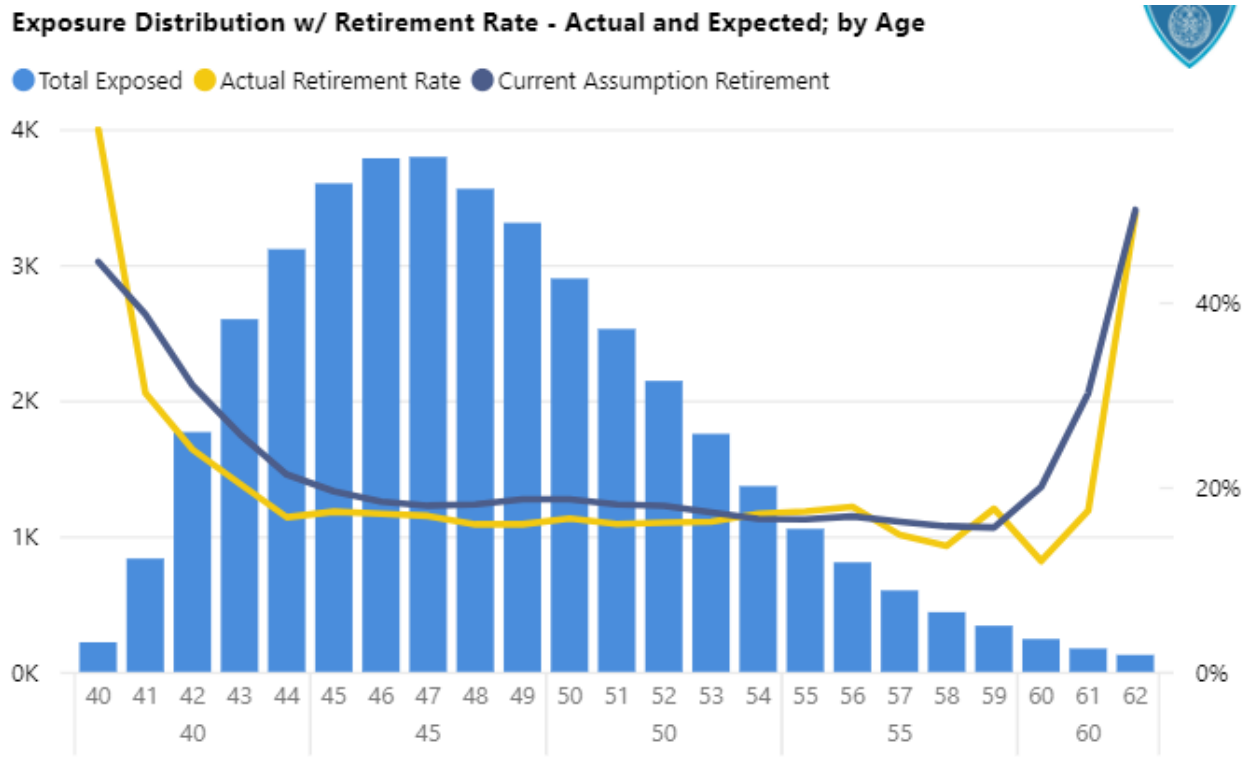
The following chart shows the experience by age for members retiring at 20 years of service for the age range (40 to 62).

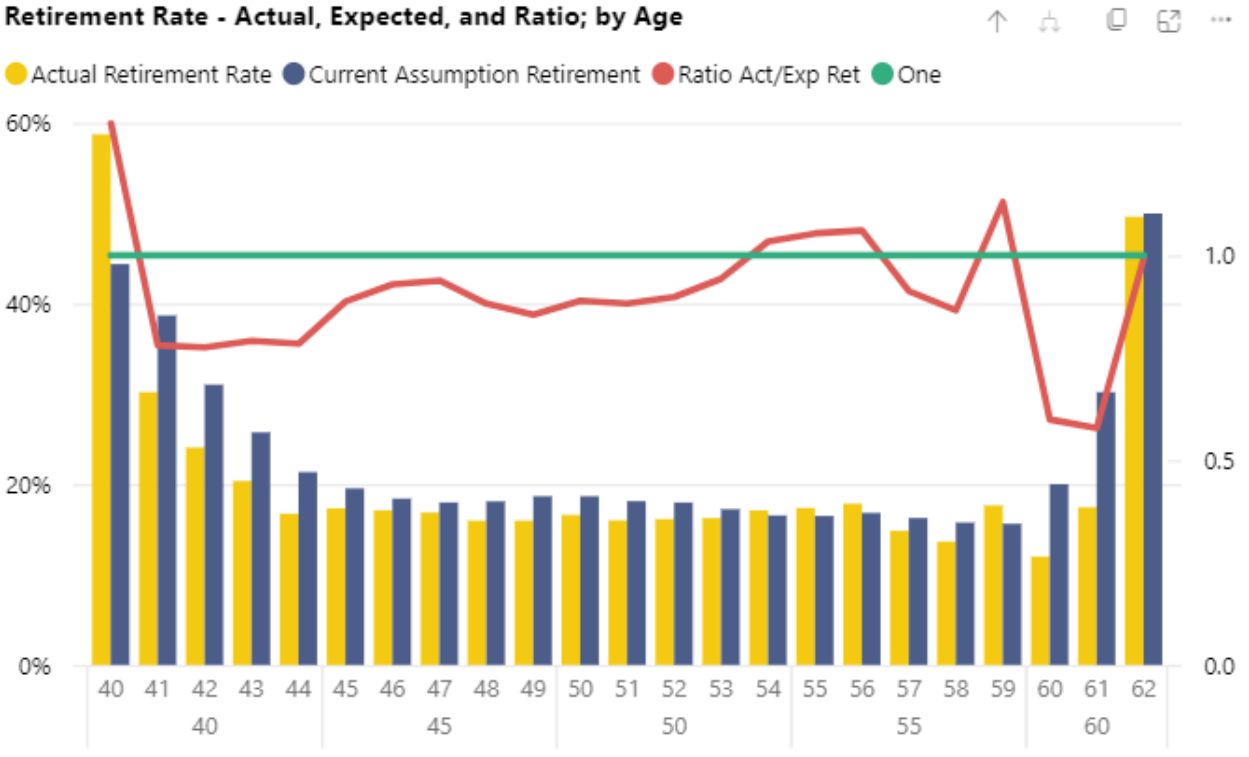


Impact of WTC Benefits

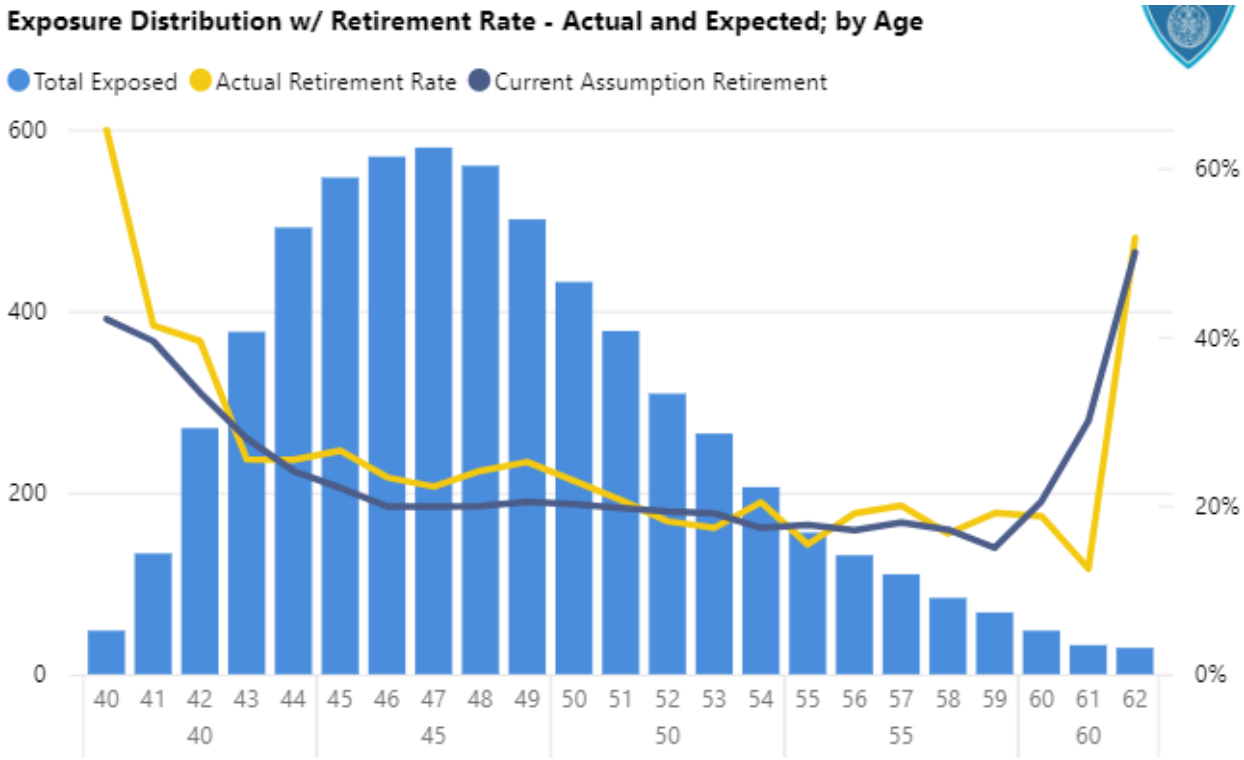
In the accidental disability retirement section, we discuss the impact of members who qualify for WTC benefits. Some members received an accidental disability retirement benefit because they qualified for the WTC benefits. It appears that this may have led to fewer members coded as service retirements rather than accidental disability retirements.

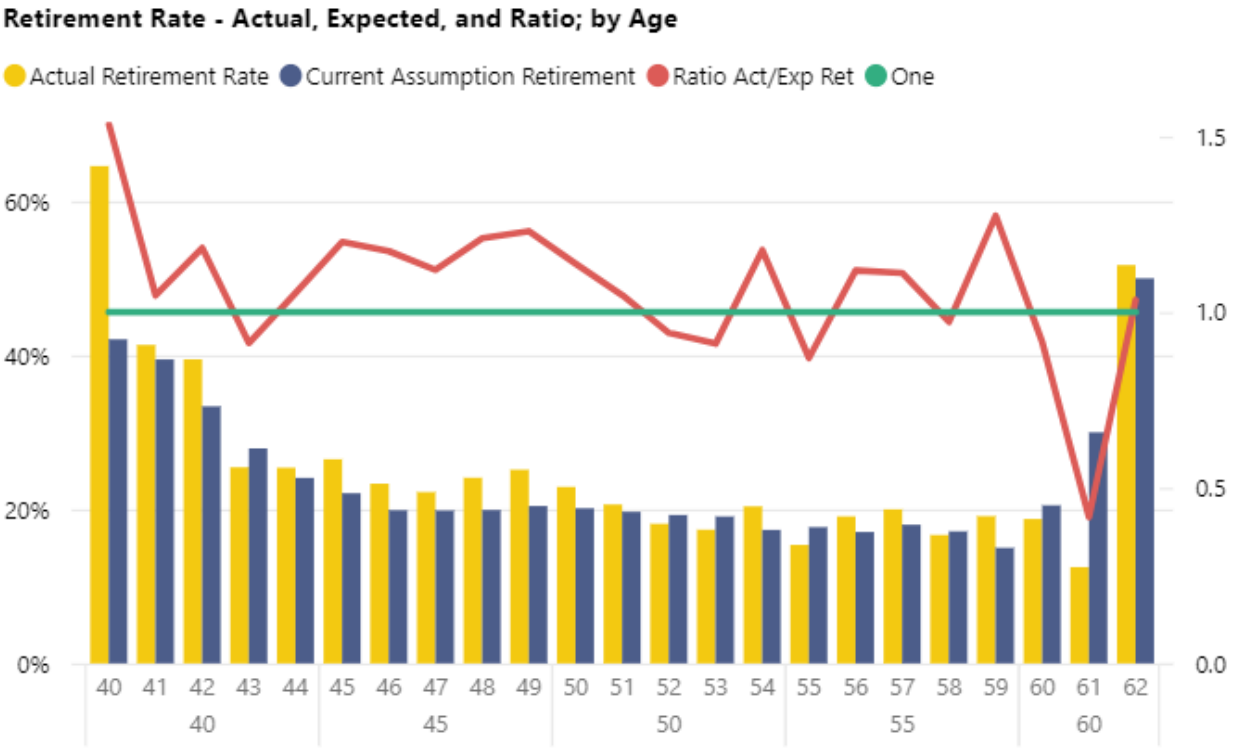
The following charts show the experience by age for members who are eligible for WTC benefits for the age range (40 to 62).





The following charts show the experience by age for members who are not eligible for WTC benefits for the age range (40 to 62).





Specific observations:

- Among members who are eligible for WTC benefits, the actual retirement rates were smaller than expected (A/E ratio of 0.88).
- Among members who are not eligible for WTC benefits, the actual retirement rates were greater than expected (A/E ratio of 1.10).

The effect of eligibility for WTC benefits on the number of retirements and disabilities leads to the following question: how should retirement rates and disability rates be adjusted to account for the impact of WTC benefits?

Disability

The current ordinary disability assumption varies by age. They apply to all service periods for Tier 1 and Tier 2 members, but do not apply before the five-year eligibility period is satisfied for Tier 3 members. Furthermore, different rates apply to accidental disability; these rates depend on age, Tier, and eligibility for World Trade Center disability benefits (WTC). We assumed that anyone with a WTC ultimate code would be eligible for the WTC benefits.

Ordinary disability benefits are as follows:

- For Tier 1 and Tier 2 members: 1/3 of final average salary (FAS) if the member has fewer than 10 years of service; 50% of FAS if the member has at least 10 years of service; 2.5% of FAS times the number of years of service if the member has completed 20 years of service. The member can elect a service retirement benefit instead of the ordinary disability benefit.

- For Tier 3 members: the greater of 1/3 of FAS, or 2% of FAS times the number of years of credited service

The base accidental disability benefit equals 75% of final average salary plus 1/60th of total earnings after the 20th anniversary, which is greater than the service retirement benefit.

Ordinary Disability

The following tables show the experience of ordinary disability retirement by year, based on the age range (25 to 62) and service range (0 to 44 years). The actual rate of disability retirements was smaller than expected (A/E ratio of 0.70) during the period 2012 – 2021.

Plan Year	Actual Ordinary Disabilities	Expected Ordinary Disabilities	Total Exposed	Actual Ordinary Disability Rate	Current Assumption Ordinary Disability	Ratio Act/Exp Ordinary Disability
2012	35	44.3	32,137	0.1089%	0.1378%	0.79
2013	41	43.6	30,478	0.1345%	0.1431%	0.94
2014	30	45.1	29,322	0.1023%	0.1538%	0.67
2015	36	44.6	27,613	0.1304%	0.1617%	0.81
2016	35	45.7	27,291	0.1282%	0.1674%	0.77
2017	40	48.2	27,266	0.1467%	0.1768%	0.83
2018	38	49.7	27,460	0.1384%	0.1810%	0.76
2019	34	53.2	27,843	0.1221%	0.1909%	0.64
2020	30	54.5	27,504	0.1091%	0.1983%	0.55
2021	18	55.5	27,888	0.0645%	0.1989%	0.32
Total	**337**	**484.4**	**284,802**	**0.1183%**	**0.1701%**	**0.70**

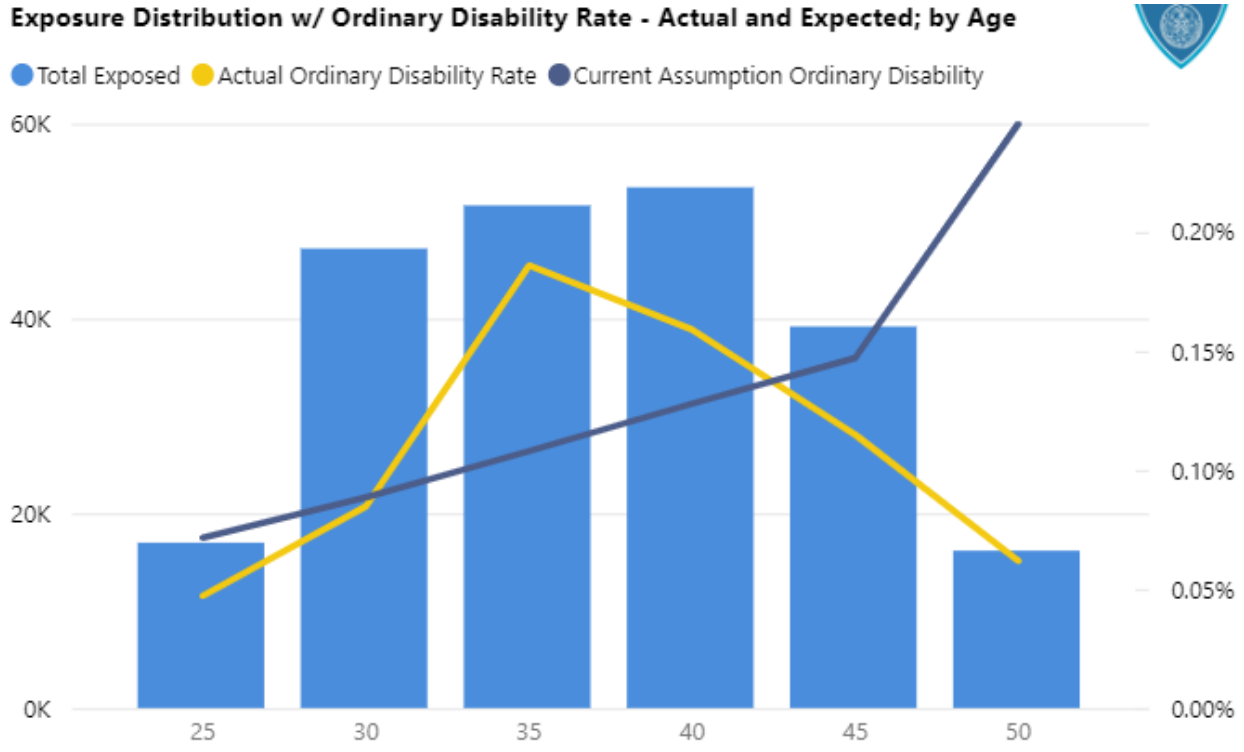
The number of ordinary disabilities in 2020 and 2021 may be understated because they are reported with delays. When these two years are excluded from the analysis, the actual rate of ordinary disability is slightly higher, resulting in an A/E ratio of 0.77.

The following tables show the experience of ordinary disability retirement by age, for the age range (25 to 62) and the service range (0 to 44), during the period 2012 – 2019.

Age	Actual Ordinary Disabilities	Expected Ordinary Disabilities	Total Exposed	Actual Ordinary Disability Rate	Current Assumption Ordinary Disability	Ratio Act/Exp Ordinary Disability
25	0	0.4	643	0.0000%	0.0600%	0.00
26	1	1.0	1,570	0.0637%	0.0640%	1.00
27	0	2.2	3,260	0.0000%	0.0680%	0.00
28	2	3.5	4,930	0.0406%	0.0720%	0.56
29	5	5.0	6,572	0.0761%	0.0760%	1.00
30	0	6.4	8,023	0.0000%	0.0800%	0.00
31	7	7.6	9,098	0.0769%	0.0840%	0.92
32	7	8.5	9,670	0.0724%	0.0880%	0.82
33	8	9.2	10,016	0.0799%	0.0920%	0.87
34	18	10.0	10,372	0.1735%	0.0960%	1.81
35	23	10.4	10,398	0.2212%	0.1000%	2.21
36	14	10.9	10,458	0.1339%	0.1040%	1.29
37	16	11.1	10,313	0.1551%	0.1080%	1.44
38	23	11.4	10,199	0.2255%	0.1120%	2.01
39	20	11.9	10,231	0.1955%	0.1160%	1.69
40	17	12.8	10,708	0.1588%	0.1200%	1.32
41	21	13.7	11,032	0.1904%	0.1240%	1.54
42	19	14.1	10,991	0.1729%	0.1280%	1.35
43	16	14.0	10,591	0.1511%	0.1320%	1.14
44	12	13.8	10,133	0.1184%	0.1360%	0.87
45	9	13.4	9,565	0.0941%	0.1400%	0.67
46	13	12.8	8,873	0.1465%	0.1440%	1.02
47	10	11.7	7,933	0.1261%	0.1480%	0.85
48	4	10.5	6,923	0.0578%	0.1520%	0.38
49	9	9.2	5,879	0.1531%	0.1560%	0.98

50	5	7.7	4,840	0.1033%	0.1600%	0.65
51	0	7.9	3,950	0.0000%	0.2000%	0.00
52	3	7.4	3,103	0.0967%	0.2400%	0.40
53	2	7.7	2,420	0.0826%	0.3200%	0.26
54	0	8.8	1,843	0.0000%	0.4800%	0.00
55	1	8.8	1,382	0.0724%	0.6400%	0.11
56	2	8.3	1,032	0.1938%	0.8000%	0.24
57	0	12.3	767	0.0000%	1.6000%	0.00
58	0	13.5	561	0.0000%	2.4000%	0.00
59	0	13.8	430	0.0000%	3.2000%	0.00
60	1	15.0	312	0.3205%	4.8000%	0.07
61	0	14.1	220	0.0000%	6.4000%	0.00
62	1	13.5	169	0.5917%	8.0000%	0.07
Total	**289**	**374.4**	**229,410**	**0.1260%**	**0.1632%**	**0.77**

Due to increases in the rates of disability for ages 55 and older, the following graph was limited to age 54 to provide a better visual of the results.

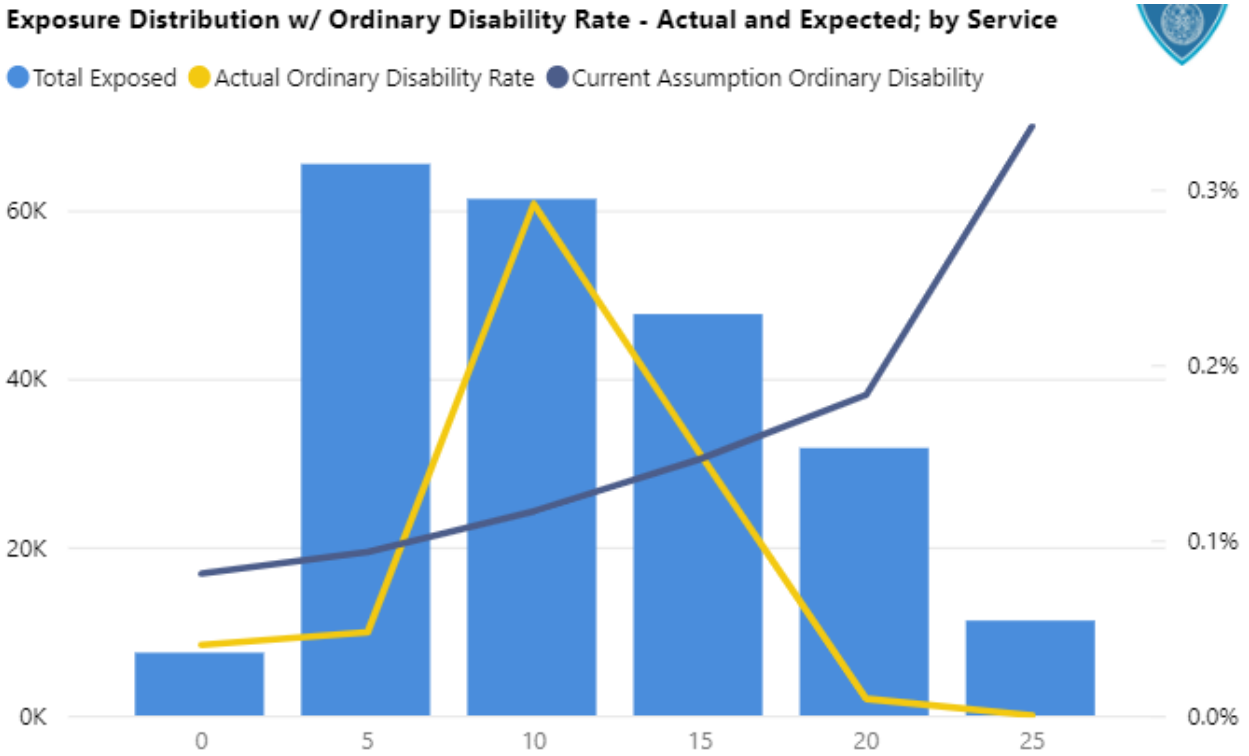


The following tables show the experience of ordinary disability retirement by service, for the age range (25 to 62) and the service range (0 to 44 years), during the period 2012 – 2019.

Service	Actual Ordinary Disabilities	Expected Ordinary Disabilities	Total Exposed	Actual Ordinary Disability Rate	Current Assumption Ordinary Disability	Ratio Act/Exp Ordinary Disability
0	0	0.0	7	0.0000%	0.0857%	0.00
1	0	0.1	133	0.0000%	0.0865%	0.00
2	0	0.3	422	0.0000%	0.0813%	0.00
3	0	2.0	2,456	0.0000%	0.0796%	0.00
4	3	3.6	4,438	0.0676%	0.0813%	0.83
5	3	10.7	12,508	0.0240%	0.0855%	0.28
6	10	11.9	13,400	0.0746%	0.0887%	0.84
7	5	12.3	13,335	0.0375%	0.0926%	0.40
8	3	12.5	12,908	0.0232%	0.0968%	0.24
9	10	13.6	13,355	0.0749%	0.1015%	0.74
10	58	14.5	13,643	0.4251%	0.1066%	3.99
11	40	15.0	13,439	0.2976%	0.1117%	2.66
12	26	14.5	12,426	0.2092%	0.1166%	1.79
13	27	14.1	11,586	0.2330%	0.1219%	1.91
14	28	13.3	10,265	0.2728%	0.1292%	2.11
15	22	12.7	9,462	0.2325%	0.1339%	1.74
16	20	13.5	9,660	0.2070%	0.1401%	1.48
17	13	13.7	9,434	0.1378%	0.1449%	0.95
18	10	15.5	10,168	0.0983%	0.1521%	0.65
19	6	14.3	8,951	0.0670%	0.1598%	0.42

20	1	17.8	10,598	0.0094%	0.1684%	◆	0.06
21	1	12.1	6,887	0.0145%	0.1762%	◆	0.08
22	1	10.4	5,476	0.0183%	0.1890%	◆	0.10
23	0	9.4	4,705	0.0000%	0.1990%	◆	0.00
24	0	8.3	4,110	0.0000%	0.2031%	◆	0.00
25	0	8.3	3,540	0.0000%	0.2347%	◆	0.00
26	0	7.1	2,558	0.0000%	0.2769%	◆	0.00
27	0	6.9	2,066	0.0000%	0.3353%	◆	0.00
28	0	7.9	1,752	0.0000%	0.4520%	◆	0.00
29	0	7.6	1,355	0.0000%	0.5632%	◆	0.00
30	0	9.3	1,200	0.0000%	0.7722%	◆	0.00
31	0	9.6	935	0.0000%	1.0216%	◆	0.00
32	0	9.4	718	0.0000%	1.3150%	◆	0.00
33	0	9.0	512	0.0000%	1.7611%	◆	0.00
34	0	8.3	365	0.0000%	2.2720%	◆	0.00
35	0	6.3	232	0.0000%	2.7207%	◆	0.00
36	0	4.9	142	0.0000%	3.4749%	◆	0.00
37	0	4.3	102	0.0000%	4.2588%	◆	0.00
38	1	3.5	70	1.4286%	4.9714%	◆	0.29
39	0	2.1	38	0.0000%	5.4947%	◆	0.00
40	0	1.2	19	0.0000%	6.2316%	◆	0.00
41	0	1.1	15	0.0000%	7.0400%	◆	0.00
42	1	0.4	6	16.6667%	7.4667%	◆	2.23
43	0	0.8	10	0.0000%	7.6800%	◆	0.00
44	0	0.2	3	0.0000%	8.0000%	◆	0.00
Total	**289**	**374.4**	**229,410**	**0.1260%**	**0.1632%**	▲	**0.77**

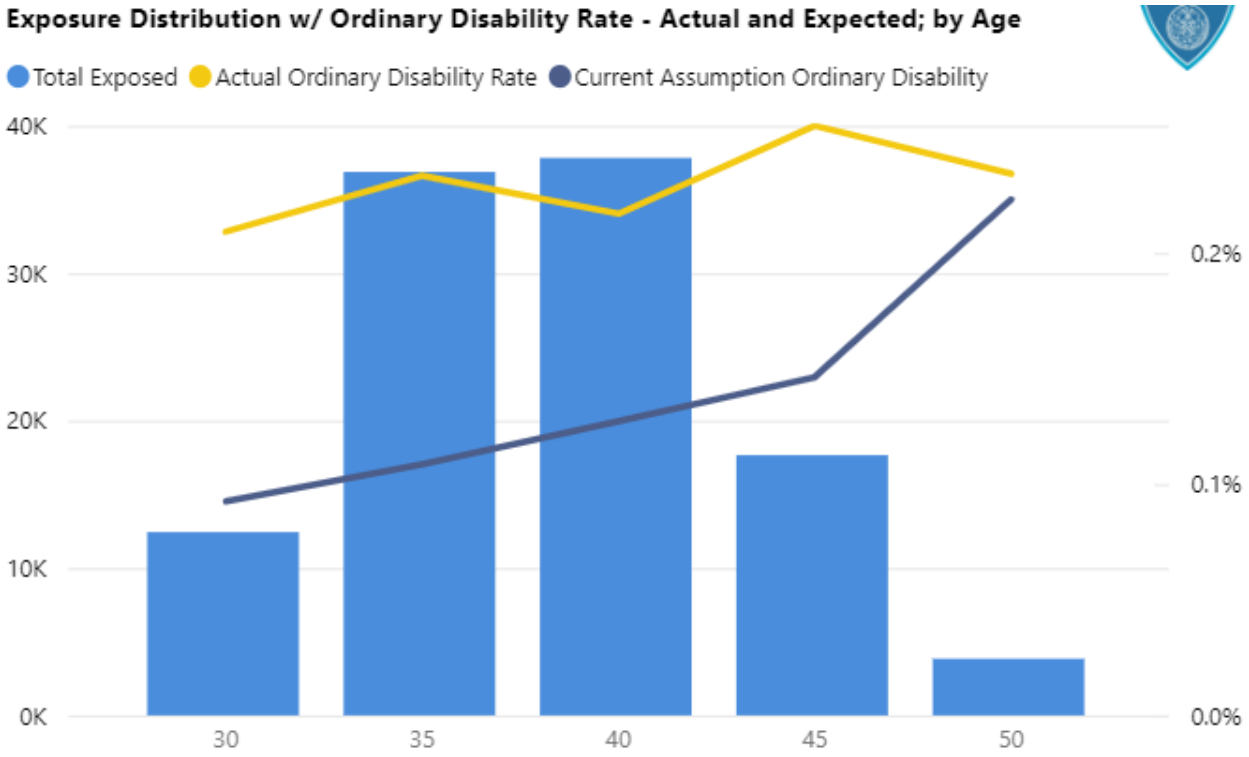
Due to few exposures among members with more than 30 years of service, the following graph was limited to service up to 29 years to provide a better visual of the results.

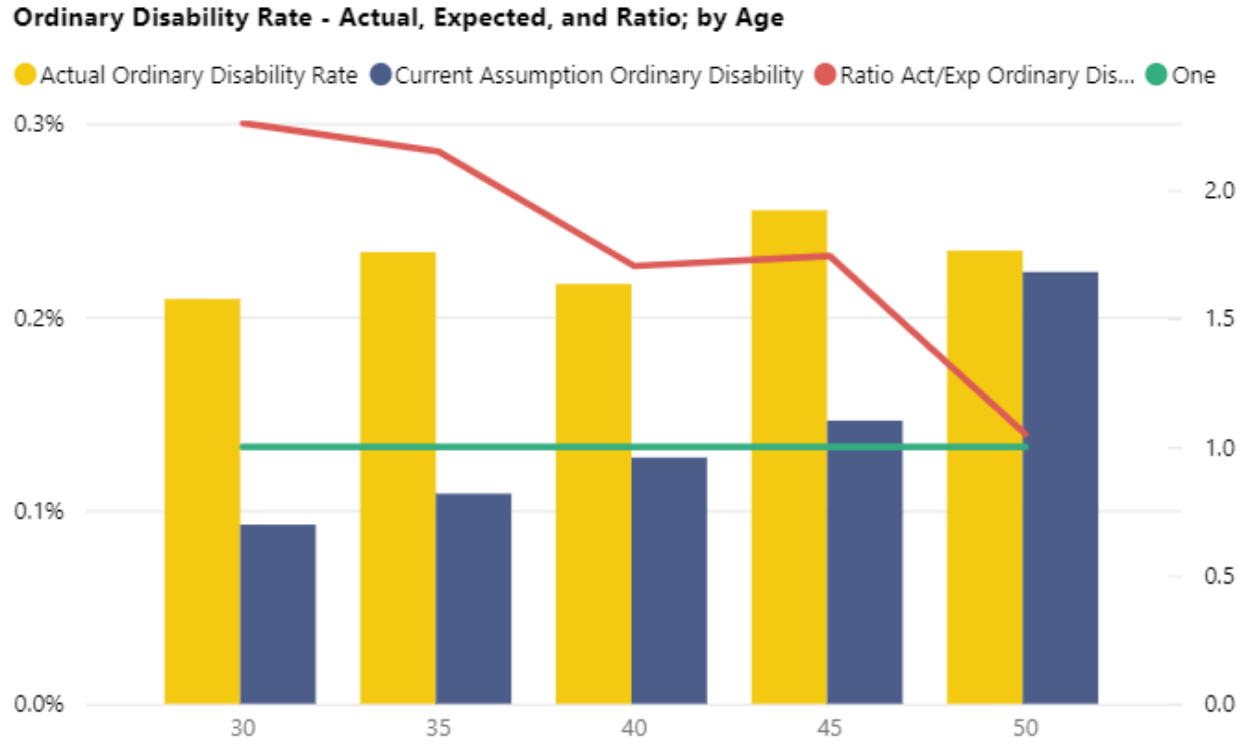


Specific observations:

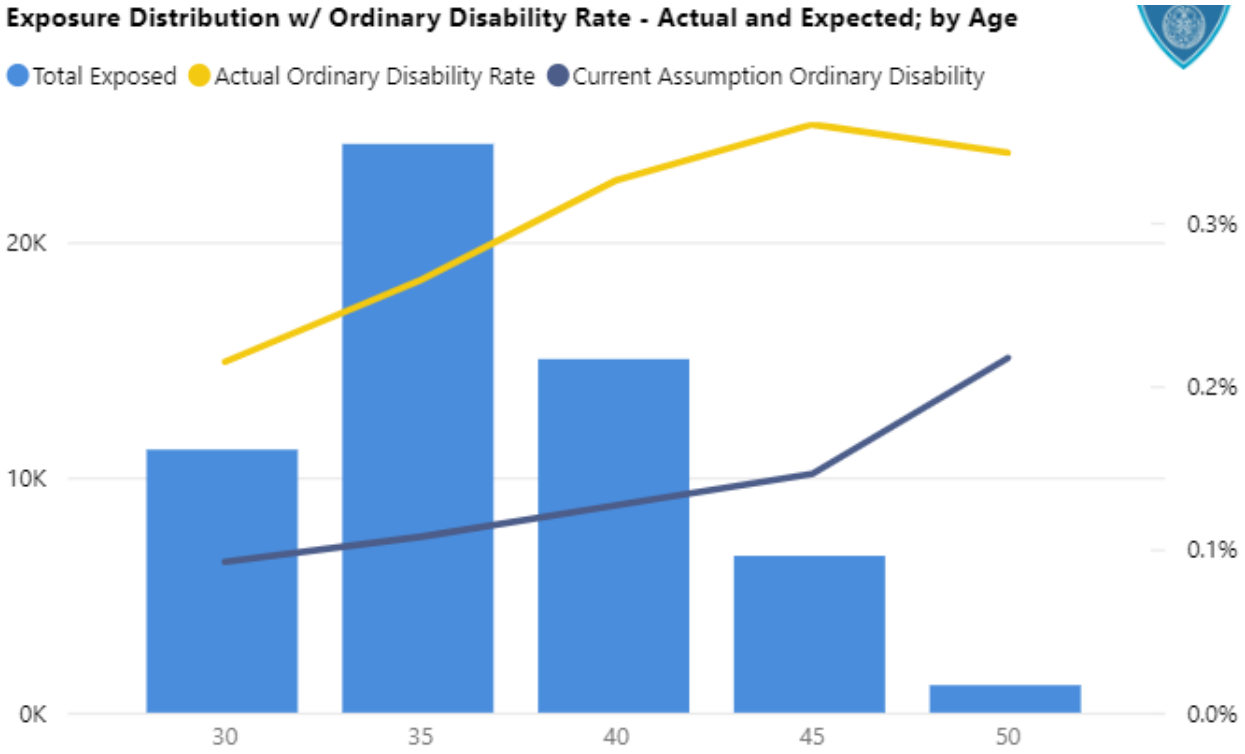
- Rates of disability vary by years of service with the highest rates occurring between 10 and 19 years of service.
- There were only 5 actual ordinary disability retirements for members with at least 20 years of service versus the expected number of 166.
- For members with between 10 and 19 years of service, the actual rate of ordinary disability retirement exceeded the assumption by 77% (A/E ratio of 1.77).
- For members with between 5 and 9 years of service, the actual rate of ordinary disability retirement was nearly half the assumption (A/E ratio of 0.51).
- Since qualifying for ordinary disability in Tier 3 requires length of service equal to, or greater than, the elimination period (five years), we excluded in this analysis members who have not satisfied the elimination period.

