

Table of life for beneficiaries of the Institute of Security and Social Services of State Workers (ISSSTE), Mexico 2021

Tabla de vida para derechohabientes del Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado (ISSSTE), México 2021

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Abstract

Objective: Determine the life expectancy in the covered population of the Institute of Security and Social Services of State Workers in México for 2021. **Method:** We used the abrogated method from Reed-Merrel, for calculate the life expectancy in age groups. **Results:** By 2021, life expectancy general was 79.51 years; 81.40 years and 78.91 years for woman and men, respectively. **Conclusions:** The calculated life expectancy not show a reduction in the population of federal and State employees in Mexico.

Keywords: Life expectancy. ISSSTE. Mexico.

Resumen

Objetivo: Determinar la esperanza de vida en la población amparada del Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado en México para 2021. **Método:** Se utilizó el método abreviado de Reed-Merrel para calcular la esperanza de vida en grupos quinquenales de edad. **Resultados:** Para 