The following charts show the experience of members with between 10 and 19 years of service, for the age range (30 to 54). Due to increases in the rates of disability for ages 55 and older, the following graphs were limited to age 54 to provide a better visual of the results.





By limiting the experience to those not eligible for the WTC benefits, the A/E ratio increases from 1.77 to 2.41 as shown in the following chart. For visual purposes, the following chart excludes members 55 and older.



Accidental Disability

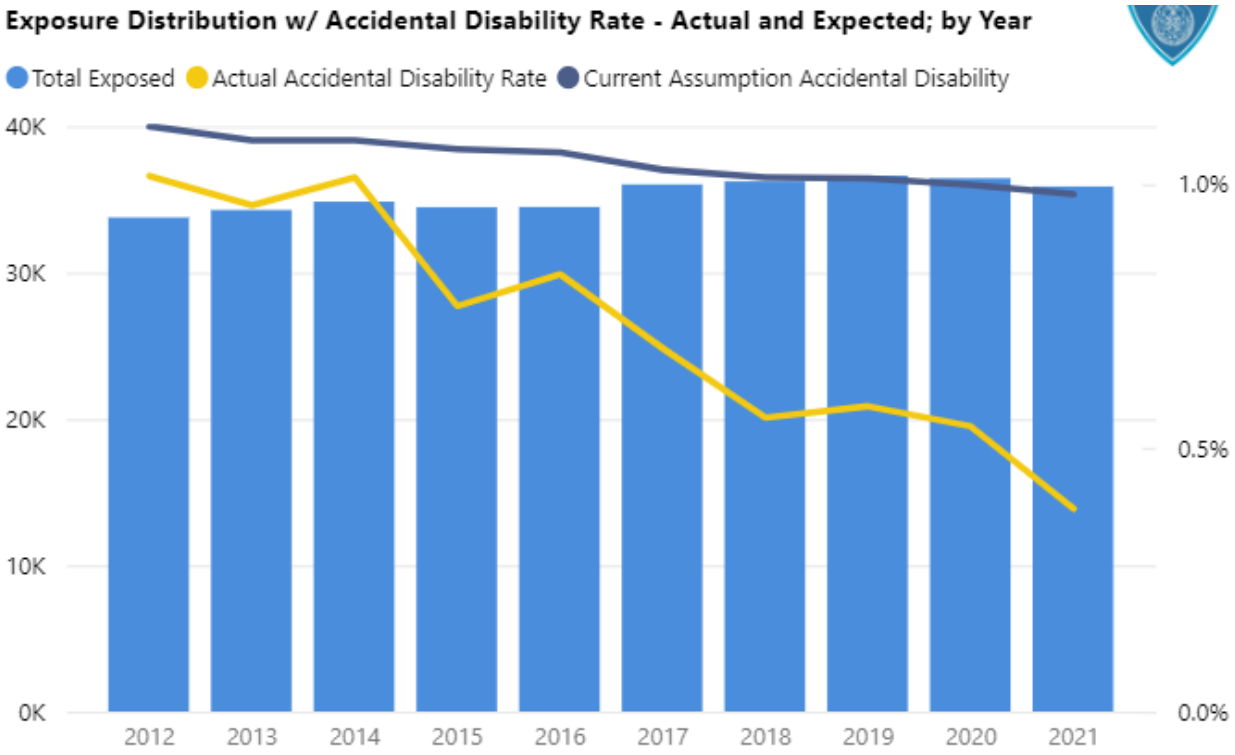
In performing the experience analysis, it is necessary to reassign disability retirement codes retroactively to reflect the eventual approval of a disability retirement. Members with a disability code in a given year had all inactive status codes in prior years changed to a disability status code. We made adjustments as far back as 2012. For POLICE, this had a significant impact on members coded as accidental disability as many records previously coded as service retirements were changed to accidental disability retirements, which includes members who were eligible for WTC benefits.

It is difficult to determine how future years would impact the experience during the study period as we believe that this type of retroactive adjustment will be required in subsequent iterations of this study. The consequence will be a restatement of the number of disability retirements experienced during this study period, specifically 2020 – 2021.

Keeping these considerations in mind, we found that the accidental disability rates declined most years since 2014, which is consistent with the experience of ordinary disability.

The following tables show the experience of accidental disability retirement, by year, based on the age range (21 to 62) and service range (0 to 44), during the period 2012 – 2021.

Plan Year	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
2012	343	374.8	33,767	1.0158%	1.1099%	0.92
2013	329	371.2	34,277	0.9598%	1.0831%	0.89
2014	353	377.4	34,846	1.0130%	1.0831%	0.94
2015	265	367.5	34,464	0.7689%	1.0664%	0.72
2016	286	365.5	34,484	0.8294%	1.0600%	0.78
2017	248	370.1	36,023	0.6884%	1.0273%	0.67
2018	202	367.0	36,234	0.5575%	1.0129%	0.55
2019	212	369.7	36,624	0.5789%	1.0094%	0.57
2020	197	363.3	36,455	0.5404%	0.9965%	0.54
2021	138	350.8	35,883	0.3846%	0.9775%	0.39
Total	**2,573**	**3,677.3**	**353,057**	**0.7288%**	**1.0416%**	**0.70**



The rates of accidental disability retirement vary by the following characteristics:

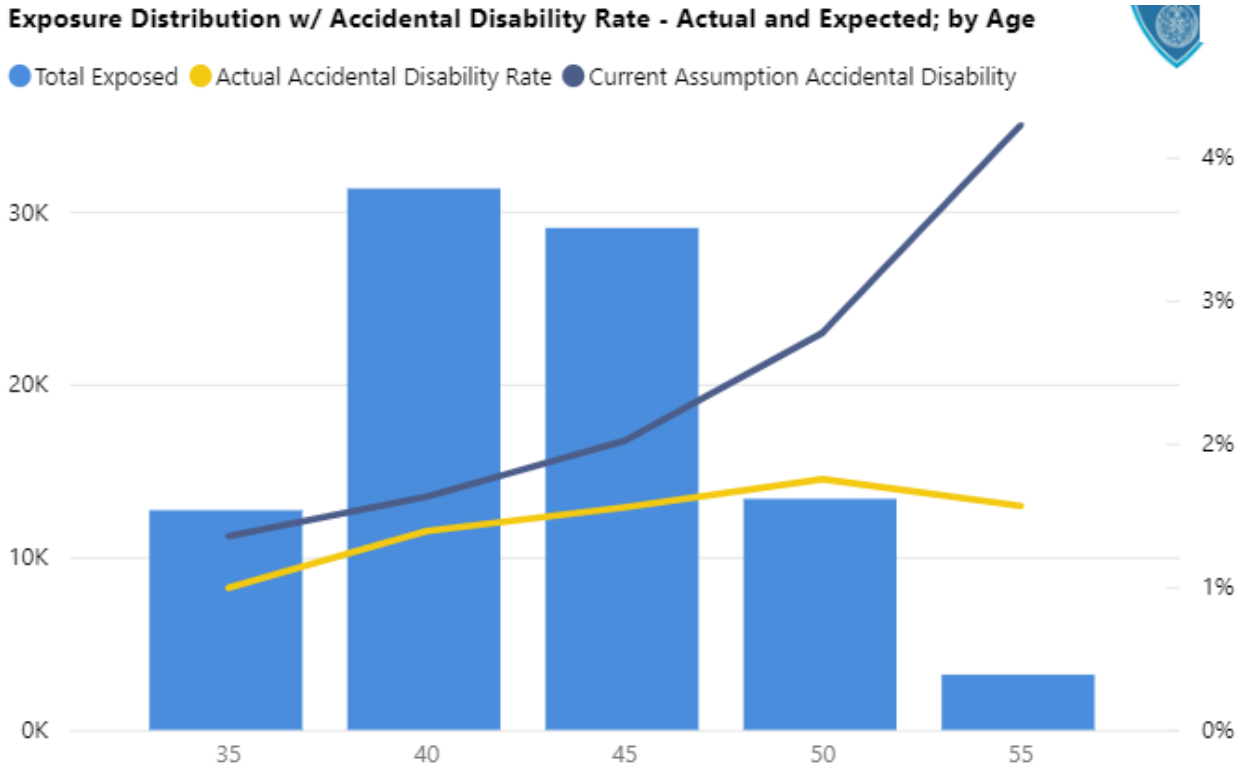
1. Tier 1 and 2 members eligible for WTC benefits
2. Tier 1 and 2 members not eligible for WTC benefits
3. Tier 3 members.

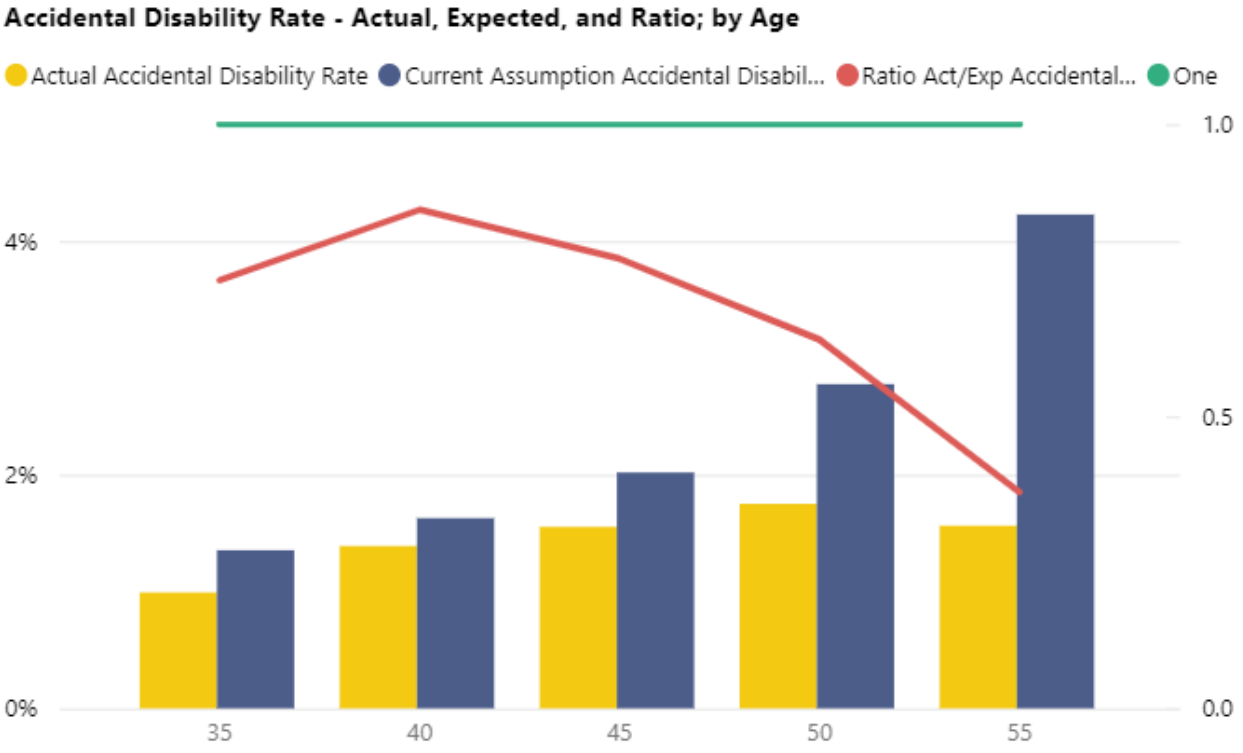
Members Who Are Eligible for WTC Benefits (Tiers 1 and 2)

The following charts display the experience of members who are eligible for WTC benefits by year and by age, for the age range (35 to 59) and service range (10 to 34), during the period 2012 – 2019.

Plan Year	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
2012	243	262.8	14,718	1.6510%	1.7857%	0.92
2013	213	251.9	13,728	1.5516%	1.8346%	0.85
2014	221	249.4	13,111	1.6856%	1.9020%	0.89
2015	160	229.7	11,684	1.3694%	1.9655%	0.70
2016	162	216.1	10,602	1.5280%	2.0384%	0.75
2017	126	202.7	9,611	1.3110%	2.1095%	0.62
2018	86	187.2	8,542	1.0068%	2.1912%	0.46
2019	85	174.1	7,632	1.1137%	2.2815%	0.49
Total	**1,296**	**1,773.9**	**89,628**	**1.4460%**	**1.9791%**	**0.73**

Age	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
35	7	14.4	1,200	0.5833%	1.2000%	0.49
36	17	22.8	1,806	0.9413%	1.2600%	0.75
37	23	32.4	2,458	0.9357%	1.3200%	0.71
38	41	44.3	3,207	1.2785%	1.3800%	0.93
39	38	58.1	4,038	0.9411%	1.4400%	0.65
40	54	76.8	5,122	1.0543%	1.5000%	0.70
41	89	94.5	6,055	1.4699%	1.5600%	0.94
42	83	106.8	6,592	1.2591%	1.6200%	0.78
43	116	113.9	6,779	1.7112%	1.6800%	1.02
44	93	117.8	6,771	1.3735%	1.7400%	0.79
45	119	120.8	6,711	1.7732%	1.8000%	0.99
46	86	123.3	6,421	1.3394%	1.9200%	0.70
47	76	121.1	5,937	1.2801%	2.0400%	0.63
48	76	114.9	5,318	1.4291%	2.1600%	0.66
49	94	106.0	4,647	2.0228%	2.2800%	0.89
50	67	93.7	3,906	1.7153%	2.4000%	0.71
51	64	85.6	3,242	1.9741%	2.6400%	0.75
52	41	75.1	2,606	1.5733%	2.8800%	0.55
53	35	63.9	2,049	1.7082%	3.1200%	0.55
54	27	52.6	1,564	1.7263%	3.3600%	0.51
55	13	41.7	1,159	1.1217%	3.6000%	0.31
56	10	33.4	819	1.2210%	4.0800%	0.30
57	11	26.0	571	1.9264%	4.5600%	0.42
58	8	19.7	390	2.0513%	5.0400%	0.41
59	8	14.4	260	3.0769%	5.5200%	0.56
Total	**1,296**	**1,773.9**	**89,628**	**1.4460%**	**1.9791%**	**0.73**





Specific observations:

- The number of members who qualified for accidental disability benefits has declined steadily since 2014.
    - This pattern could be caused by a declining number of members receiving these benefits or by delays in registering the actual elections in the data.
- The number of members who qualified for accidental disability benefits is less than expected at all ages (A/E ratio of 0.73), except at age 43.

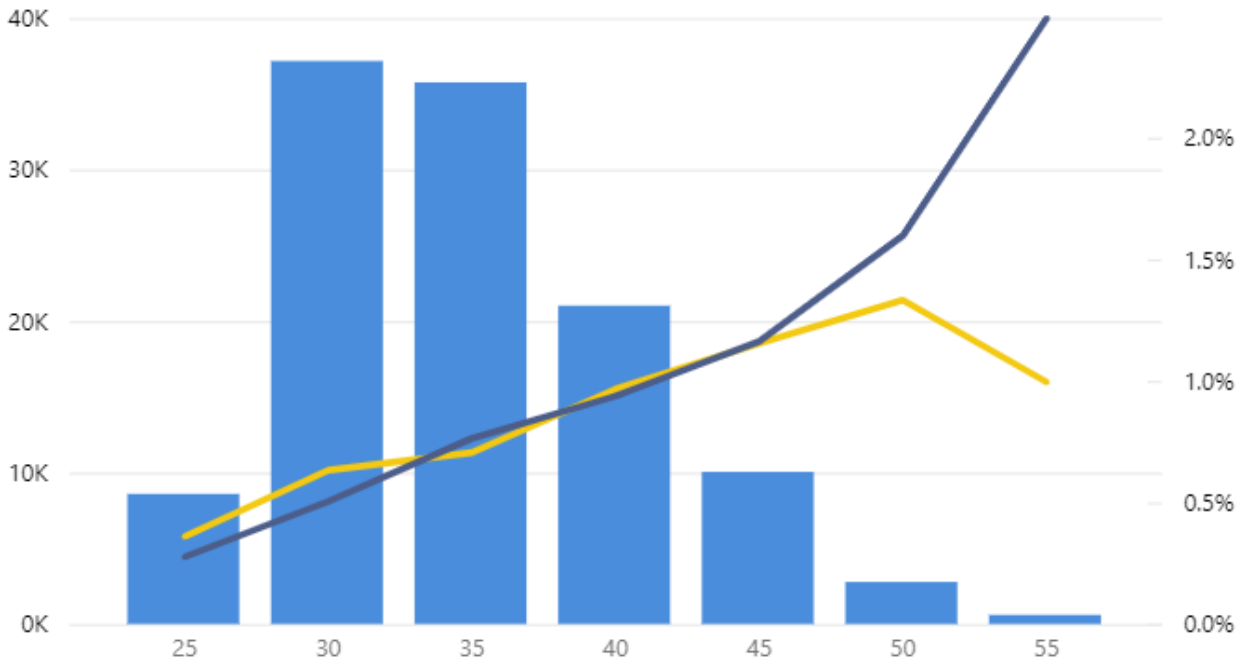
Members Who Are Not Eligible for WTC Benefits (Tiers 1 and 2)

The following charts display the experience of members who are not eligible for WTC benefits by year and by age, for the age range (25 to 59) and service range (5 to 34), during the period 2012 – 2019.

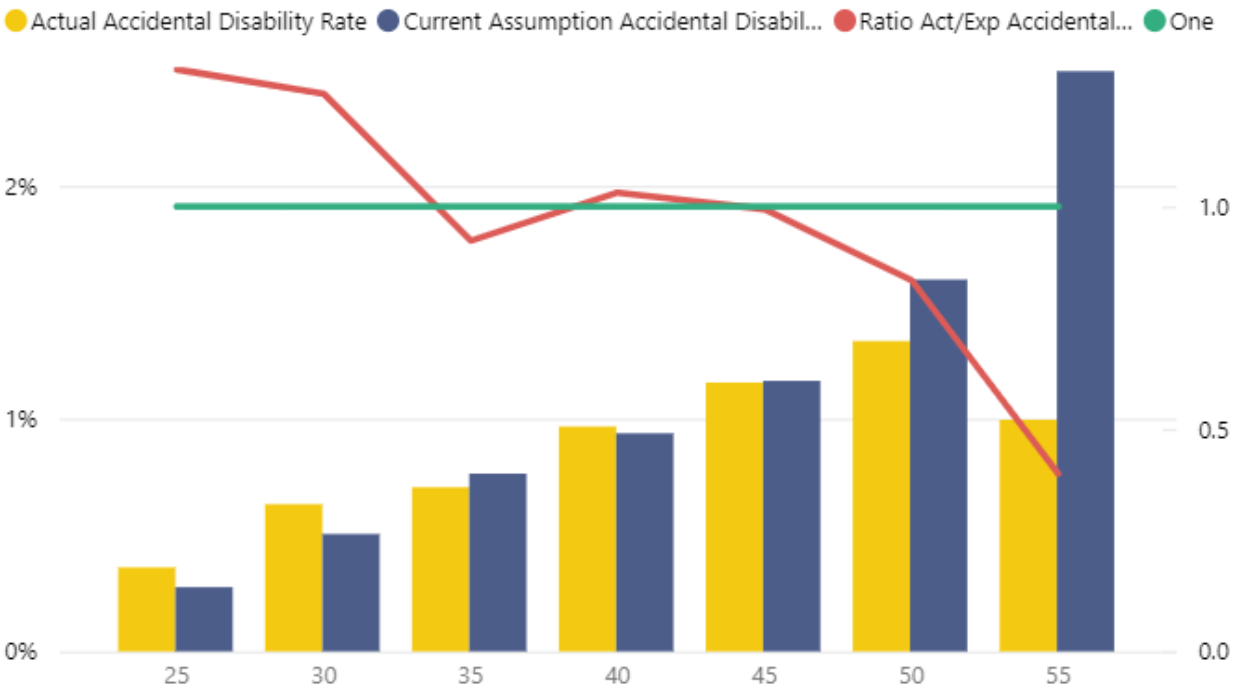
Plan Year	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
2012	87	81.8	12,526	0.6946%	0.6530%	1.06
2013	107	90.9	13,828	0.7738%	0.6575%	1.18
2014	128	103.8	15,605	0.8202%	0.6651%	1.23
2015	102	107.8	15,383	0.6631%	0.7009%	0.95
2016	122	112.2	15,072	0.8094%	0.7447%	1.09
2017	117	116.7	14,806	0.7902%	0.7880%	1.00
2018	101	120.1	14,500	0.6966%	0.8282%	0.84
2019	116	123.8	14,216	0.8160%	0.8709%	0.94
Total	**880**	**857.1**	**115,936**	**0.7590%**	**0.7393%**	**1.03**

Age	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
25	0	0.0	8	0.0000%	0.1400%	0.00
26	0	0.5	297	0.0000%	0.1820%	0.00
27	5	3.2	1,447	0.3455%	0.2240%	1.54
28	10	7.3	2,740	0.3650%	0.2660%	1.37
29	16	12.6	4,097	0.3905%	0.3080%	1.27
30	27	19.2	5,499	0.4910%	0.3500%	1.40
31	43	28.8	6,865	0.6264%	0.4200%	1.49
32	47	38.4	7,839	0.5996%	0.4900%	1.22
33	54	46.9	8,376	0.6447%	0.5600%	1.15
34	64	54.1	8,582	0.7457%	0.6300%	1.18
35	45	58.2	8,315	0.5412%	0.7000%	0.77
36	64	58.1	7,902	0.8099%	0.7350%	1.10
37	57	55.9	7,261	0.7850%	0.7700%	1.02
38	42	52.4	6,504	0.6458%	0.8050%	0.80
39	44	48.5	5,769	0.7627%	0.8400%	0.91
40	42	45.6	5,211	0.8060%	0.8750%	0.92
41	37	42.7	4,694	0.7882%	0.9100%	0.87
42	48	39.4	4,170	1.1511%	0.9450%	1.22
43	46	35.9	3,660	1.2568%	0.9800%	1.28
44	30	33.3	3,277	0.9155%	1.0150%	0.90
45	32	29.5	2,811	1.1384%	1.0500%	1.08
46	40	27.1	2,423	1.6508%	1.1200%	1.47
47	21	23.6	1,984	1.0585%	1.1900%	0.89
48	12	20.1	1,599	0.7505%	1.2600%	0.60
49	11	16.3	1,227	0.8965%	1.3300%	0.67
50	11	13.0	931	1.1815%	1.4000%	0.84
51	7	10.8	704	0.9943%	1.5400%	0.65
52	8	8.3	494	1.6194%	1.6800%	0.96
53	7	6.7	369	1.8970%	1.8200%	1.04
54	4	5.4	278	1.4388%	1.9600%	0.73
55	2	4.2	201	0.9950%	2.1000%	0.47
56	0	3.6	151	0.0000%	2.3800%	0.00
57	3	3.1	116	2.5862%	2.6600%	0.97
58	1	2.3	78	1.2821%	2.9400%	0.44
59	0	1.8	57	0.0000%	3.2200%	0.00
Total	**880**	**857.1**	**115,936**	**0.7590%**	**0.7393%**	**1.03**

Exposure Distribution w/ Accidental Disability Rate - Actual and Expected; by Age



Accidental Disability Rate - Actual, Expected, and Ratio; by Age



Specific observations:

- Overall, the actual experience is consistent with expectations (A/E ratio of 1.03).
- Experience begins to deviate from the assumption for ages 48 and older.

Tier 3 Members

The following charts display the experience by year for the age range (25 to 44) and service range (0 to 10). Age and service ranges were chosen based on available experience.

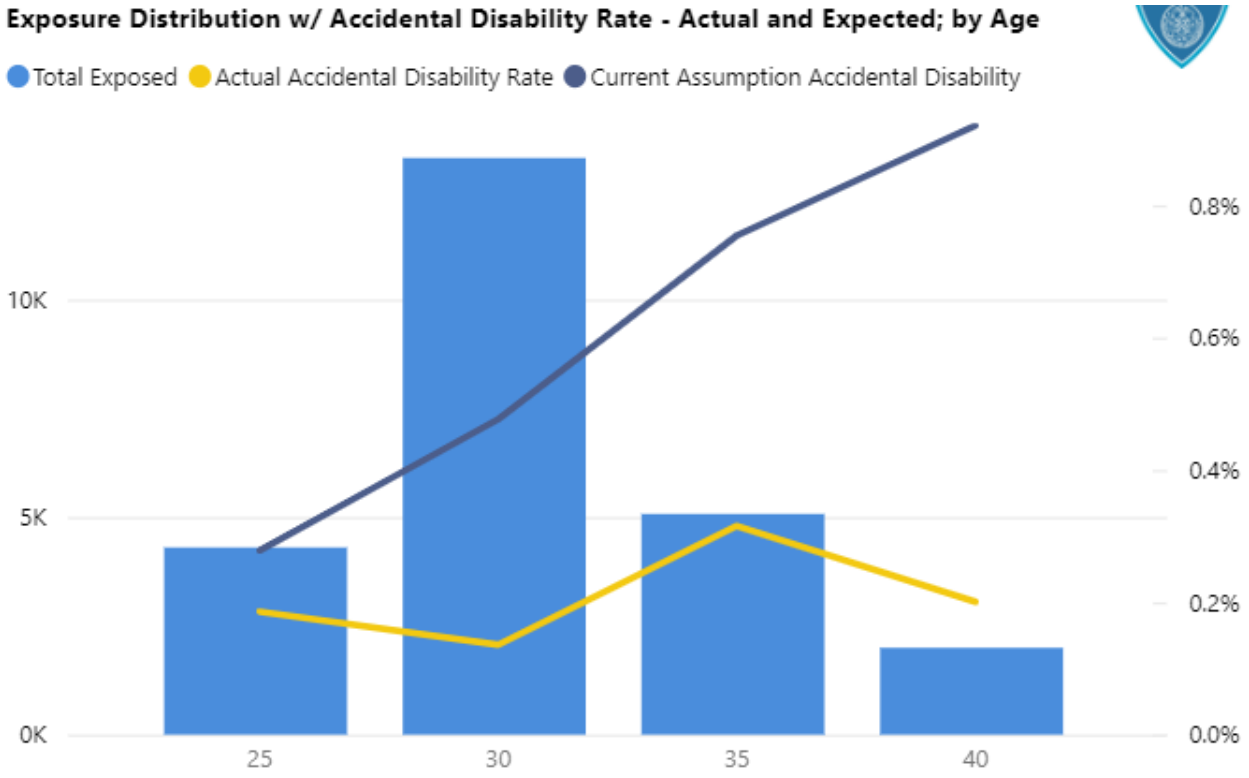
Plan Year	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
2012	0	2.8	930	0.0000%	0.2998%	0.00
2013	0	9.2	2,949	0.0000%	0.3123%	0.00
2014	0	15.1	4,663	0.0000%	0.3247%	0.00
2015	0	21.4	6,228	0.0000%	0.3431%	0.00
2016	1	27.9	7,705	0.0130%	0.3619%	0.04
2017	1	37.7	10,042	0.0100%	0.3756%	0.03
2018	9	46.1	11,632	0.0774%	0.3967%	0.20
2019	8	55.7	13,102	0.0611%	0.4250%	0.14
2020	21	64.4	14,351	0.1463%	0.4488%	0.33
2021	11	71.0	15,079	0.0729%	0.4710%	0.15
Total	**51**	**351.4**	**86,681**	**0.0588%**	**0.4054%**	**0.15**

Specific observations:

- There were no accidental disability retirements among Tier 3 members prior to 2016.
- We included 2020 and 2021 in the analysis because there was limited experience prior to 2020.
- There were very few accidental disability retirements prior to completing 5 years of service.

The following charts display the experience by age, for the age range (25 to 44) and service range (5 to 10), during 2018 to 2021.

Age	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
26	0	0.2	120	0.0000%	0.1820%	0.00
27	0	1.5	668	0.0000%	0.2240%	0.00
28	3	3.6	1,370	0.2190%	0.2660%	0.82
29	5	6.6	2,144	0.2332%	0.3080%	0.76
30	1	10.1	2,872	0.0348%	0.3500%	0.10
31	8	12.9	3,079	0.2598%	0.4200%	0.62
32	3	14.4	2,935	0.1022%	0.4900%	0.21
33	4	13.7	2,452	0.1631%	0.5600%	0.29
34	2	12.1	1,917	0.1043%	0.6300%	0.17
35	4	10.4	1,490	0.2685%	0.7000%	0.38
36	4	8.4	1,149	0.3481%	0.7339%	0.47
37	2	7.4	963	0.2077%	0.7679%	0.27
38	3	6.4	803	0.3736%	0.8022%	0.47
39	3	5.6	668	0.4491%	0.8352%	0.54
40	0	4.7	541	0.0000%	0.8700%	0.00
41	1	4.5	498	0.2008%	0.9003%	0.22
42	1	3.8	410	0.2439%	0.9322%	0.26
43	1	3.1	322	0.3106%	0.9648%	0.32
44	1	2.3	225	0.4444%	1.0018%	0.44
Total	**46**	**131.8**	**24,626**	**0.1868%**	**0.5352%**	**0.35**



Specific observations:

- The actual number of accidental disability retirements was significantly smaller than expected (A/E ratio of 0.35) even when the exposure period was selected to maximize it.

Pre-retirement Death

Plan codes excluded in the analysis of other contingencies are part of the analysis of pre-retirement death.

Mortality assumptions involve two components: a base table and a mortality improvement scale. The mortality improvement scale adjusts the mortality rates of the base table to reflect that generally rates of mortality are anticipated to improve over time.

The Society of Actuaries (SOA) has published mortality improvement scales (MP scales) each year from 2014 to 2021. In the last several actuarial valuations, OA has used the mortality improvement scale that coincides with the valuation date. For example, OA used the MP-2020 scale in its June 30, 2020 lag actuarial valuation. In this analysis, we used the most recent improvement scale (MP-2021) published by the SOA as of the date of this analysis. Please note that the SOA did not publish a MP-2022 scale.

In this study the base table corresponds to the year 2012; expected mortality rates in future years are obtained from the base table and the MP-2021 scale. For example, the 2017 (July 1, 2016 – June 30, 2017) mortality rates are derived from the base table (2012) adjusted with four years of improvements. This method links mortality rates across the years and, consequently, allows mortality comparisons from one year to another.

The SOA MP-2021 improvement scale is based on data through 2019 (before the onset of Covid) from the Social Security Administration (SSA). Even though the aggregate (for all ages) long-term trend has been towards mortality improvements, this is not always the case for each age. Therefore, there are situations where the expected mortality rate in a later year is higher than the base rate.

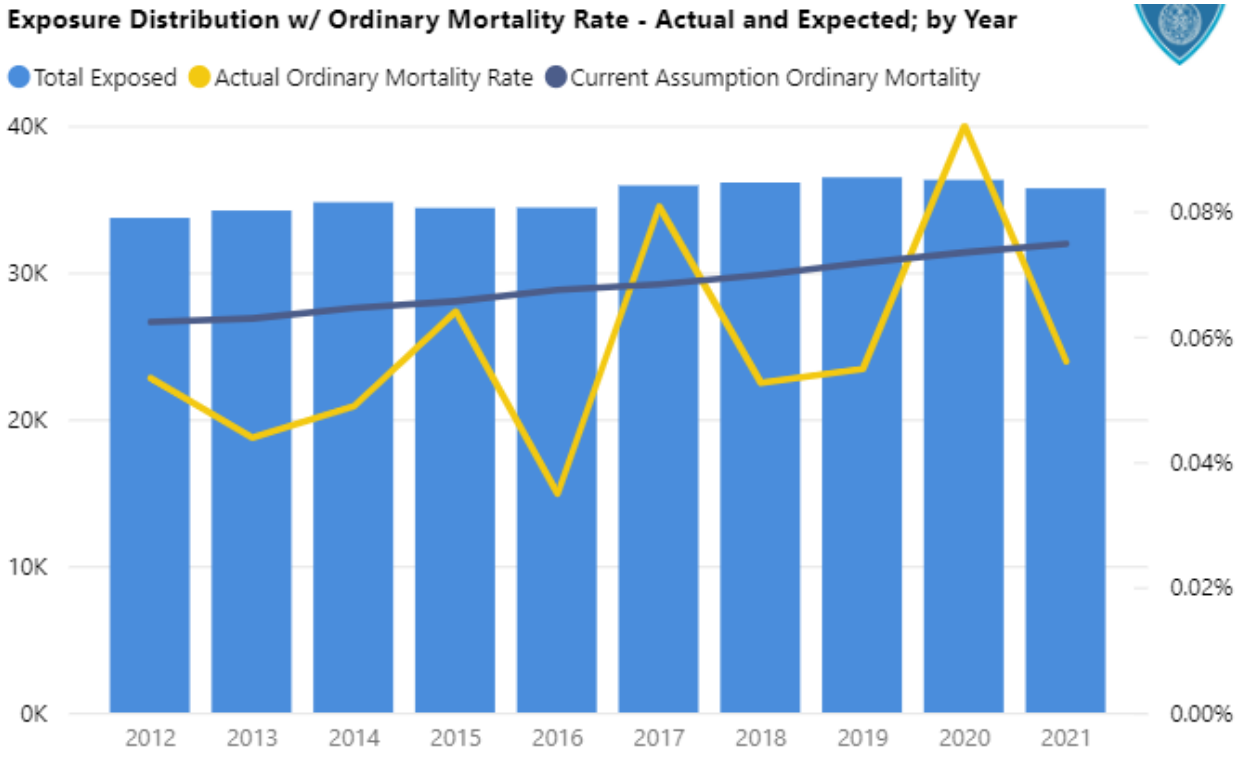
There is much discussion in the actuarial profession and among retirement systems about the development of mortality tables and the treatment of excess deaths due to the Covid pandemic, which occurred in 2020 – 2022. The purpose of this analysis is to share our observations about the experience during the study period. In subsequent analyses, we will recommend changes to mortality assumptions as appropriate.

Please note that the charts by age are based on 5-year brackets. For example, the age bracket 45 should be interpreted as the interval 45 – 49.

Ordinary Death

The following tables show the experience of ordinary death by year, for males and females combined, based on the age range (21 to 59) and service range (0 to 44), during the period 2012 – 2021.

Plan Year	Actual Ordinary Deaths	Expected Ordinary Deaths	Total Exposed	Actual Ordinary Mortality Rate	Current Assumption Ordinary Mortality	Ratio Act/Exp Ordinary Mortality
2012	18	21.0	33,712	0.0534%	0.0623%	0.86
2013	15	21.5	34,214	0.0438%	0.0629%	0.70
2014	17	22.4	34,777	0.0489%	0.0645%	0.76
2015	22	22.6	34,387	0.0640%	0.0656%	0.97
2016	12	23.2	34,413	0.0349%	0.0674%	0.52
2017	29	24.5	35,923	0.0807%	0.0683%	1.18
2018	19	25.2	36,122	0.0526%	0.0698%	0.75
2019	20	26.2	36,476	0.0548%	0.0718%	0.76
2020	34	26.6	36,302	0.0937%	0.0734%	1.28
2021	20	26.7	35,730	0.0560%	0.0748%	0.75
Total	**206**	**240.1**	**352,056**	**0.0585%**	**0.0682%**	**0.86**



Specific observations:

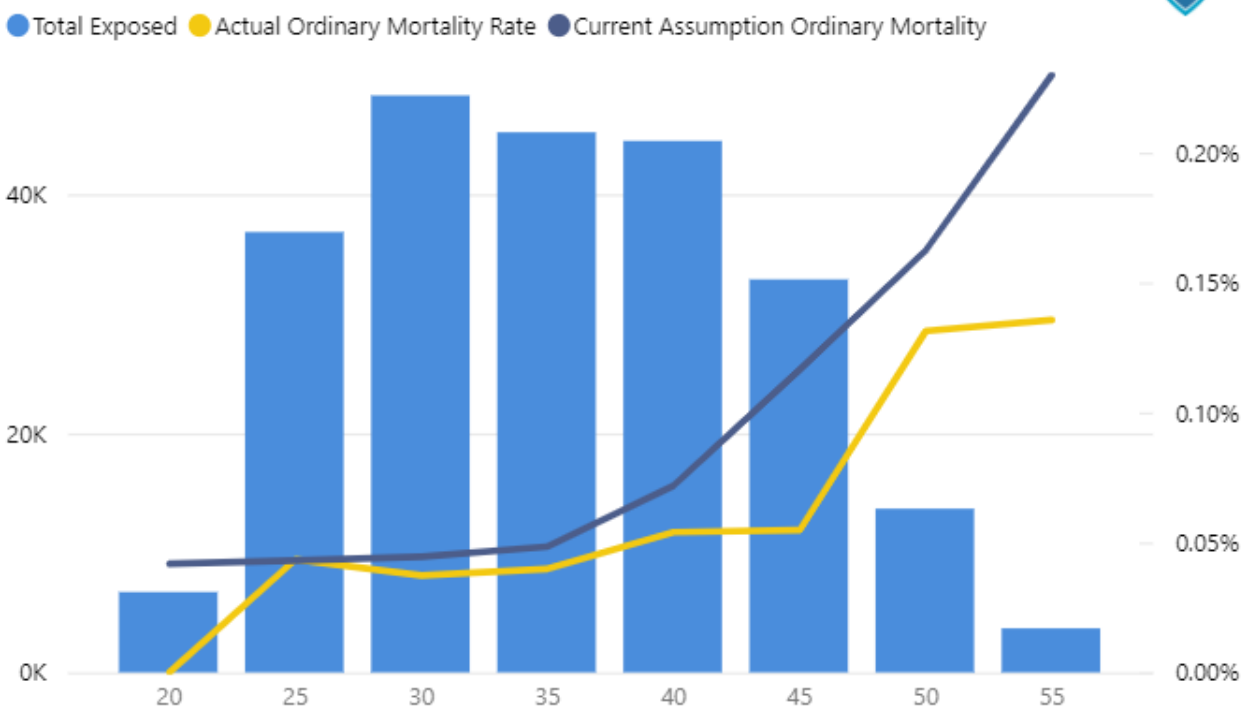
- There were fewer actual deaths than expected (A/E ratio of 0.86) during the study period, which includes a higher number of deaths during 2020.
- In 2020, actual deaths were 28% higher than expected.
- While there were very few actual deaths for females, it exceeded expectations by 34% (A/E ratio of 1.34)

Males

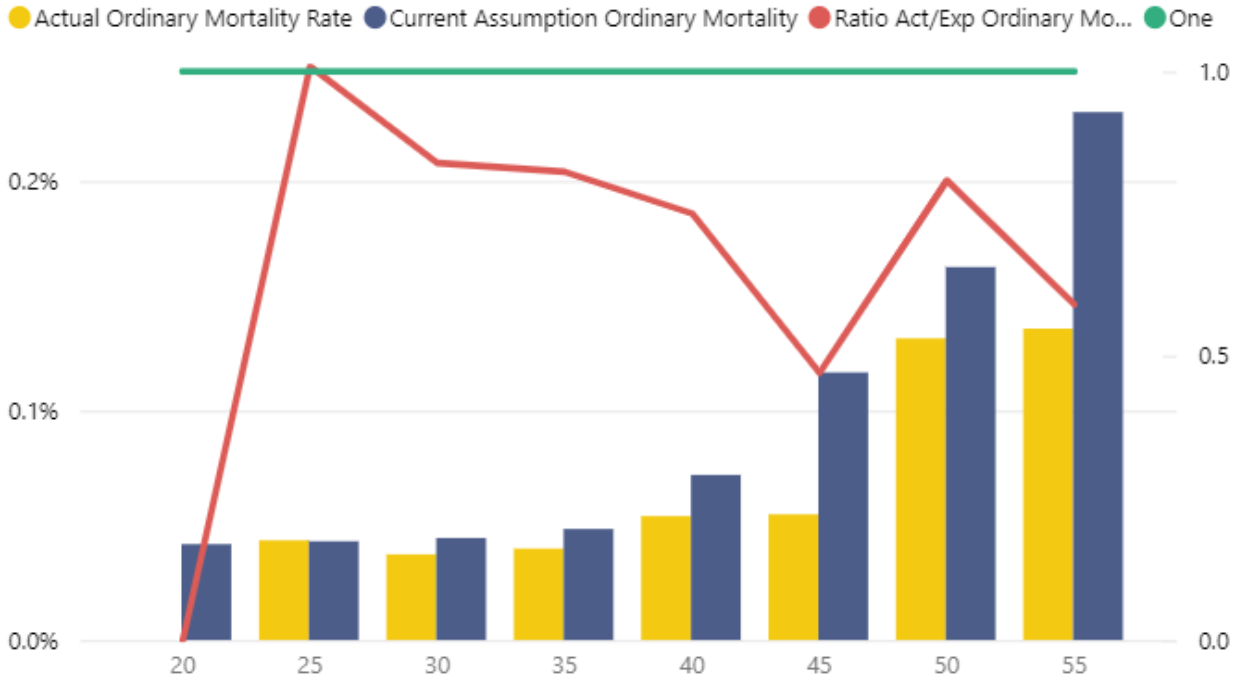
The following tables show the experience of ordinary death by age, for males, for the age range (21 to 59) and service range (0 to 44), during the period 2012 – 2019.

Age (bins)	Actual Ordinary Deaths	Expected Ordinary Deaths	Total Exposed	Actual Ordinary Mortality Rate	Current Assumption Ordinary Mortality	Ratio Act/Exp Ordinary Mortality
20	0	2.8	6,724	0.0000%	0.0418%	0.00
25	16	15.9	36,840	0.0434%	0.0430%	1.01
30	18	21.5	48,258	0.0373%	0.0445%	0.84
35	18	21.9	45,180	0.0398%	0.0484%	0.82
40	24	32.0	44,463	0.0540%	0.0719%	0.75
45	18	38.3	32,876	0.0548%	0.1166%	0.47
50	18	22.3	13,696	0.1314%	0.1625%	0.81
55	5	8.5	3,686	0.1356%	0.2300%	0.59
Total	**117**	**163.0**	**231,723**	**0.0505%**	**0.0704%**	**0.72**

Exposure Distribution w/ Ordinary Mortality Rate - Actual and Expected; by Age



Ordinary Mortality Rate - Actual, Expected, and Ratio; by Age

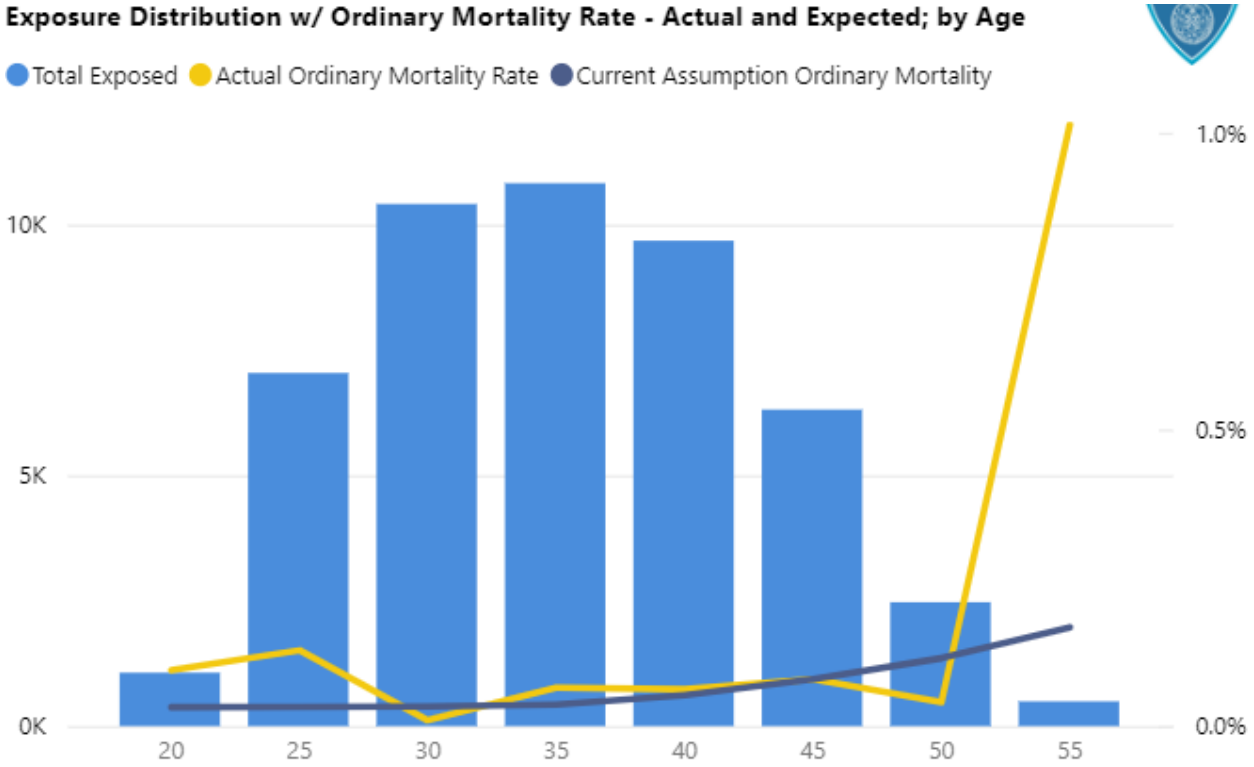


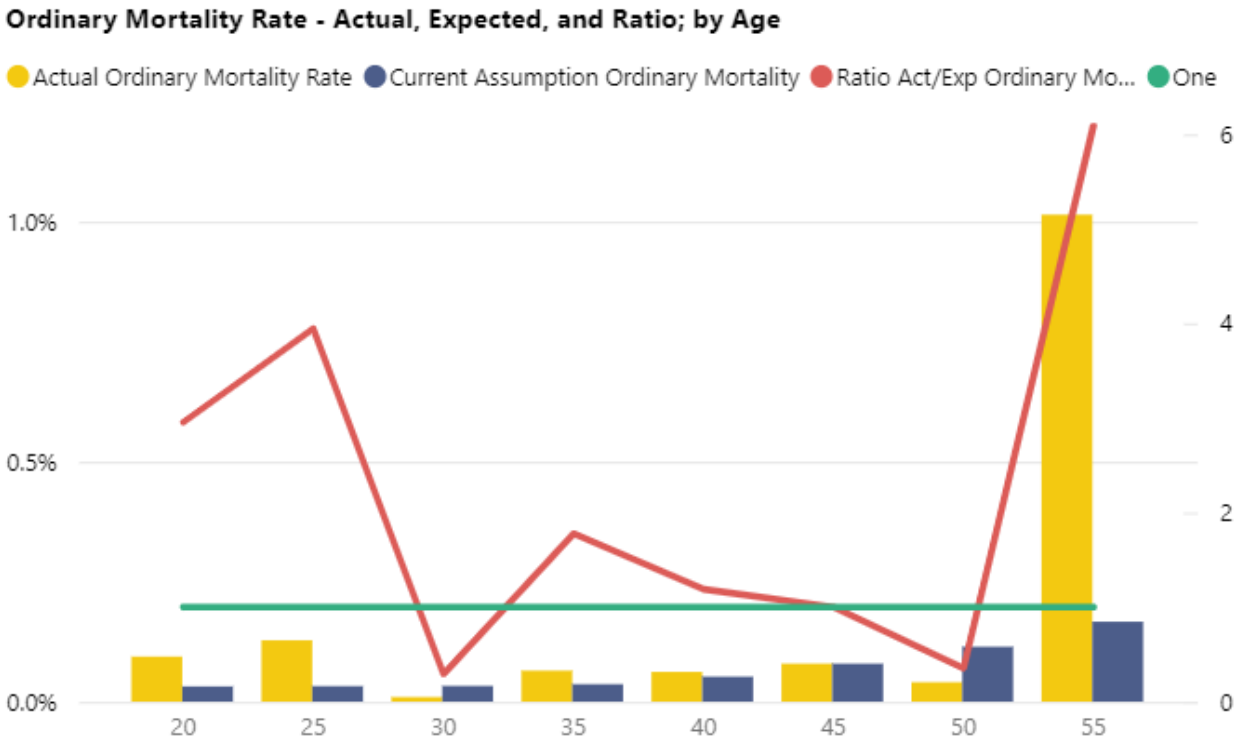
Females

The following tables show the experience of ordinary death by age, for females, for the age range (21 to 59) and service range (0 to 44), during the period 2012 – 2019.

Age (bins)	Actual Ordinary Deaths	Expected Ordinary Deaths	Total Exposed	Actual Ordinary Mortality Rate	Current Assumption Ordinary Mortality	Ratio Act/Exp Ordinary Mortality
20	1	0.3	1,065	0.0939%	0.0318%	2.95
25	9	2.3	7,042	0.1278%	0.0324%	3.94
30	1	3.4	10,412	0.0096%	0.0328%	0.29
35	7	3.9	10,826	0.0647%	0.0364%	1.78
40	6	5.0	9,680	0.0620%	0.0521%	1.19
45	5	5.0	6,312	0.0792%	0.0792%	1.00
50	1	2.8	2,471	0.0405%	0.1144%	0.35
55	5	0.8	493	1.0142%	0.1665%	6.09
Total	**35**	**23.7**	**48,301**	**0.0725%**	**0.0490%**	**1.48**

Exposure Distribution w/ Ordinary Mortality Rate - Actual and Expected; by Age



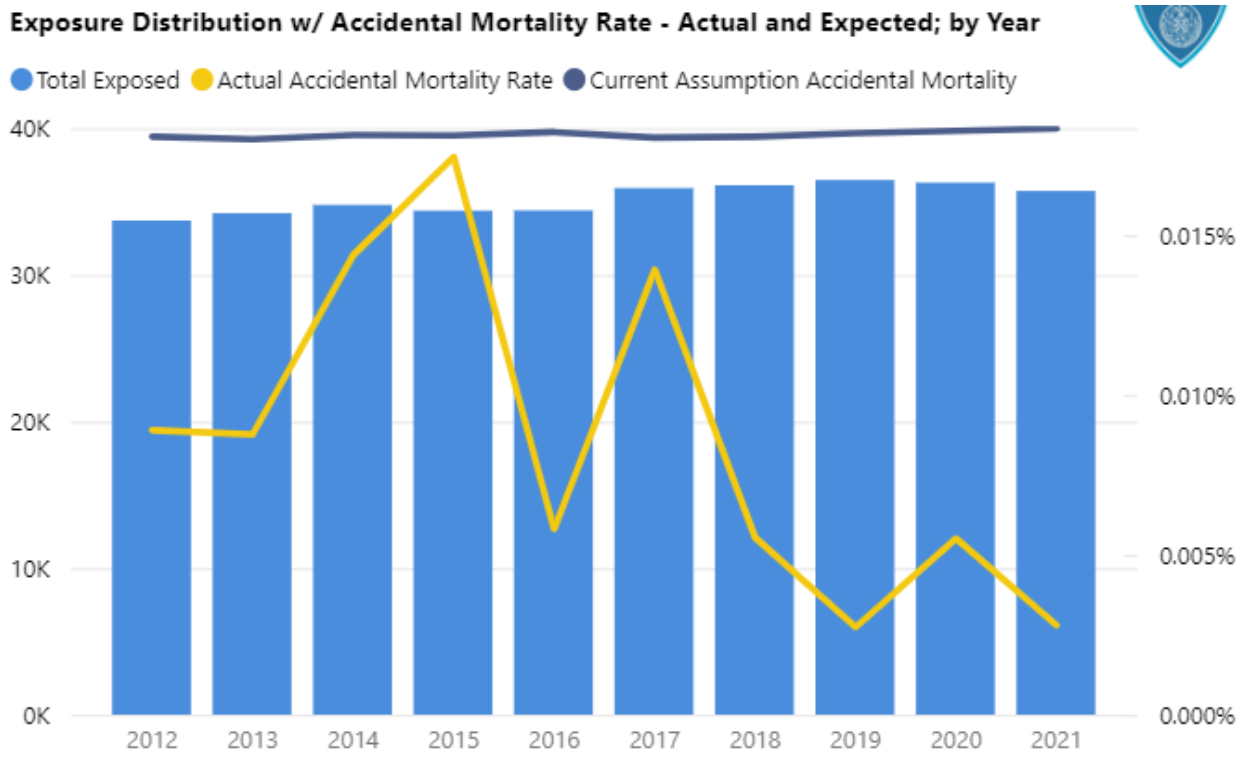


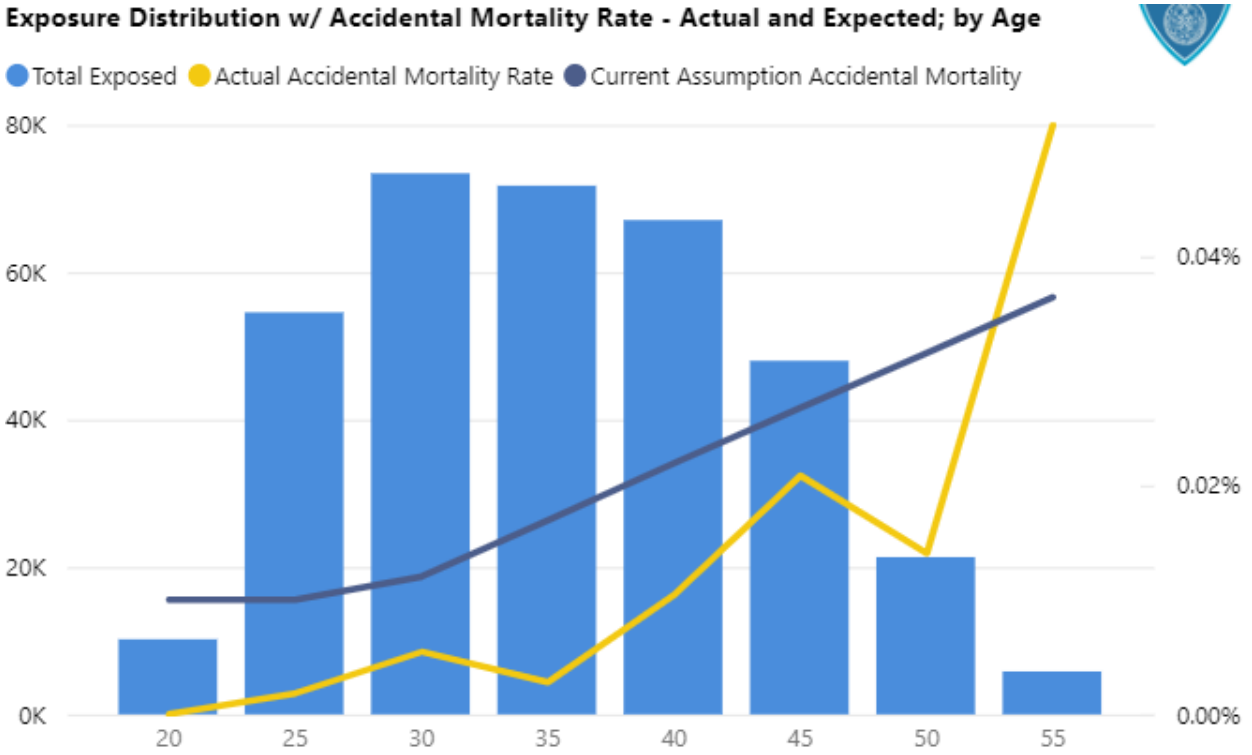
Accidental Death

The accidental death rate assumptions are unisex, increase with age, and are not subject to mortality improvements.

The following tables show the experience of accidental death by year and by age, for the age range (21 to 59) and service range (0 to 44), during the period 2012 – 2021.

Plan Year	Actual Accidental Deaths	Expected Accidental Deaths	Total Exposed	Actual Accidental Mortality Rate	Current Assumption Accidental Mortality	Ratio Act/Exp Accidental Mortality
2012	3	6.1	33,712	0.0089%	0.0181%	0.49
2013	3	6.2	34,214	0.0088%	0.0180%	0.49
2014	5	6.3	34,777	0.0144%	0.0181%	0.79
2015	6	6.2	34,387	0.0174%	0.0181%	0.96
2016	2	6.3	34,413	0.0058%	0.0182%	0.32
2017	5	6.5	35,923	0.0139%	0.0181%	0.77
2018	2	6.5	36,122	0.0055%	0.0181%	0.31
2019	1	6.6	36,476	0.0027%	0.0182%	0.15
2020	2	6.6	36,302	0.0055%	0.0183%	0.30
2021	1	6.6	35,730	0.0028%	0.0183%	0.15
Total	**30**	**63.9**	**352,056**	**0.0085%**	**0.0181%**	**0.47**





Specific observations:

- The number of expected annual deaths is between 6 and 7 per year, but only once during the study period did at least 6 accidental deaths occur.
- Although the number of accidental deaths was small, the experience shows that it was correlated with age.

Postretirement Mortality

In addition to gender, the post-retirement mortality assumption depends on the type of inactive member:

1) Service Retirees
2) Disabled Retirees
3) Contingent Beneficiaries

The MEST contains all retirees on one page and beneficiaries on another page. On the retiree page, the experience can be examined by status to review disabled retirees versus service retirees. Service retirees include members who have commenced their pension benefit from a terminated vested status. Vested members prior to commencement are included in the MEST but are essentially excluded in the analysis below.

Analogous to the pre-retirement death assumption, the mortality assumption involves two components: a base table and a mortality improvement scale. The mortality improvement scale adjusts the mortality rates of the base table to reflect that generally rates of mortality are anticipated to improve over time. The same mortality improvement scale applies to the post-retirement mortality base table that applies to the pre-retirement death base table. In this study the base table corresponds to the year 2012.

Many mortality studies have found that greater benefits are positively correlated with smaller mortality rates and longer life expectancy. Accordingly, the OA utilizes adjustment factors to convert post-retirement mortality weighted by headcounts to post-retirement mortality weighted by benefit amounts. The adjustment factors used by the OA are:

Post-Retirement Mortality Adjustment Factor To Convert from Headcount-Weighted to Amount-Weighted		
	Males	Females
Service Retiree	0.910	0.910
Disabled Retiree	0.876	0.876
Contingent Beneficiary	0.890	0.951

We examined the implications of using both types of weights in the post-retirement mortality analysis. Pure mortality is the same as post-retirement mortality weighted by headcounts; pure mortality multiplied by the adjustment factor is post-retirement mortality weighted by benefit amount. The benefit amount weighting approach was not applied to the experience prior to 2015 because the historical database did not contain benefit amounts prior to 2015.

There is much discussion in the actuarial profession and among retirement systems about the development of mortality tables and the treatment of excess deaths due to the Covid pandemic, which occurred in 2020 – 2022. The purpose of this analysis is to share our observations about the experience during the study period. In subsequent analyses, we will recommend changes to mortality assumptions as appropriate.

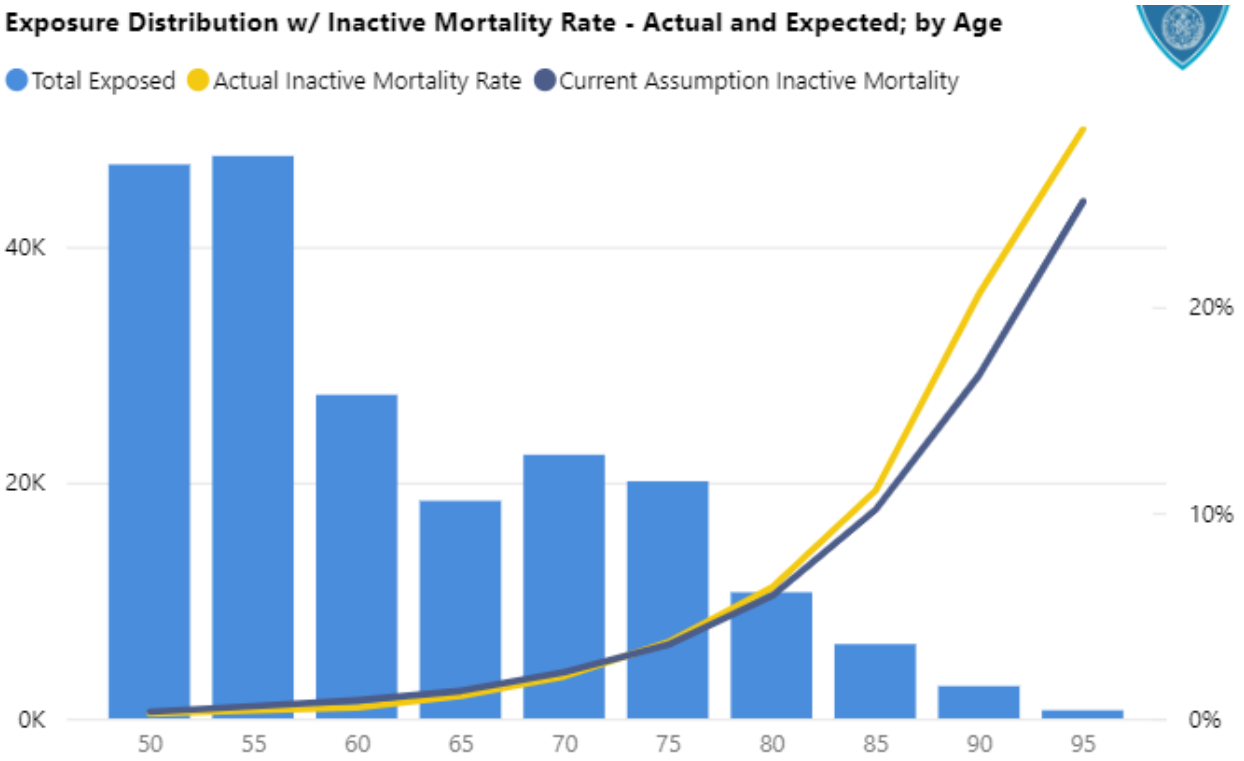
The charts by age are based on 5-year age brackets. For example, the age bracket 45 should be interpreted as the interval 45-49.

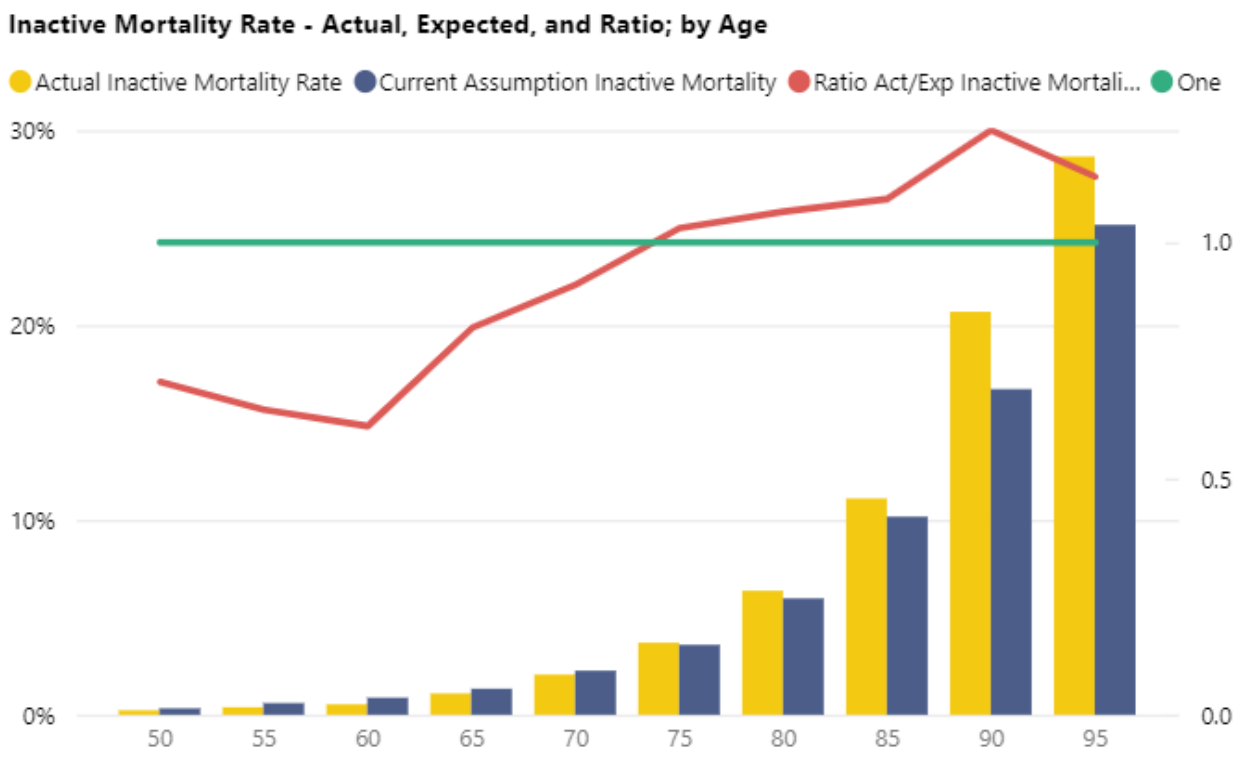
Postretirement Mortality – Service Retirees

The following charts show the postretirement mortality experience on a headcount-weighted basis by year and by age, for males and females combined, for the age range (50 to 99) during the period 2015 – 2021.

Plan Year	Actual Inactive Deaths	Expected Inactive Deaths	Total Exposed	Actual Inactive Mortality Rate	Current Assumption Inactive Mortality	Ratio Act/Exp Inactive Mortality
2015	578	545.9	26,099	2.2146%	2.0917%	1.06
2016	532	552.4	27,213	1.9549%	2.0299%	0.96
2017	549	566.4	28,173	1.9487%	2.0105%	0.97
2018	561	576.3	29,194	1.9216%	1.9739%	0.97
2019	559	592.2	29,943	1.8669%	1.9778%	0.94
2020	593	609.0	30,899	1.9192%	1.9709%	0.97
2021	622	625.8	32,013	1.9430%	1.9547%	0.99
Total	**3,994**	**4,067.9**	**203,534**	**1.9623%**	**1.9987%**	**0.98**

Age (bins)	Actual Inactive Deaths	Expected Inactive Deaths	Total Exposed	Actual Inactive Mortality Rate	Current Assumption Inactive Mortality	Ratio Act/Exp Inactive Mortality
50	109	154.6	46,986	0.2320%	0.3291%	0.70
55	184	285.0	47,710	0.3857%	0.5974%	0.65
60	147	240.6	27,453	0.5355%	0.8765%	0.61
65	202	246.6	18,458	1.0944%	1.3362%	0.82
70	461	506.0	22,366	2.0612%	2.2623%	0.91
75	744	721.9	20,119	3.6980%	3.5884%	1.03
80	681	639.2	10,701	6.3639%	5.9737%	1.07
85	700	641.0	6,304	11.1041%	10.1689%	1.09
90	568	459.0	2,746	20.6846%	16.7155%	1.24
95	198	173.8	691	28.6541%	25.1502%	1.14
Total	**3,994**	**4,067.9**	**203,534**	**1.9623%**	**1.9987%**	**0.98**



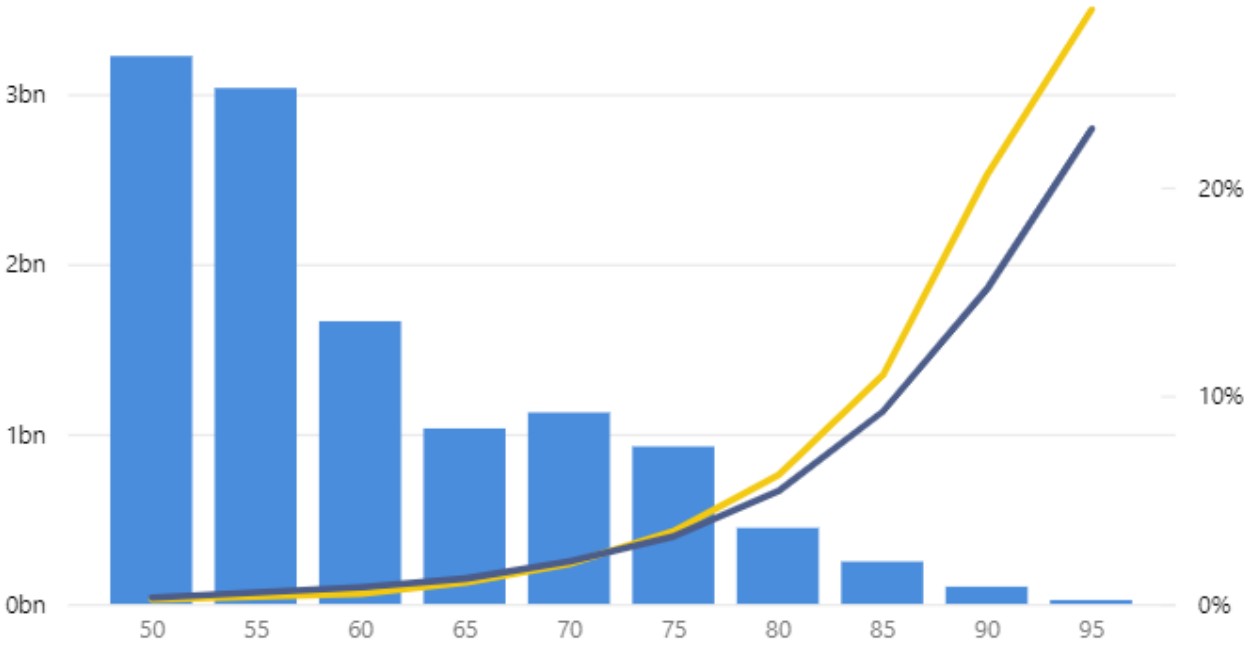


The following charts show the postretirement mortality experience on an amount-weighted basis by year and by age, for males and females combined, for the age range (50 to 99) during the period 2015 – 2021.

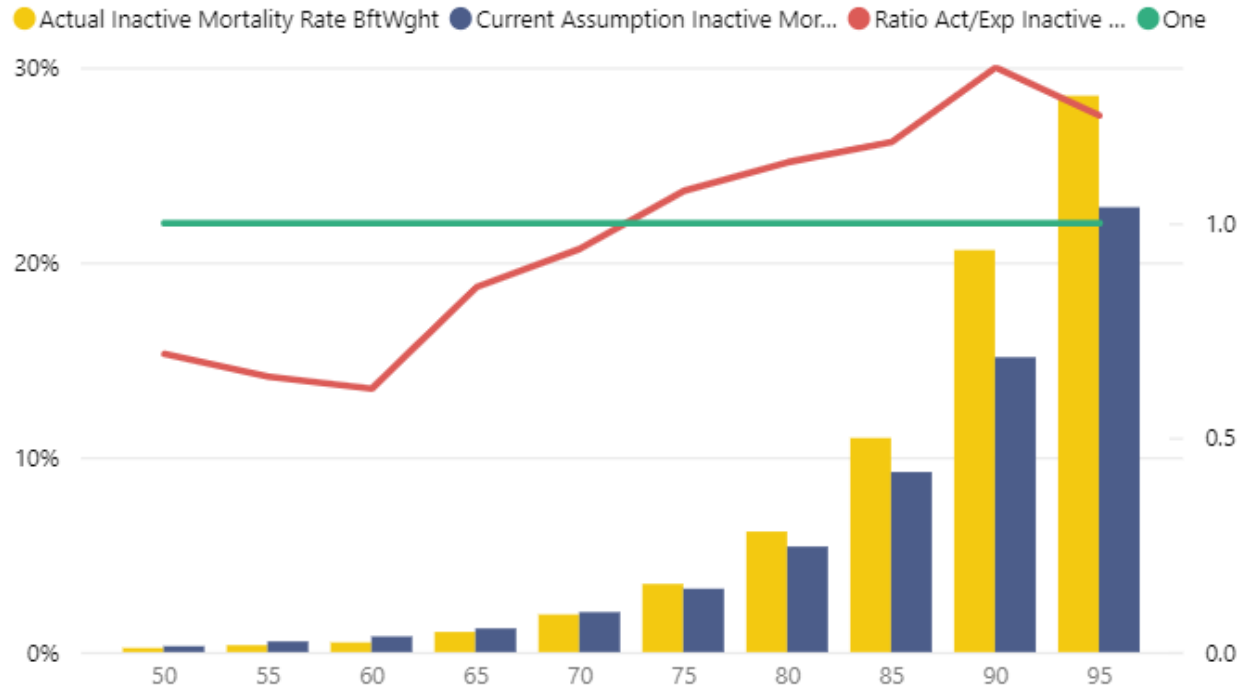
Plan Year	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
2015	23,333K	21,363K	1,375,436K	1.6964%	1.5532%	1.09
2016	21,576K	22,175K	1,474,769K	1.4630%	1.5036%	0.97
2017	23,363K	23,328K	1,572,945K	1.4853%	1.4831%	1.00
2018	24,409K	24,448K	1,684,862K	1.4487%	1.4510%	1.00
2019	25,151K	25,754K	1,779,649K	1.4132%	1.4471%	0.98
2020	26,663K	27,188K	1,899,672K	1.4035%	1.4312%	0.98
2021	28,216K	28,754K	2,042,529K	1.3814%	1.4078%	0.98
Total	**172,711K**	**173,008K**	**11,829,862K**	**1.4600%**	**1.4625%**	**1.00**

Age (bins)	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
50	6,707K	9,649K	3,223,864K	0.2080%	0.2993%	0.70
55	10,611K	16,530K	3,035,882K	0.3495%	0.5445%	0.64
60	8,177K	13,310K	1,663,508K	0.4916%	0.8001%	0.61
65	10,650K	12,521K	1,032,660K	1.0313%	1.2125%	0.85
70	21,705K	23,092K	1,126,510K	1.9268%	2.0499%	0.94
75	32,371K	30,105K	926,276K	3.4948%	3.2501%	1.08
80	27,674K	24,229K	447,639K	6.1823%	5.4125%	1.14
85	27,387K	23,026K	249,281K	10.9864%	9.2370%	1.19
90	20,931K	15,353K	101,482K	20.6253%	15.1285%	1.36
95	6,498K	5,195K	22,761K	28.5471%	22.8232%	1.25
Total	**172,711K**	**173,008K**	**11,829,862K**	**1.4600%**	**1.4625%**	**1.00**

Pension Benefit Distribution w/ Inactive Mortality Rate - Actual and Expected; by Age



Inactive Mortality Rate - Actual, Expected, and Ratio; by Age



Specific observations:

- From 2015 - 2021, the actual number of deaths was similar to expectations on both a headcount basis (A/E ratio of 0.98) and benefit basis (A/E ratio of 1.00).
- During 2020 – 2021, the actual experience is similar to the experience from 2015 – 2019.
- For ages 75 to 99, actual deaths exceeded expectations (A/E ratio of 1.17 on a benefits basis).
- For ages 50 to 74, actual deaths were smaller than expected (A/E ratio of 0.77 on a benefits basis).
- For males, the rate of mortality on an amount-weighted basis was 74.1% of the rate of mortality on a headcount-weighted basis, versus the ratio on an expected basis of 72.9%. The assumed percentage is 91%. The actual weighting of benefits will result in a difference from the assumed percentage.
- For females, the rate of mortality on an amount-weighted basis was 86.2% of the rate of mortality on a headcount-weighted basis, versus the ratio on an expected basis of 81.7%. The assumed percentage is 91%. The actual weighting of benefits will result in a difference from the assumed percentage.
- The mortality rates for members retiring directly from active service are lower than the mortality rates of members commencing a pension benefit from vested status, although the number of deaths of the latter is minimal.

The following chart shows the postretirement mortality experience of members retiring directly from active service on an amount-weighted basis by age, for males and females combined, for the age range (50 to 99) during the period 2015 – 2021.

Age (bins)	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
50	6,623K	9,540K	3,184,426K	0.2080%	0.2996%	0.69
55	10,528K	16,416K	3,013,615K	0.3494%	0.5447%	0.64
60	8,100K	13,240K	1,654,555K	0.4896%	0.8002%	0.61
65	10,569K	12,363K	1,020,351K	1.0358%	1.2116%	0.85
70	21,055K	22,415K	1,094,242K	1.9242%	2.0484%	0.94
75	30,908K	29,037K	893,428K	3.4595%	3.2501%	1.06
80	26,539K	23,393K	432,212K	6.1403%	5.4124%	1.13
85	26,893K	22,512K	243,508K	11.0438%	9.2448%	1.19
90	20,616K	15,166K	100,185K	20.5774%	15.1384%	1.36
95	6,483K	5,142K	22,526K	28.7795%	22.8248%	1.26
Total	**168,314K**	**169,224K**	**11,659,049K**	**1.4436%**	**1.4514%**	**0.99**

The following chart shows the postretirement mortality experience of members commencing from a vested status on an amount-weighted basis by age, for males and females combined, for the age range (50 to 99) during the period 2015 – 2021.

Age (bins)	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
50	84K	109K	39,438K	0.2118%	0.2760%	0.77
55	83K	114K	22,267K	0.3708%	0.5116%	0.72
60	77K	70K	8,952K	0.8578%	0.7801%	1.10
65	81K	158K	12,310K	0.6599%	1.2810%	0.52
70	650K	677K	32,267K	2.0145%	2.0985%	0.96
75	1,463K	1,068K	32,848K	4.4544%	3.2509%	1.37
80	1,135K	835K	15,427K	7.3594%	5.4158%	1.36
85	494K	514K	5,773K	8.5651%	8.9091%	0.96
90	315K	186K	1,297K	24.3319%	14.3613%	1.69
95	15K	53K	235K	6.2397%	22.6710%	0.28
Total	**4,397K**	**3,784K**	**170,813K**	**2.5743%**	**2.2155%**	**1.16**

Specific observations:

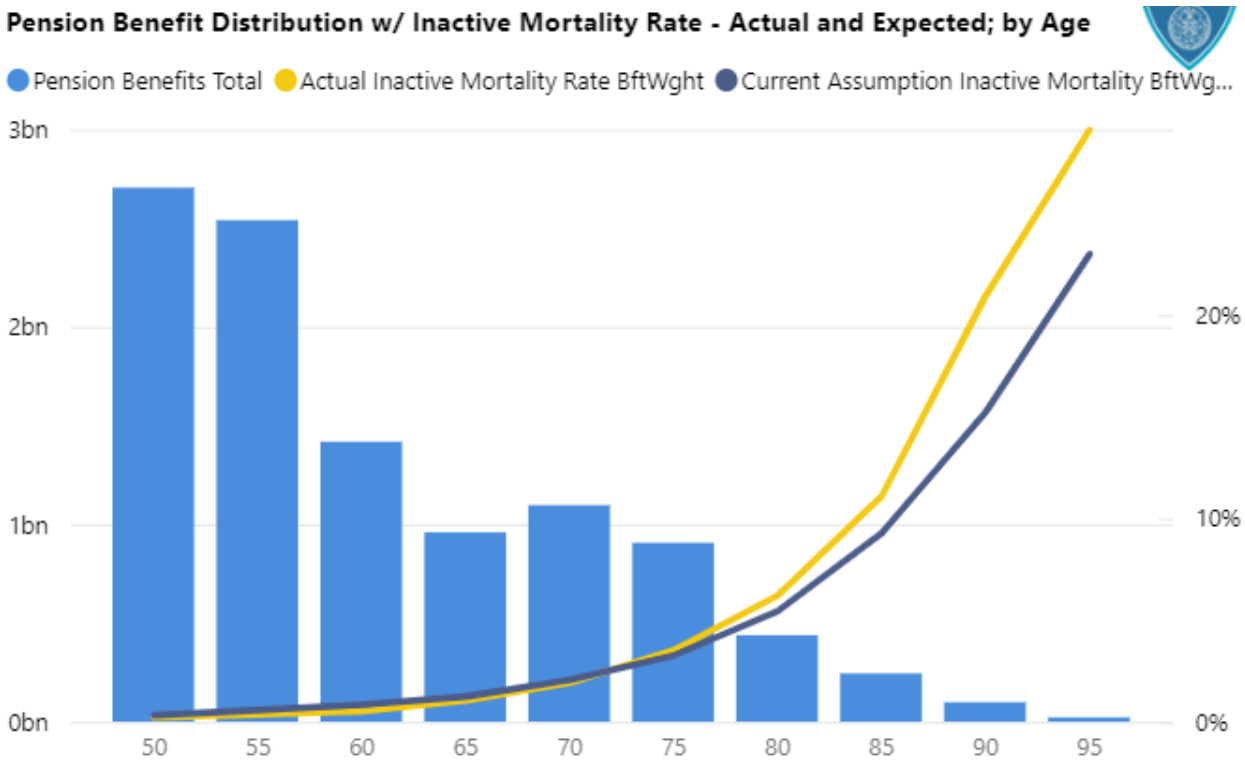
- Although the mortality experience of members commencing to receive retirement benefits from vested status is not credible, it is interesting that this group exhibits greater than the mortality experience of members retiring from active service.

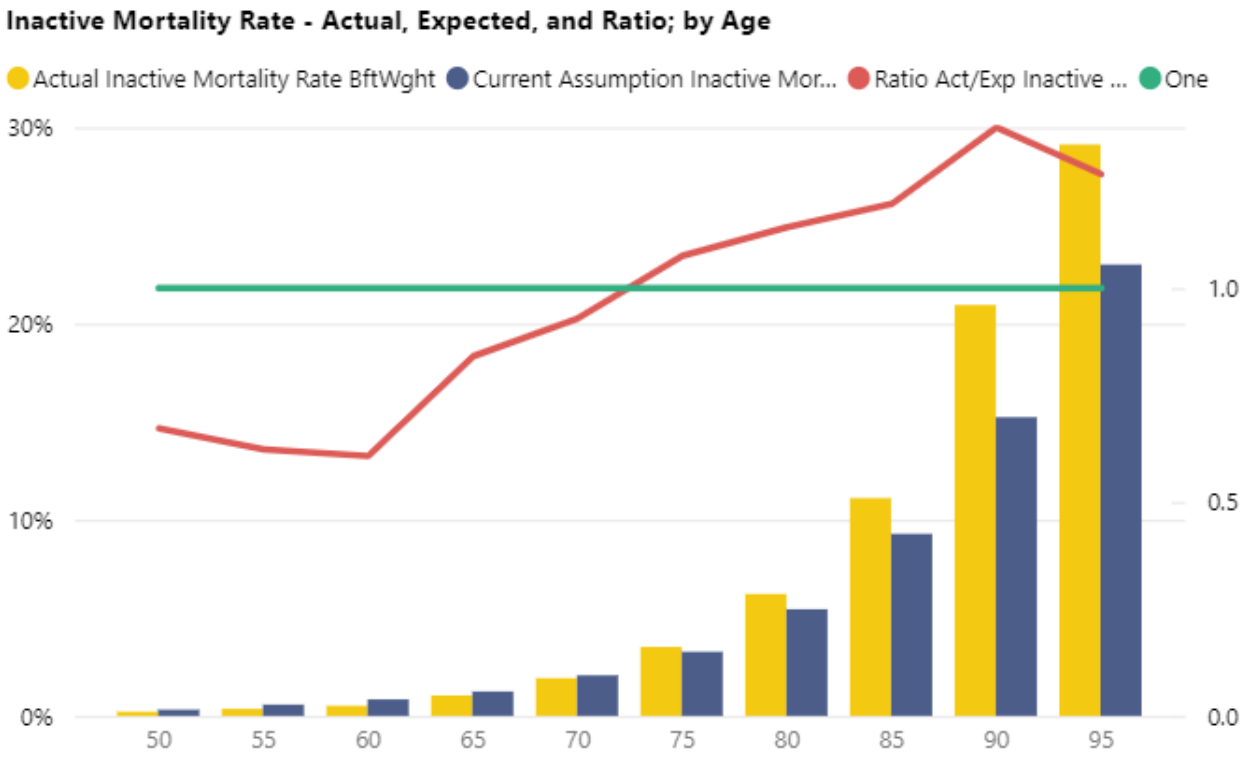
Since the overall rates of mortality for 2020 and 2021 are similar to prior years and amount-weighted mortality rates are not available prior to 2015, the following analysis contains the entire study period from 2015 – 2021.

Service Retirees - Males

The following charts show the postretirement mortality experience on an amount-weighted basis by age, for males, for the age range (50 to 99) during the period 2015 – 2021.

Age (bins)	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
50	5,764K	8,577K	2,705,782K	0.2130%	0.3170%	0.67
55	9,084K	14,582K	2,540,773K	0.3575%	0.5739%	0.62
60	7,248K	11,926K	1,418,621K	0.5109%	0.8407%	0.61
65	10,019K	11,923K	959,557K	1.0441%	1.2426%	0.84
70	21,059K	22,674K	1,097,135K	1.9194%	2.0666%	0.93
75	31,859K	29,619K	906,611K	3.5141%	3.2670%	1.08
80	27,247K	23,845K	438,533K	6.2133%	5.4374%	1.14
85	27,176K	22,712K	244,795K	11.1016%	9.2778%	1.20
90	20,680K	15,030K	98,731K	20.9458%	15.2233%	1.38
95	6,420K	5,071K	22,042K	29.1263%	23.0054%	1.27
Total	**166,556K**	**165,958K**	**10,432,580K**	**1.5965%**	**1.5908%**	**1.00**





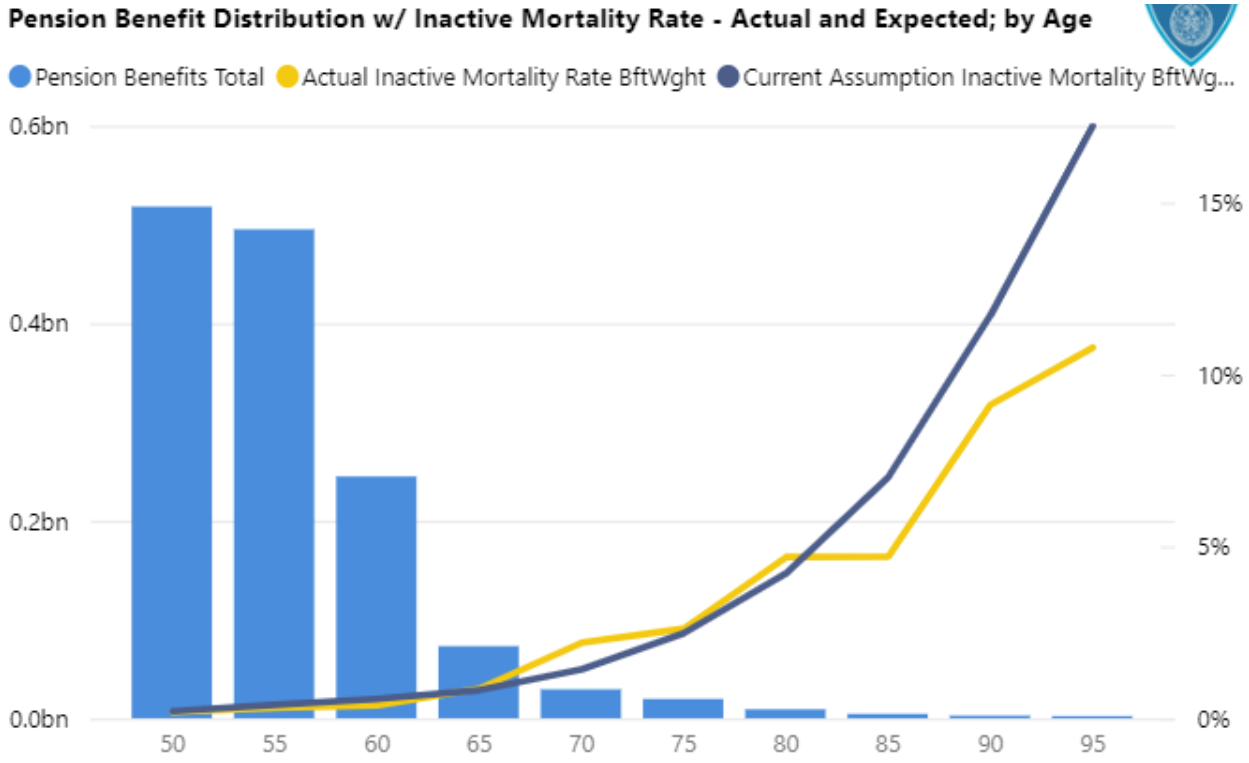
Specific observations:

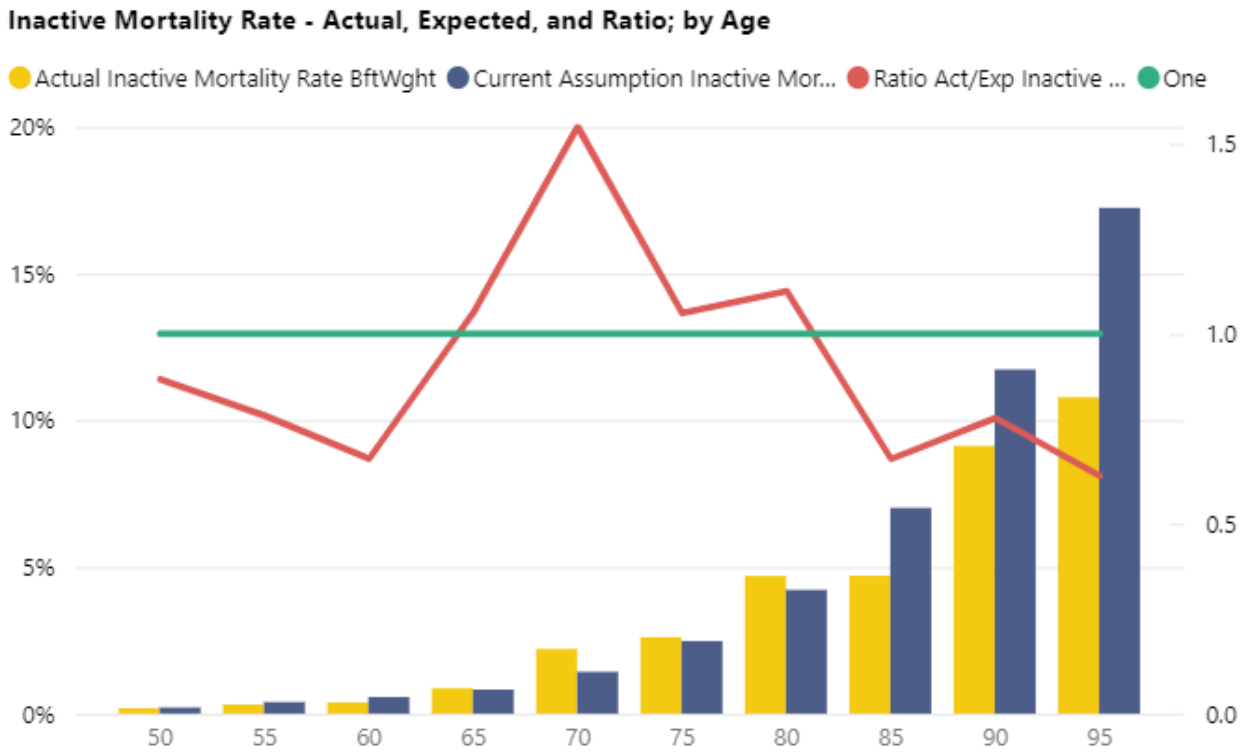
- From 2015 - 2021, the actual number of male deaths was similar to expectations on both a headcount basis (A/E ratio of 0.99) and benefit basis (A/E ratio of 1.00).
- For ages 75 to 99, the number of actual deaths exceeded expectations (A/E ratio of 1.18 on a benefits basis).
- For ages 50 to 74, the number of actual deaths was smaller than expected (A/E ratio of 0.76 on a benefits basis).

Service Retirees - Females

The following charts show the postretirement mortality experience on an amount-weighted basis by age, for females, for the age range (50 to 99) during the period 2015 – 2021.

Age (bins)	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
50	943K	1,072K	518,081K	0.1820%	0.2069%	0.88
55	1,527K	1,948K	495,109K	0.3084%	0.3934%	0.78
60	929K	1,384K	244,887K	0.3795%	0.5653%	0.67
65	631K	597K	73,103K	0.8630%	0.8170%	1.06
70	646K	418K	29,375K	2.2004%	1.4243%	1.54
75	512K	486K	19,665K	2.6039%	2.4710%	1.05
80	427K	384K	9,106K	4.6900%	4.2156%	1.11
85	211K	314K	4,486K	4.7005%	7.0113%	0.67
90	251K	323K	2,751K	9.1226%	11.7251%	0.78
95	77K	124K	719K	10.7832%	17.2357%	0.63
Total	**6,155K**	**7,050K**	**1,397,282K**	**0.4405%**	**0.5046%**	**0.87**





Specific observations:

- The mortality experience for female members is not fully credible.
- From 2015 - 2021, the actual number of female deaths was less than expected on both a headcount basis (A/E ratio of 0.83) and benefit basis (A/E ratio of 0.87).
- However, there were very few exposures after age 74 where the number of deaths was higher than expected on male basis.
- For ages 50 to 74, actual deaths were smaller than expected (A/E ratio of 0.86 on a benefits basis), but this was closer to the assumption than the experience for males at these ages (A/E ratio of 0.76 on a benefits basis).

Postretirement Mortality – Disability Retirees

The following charts show the postretirement mortality experience on a headcount-weighted basis by year and by age, for males and females combined, for the age range (40 to 99) during the period 2015 – 2021.

Plan Year	Actual Inactive Deaths	Expected Inactive Deaths	Total Exposed	Actual Inactive Mortality Rate	Current Assumption Inactive Mortality	Ratio Act/Exp Inactive Mortality
2015	356	342.8	15,170	2.3467%	2.2599%	1.04
2016	314	344.1	15,112	2.0778%	2.2770%	0.91
2017	302	349.8	15,106	1.9992%	2.3159%	0.86
2018	334	359.6	15,101	2.2118%	2.3815%	0.93
2019	348	364.7	15,076	2.3083%	2.4191%	0.95
2020	388	370.4	15,037	2.5803%	2.4631%	1.05
2021	371	371.4	14,976	2.4773%	2.4801%	1.00
Total	**2,413**	**2,502.9**	**105,578**	**2.2855%**	**2.3707%**	**0.96**

Age (bins)	Actual Inactive Deaths	Expected Inactive Deaths	Total Exposed	Actual Inactive Mortality Rate	Current Assumption Inactive Mortality	Ratio Act/Exp Inactive Mortality
40	7	9.0	5,293	0.1323%	0.1697%	0.78
45	41	32.0	13,307	0.3081%	0.2404%	1.28
50	90	84.4	18,186	0.4949%	0.4640%	1.07
55	90	106.7	15,344	0.5865%	0.6952%	0.84
60	90	89.0	8,576	1.0494%	1.0382%	1.01
65	160	157.2	9,475	1.6887%	1.6587%	1.02
70	350	376.6	14,073	2.4870%	2.6764%	0.93
75	417	458.6	10,744	3.8812%	4.2682%	0.91
80	347	366.0	5,148	6.7405%	7.1103%	0.95
85	417	427.7	3,486	11.9621%	12.2678%	0.98
90	318	319.1	1,663	19.1221%	19.1857%	1.00
95	86	76.7	283	30.3887%	27.1062%	1.12
Total	**2,413**	**2,502.9**	**105,578**	**2.2855%**	**2.3707%**	**0.96**

The following charts show the postretirement mortality experience on an amount-weighted basis by year and by age, for males and females combined, for the age range (40 to 99) during the period 2015 – 2021.

Plan Year	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
2015	14,063K	12,922K	769,083K	1.8285%	1.6802%	1.09
2016	12,885K	13,199K	785,191K	1.6410%	1.6810%	0.98
2017	12,570K	13,640K	806,412K	1.5587%	1.6915%	0.92
2018	15,541K	14,236K	828,305K	1.8762%	1.7187%	1.09
2019	14,114K	14,586K	849,114K	1.6623%	1.7178%	0.97
2020	16,832K	15,095K	873,349K	1.9273%	1.7284%	1.12
2021	16,403K	15,443K	895,944K	1.8308%	1.7236%	1.06
Total	**102,408K**	**99,122K**	**5,807,399K**	**1.7634%**	**1.7068%**	**1.03**

Age (bins)	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
40	437K	541K	357,154K	0.1223%	0.1515%	0.81
45	2,732K	1,967K	924,847K	0.2954%	0.2127%	1.39
50	6,082K	4,984K	1,217,942K	0.4993%	0.4092%	1.22
55	5,207K	5,700K	933,829K	0.5576%	0.6103%	0.91
60	4,591K	4,388K	479,754K	0.9570%	0.9146%	1.05
65	6,761K	6,200K	429,018K	1.5758%	1.4452%	1.09
70	12,736K	13,300K	567,514K	2.2441%	2.3436%	0.96
75	15,666K	16,232K	432,818K	3.6195%	3.7503%	0.97
80	13,520K	13,934K	222,359K	6.0802%	6.2663%	0.97
85	17,559K	17,032K	158,674K	11.0659%	10.7342%	1.03
90	13,760K	12,005K	71,563K	19.2273%	16.7754%	1.15
95	3,359K	2,839K	11,927K	28.1615%	23.8003%	1.18
Total	**102,408K**	**99,122K**	**5,807,399K**	**1.7634%**	**1.7068%**	**1.03**

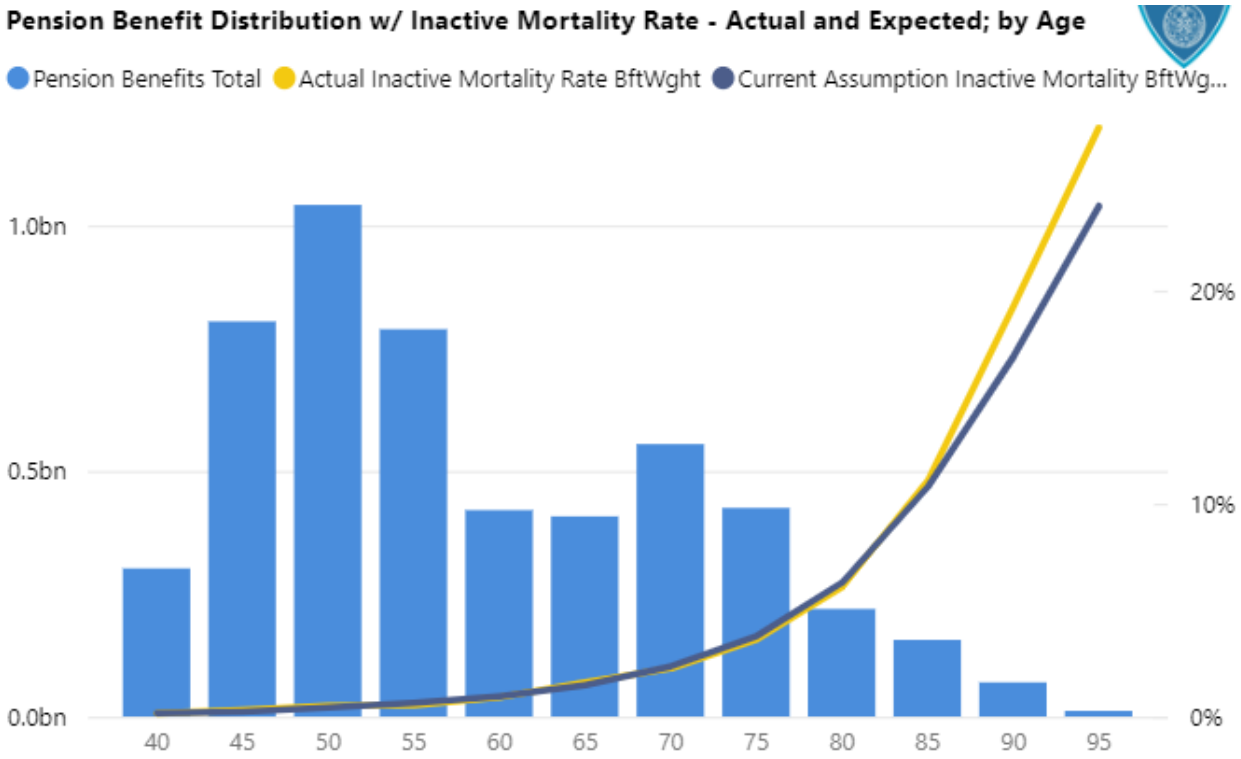
Specific observations:

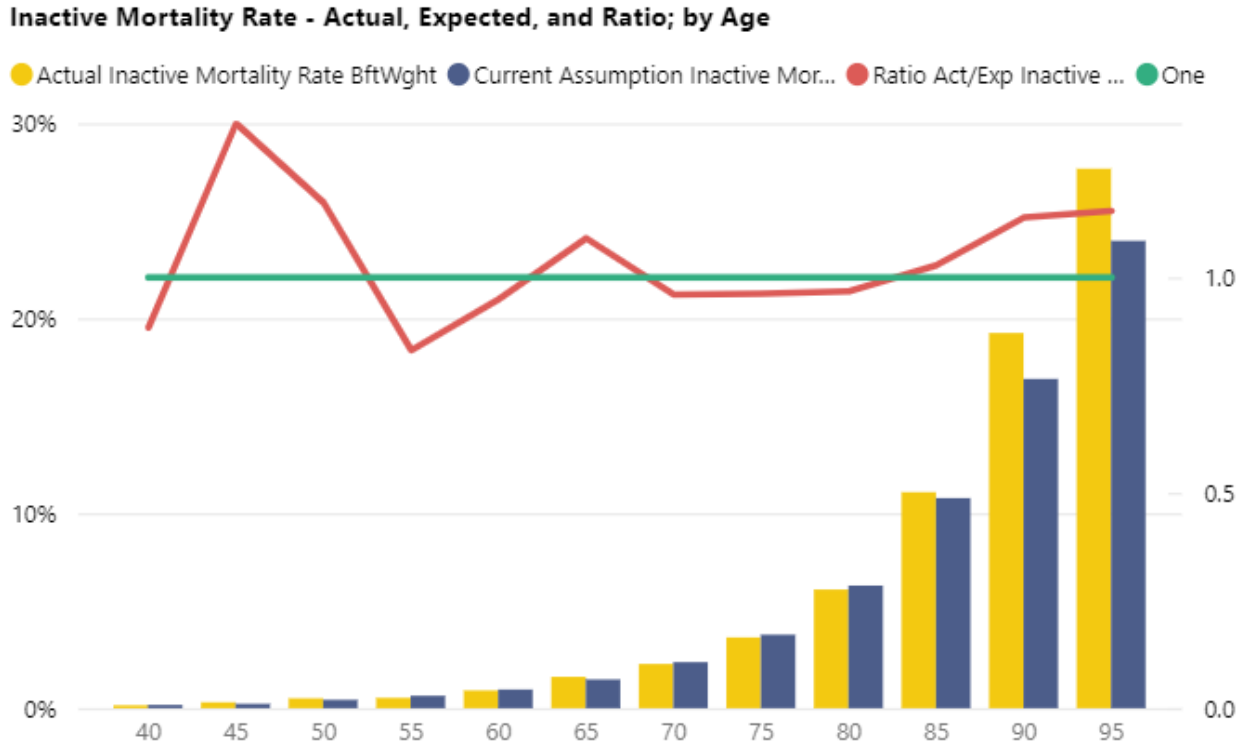
- From 2015 - 2021, the actual number of deaths was smaller than expected on a headcount basis (A/E ratio of 0.96), but greater on benefit basis (A/E ratio of 1.03).
- During 2020 – 2021, the actual experience appears to be slightly higher than the experience from 2015 – 2019, although the volume of data is small.
- For males, the rate of mortality on an amount-weighted basis was 76.3% of the rate of mortality on a headcount-weighted basis, versus the ratio on an expected basis of 71.5%. The assumed percentage is 87.6%. The actual weighting of benefits will result in a difference from the assumed percentage.
    - There is no credible experience to report for females.
- Unlike the results for service retirees, there was no distinction in experience for younger versus older ages.

Disabled Retirees - Males

The following charts show the postretirement mortality experience on an amount-weighted basis by age, for males, for the age range (40 to 99) during the period 2015 – 2021.

Age (bins)	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
40	437K	495K	301,601K	0.1449%	0.1640%	0.88
45	2,414K	1,778K	804,356K	0.3001%	0.2210%	1.36
50	5,247K	4,472K	1,041,519K	0.5037%	0.4293%	1.17
55	4,168K	5,016K	788,472K	0.5286%	0.6362%	0.83
60	3,813K	4,016K	420,328K	0.9072%	0.9553%	0.95
65	6,546K	6,000K	407,553K	1.6061%	1.4722%	1.09
70	12,568K	13,086K	554,665K	2.2658%	2.3593%	0.96
75	15,409K	16,009K	424,772K	3.6275%	3.7688%	0.96
80	13,333K	13,776K	219,134K	6.0842%	6.2867%	0.97
85	17,293K	16,821K	156,108K	11.0777%	10.7752%	1.03
90	13,393K	11,754K	69,598K	19.2433%	16.8880%	1.14
95	3,223K	2,792K	11,648K	27.6708%	23.9697%	1.15
Total	**97,842K**	**96,014K**	**5,199,753K**	**1.8817%**	**1.8465%**	**1.02**





Specific observations:

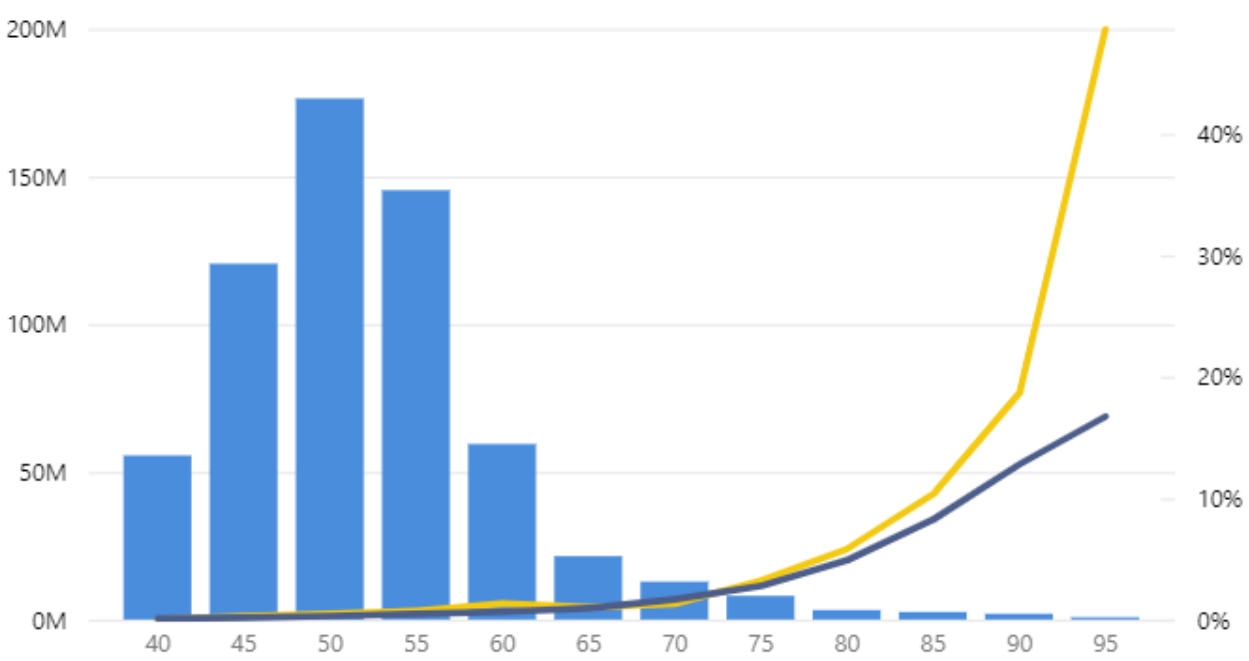
- From 2015 - 2021, the actual number of deaths was smaller than expected on a headcount basis (A/E ratio of 0.95), but slightly greater on a benefit basis (A/E ratio of 1.02).
- For ages 85 to 99, actual deaths exceeded expectations (A/E ratio of 1.08 on a benefits basis).

Disabled Retirees - Females

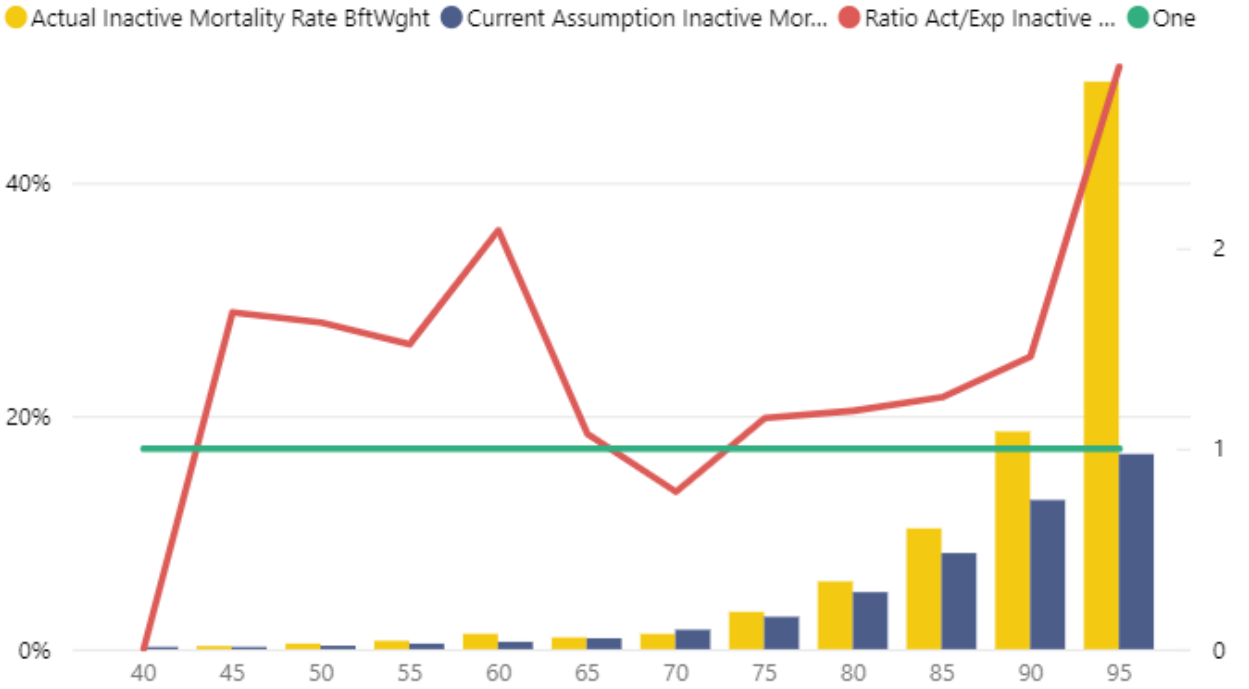
The following charts show the postretirement mortality experience on an amount-weighted basis by age, for females, for the age range (40 to 99) during the period 2015 – 2021.

Age (bins)	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
40	0K	47K	55,552K	0.0000%	0.0838%	0.00
45	318K	189K	120,491K	0.2639%	0.1571%	1.68
50	835K	513K	176,423K	0.4734%	0.2905%	1.63
55	1,039K	683K	145,357K	0.7151%	0.4701%	1.52
60	778K	372K	59,426K	1.3098%	0.6267%	2.09
65	215K	200K	21,465K	1.0005%	0.9316%	1.07
70	168K	214K	12,850K	1.3064%	1.6657%	0.78
75	257K	223K	8,046K	3.1970%	2.7738%	1.15
80	187K	157K	3,224K	5.8061%	4.8843%	1.19
85	266K	211K	2,566K	10.3499%	8.2374%	1.26
90	367K	251K	1,965K	18.6607%	12.7871%	1.46
95	136K	47K	279K	48.6558%	16.7241%	2.91
Total	**4,566K**	**3,108K**	**607,645K**	**0.7514%**	**0.5115%**	**1.47**

Pension Benefit Distribution w/ Inactive Mortality Rate - Actual and Expected; by Age



Inactive Mortality Rate - Actual, Expected, and Ratio; by Age



Specific observations:

- The mortality experience for female members is not credible as there were only 99 deaths during the study period.

Postretirement Mortality – Contingent Beneficiaries

The following charts show the postretirement mortality experience on a headcount-weighted basis by year and by age, for males and females combined, for the age range (50 to 99) during the period 2015 – 2021.

Plan Year	Actual Beneficiary Deaths	Expected Beneficiary Deaths	Total Exposed	Actual Beneficiary Mortality Rate	Current Assumption Beneficiary Mortality	Ratio Act/Exp Beneficiary Mortality
2015	46	43.1	993	4.6324%	4.3425%	1.07
2016	26	43.4	1,021	2.5465%	4.2486%	0.60
2017	31	44.1	1,066	2.9081%	4.1394%	0.70
2018	48	44.7	1,120	4.2857%	3.9878%	1.07
2019	40	44.0	1,141	3.5057%	3.8596%	0.91
2020	52	45.0	1,206	4.3118%	3.7290%	1.16
2021	55	46.1	1,246	4.4141%	3.6969%	1.19
Total	**298**	**310.4**	**7,793**	**3.8239%**	**3.9826%**	**0.96**

Age Bene (bins)	Actual Beneficiary Deaths	Expected Beneficiary Deaths	Total Exposed	Actual Beneficiary Mortality Rate	Current Assumption Beneficiary Mortality	Ratio Act/Exp Beneficiary Mortality
50	0	2.7	732	0.0000%	0.3692%	0.00
55	2	4.8	774	0.2584%	0.6240%	0.41
60	3	6.4	687	0.4367%	0.9254%	0.47
65	9	10.8	873	1.0309%	1.2402%	0.83
70	26	20.4	1,155	2.2511%	1.7695%	1.27
75	31	32.1	1,114	2.7828%	2.8811%	0.97
80	50	43.7	895	5.5866%	4.8850%	1.14
85	60	65.5	794	7.5567%	8.2537%	0.92
90	72	72.9	521	13.8196%	13.9961%	0.99
95	45	50.9	248	18.1452%	20.5402%	0.88
Total	**298**	**310.4**	**7,793**	**3.8239%**	**3.9826%**	**0.96**

The following charts show the postretirement mortality experience on an amount-weighted basis by year and by age, for males and females combined, for the age range (50 to 99) during the period 2015 – 2021.

Plan Year	Actual Beneficiary Benefits Released	Expected Beneficiary Benefits Released	Pension Benefits Total	Actual Beneficiary Mortality Rate BftWght	Current Assumption Beneficiary Mortality BftWght	Ratio Act/Exp Beneficiary Mortality BftWght
2015	940K	717K	24,024K	3.9144%	2.9827%	1.31
2016	490K	695K	24,000K	2.0414%	2.8952%	0.71
2017	554K	727K	26,525K	2.0898%	2.7393%	0.76
2018	821K	767K	28,840K	2.8452%	2.6599%	1.07
2019	754K	977K	34,866K	2.1637%	2.8012%	0.77
2020	1,066K	1,028K	35,859K	2.9727%	2.8680%	1.04
2021	1,170K	1,112K	41,000K	2.8539%	2.7130%	1.05
Total	**5,796K**	**6,023K**	**215,114K**	**2.6943%**	**2.7997%**	**0.96**

Age Bene (bins)	Actual Beneficiary Benefits Released	Expected Beneficiary Benefits Released	Pension Benefits Total	Actual Beneficiary Mortality Rate BftWght	Current Assumption Beneficiary Mortality BftWght	Ratio Act/Exp Beneficiary Mortality BftWght
50	0K	106K	30,665K	0.0000%	0.3458%	0.00
55	27K	174K	29,864K	0.0919%	0.5819%	0.16
60	70K	201K	23,083K	0.3016%	0.8723%	0.35
65	171K	286K	24,296K	0.7052%	1.1784%	0.60
70	678K	512K	30,517K	2.2207%	1.6764%	1.32
75	629K	762K	28,005K	2.2443%	2.7209%	0.82
80	1,271K	969K	21,050K	6.0397%	4.6049%	1.31
85	1,088K	1,204K	15,474K	7.0340%	7.7837%	0.90
90	1,193K	1,167K	8,867K	13.4583%	13.1657%	1.02
95	668K	640K	3,293K	20.2863%	19.4468%	1.04
Total	**5,796K**	**6,023K**	**215,114K**	**2.6943%**	**2.7997%**	**0.96**

Specific observations:

- From 2015 - 2021, the actual number of deaths was smaller than expected on a headcount basis (A/E ratio of 0.96) and a benefit basis (A/E ratio of 0.96).
- During 2020 – 2021, the actual experience appears to be slightly higher than the experience from 2015 – 2019, although the volume of data is small.

Contingent Beneficiaries - Males

The following charts show the postretirement mortality experience on an amount-weighted basis by age, for males, for the age range (50 to 99) during the period 2015 – 2021.

Age Bene (bins)	Actual Beneficiary Benefits Released	Expected Beneficiary Benefits Released	Pension Benefits Total	Actual Beneficiary Mortality Rate BftWght	Current Assumption Beneficiary Mortality BftWght	Ratio Act/Exp Beneficiary Mortality BftWght
50	0K	20K	3,943K	0.0000%	0.5154%	0.00
55	0K	22K	2,660K	0.0000%	0.8290%	0.00
60	0K	12K	1,029K	0.0000%	1.1283%	0.00
65	20K	18K	1,216K	1.6453%	1.5191%	1.08
70	38K	15K	724K	5.2440%	2.0697%	2.53
75	204K	37K	1,052K	19.4252%	3.5422%	5.48
80	282K	59K	1,059K	26.6436%	5.5634%	4.79
85	106K	32K	339K	31.2570%	9.5369%	3.28
90	69K	55K	345K	20.0155%	15.8407%	1.26
95	82K	40K	170K	48.0144%	23.6121%	2.03
Total	**801K**	**311K**	**12,535K**	**6.3900%**	**2.4788%**	**2.58**

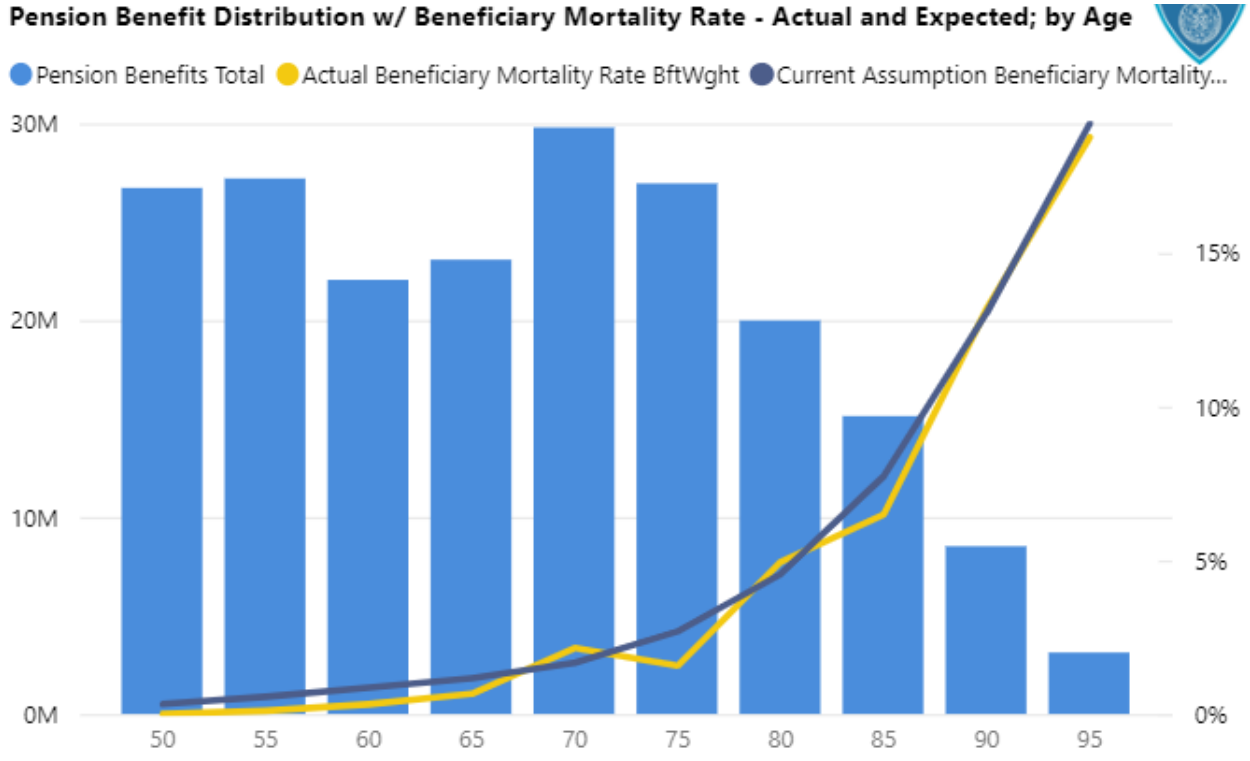
Specific observations:

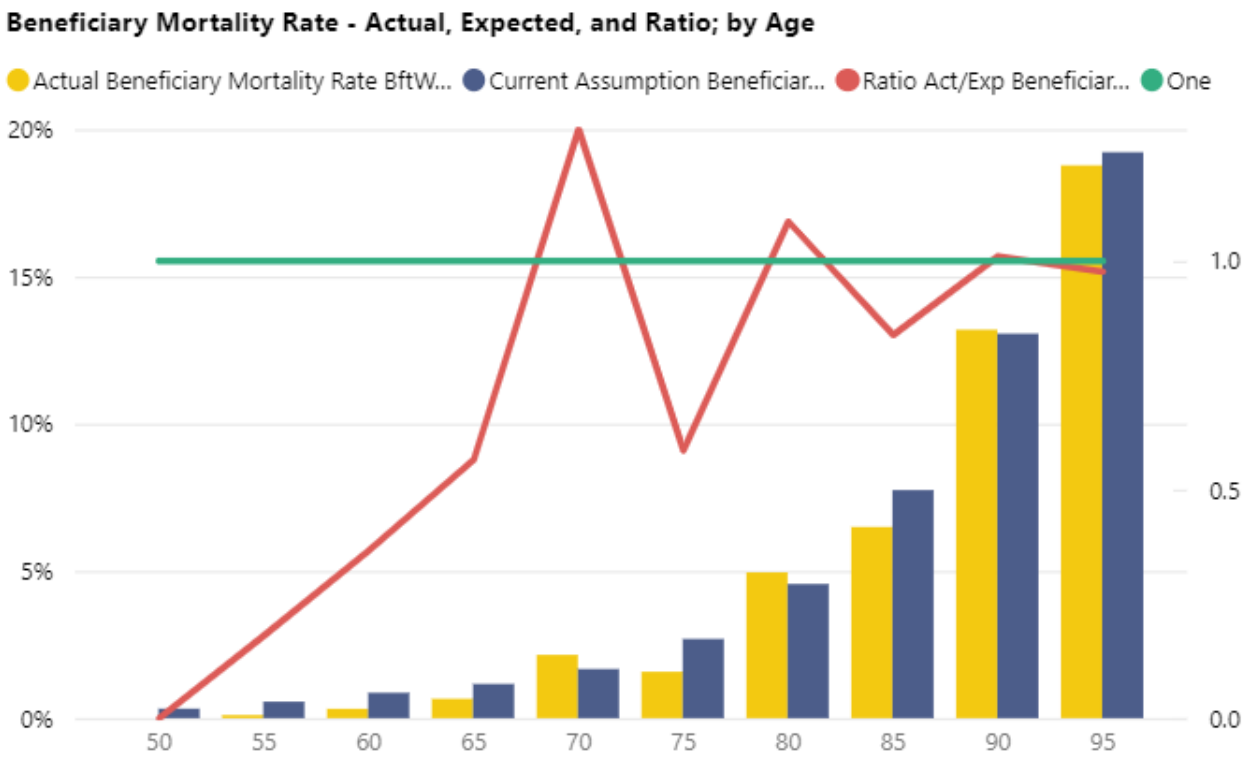
- The mortality experience of male beneficiaries is not credible as there were only 38 deaths during the study period.

Contingent Beneficiaries - Females

The following charts show the postretirement mortality experience on an amount-weighted basis by age, for females, for the age range (50 to 99) during the period 2015 – 2021.

Age Bene (bins)	Actual Beneficiary Benefits Released	Expected Beneficiary Benefits Released	Pension Benefits Total	Actual Beneficiary Mortality Rate BftWght	Current Assumption Beneficiary Mortality BftWght	Ratio Act/Exp Beneficiary Mortality BftWght
50	0K	86K	26,723K	0.0000%	0.3208%	0.00
55	27K	152K	27,204K	0.1009%	0.5578%	0.18
60	70K	190K	22,054K	0.3157%	0.8604%	0.37
65	151K	268K	23,080K	0.6557%	1.1605%	0.57
70	640K	497K	29,794K	2.1473%	1.6669%	1.29
75	424K	725K	26,953K	1.5738%	2.6888%	0.59
80	989K	910K	19,991K	4.9486%	4.5542%	1.09
85	983K	1,172K	15,135K	6.4922%	7.7445%	0.84
90	1,124K	1,113K	8,522K	13.1930%	13.0574%	1.01
95	586K	600K	3,122K	18.7731%	19.2195%	0.98
Total	**4,995K**	**5,712K**	**202,579K**	**2.4656%**	**2.8196%**	**0.87**





Specific observations:

- The mortality experience for female beneficiaries is not fully credible.
- From 2015 - 2021, the actual number of deaths was smaller than expected on a headcount basis (A/E ratio of 0.88) and a benefit basis (A/E ratio of 0.87).

Section V –New York City Fire Pension Fund (FIRE)

Exposures and Decrements

To set the exposures and actual decrements for FIRE, the eligibility criteria for retirement is 20 years of service. Thus, if a member has not accrued 20 years of service, the member would be considered a withdrawal exposure whereas a member with 20 or more years of service is considered a retirement exposure. Members with 19 years of service in their last active record with a status code of retirement the following year were included as retirements with 20 years of service.

Tier 3 was effective for new hires beginning no earlier than July 1, 2009. All retirement data is for Tier 2 members, except for a few exposures under Tier 1.

Using the age and service slider tools, a user can drill down to view the results that reflect a variety of conditions such as retirement at first eligibility.

OA's retirement assumptions depend on whether the member retires at first eligibility (20 years of service) or later.

We note that there was a hiring freeze for FIRE from 2007 to 2013 limiting certain age and service combinations in the study.

Withdrawal

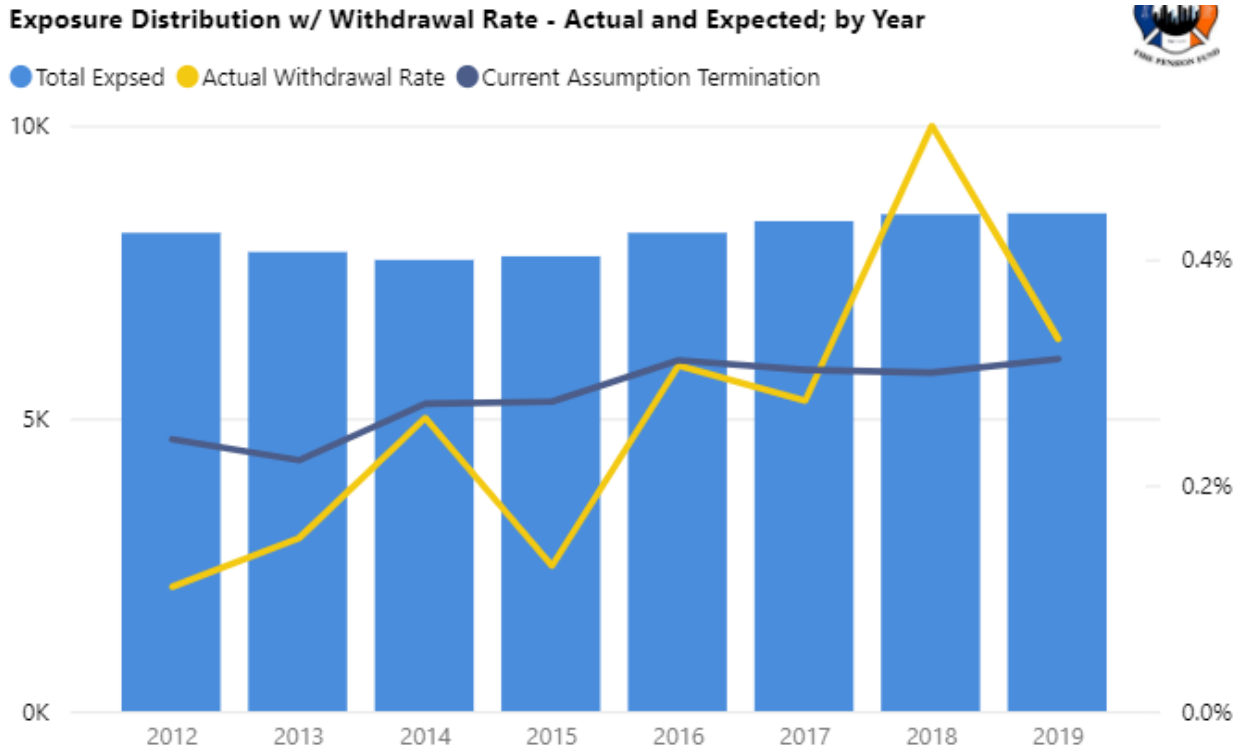
The current withdrawal assumption varies by service.

The following table shows the experience of withdrawal by year for the age range (22 to 54) and service range (0 to 19 years). Based on the current assumptions, the overall expected rate of withdrawal averaged 0.28%, whereas the actual rate was smaller at 0.25%, for an A/E ratio of 0.90.

Plan Year	Actual Withdrawals	Expected Withdrawals	Total Exposed	Actual Withdrawal Rate	Current Assumption Termination	Ratio Act/Exp Term
2012	9	19.7	8,166	0.110%	0.241%	0.46
2013	12	17.4	7,838	0.153%	0.222%	0.69
2014	20	21.0	7,704	0.260%	0.272%	0.95
2015	10	21.3	7,766	0.129%	0.274%	0.47
2016	25	25.4	8,167	0.306%	0.311%	0.99
2017	23	25.3	8,366	0.275%	0.302%	0.91
2018	44	25.4	8,482	0.519%	0.300%	1.73
2019	28	26.5	8,498	0.329%	0.312%	1.06
2020	20	27.0	8,436	0.237%	0.321%	0.74
2021	17	22.2	8,314	0.204%	0.267%	0.77
Total	**208**	**231.2**	**81,737**	**0.254%**	**0.283%**	**0.90**

The rate of termination during 2020 and 2021 may be artificially low due to the treatment of members with a LOA status code. A record with a LOA status code is included as an exposure and not a decrement. Compared with the other systems, FIRE has very few records with a LOA status code. Note that from 2016 to 2020, about 50% of the records with a status code of LOA were changed to a rehire code. However, given the small number of actual withdrawals, the addition of a few records could impact the A/E ratios determined in the analysis. Excluding 2020 and 2021, the actual rate of termination increased slightly to 0.26% for an A/E ratio of 0.94, as shown in the following tables.

Plan Year	Actual Withdrawals	Expected Withdrawals	Total Exposed	Actual Withdrawal Rate	Current Assumption Termination	Ratio Act/Exp Term
2012	9	19.7	8,166	0.110%	0.241%	0.46
2013	12	17.4	7,838	0.153%	0.222%	0.69
2014	20	21.0	7,704	0.260%	0.272%	0.95
2015	10	21.3	7,766	0.129%	0.274%	0.47
2016	25	25.4	8,167	0.306%	0.311%	0.99
2017	23	25.3	8,366	0.275%	0.302%	0.91
2018	44	25.4	8,482	0.519%	0.300%	1.73
2019	28	26.5	8,498	0.329%	0.312%	1.06
Total	**171**	**181.9**	**64,987**	**0.263%**	**0.280%**	**0.94**



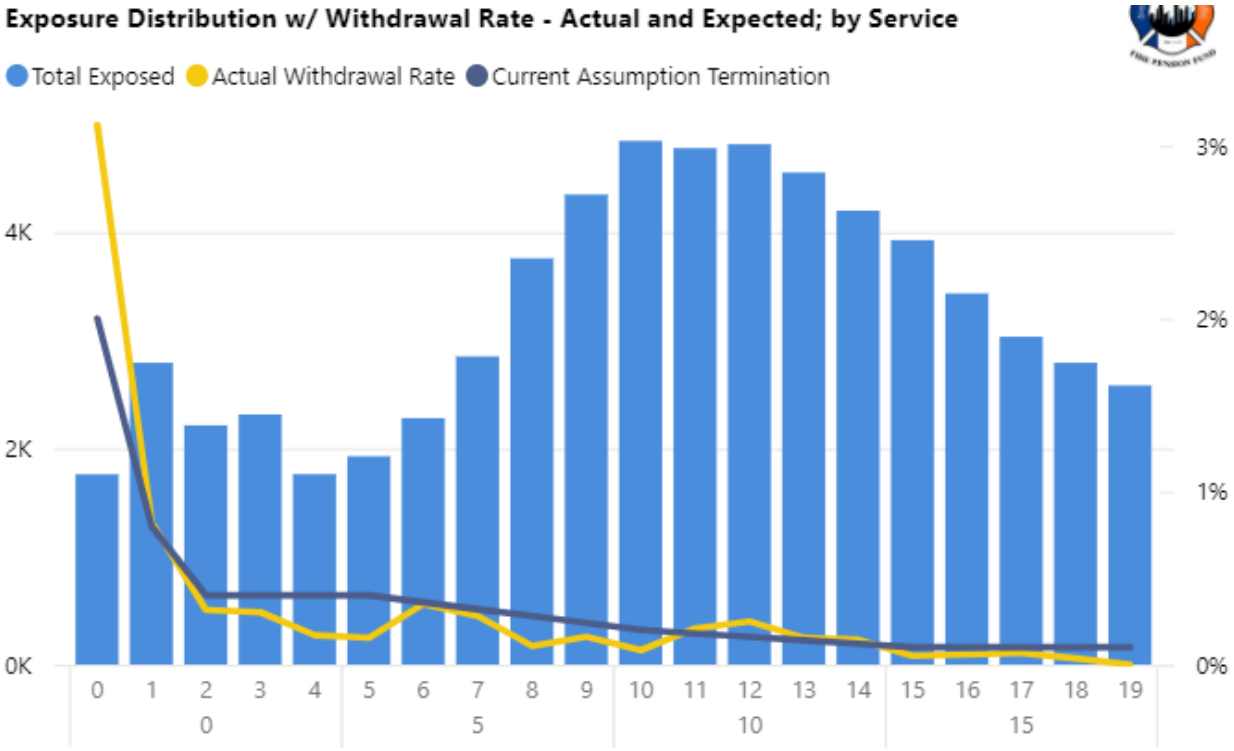
Specific observations through 2019:

- The number of withdrawals during 2018 – 2019 was the highest during the study period.
- FIRE has the lowest rate of withdrawal among all the systems, but the volume of data is limited, partially due to the hiring freeze.

Due to the low volume of data, we did not split out the experience during 2018-2019 as we did for other systems.

The following charts show the experience by service for the age range (22 to 54) during 2012 - 2019.

Service	Actual Withdrawals	Expected Withdrawals	Total Exposed	Actual Withdrawal Rate	Current Assumption Termination	Ratio Act/Exp Term
0	55	35.2	1,761	3.123%	2.000%	1.56
1	23	22.3	2,793	0.823%	0.800%	1.03
2	7	8.9	2,214	0.316%	0.400%	0.79
3	7	9.3	2,315	0.302%	0.400%	0.76
4	3	7.0	1,762	0.170%	0.400%	0.43
5	3	7.7	1,928	0.156%	0.400%	0.39
6	8	8.2	2,281	0.351%	0.360%	0.97
7	8	9.1	2,852	0.281%	0.320%	0.88
8	4	10.5	3,760	0.106%	0.280%	0.38
9	7	10.4	4,350	0.161%	0.240%	0.67
10	4	9.7	4,847	0.083%	0.200%	0.41
11	10	8.6	4,780	0.209%	0.180%	1.16
12	12	7.7	4,816	0.249%	0.160%	1.56
13	7	6.4	4,554	0.154%	0.140%	1.10
14	6	5.0	4,201	0.143%	0.120%	1.19
15	2	3.9	3,928	0.051%	0.100%	0.51
16	2	3.4	3,435	0.058%	0.100%	0.58
17	2	3.0	3,034	0.066%	0.100%	0.66
18	1	2.8	2,793	0.036%	0.100%	0.36
19	0	2.6	2,583	0.000%	0.100%	0.00
Total	**171**	**181.9**	**64,987**	**0.263%**	**0.280%**	**0.94**



Specific observations:

- Actual withdrawals were higher in the first year of service (A/E ratio of 1.56).
- Excluding the first year, the actual rate of withdrawal was less than expected (A/E ratio of 0.79).

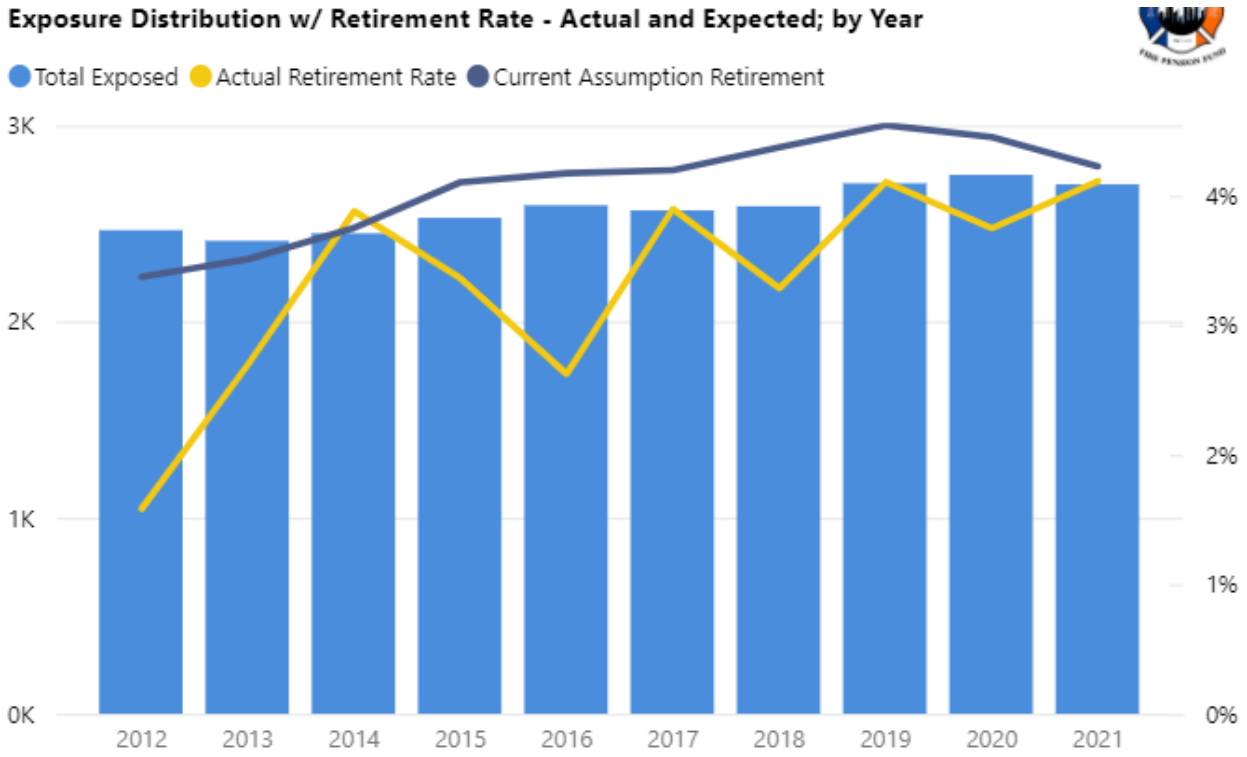
Retirement

The current retirement assumption varies by age and first eligibility for unreduced retirement. Since Tier 3 became effective July 1, 2009, and requires 20 years of service to retire, there is no retirement experience associated with this tier.

Please note that members who retired with World Trade Center (WTC) benefits are considered accidental disability retirements for purposes of this analysis, thus potentially reducing the number of service retirements. See the section below for details.

The following table shows the experience for retirement by year, for the age range (40 to 64) and service range (20 to 39 years). Based on current assumptions, the overall expected rate of retirement was 4.08% whereas the actual rate was smaller at 3.35%, for an A/E ratio of 0.82.

Plan Year	Actual Retirements	Expected Retirements	Total Exposed	Actual Retirement Rate	Current Assumption Retirement	Ratio Act/Exp Ret
2012	39	83.1	2,465	1.58%	3.37%	0.47
2013	65	84.7	2,411	2.70%	3.51%	0.77
2014	95	91.9	2,449	3.88%	3.75%	1.03
2015	85	103.7	2,528	3.36%	4.10%	0.82
2016	68	108.2	2,592	2.62%	4.17%	0.63
2017	100	107.7	2,566	3.90%	4.20%	0.93
2018	85	113.1	2,587	3.29%	4.37%	0.75
2019	111	122.9	2,704	4.11%	4.54%	0.90
2020	103	122.3	2,747	3.75%	4.45%	0.84
2021	111	114.1	2,699	4.11%	4.23%	0.97
Total	**862**	**1,051.7**	**25,748**	**3.35%**	**4.08%**	**0.82**



Similar to POLICE but unlike the other systems, few members with a LOA status code in a given year have a retired status code in the following two years. Consequently, we do not believe LOA status codes have a significant impact on the number of retirements in any year.

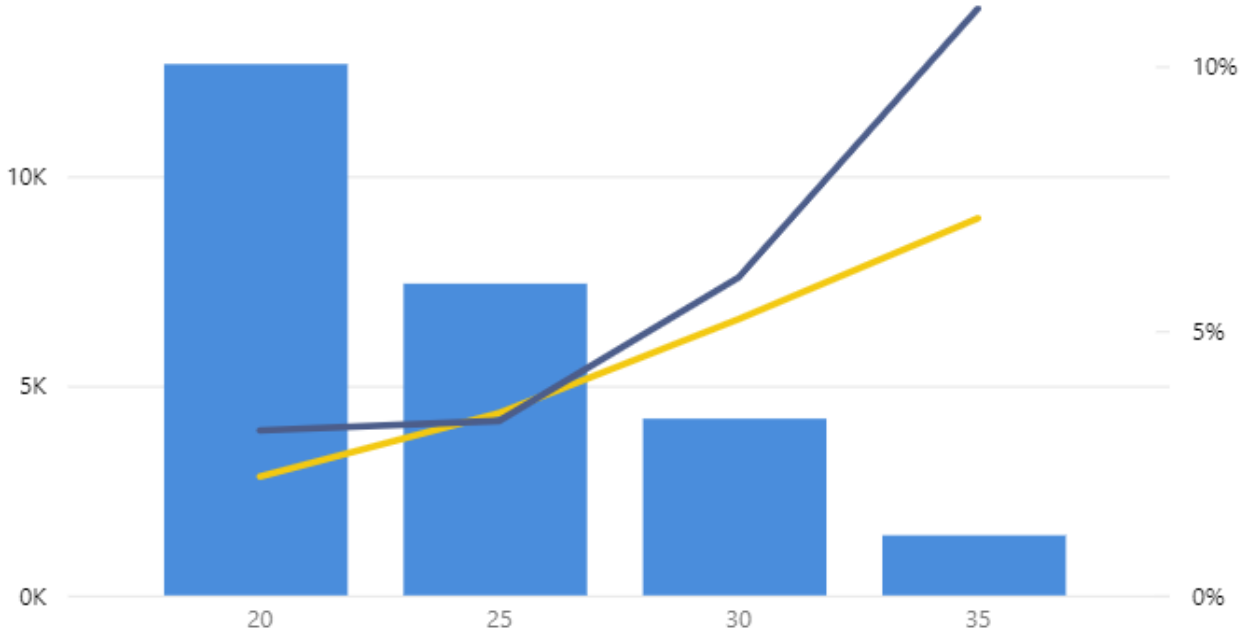
Specific observations:

- Four of the five years with the highest rates of retirement have occurred since 2017.
- The number of actual retirements was smaller than expected each year of the study period, except in 2014, which may be in part due to the members' ability to elect WTC benefits.

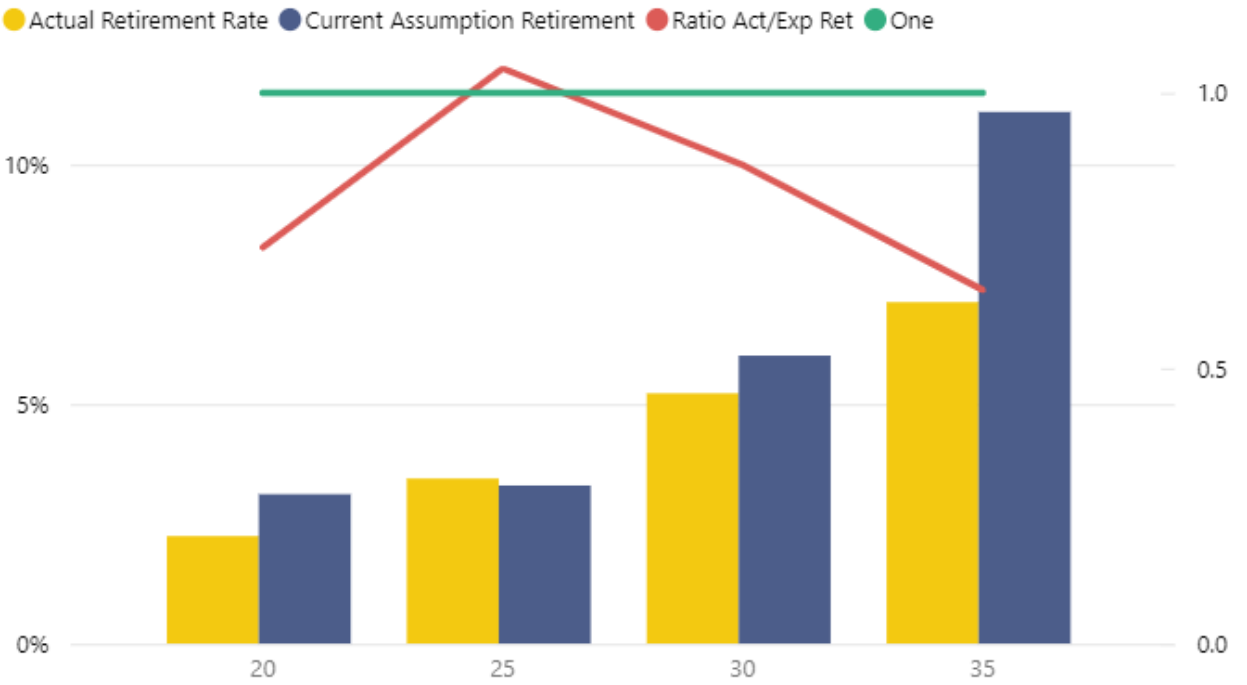
The following charts display the experience by service, for the age range (40 to 64) and service range (20 to 39), during the period 2012 – 2019.

Service	Actual Retirements	Expected Retirements	Total Exposed	Actual Retirement Rate	Current Assumption Retirement	Ratio Act/Exp Ret
20	121	196.3	3,050	3.97%	6.43%	0.62
21	40	54.0	2,897	1.38%	1.86%	0.74
22	50	49.6	2,530	1.98%	1.96%	1.01
23	30	46.4	2,176	1.38%	2.13%	0.65
24	43	48.4	2,015	2.13%	2.40%	0.89
25	63	48.3	1,777	3.55%	2.72%	1.30
26	47	47.2	1,606	2.93%	2.94%	1.00
27	49	47.3	1,458	3.36%	3.24%	1.04
28	46	49.2	1,348	3.41%	3.65%	0.93
29	51	53.0	1,245	4.10%	4.26%	0.96
30	61	55.5	1,157	5.27%	4.80%	1.10
31	37	49.0	889	4.16%	5.51%	0.75
32	51	50.9	827	6.17%	6.15%	1.00
33	35	50.0	724	4.83%	6.91%	0.70
34	36	47.6	617	5.83%	7.72%	0.76
35	28	43.7	494	5.67%	8.85%	0.64
36	22	36.3	348	6.32%	10.42%	0.61
37	21	31.0	253	8.30%	12.24%	0.68
38	14	26.2	197	7.11%	13.30%	0.53
39	17	21.7	140	12.14%	15.47%	0.79
Total	**862**	**1,051.7**	**25,748**	**3.35%**	**4.08%**	**0.82**

Exposure Distribution w/ Retirement Rate - Actual and Expected; by Service



Retirement Rate - Actual, Expected, and Ratio; by Service



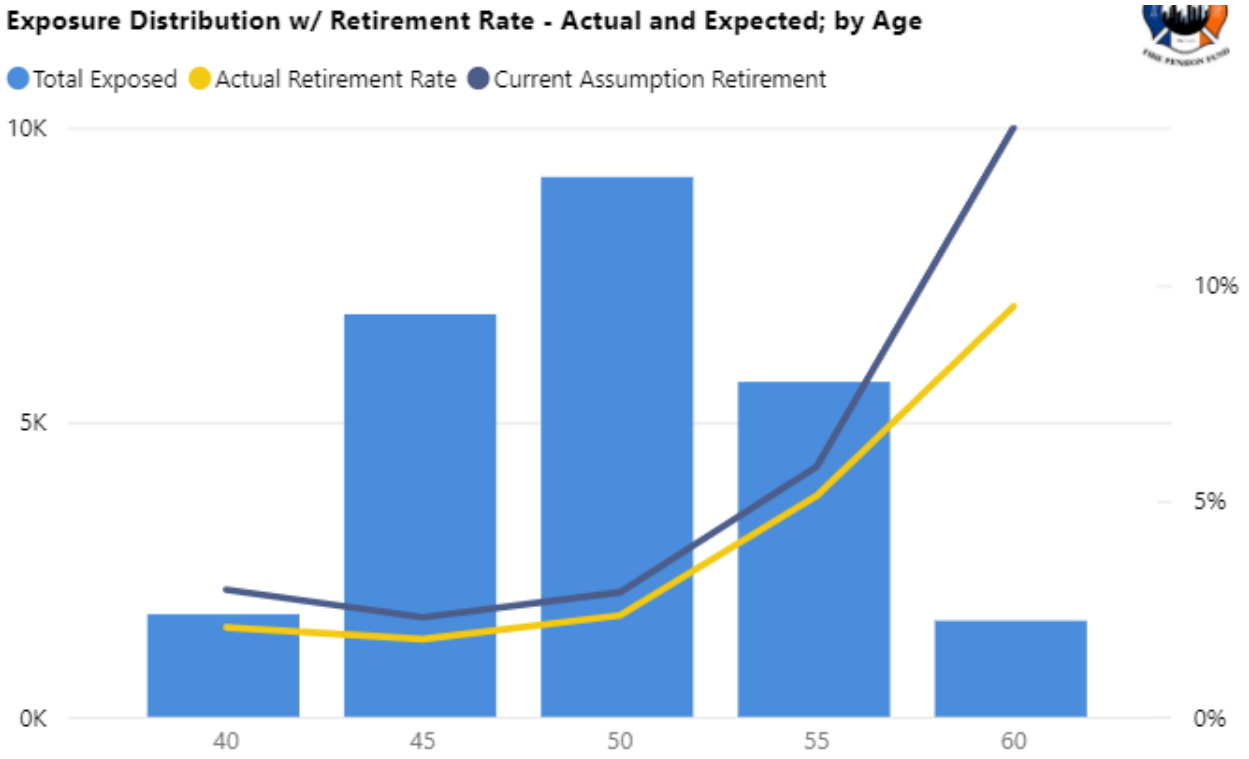
Specific observations:

- Actual experience was lower than expected at first eligibility of 20 years of service (A/E ratio of 0.62).
- The rate of retirement increased beginning at 25 years of service from the earlier service periods.
    - This could be a consequence of the provision under which the member's full longevity salary becomes pensionable earnings after attaining 25 years of service.
- Rates of retirement are higher beginning at age 55 than younger ages for similar service periods.
    - For the service period 20 – 24, the retirement rate was 1.96% for ages 45 to 54, versus 4.79% for ages 55 to 59.
    - For the service period 25 – 29, the retirement rate was 2.44% for ages 45 to 54, versus 5.59% for ages 55 to 59.

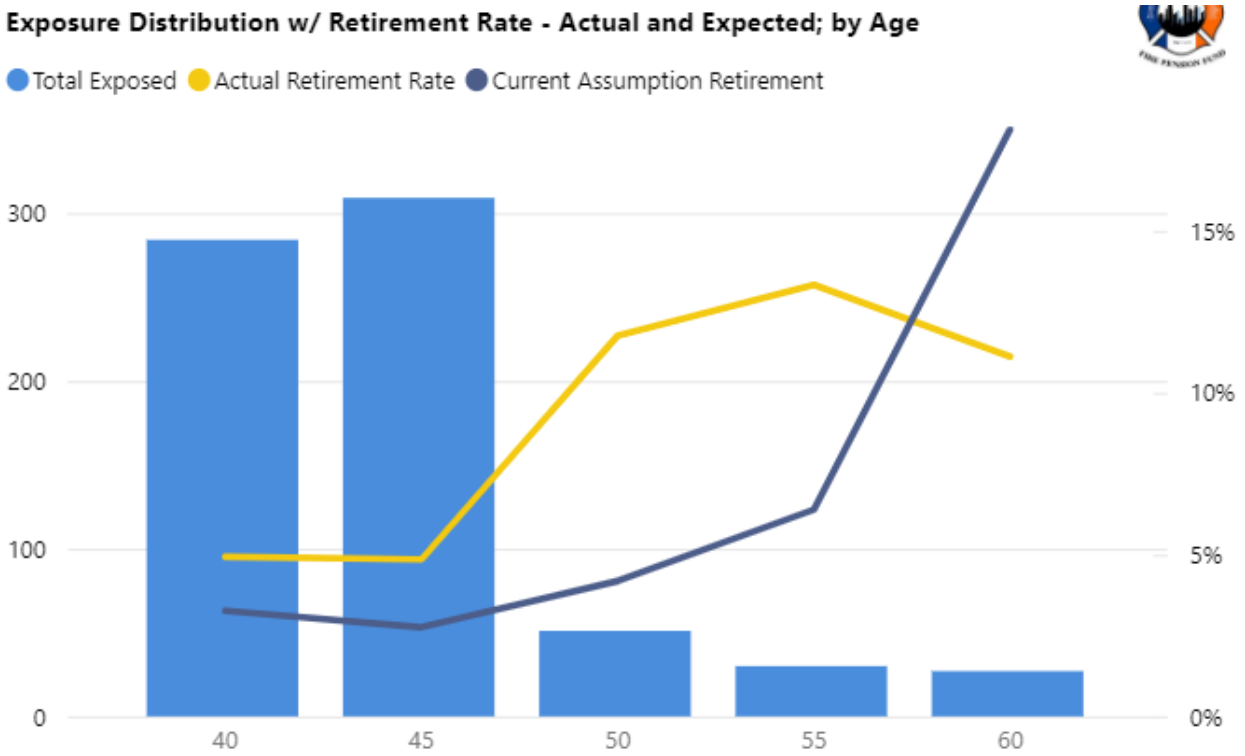
Impact of WTC Benefits

In the accidental disability retirement section, we discuss the impact of members who qualify for WTC benefits. Some members received an accidental disability retirement benefit because they qualified for the WTC benefits. It appears that this may have led to fewer members coded as service retirements rather than accidental disability retirements.

The following chart shows the experience by age for members who are eligible for WTC benefits for the age range 40 to 64.



The following chart shows the experience by age of members who are not eligible for WTC benefits for the age range 40 to 64.



Specific observations:

- Among members who are eligible for WTC benefits, the actual retirement rates were smaller than expected (A/E ratio of 0.80).
- Among members who are not eligible for WTC benefits, the actual retirement rates were greater than expected (A/E ratio of 1.57), although the volume of data was small.

The effect of eligibility for WTC benefits on the number of retirements and disabilities leads to the following question: how should retirement rates and disability rates be adjusted to account for the impact of WTC benefits?

Disability

The current ordinary disability assumption varies by age. They apply to all service periods for Tier 1 and Tier 2 members but do not apply before the five-year eligibility period is satisfied for Tier 3 members. Furthermore, different rates apply to accidental disability; these rates depend on age, and eligibility for World Trade Center disability benefits (WTC). We assumed that anyone with a WTC ultimate code would be eligible for the WTC benefits.

Ordinary disability benefits are as follows:

- For Tier 1 and Tier 2 members: 1/3 of final average salary (FAS) if the member has fewer than 10 years of service; 50% of FAS if the member has at least 10 years of service; 2.5% of FAS times the number of years of service if the member has completed 20 years of service. The member can elect a service retirement benefit instead of the ordinary disability benefit.

- For Tier 3 members: the greater of 1/3 of FAS, or 2% of FAS times the number of years of credited service

The base accidental disability benefit equals 75% of final average salary plus 1/60th of total earnings after the 20th anniversary, which is greater than the service retirement benefit.

Ordinary Disability

The following tables show the experience of ordinary disability retirement by year, for the age range (25 to 64) and service range (0 to 39 years). The actual rate of disability retirements was much smaller than expected (A/E ratio of 0.22) during the period 2012 – 2021.

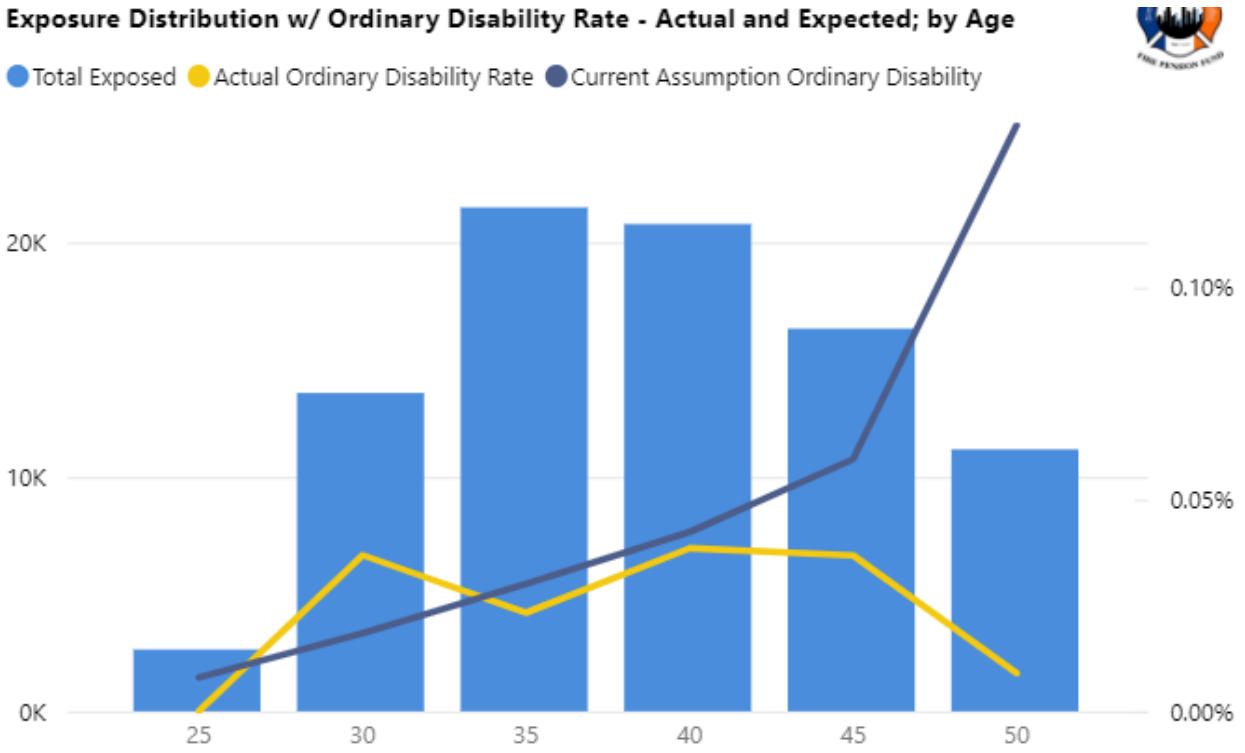
Plan Year	Actual Ordinary Disabilities	Expected Ordinary Disabilities	Total Exposed	Actual Ordinary Disability Rate	Current Assumption Ordinary Disability	Ratio Act/Exp Ordinary Disability
2012	2	8.7	10,635	0.0188%	0.0821%	0.23
2013	0	9.7	10,257	0.0000%	0.0946%	0.00
2014	1	10.3	9,933	0.0101%	0.1041%	0.10
2015	2	11.3	9,761	0.0205%	0.1155%	0.18
2016	3	11.8	9,393	0.0319%	0.1256%	0.25
2017	2	12.4	8,985	0.0223%	0.1380%	0.16
2018	6	12.8	8,607	0.0697%	0.1491%	0.47
2019	1	13.0	8,506	0.0118%	0.1525%	0.08
2020	3	12.4	8,517	0.0352%	0.1450%	0.24
2021	5	12.4	8,849	0.0565%	0.1400%	0.40
Total	**25**	**114.8**	**93,443**	**0.0268%**	**0.1228%**	**0.22**

The number of ordinary disabilities in 2020 and 2021 may be understated because they are reported with delays. Before 2020, there were cases in which certain status codes were reclassified as accidental disability retirements, but this did not happen for ordinary disability retirements. Therefore, any understatement of ordinary disabilities may be minor.

There were no disability retirements among members aged 55 or older. The following analysis reviews the experience of members up to age 54.

The following tables show the experience of ordinary disability retirement by age, for the age range (25 to 54) and service range (0 to 39), during 2012 to 2021.

Age	Actual Ordinary Disabilities	Expected Ordinary Disabilities	Total Exposed	Actual Ordinary Disability Rate	Current Assumption Ordinary Disability	Ratio Act/Exp Ordinary Disability
25	0	0.0	33	0.0000%	0.0025%	0.00
26	0	0.0	126	0.0000%	0.0025%	0.00
27	0	0.0	403	0.0000%	0.0050%	0.00
28	0	0.1	821	0.0000%	0.0075%	0.00
29	0	0.1	1,253	0.0000%	0.0100%	0.00
30	0	0.2	1,707	0.0000%	0.0125%	0.00
31	0	0.3	2,250	0.0000%	0.0150%	0.00
32	0	0.5	2,719	0.0000%	0.0175%	0.00
33	1	0.6	3,226	0.0310%	0.0200%	1.55
34	4	0.8	3,674	0.1089%	0.0225%	4.84
35	0	1.0	4,045	0.0000%	0.0250%	0.00
36	0	1.2	4,255	0.0000%	0.0275%	0.00
37	0	1.3	4,382	0.0000%	0.0300%	0.00
38	2	1.4	4,403	0.0454%	0.0325%	1.40
39	3	1.5	4,404	0.0681%	0.0350%	1.95
40	1	1.7	4,444	0.0225%	0.0375%	0.60
41	3	1.7	4,371	0.0686%	0.0400%	1.72
42	1	1.8	4,239	0.0236%	0.0425%	0.56
43	2	1.8	3,964	0.0505%	0.0450%	1.12
44	1	1.8	3,762	0.0266%	0.0475%	0.56
45	0	1.8	3,539	0.0000%	0.0500%	0.00
46	2	1.9	3,457	0.0579%	0.0550%	1.05
47	1	2.0	3,269	0.0306%	0.0600%	0.51
48	2	2.0	3,134	0.0638%	0.0650%	0.98
49	1	2.0	2,923	0.0342%	0.0700%	0.49
50	1	2.0	2,686	0.0372%	0.0750%	0.50
51	0	2.7	2,433	0.0000%	0.1100%	0.00
52	0	3.2	2,197	0.0000%	0.1450%	0.00
53	0	3.6	2,019	0.0000%	0.1800%	0.00
54	0	3.9	1,835	0.0000%	0.2150%	0.00
Total	**25**	**43.1**	**85,973**	**0.0291%**	**0.0502%**	**0.58**



The following tables show the experience of ordinary disability retirement by service for the age range (25 to 54) and service range (0 to 39), during 2012 to 2021.

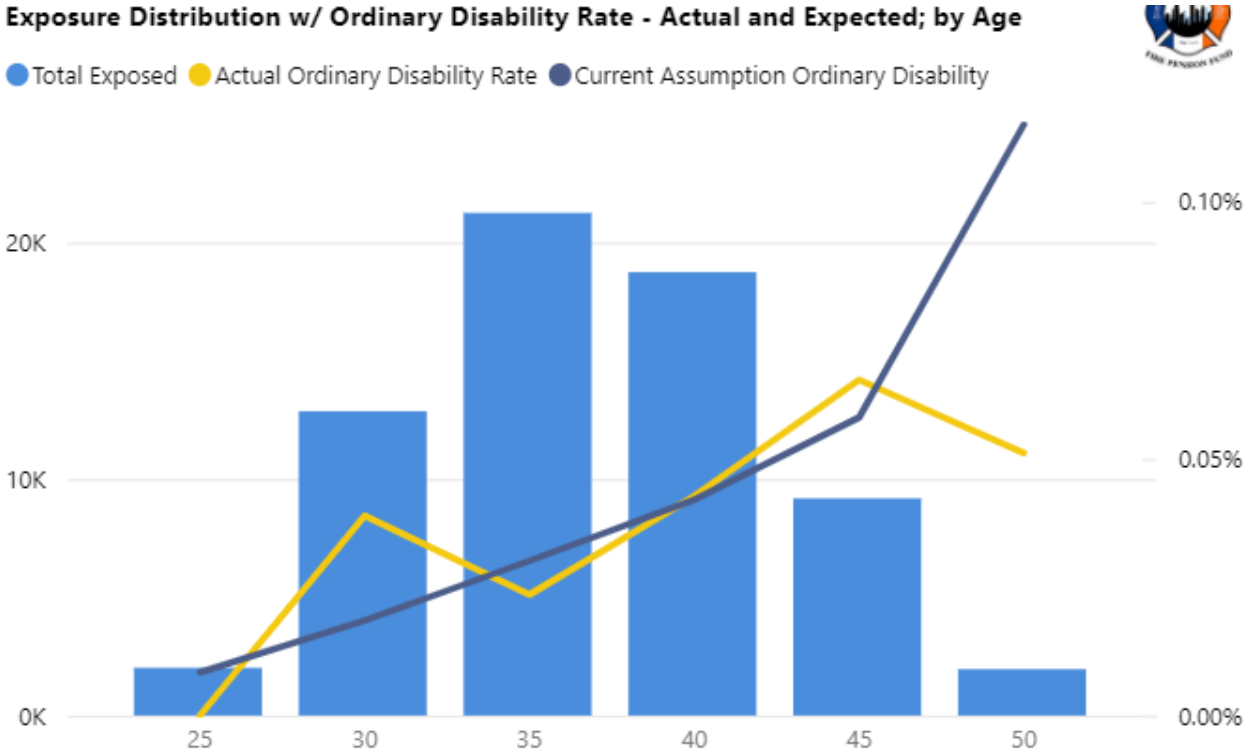
Service	Actual Ordinary Disabilities	Expected Ordinary Disabilities	Total Exposed	Actual Ordinary Disability Rate	Current Assumption Ordinary Disability	Ratio Act/Exp Ordinary Disability
0	0	0.0	66	0.0000%	0.0116%	0.00
1	0	0.0	82	0.0000%	0.0153%	0.00
2	0	0.0	50	0.0000%	0.0196%	0.00
3	0	0.1	445	0.0000%	0.0140%	0.00
4	0	0.1	927	0.0000%	0.0151%	0.00
5	1	0.5	3,002	0.0333%	0.0173%	1.93
6	1	0.6	3,306	0.0302%	0.0188%	1.61
7	0	0.7	3,186	0.0000%	0.0207%	0.00
8	1	0.9	3,823	0.0262%	0.0236%	1.11
9	1	1.2	4,424	0.0226%	0.0261%	0.87
10	1	1.4	4,948	0.0202%	0.0285%	0.71
11	5	1.6	5,235	0.0955%	0.0312%	3.06
12	4	1.9	5,606	0.0714%	0.0344%	2.07
13	4	2.1	5,661	0.0707%	0.0373%	1.89
14	1	2.2	5,481	0.0182%	0.0401%	0.45
15	3	2.2	5,004	0.0600%	0.0435%	1.38
16	0	2.3	4,746	0.0000%	0.0479%	0.00
17	2	2.4	4,446	0.0450%	0.0534%	0.84
18	1	2.3	3,835	0.0261%	0.0591%	0.44
19	0	2.2	3,300	0.0000%	0.0656%	0.00

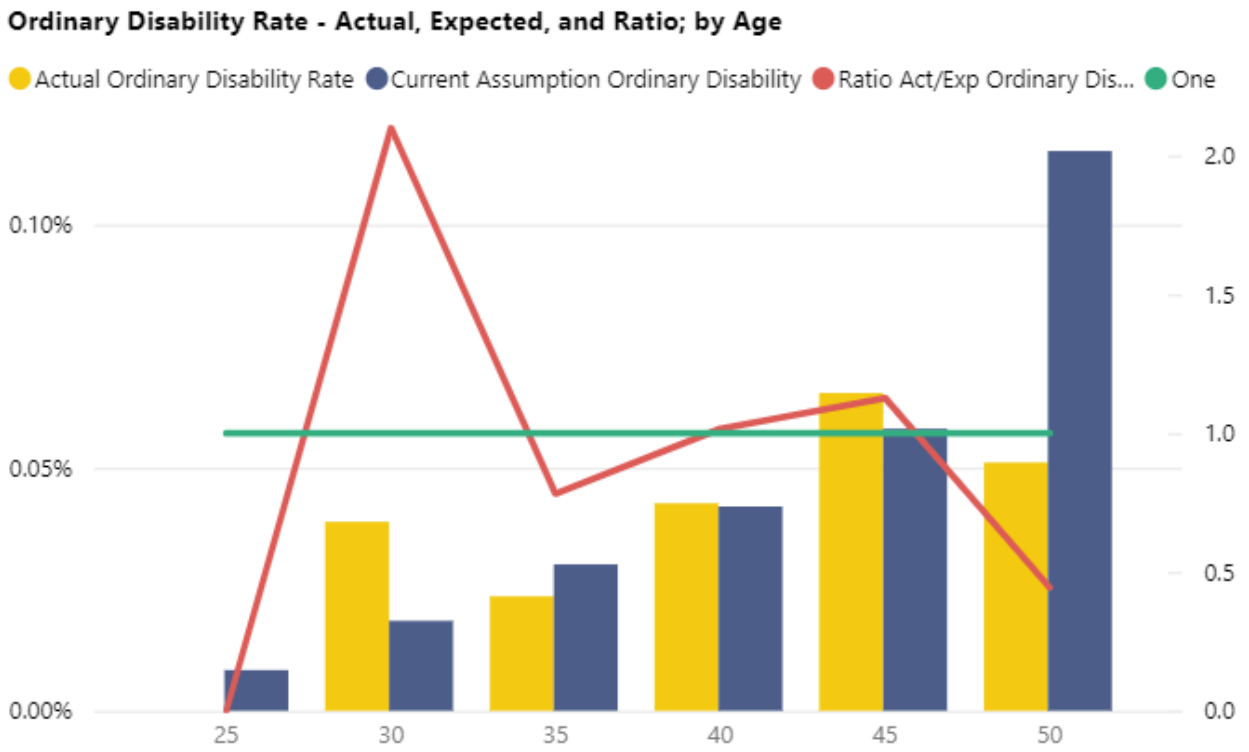
20	0	2.2	2,976	0.0000%	0.0735%	◆	0.00
21	0	2.2	2,769	0.0000%	0.0786%	◆	0.00
22	0	2.0	2,358	0.0000%	0.0831%	◆	0.00
23	0	1.8	1,976	0.0000%	0.0909%	◆	0.00
24	0	1.8	1,739	0.0000%	0.1010%	◆	0.00
25	0	1.5	1,424	0.0000%	0.1081%	◆	0.00
26	0	1.4	1,227	0.0000%	0.1138%	◆	0.00
27	0	1.3	1,070	0.0000%	0.1217%	◆	0.00
28	0	1.2	890	0.0000%	0.1315%	◆	0.00
29	0	1.0	700	0.0000%	0.1444%	◆	0.00
30	0	0.9	547	0.0000%	0.1603%	◆	0.00
31	0	0.6	329	0.0000%	0.1726%	◆	0.00
32	0	0.4	229	0.0000%	0.1872%	◆	0.00
33	0	0.3	131	0.0000%	0.2046%	◆	0.00
34	0	0.1	27	0.0000%	0.2072%	◆	0.00
35	0	0.0	4	0.0000%	0.1975%	◆	0.00
36	0	0.0	1	0.0000%	0.1800%	◆	0.00
37	0	0.0	2	0.0000%	0.2150%	◆	0.00
38	0	0.0	1	0.0000%	0.0750%	◆	0.00
Total	**25**	**43.1**	**85,973**	**0.0291%**	**0.0502%**	▲	**0.58**

Specific observations:

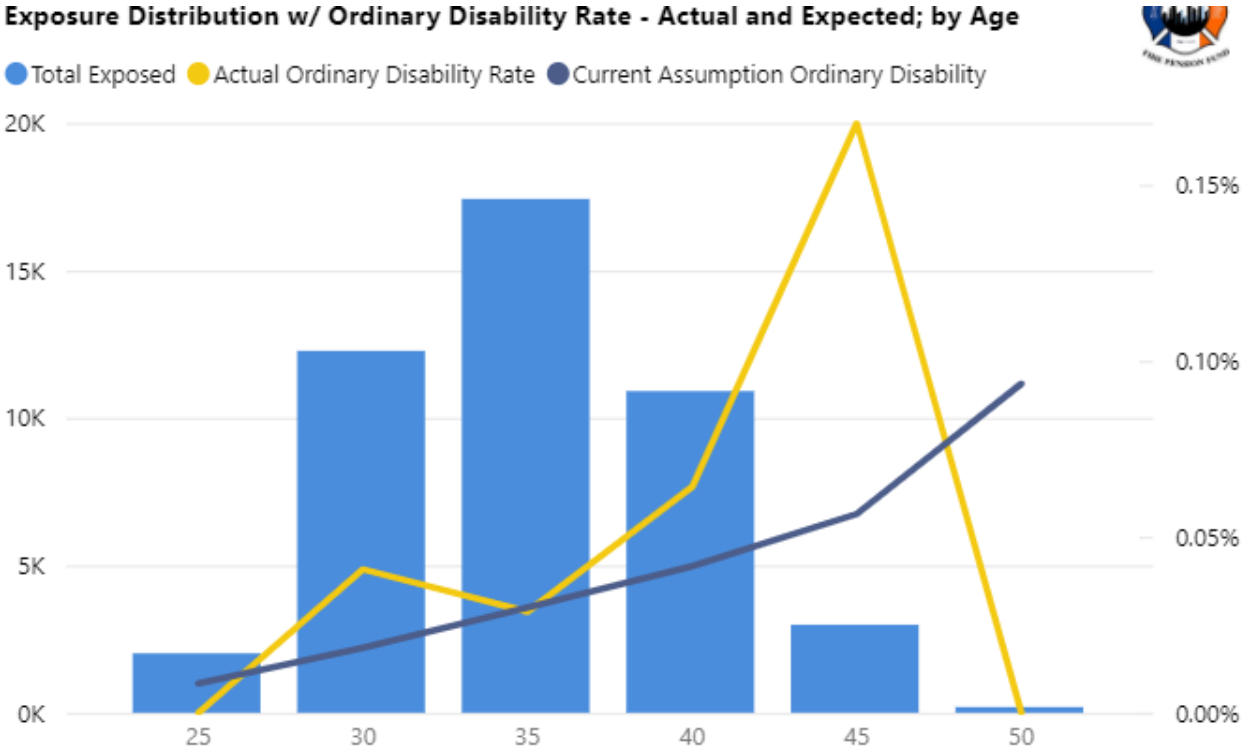
- The small volume of data during the study period resulted in volatility at individual ages and lengths of service.
- There were no ordinary disability retirements for members with at least 20 years of service in the selected age range.
- There were no disability retirements for members aged 55 and older.
- The ordinary disability retirement rate of members with between 5 and 19 years of service was in line with the assumption (A/E ratio of 1.02).

The following charts show the experience of members with between 5 and 19 years of service for the age range (25 to 54).





For members not eligible for the WTC benefits with a service range of 5 to 19 years, the A/E ratio increases from 1.02 to 1.57, as shown in the following chart.



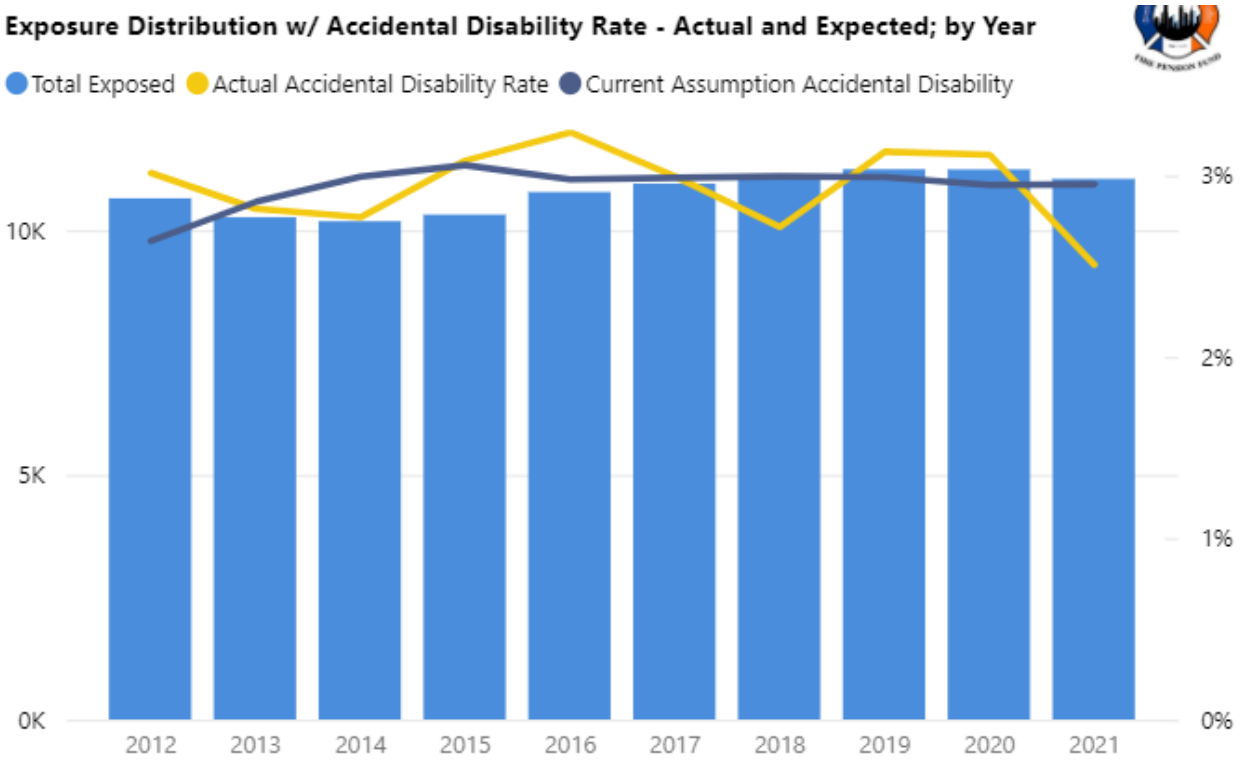
Accidental Disability

In performing the experience analysis, it is necessary to reassign disability retirement codes retroactively to reflect the eventual approval of a disability retirement. Members with a disability code in a given year had all inactive status codes in prior years changed to a disability status code. We made adjustments as far back as 2012. For FIRE, this had a significant impact on members coded as accidental disability as many records previously coded as service retirements were changed to accidental disability retirements, which includes members who were eligible for WTC benefits.

It is difficult to determine how future years would impact the experience during the study period as we believe that this type of retroactive adjustment will be required in subsequent iterations of this study. The consequence will be a restatement of the number of disability retirements experienced during this study period, specifically 2021. Surprisingly, 2020 was one of the greatest years of accidental disability retirements.

The following tables show the experience of accidental disability retirement by year, for the age range (22 to 64) and service range (0 to 44), during 2012 – 2021.

Plan Year	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
2012	321	281.0	10,651	3.0138%	2.6380%	1.14
2013	289	293.0	10,264	2.8157%	2.8542%	0.99
2014	282	304.8	10,182	2.7696%	2.9934%	0.93
2015	318	315.4	10,318	3.0820%	3.0564%	1.01
2016	349	321.0	10,778	3.2381%	2.9779%	1.09
2017	328	327.0	10,950	2.9954%	2.9866%	1.00
2018	301	331.9	11,083	2.7159%	2.9951%	0.91
2019	352	336.3	11,245	3.1303%	2.9903%	1.05
2020	350	331.2	11,241	3.1136%	2.9468%	1.06
2021	277	326.1	11,048	2.5072%	2.9513%	0.85
Total	**3,167**	**3,167.6**	**107,760**	**2.9389%**	**2.9395%**	**1.00**



Specific observations:

- Overall, the number of accidental disability retirements is similar to that expected (A/E ratio of 1.0).
- As shown in the following graphs and charts, results vary by tier.

The rates of accidental disability retirement vary by the following characteristics:

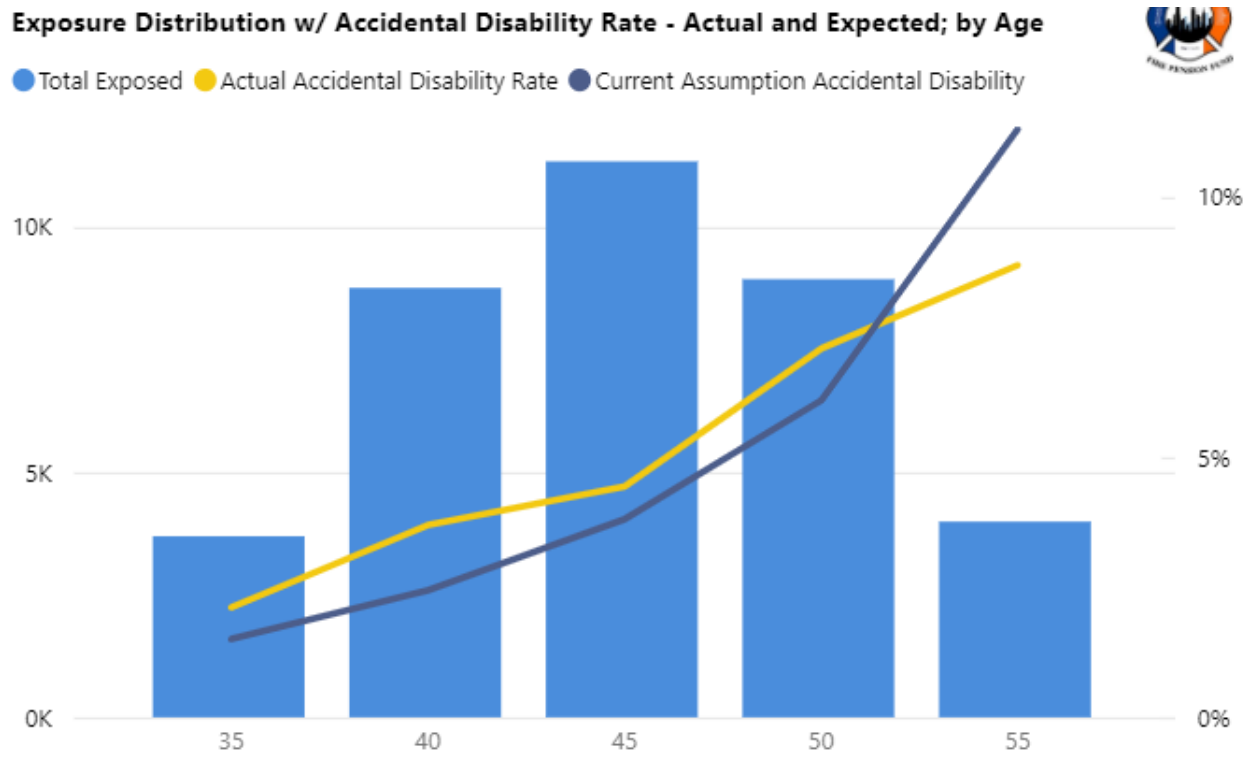
1. Tier 1 and 2 members eligible for WTC benefits.
2. Tier 1 and 2 members not eligible for WTC benefits, and members of the Tier 3 Enhanced Plan.
3. Tier 3 Modified members.
    a. There are only two members with this Tier code, hence the data is not credible, and no analysis is included in this study.

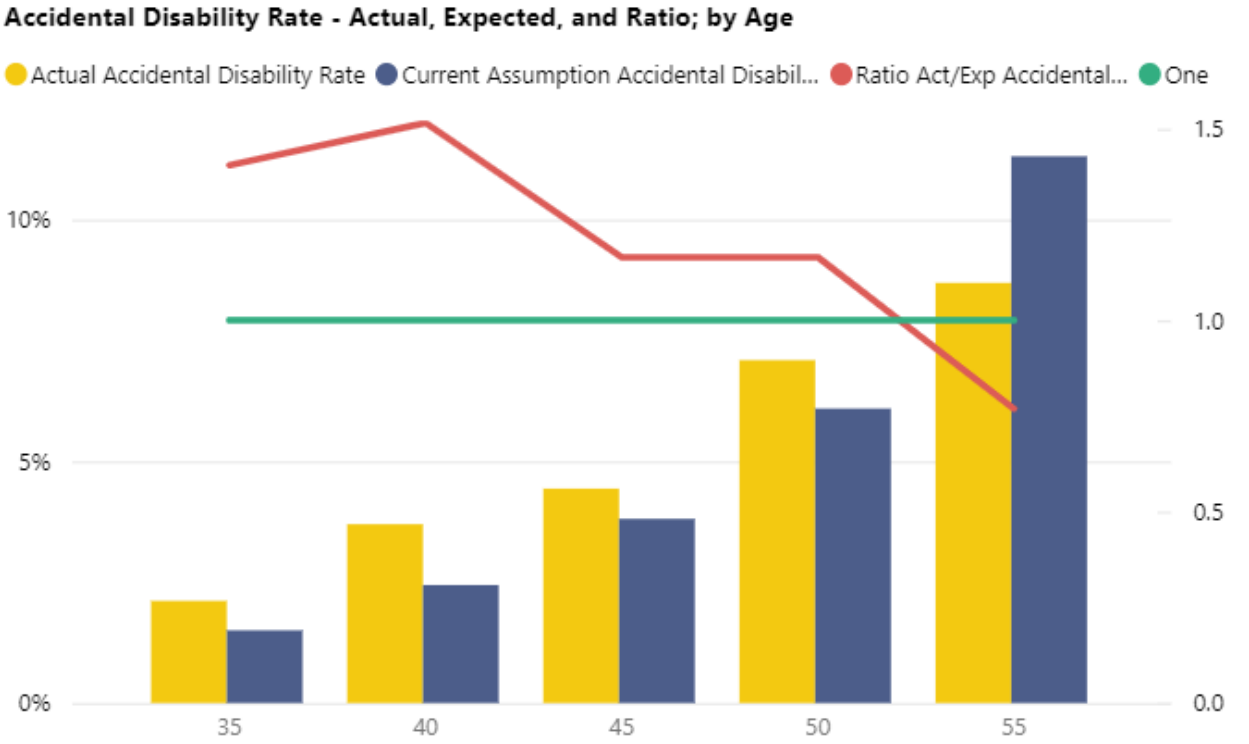
Members Who Are Eligible for WTC Benefits (Tiers 1 and 2)

The following charts display the experience of members who are eligible for WTC benefits, by year and by age, for the age range (35 to 59) and service range (10 to 34), during 2012 – 2019.

Plan Year	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
2012	289	226.7	5,602	5.1589%	4.0474%	1.27
2013	236	230.9	5,475	4.3105%	4.2181%	1.02
2014	224	229.1	5,197	4.3102%	4.4081%	0.98
2015	232	218.0	4,820	4.8133%	4.5234%	1.06
2016	263	211.9	4,476	5.8758%	4.7342%	1.24
2017	229	201.9	4,085	5.6059%	4.9430%	1.13
2018	193	192.6	3,700	5.2162%	5.2051%	1.00
2019	220	186.2	3,378	6.5127%	5.5133%	1.18
Total	**1,886**	**1,697.4**	**36,733**	**5.1343%**	**4.6210%**	**1.11**

Age	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
35	5	4.0	398	1.2563%	1.0000%	1.26
36	11	6.3	529	2.0794%	1.2000%	1.73
37	13	9.7	694	1.8732%	1.4000%	1.34
38	20	14.8	928	2.1552%	1.6000%	1.35
39	29	20.6	1,145	2.5328%	1.8000%	1.41
40	35	27.8	1,390	2.5180%	2.0000%	1.26
41	49	34.9	1,586	3.0895%	2.2000%	1.40
42	63	42.5	1,770	3.5593%	2.4000%	1.48
43	75	50.0	1,924	3.8981%	2.6000%	1.50
44	102	58.6	2,092	4.8757%	2.8000%	1.74
45	68	64.7	2,157	3.1525%	3.0000%	1.05
46	114	77.5	2,279	5.0022%	3.4000%	1.47
47	100	87.9	2,313	4.3234%	3.8000%	1.14
48	106	98.1	2,335	4.5396%	4.2000%	1.08
49	115	104.0	2,260	5.0885%	4.6000%	1.11
50	135	105.5	2,111	6.3951%	5.0000%	1.28
51	131	109.8	1,960	6.6837%	5.6000%	1.19
52	136	110.4	1,781	7.6362%	6.2000%	1.23
53	121	110.6	1,627	7.4370%	6.8000%	1.09
54	111	108.1	1,461	7.5975%	7.4000%	1.03
55	106	98.6	1,233	8.5969%	8.0000%	1.07
56	75	98.5	985	7.6142%	10.0000%	0.76
57	85	95.6	797	10.6650%	12.0000%	0.89
58	44	86.3	575	7.6522%	15.0000%	0.51
59	37	72.5	403	9.1811%	18.0000%	0.51
Total	**1,886**	**1,697.4**	**36,733**	**5.1343%**	**4.6210%**	**1.11**





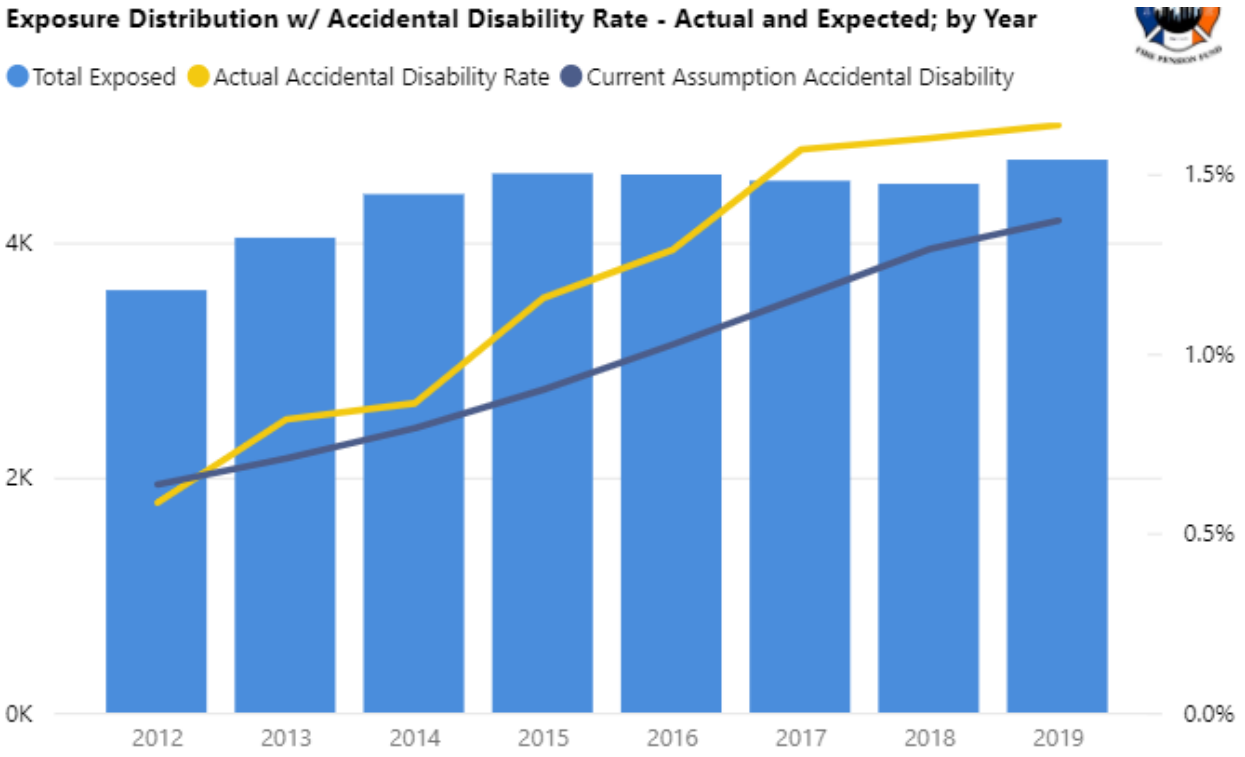
Specific observations:

- Unlike POLICE, the rates of accidental disability for those receiving WTC benefits are higher than expected at all ages (A/E ratio of 1.11) and even higher prior to age 55 (A/E ratio of 1.24).
- After age 55 the A/E ratio drops (A/E ratio of 0.69 for the age range 55 to 64).
- The rates of accidental disability for those receiving WTC benefits increased once a member completed 20 years of service with the highest rate at 20 years of service.

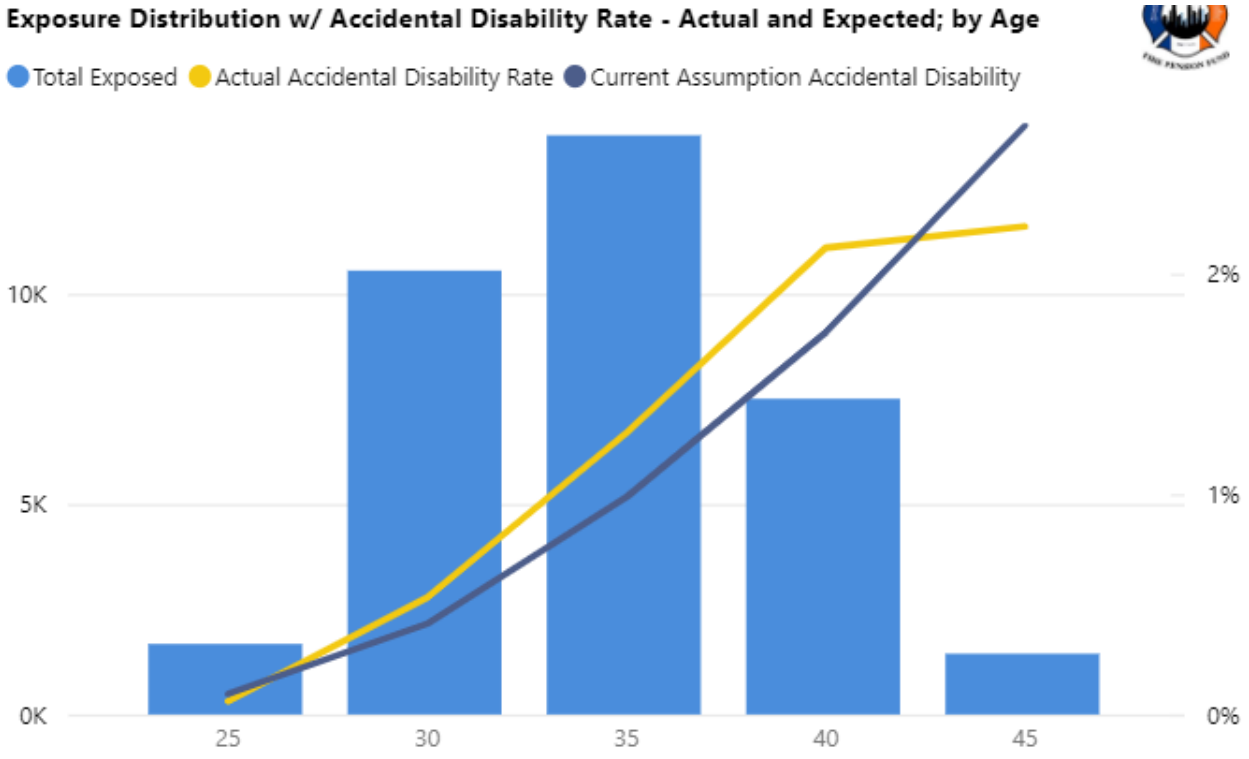
Members Who Are Not Eligible for WTC Benefits (Tiers 1 and 2 plus Tier 3 Enhanced)

The following charts display the experience by year and by age, for the age range (25 to 49) and service range (5 to 19 years), during 2012 – 2019 for members not eligible for WTC benefits plus Tier 3 Enhanced Plan members.

Plan Year	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
2012	21	22.8	3,595	0.5841%	0.6353%	0.92
2013	33	28.6	4,041	0.8166%	0.7073%	1.15
2014	38	35.0	4,412	0.8613%	0.7926%	1.09
2015	53	41.3	4,588	1.1552%	0.8999%	1.28
2016	59	46.9	4,579	1.2885%	1.0249%	1.26
2017	71	52.4	4,526	1.5687%	1.1574%	1.36
2018	72	58.1	4,500	1.6000%	1.2912%	1.24
2019	77	64.5	4,705	1.6366%	1.3701%	1.19
Total	**424**	**349.6**	**34,946**	**1.2133%**	**1.0003%**	**1.21**



Age	Actual Accidental Disabilities	Expected Accidental Disabilities	Total Exposed	Actual Accidental Disability Rate	Current Assumption Accidental Disability	Ratio Act/Exp Accidental Disability
25	0	0.0	4	0.0000%	0.0350%	0.00
26	0	0.0	36	0.0000%	0.0450%	0.00
27	0	0.1	217	0.0000%	0.0550%	0.00
28	0	0.4	521	0.0000%	0.0750%	0.00
29	1	1.0	898	0.1114%	0.1150%	0.97
30	0	2.3	1,295	0.0000%	0.1750%	0.00
31	7	4.8	1,740	0.4023%	0.2750%	1.46
32	11	8.0	2,143	0.5133%	0.3750%	1.37
33	17	12.1	2,538	0.6698%	0.4750%	1.41
34	21	16.3	2,836	0.7405%	0.5750%	1.29
35	33	20.7	2,957	1.1160%	0.7000%	1.59
36	38	24.6	2,896	1.3122%	0.8500%	1.54
37	37	28.1	2,810	1.3167%	1.0000%	1.32
38	27	30.7	2,668	1.0120%	1.1500%	0.88
39	41	31.7	2,436	1.6831%	1.3000%	1.29
40	43	32.4	2,157	1.9935%	1.5000%	1.33
41	39	30.5	1,848	2.1104%	1.6500%	1.28
42	42	27.0	1,499	2.8019%	1.8000%	1.56
43	16	22.2	1,141	1.4023%	1.9500%	0.72
44	19	18.1	861	2.2067%	2.1000%	1.05
45	12	13.8	599	2.0033%	2.3000%	0.87
46	9	10.5	398	2.2613%	2.6500%	0.85
47	6	7.6	253	2.3715%	3.0000%	0.79
48	1	4.9	145	0.6897%	3.3500%	0.21
49	4	1.8	50	8.0000%	3.7000%	2.16
Total	**424**	**349.6**	**34,946**	**1.2133%**	**1.0003%**	**1.21**



Specific observations:

- The rates of accidental disability during the period 2018 – 2019 are greater than corresponding rates of earlier years.
- Overall, the actual number of accidental disabilities is greater than expected (A/E ratio of 1.21). The largest difference is for members with at least 10 years of service.

Pre-retirement Death

Plan codes excluded in the analysis of other contingencies are part of the analysis of pre-retirement death.

Mortality assumptions involve two components: a base table and a mortality improvement scale. The mortality improvement scale adjusts the mortality rates of the base table to reflect that generally rates of mortality are anticipated to improve over time.

The Society of Actuaries (SOA) has published mortality improvement scales (MP scales) each year from 2014 to 2021. In the last several actuarial valuations, OA has used the mortality improvement scale that coincides with the valuation date. For example, OA used the MP-2020 scale in its June 30, 2020 lag actuarial valuation. In this analysis, we used the most recent improvement scale (MP-2021) published by the SOA as of the date of this analysis. Please note that the SOA did not publish a MP-2022 scale.

In this study the base table corresponds to the year 2012; expected mortality rates in future years are obtained from the base table and the MP-2021 scale. For example, the 2017 (July 1, 2016 – June 30, 2017) mortality rates are derived from the base table (2012) adjusted with four years of improvements. This method links mortality rates across the years and, consequently, allows mortality comparisons from one year to another.

The SOA MP-2021 improvement scale is based on data through 2019 (before the onset of Covid) from the Social Security Administration (SSA). Even though the aggregate (for all ages) long-term trend has been towards mortality improvements, this is not always the case for each age. Therefore, there are situations where the expected mortality rate in a later year is higher than the base rate.

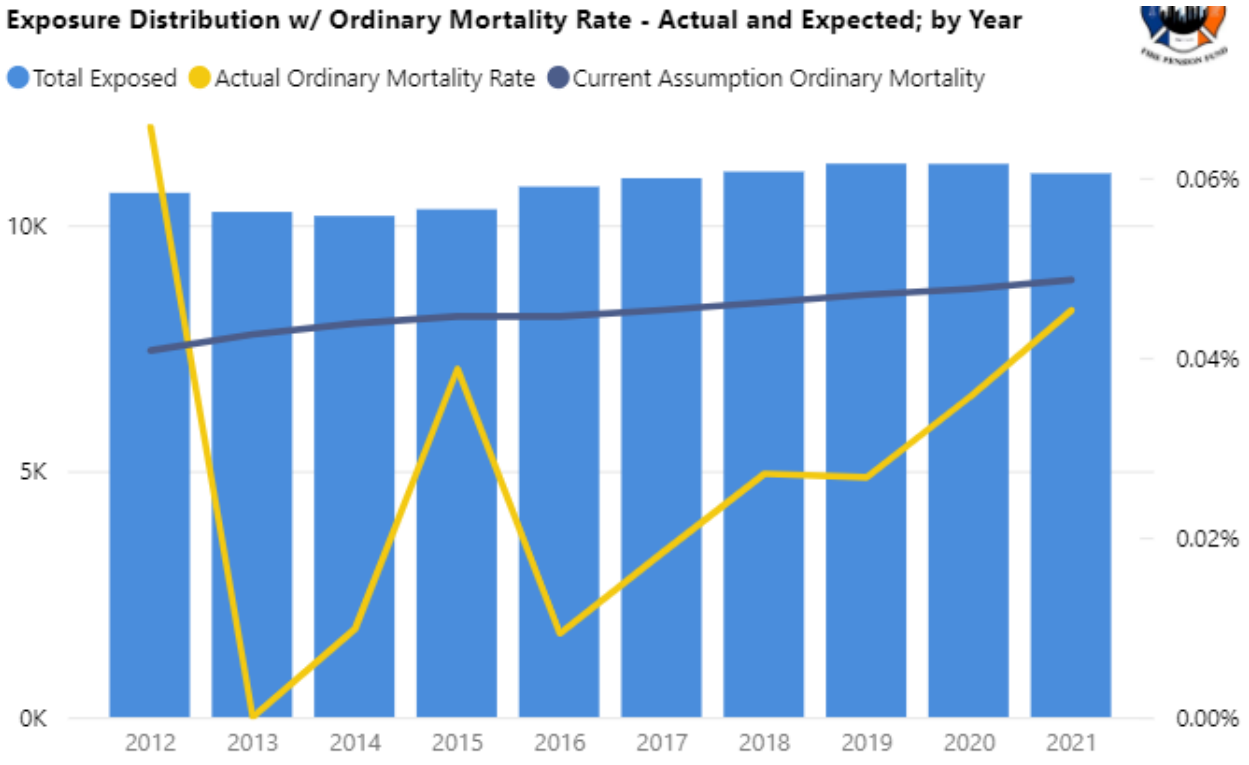
There is much discussion in the actuarial profession and among retirement systems about the development of mortality tables and the treatment of excess due to the Covid pandemic, which occurred in 2020 – 2022. The purpose of this analysis is to share our observations about the experience during the study period. In subsequent analyses, we will recommend changes to mortality assumptions as appropriate.

Please note that the charts by age are based on 5-year brackets. For example, the age bracket 45 should be interpreted as the interval 45 – 49.

Ordinary Death

The following tables show the ordinary death experience by year, for males and females combined, based on the age range (22 to 64) and service range (0 to 47), during the period 2012 – 2021.

Plan Year	Actual Ordinary Deaths	Expected Ordinary Deaths	Total Exposed	Actual Ordinary Mortality Rate	Current Assumption Ordinary Mortality	Ratio Act/Exp Ordinary Mortality
2012	7	4.3	10,652	0.0657%	0.0408%	1.61
2013	0	4.4	10,265	0.0000%	0.0426%	0.00
2014	1	4.5	10,183	0.0098%	0.0438%	0.22
2015	4	4.6	10,318	0.0388%	0.0446%	0.87
2016	1	4.8	10,778	0.0093%	0.0446%	0.21
2017	2	5.0	10,950	0.0183%	0.0453%	0.40
2018	3	5.1	11,083	0.0271%	0.0461%	0.59
2019	3	5.3	11,246	0.0267%	0.0470%	0.57
2020	4	5.4	11,241	0.0356%	0.0476%	0.75
2021	5	5.4	11,048	0.0453%	0.0486%	0.93
Total	**30**	**48.7**	**107,764**	**0.0278%**	**0.0452%**	**0.62**



Specific observations:

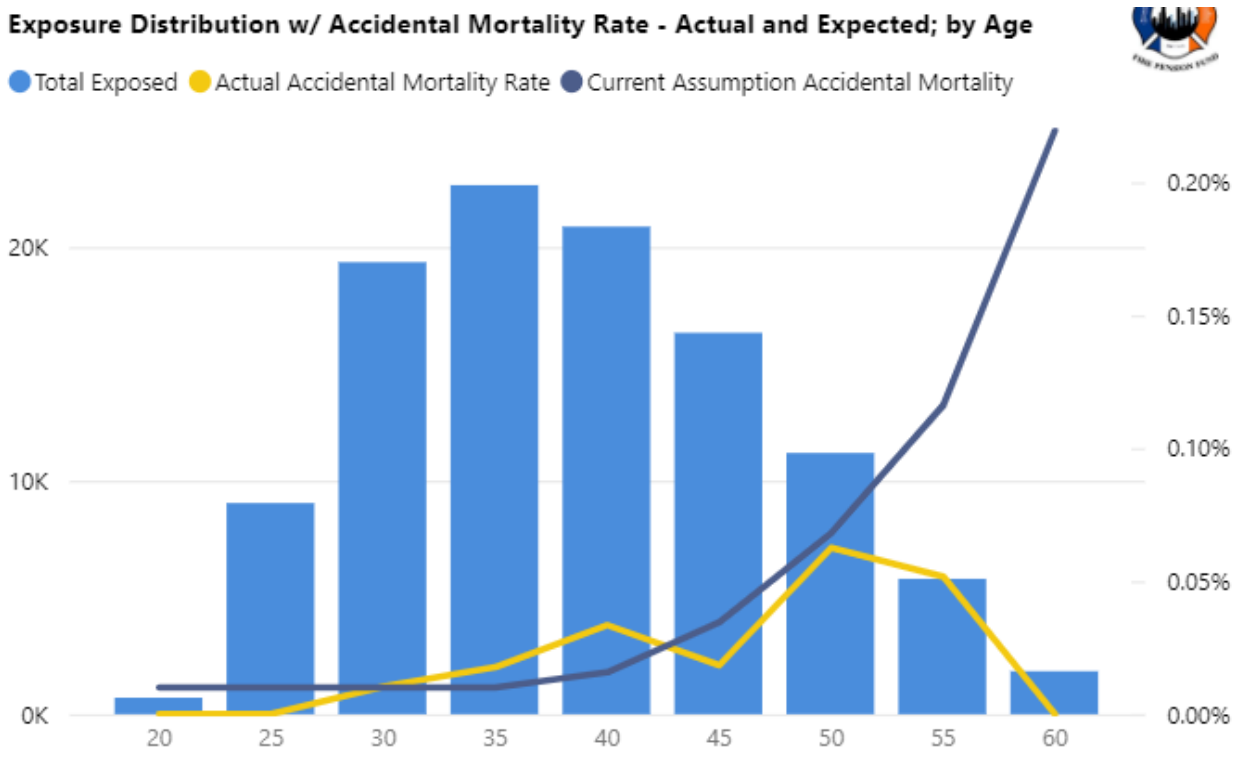
- Experience was very limited as there were only 30 ordinary deaths during the study period.
- Due to the limited experience, there is no discernible conclusion regarding experience during 2020 – 2021.
- Due to the small number of deaths during the study period, we did not include any gender specific analysis.
- We may wish to combine the experience of FIRE with POLICE when reviewing changes in assumptions.

Accidental Death

The accidental death rate assumptions are unisex, increase with age, and are not subject to mortality improvements.

The following tables show the accidental death experience by year and by age, for the age range (22 to 64) and service range (0 to 47), during the period 2012 – 2021.

Plan Year	Actual Accidental Deaths	Expected Accidental Deaths	Total Exposed	Actual Accidental Mortality Rate	Current Assumption Accidental Mortality	Ratio Act/Exp Accidental Mortality
2012	3	2.9	10,652	0.0282%	0.0268%	1.05
2013	4	2.9	10,265	0.0390%	0.0286%	1.36
2014	0	3.0	10,183	0.0000%	0.0299%	0.00
2015	3	3.1	10,318	0.0291%	0.0305%	0.95
2016	0	3.3	10,778	0.0000%	0.0302%	0.00
2017	3	3.3	10,950	0.0274%	0.0305%	0.90
2018	4	3.4	11,083	0.0361%	0.0308%	1.17
2019	3	3.5	11,246	0.0267%	0.0312%	0.85
2020	4	3.5	11,241	0.0356%	0.0312%	1.14
2021	2	3.5	11,048	0.0181%	0.0313%	0.58
Total	**26**	**32.5**	**107,764**	**0.0241%**	**0.0301%**	**0.80**



Specific observations:

- The number of expected annual deaths is between approximately 3 and 4 per year and at least 3 accidental deaths occurred 7 out of the 10 years.
- Although the number of accidental deaths was small, the experience shows that there may be some correlation with age although there is less experience than expected after age 55.

Postretirement Mortality

In addition to gender, the post-retirement mortality assumption varies by type of inactive member:

1) Service Retirees
2) Disabled Retirees
3) Contingent Beneficiaries

The MEST contains all retirees on one page and beneficiaries on another page. On the retiree page, the experience can be examined by status to review disabled retirees versus service retirees. Service retirees include members who have commenced their pension benefit from a terminated vested status. Vested members prior to commencement are included in the MEST but are essentially excluded in the analysis below.

Analogous to the pre-retirement death assumption, the mortality assumption involves two components: a base table and a mortality improvement scale. The mortality improvement scale adjusts the mortality rates of the base table to reflect that generally rates of mortality are anticipated to improve over time. The same mortality improvement scale applies to the post-retirement mortality base table that applies to the pre-retirement death base table. In this study the base table corresponds to the year 2012.

Many mortality studies have found that greater benefits are positively correlated with smaller mortality rates and longer life expectancy. Accordingly, the OA utilizes adjustment factors to convert post-retirement mortality weighted by headcounts to post-retirement mortality weighted by benefit amounts. The adjustment factors used by the OA are:

Post-Retirement Mortality Adjustment Factor To Convert from Headcount-Weighted to Amount-Weighted		
	Males	Females
Service Retiree	0.910	0.910
Disabled Retiree	0.830	0.830
Contingent Beneficiary	0.890	0.951

We examined the implications of using both types of weights in the post-retirement mortality analysis. Pure mortality is the same as post-retirement mortality weighted by headcounts; pure mortality multiplied by the adjustment factor is post-retirement mortality weighted by benefit amount. The benefit amount weighting approach was not applied to the experience prior to 2015 because the historical database did not contain benefit amounts prior to 2015.

There is much discussion in the actuarial profession and among retirement systems about the development of mortality tables and the treatment of excess deaths due to the Covid pandemic, which occurred in 2020 – 2022. The purpose of this analysis is to share our observations about the experience during the study period. In subsequent analyses, we will recommend changes to mortality assumptions as appropriate.

The charts by age are based on 5-year age brackets. For example, the age bracket 45 should be interpreted as the interval 45-49.

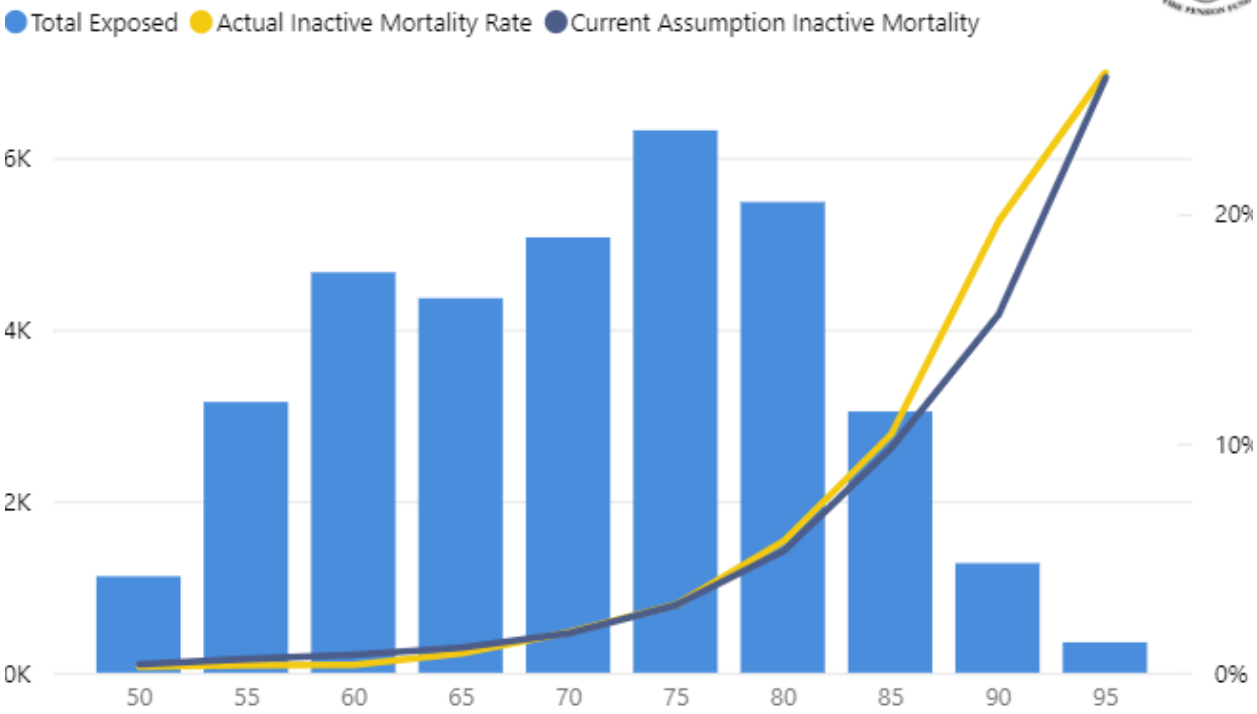
Postretirement Mortality – Service Retirees

The following charts show the postretirement mortality experience on a headcount-weighted basis by year and by age, for males and females combined, for the age range (50 to 99) during the period 2015 – 2021.

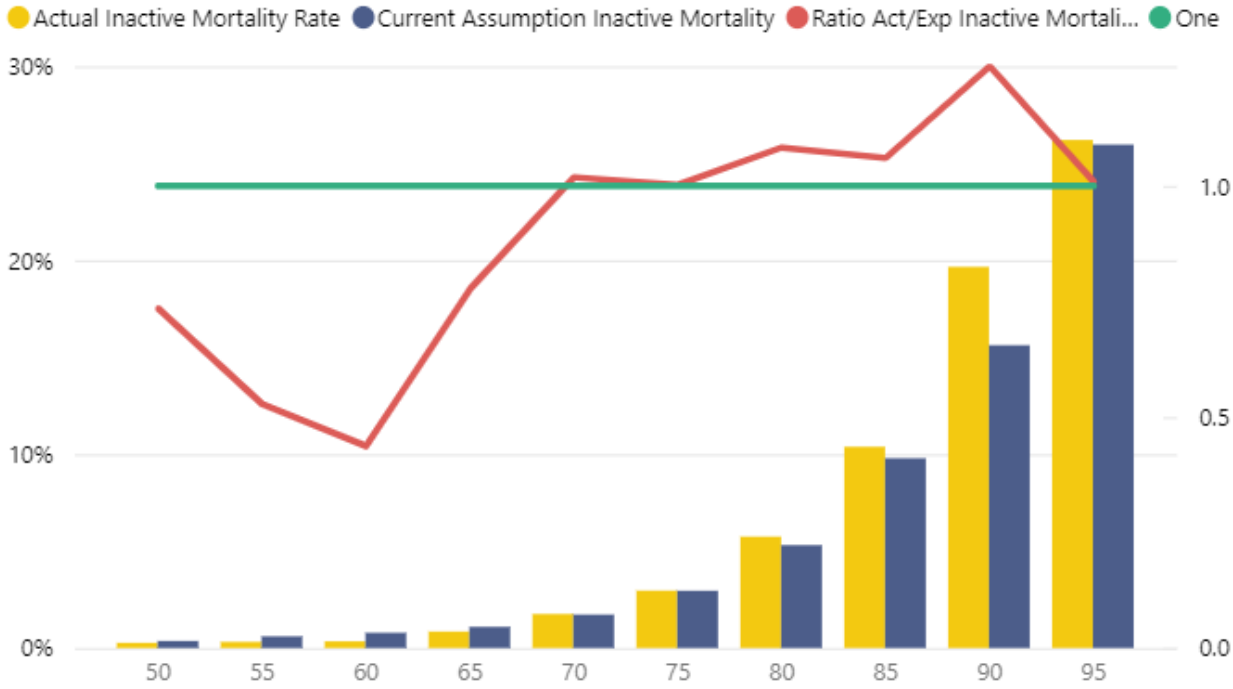
Plan Year	Actual Inactive Deaths	Expected Inactive Deaths	Total Exposed	Actual Inactive Mortality Rate	Current Assumption Inactive Mortality	Ratio Act/Exp Inactive Mortality
2015	181	177.9	5,270	3.43%	3.38%	1.02
2016	188	178.3	5,170	3.64%	3.45%	1.05
2017	183	178.7	5,061	3.62%	3.53%	1.02
2018	177	180.7	4,986	3.55%	3.62%	0.98
2019	186	183.7	4,895	3.80%	3.75%	1.01
2020	213	182.7	4,800	4.44%	3.81%	1.17
2021	189	179.6	4,684	4.04%	3.83%	1.05
Total	**1,317**	**1,261.6**	**34,866**	**3.78%**	**3.62%**	**1.04**

Age (bins)	Actual Inactive Deaths	Expected Inactive Deaths	Total Exposed	Actual Inactive Mortality Rate	Current Assumption Inactive Mortality	Ratio Act/Exp Inactive Mortality
50	3	4.1	1,124	0.27%	0.36%	0.73
55	10	19.0	3,155	0.32%	0.60%	0.53
60	16	36.6	4,666	0.34%	0.78%	0.44
65	37	47.6	4,365	0.85%	1.09%	0.78
70	89	87.4	5,073	1.75%	1.72%	1.02
75	187	186.6	6,321	2.96%	2.95%	1.00
80	315	290.9	5,485	5.74%	5.30%	1.08
85	316	297.9	3,045	10.38%	9.78%	1.06
90	251	199.4	1,277	19.66%	15.61%	1.26
95	93	92.2	355	26.20%	25.96%	1.01
Total	**1,317**	**1,261.6**	**34,866**	**3.78%**	**3.62%**	**1.04**

Exposure Distribution w/ Inactive Mortality Rate - Actual and Expected; by Age



Inactive Mortality Rate - Actual, Expected, and Ratio; by Age

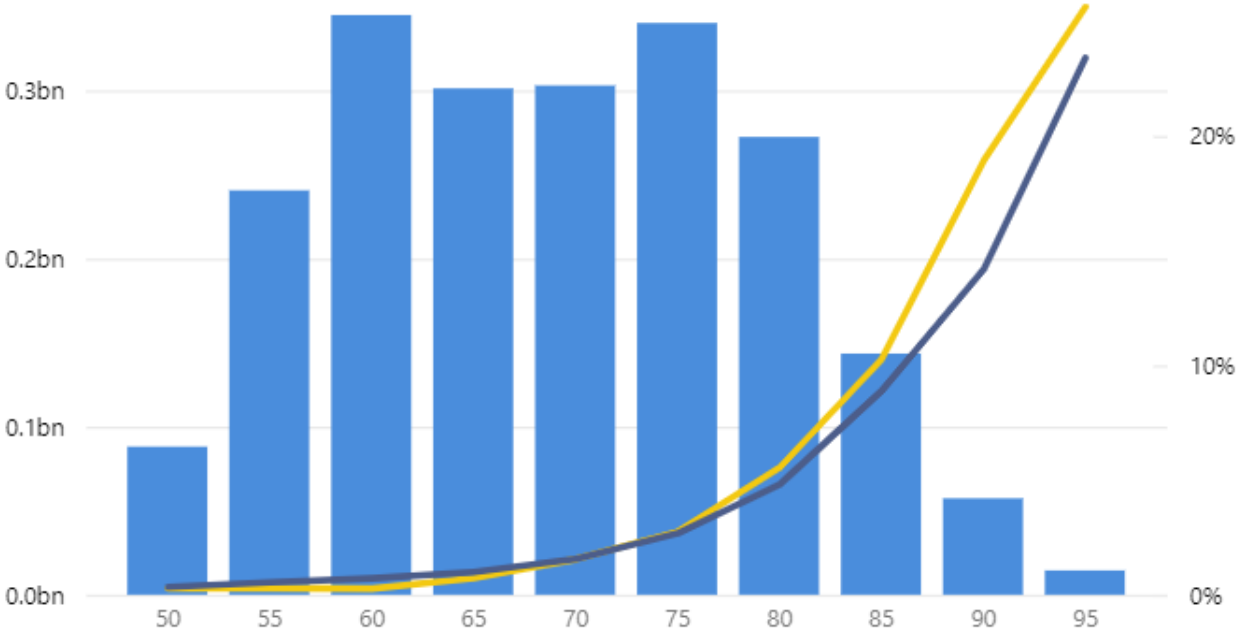


The following charts show the postretirement mortality experience on an amount-weighted basis by year and by age, for males and females combined, for the age range (50 to 99) during the period 2015 – 2021.

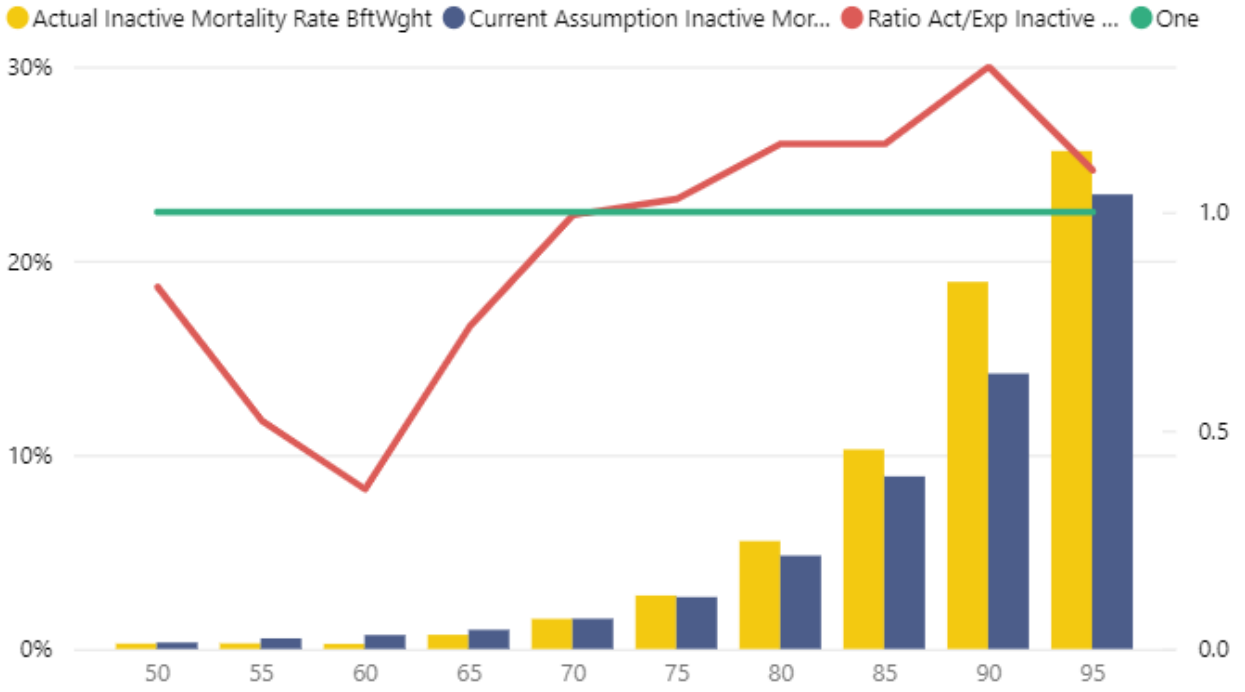
Plan Year	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
2015	7,930K	7,649K	290,812K	2.73%	2.63%	1.04
2016	8,814K	7,857K	291,737K	3.02%	2.69%	1.12
2017	8,436K	8,053K	292,054K	2.89%	2.76%	1.05
2018	8,432K	8,314K	297,031K	2.84%	2.80%	1.01
2019	8,808K	8,667K	307,449K	2.86%	2.82%	1.02
2020	10,762K	8,822K	312,053K	3.45%	2.83%	1.22
2021	9,333K	8,863K	314,438K	2.97%	2.82%	1.05
Total	**62,515K**	**58,226K**	**2,105,574K**	**2.97%**	**2.77%**	**1.07**

Age (bins)	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
50	242K	292K	88,109K	0.27%	0.33%	0.83
55	688K	1,314K	240,566K	0.29%	0.55%	0.52
60	901K	2,464K	344,869K	0.26%	0.71%	0.37
65	2,195K	2,977K	301,258K	0.73%	0.99%	0.74
70	4,693K	4,724K	302,970K	1.55%	1.56%	0.99
75	9,364K	9,091K	340,149K	2.75%	2.67%	1.03
80	15,134K	13,089K	272,354K	5.56%	4.81%	1.16
85	14,741K	12,751K	143,473K	10.27%	8.89%	1.16
90	10,846K	8,136K	57,358K	18.91%	14.18%	1.33
95	3,711K	3,387K	14,468K	25.65%	23.41%	1.10
Total	**62,515K**	**58,226K**	**2,105,574K**	**2.97%**	**2.77%**	**1.07**

Pension Benefit Distribution w/ Inactive Mortality Rate - Actual and Expected; by Age



Inactive Mortality Rate - Actual, Expected, and Ratio; by Age



Specific observations:

- Due to smaller volume of data, we would anticipate greater variation in the experience relative to the assumption.
- From 2015 - 2021, the actual number of deaths was greater than expected on both a headcount basis (A/E ratio of 1.04) and benefit basis (A/E ratio of 1.07).
- During 2020, actual experience is somewhat greater than from 2015 – 2019 (A/E ratio of 1.17 on headcount basis) whereas actual experience during 2021 was slightly greater than previous years 2015 – 2019 (A/E ratio of 1.05 on headcount basis).
- For ages 75 to 99, actual deaths exceeded expectations (A/E ratio of 1.16 on a benefits basis), which is similar to POLICE experience (A/E ratio of 1.17).
- For ages 50 to 74, actual deaths were smaller than expected (A/E ratio of 0.74 on a benefits basis), which is similar to POLICE experience (A/E ratio of 0.77).
- Since there was very low volume of data among females during the study period, our commentary below is focused on males only.
- For males, the rate of mortality on an amount-weighted basis was 78.6% of the rate of mortality on a headcount-weighted basis, versus the ratio on an expected basis of 76.5%. The assumed percentage is 91%. The actual weighting of benefits will result in a difference from the assumed percentage.
    - There is no credible experience to report for females.
- We may wish to combine the experience of FIRE with POLICE when proposing changes in assumptions.

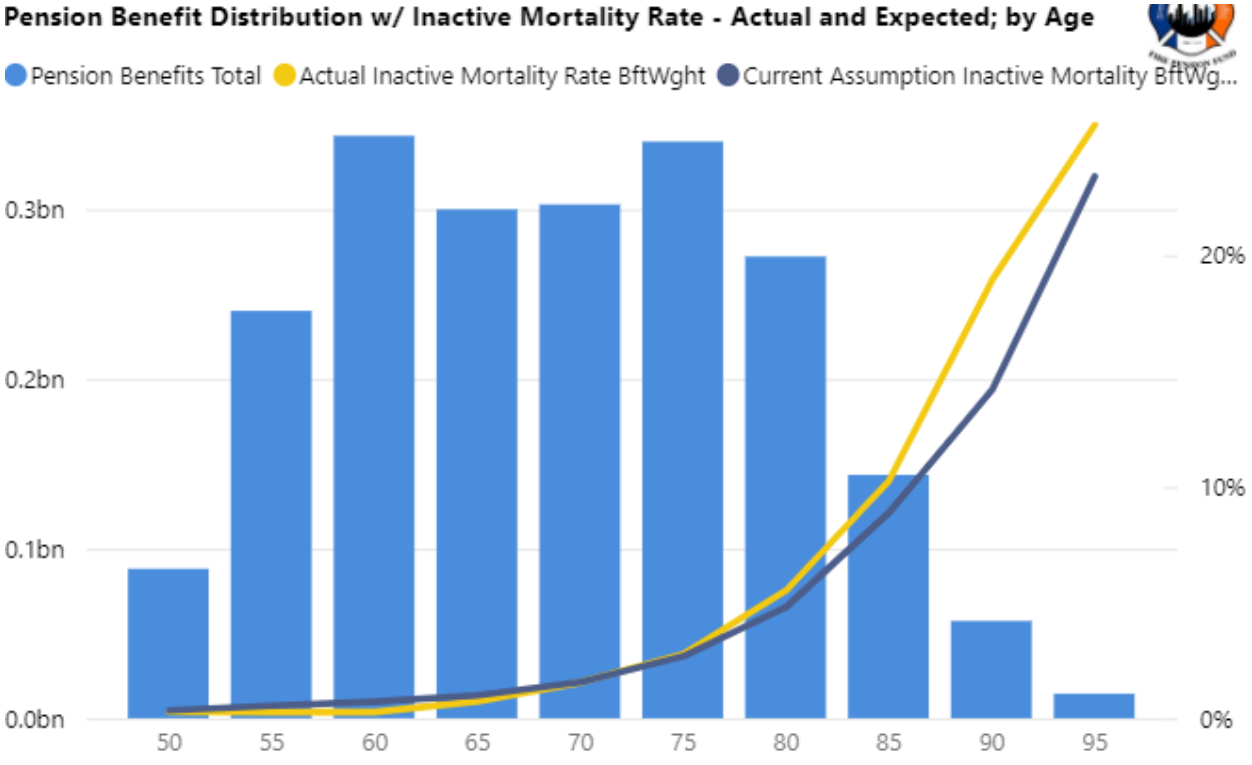
While the overall rates of mortality for 2020 and 2021 are somewhat higher than prior years, we have included these years for consistency with POLICE. Since amount-weighted mortality rates are not available prior to 2015, the following analysis contains the entire study period from 2015 – 2021.

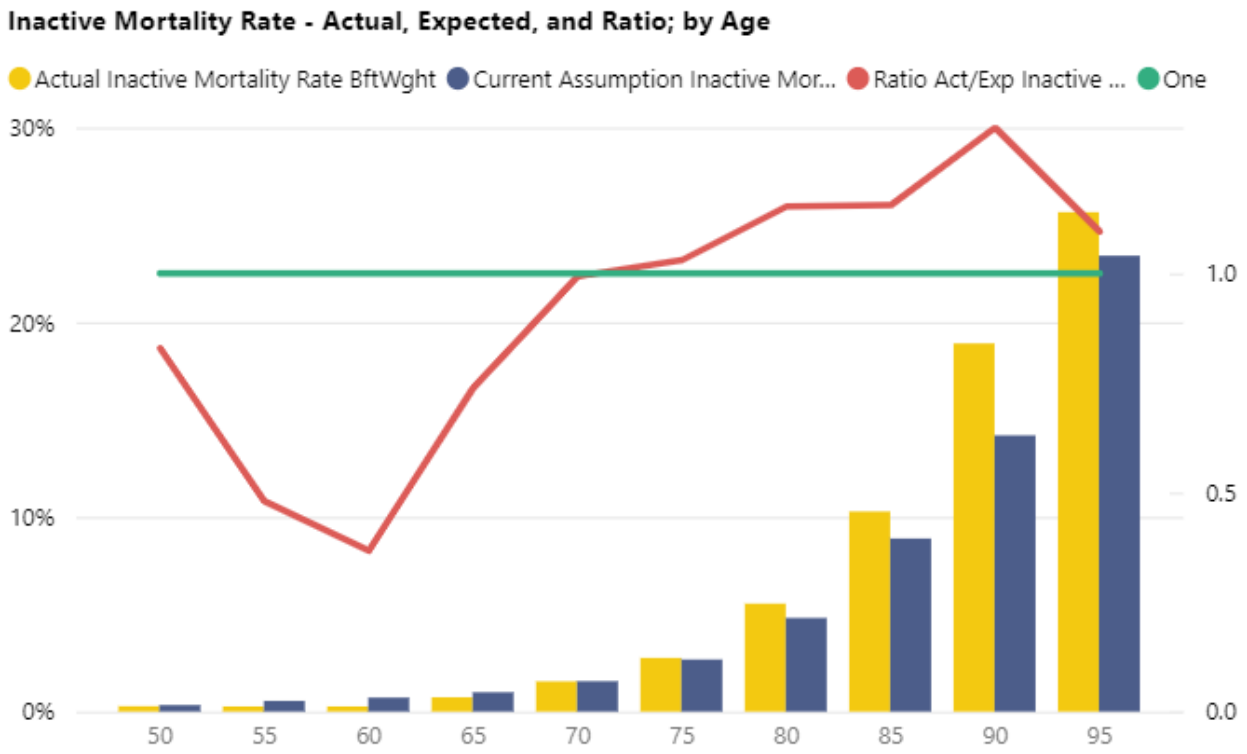
Service Retirees - Males

The following charts show the postretirement mortality experience on an amount-weighted basis by age, for males, for the age range (50 to 99) during the period 2015 – 2021.

Age (bins)	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
50	242K	292K	88,109K	0.27%	0.33%	0.83
55	630K	1,313K	240,131K	0.26%	0.55%	0.48
60	901K	2,458K	343,372K	0.26%	0.72%	0.37
65	2,195K	2,969K	299,984K	0.73%	0.99%	0.74
70	4,693K	4,723K	302,878K	1.55%	1.56%	0.99
75	9,364K	9,088K	339,963K	2.75%	2.67%	1.03
80	15,087K	13,086K	272,212K	5.54%	4.81%	1.15
85	14,741K	12,751K	143,473K	10.27%	8.89%	1.16
90	10,846K	8,136K	57,358K	18.91%	14.18%	1.33
95	3,711K	3,387K	14,468K	25.65%	23.41%	1.10
Total	**62,409K**	**58,202K**	**2,101,948K**	**2.97%**	**2.77%**	**1.07**

Pension Benefit Distribution w/ Inactive Mortality Rate - Actual and Expected; by Age





Specific observations:

- From 2015 - 2021, the actual number of male deaths was greater than expected on both a headcount basis (A/E ratio of 1.04) and benefit basis (A/E ratio of 1.07).
- For ages 75 to 99, actual deaths exceeded expectations (A/E ratio of 1.16 on a benefits basis).
- For ages 50 to 74, actual deaths were smaller than expected (A/E ratio of 0.74 on a benefits basis).

Postretirement Mortality – Disability Retirees

Since there was very low volume of data among females during the study period, our commentary below is focused on males only.

Disabled Retirees - Males

The following charts show the postretirement mortality experience on a headcount-weighted basis by year and by age, for males, for the age range (35 to 94) during the period 2015 – 2021.

Plan Year	Actual Inactive Deaths	Expected Inactive Deaths	Total Exposed	Actual Inactive Mortality Rate	Current Assumption Inactive Mortality	Ratio Act/Exp Inactive Mortality
2015	233	228.8	10,215	2.28%	2.24%	1.02
2016	247	232.4	10,293	2.40%	2.26%	1.06
2017	226	235.5	10,393	2.17%	2.27%	0.96
2018	225	239.8	10,499	2.14%	2.28%	0.94
2019	230	244.5	10,584	2.17%	2.31%	0.94
2020	261	248.5	10,714	2.44%	2.32%	1.05
2021	247	252.4	10,822	2.28%	2.33%	0.98
Total	**1,669**	**1,681.8**	**73,520**	**2.27%**	**2.29%**	**0.99**

Age (bins)	Actual Inactive Deaths	Expected Inactive Deaths	Total Exposed	Actual Inactive Mortality Rate	Current Assumption Inactive Mortality	Ratio Act/Exp Inactive Mortality
35	4	1.5	732	0.55%	0.21%	2.66
40	7	5.0	2,289	0.31%	0.22%	1.41
45	6	12.2	4,809	0.12%	0.25%	0.49
50	30	35.4	8,408	0.36%	0.42%	0.85
55	49	88.7	12,391	0.40%	0.72%	0.55
60	84	128.7	12,697	0.66%	1.01%	0.65
65	100	111.7	7,752	1.29%	1.44%	0.90
70	99	142.5	6,419	1.54%	2.22%	0.69
75	252	257.8	7,329	3.44%	3.52%	0.98
80	408	388.0	6,358	6.42%	6.10%	1.05
85	377	315.9	3,154	11.95%	10.02%	1.19
90	253	194.4	1,182	21.40%	16.45%	1.30
Total	**1,669**	**1,681.8**	**73,520**	**2.27%**	**2.29%**	**0.99**

The following charts show the postretirement mortality experience on an amount-weighted basis by year and by age, for males, for the age range (35 to 94) during the period 2015 – 2021.

Plan Year	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
2015	11,492K	10,734K	744,054K	1.54%	1.44%	1.07
2016	11,865K	11,241K	776,649K	1.53%	1.45%	1.06
2017	11,324K	11,823K	819,806K	1.38%	1.44%	0.96
2018	11,525K	12,444K	866,199K	1.33%	1.44%	0.93
2019	12,534K	13,092K	903,102K	1.39%	1.45%	0.96
2020	14,838K	13,740K	946,239K	1.57%	1.45%	1.08
2021	13,994K	14,386K	985,370K	1.42%	1.46%	0.97
Total	**87,571K**	**87,459K**	**6,041,418K**	**1.45%**	**1.45%**	**1.00**

Age (bins)	Actual Inactive Benefits Released	Expected Inactive Benefits Released	Pension Benefits Total	Actual Inactive Mortality Rate BftWght	Current Assumption Inactive Mortality BftWght	Ratio Act/Exp Inactive Mortality BftWght
35	273K	110K	64,335K	0.42%	0.17%	2.47
40	535K	377K	208,130K	0.26%	0.18%	1.42
45	583K	954K	451,079K	0.13%	0.21%	0.61
50	2,531K	2,859K	817,546K	0.31%	0.35%	0.89
55	3,624K	7,191K	1,212,283K	0.30%	0.59%	0.50
60	6,378K	10,042K	1,194,742K	0.53%	0.84%	0.64
65	6,147K	7,906K	664,759K	0.92%	1.19%	0.78
70	5,630K	8,280K	452,477K	1.24%	1.83%	0.68
75	13,069K	12,596K	434,617K	3.01%	2.90%	1.04
80	19,736K	16,661K	330,948K	5.96%	5.03%	1.18
85	17,424K	12,798K	154,137K	11.30%	8.30%	1.36
90	11,642K	7,686K	56,365K	20.66%	13.64%	1.51
Total	**87,571K**	**87,459K**	**6,041,418K**	**1.45%**	**1.45%**	**1.00**

Specific observations:

- From 2015 - 2021, the actual number of deaths was very similar to expectations on both a headcount basis (A/E ratio of 0.99 and a benefit basis (A/E ratio of 1.00).
- During 2020, the actual experience appears to be slightly higher than the experience from 2015 – 2019, although the volume of data is small.
- For ages 75 to 94, actual deaths exceeded expectations (A/E ratio of 1.24 on a benefits basis).
- For ages 35 to 74, actual deaths were smaller than expected (A/E ratio of 0.68 on a benefits basis).
- For males, the rate of mortality on an amount-weighted basis was 63.9% of the rate of mortality on a headcount-weighted basis, versus the ratio on an expected basis of 63.6%. The assumed percentage is 83%. The actual weighting of benefits will result in a difference from the assumed percentage.
    - There is no credible experience to report for females.

Postretirement Mortality – Contingent Beneficiaries

Since there was very low volume of data among male beneficiaries during the study period, our commentary below is focused on females only.

Contingent Beneficiaries - Females

The following charts show the postretirement mortality experience on an amount-weighted basis by age, for females, for the age range (45 to 99) during the period 2015 – 2021.

Plan Year	Actual Beneficiary Deaths	Expected Beneficiary Deaths	Total Exposed	Actual Beneficiary Mortality Rate	Current Assumption Beneficiary Mortality	Ratio Act/Exp Beneficiary Mortality
2015	49	56.0	947	5.17%	5.91%	0.87
2016	60	49.7	908	6.61%	5.48%	1.21
2017	43	42.9	845	5.09%	5.07%	1.00
2018	48	41.4	910	5.27%	4.54%	1.16
2019	35	36.0	867	4.04%	4.15%	0.97
2020	29	33.1	843	3.44%	3.92%	0.88
2021	25	31.3	824	3.03%	3.80%	0.80
Total	**289**	**290.3**	**6,144**	**4.70%**	**4.73%**	**1.00**

Age Bene (bins)	Actual Beneficiary Deaths	Expected Beneficiary Deaths	Total Exposed	Actual Beneficiary Mortality Rate	Current Assumption Beneficiary Mortality	Ratio Act/Exp Beneficiary Mortality
45	0	0.6	331	0.00%	0.18%	0.00
50	2	2.0	574	0.35%	0.34%	1.02
55	3	4.4	739	0.41%	0.60%	0.68
60	2	5.5	614	0.33%	0.90%	0.36
65	6	6.1	504	1.19%	1.21%	0.98
70	7	10.4	587	1.19%	1.76%	0.68
75	16	19.4	678	2.36%	2.87%	0.82
80	27	29.7	621	4.35%	4.79%	0.91
85	29	40.8	492	5.89%	8.29%	0.71
90	88	79.7	558	15.77%	14.29%	1.10
95	109	91.7	446	24.44%	20.57%	1.19
Total	**289**	**290.3**	**6,144**	**4.70%**	**4.73%**	**1.00**

The following charts show the postretirement mortality experience on an amount-weighted basis by year and by age, for females, for the age range (45 to 99) during the period 2015 – 2021.

Plan Year	Actual Beneficiary Benefits Released	Expected Beneficiary Benefits Released	Pension Benefits Total	Actual Beneficiary Mortality Rate BftWght	Current Assumption Beneficiary Mortality BftWght	Ratio Act/Exp Beneficiary Mortality BftWght
2015	548,285	715,559	24,688K	2.22%	2.90%	0.77
2016	842,536	668,014	24,306K	3.47%	2.75%	1.26
2017	643,282	609,298	23,703K	2.71%	2.57%	1.06
2018	666,846	671,836	26,966K	2.47%	2.49%	0.99
2019	534,525	741,726	29,398K	1.82%	2.52%	0.72
2020	590,251	751,424	29,631K	1.99%	2.54%	0.79
2021	773,715	859,356	31,517K	2.45%	2.73%	0.90
Total	**4,599,440**	**5,017,213**	**190,207K**	**2.42%**	**2.64%**	**0.92**

Age Bene (bins)	Actual Beneficiary Benefits Released	Expected Beneficiary Benefits Released	Pension Benefits Total	Actual Beneficiary Mortality Rate BftWght	Current Assumption Beneficiary Mortality BftWght	Ratio Act/Exp Beneficiary Mortality BftWght
45	0K	23K	13,099K	0.00%	0.17%	0.00
50	74K	75K	23,078K	0.32%	0.32%	0.99
55	120K	174K	30,694K	0.39%	0.57%	0.69
60	101K	214K	25,038K	0.40%	0.85%	0.47
65	243K	223K	19,386K	1.25%	1.15%	1.09
70	232K	341K	20,481K	1.13%	1.66%	0.68
75	414K	563K	20,913K	1.98%	2.69%	0.73
80	592K	692K	15,384K	3.85%	4.50%	0.85
85	525K	743K	9,598K	5.47%	7.74%	0.71
90	1,172K	1,061K	7,877K	14.88%	13.46%	1.11
95	1,127K	909K	4,658K	24.19%	19.51%	1.24
Total	**4,599K**	**5,017K**	**190,207K**	**2.42%**	**2.64%**	**0.92**

Specific observations:

- The mortality experience for female beneficiaries is not fully credible.
- From 2015 - 2021, the actual number of deaths was similar to expectations on a headcount basis (A/E ratio of 1.00), but smaller than expected on a benefit basis (A/E ratio of 0.92).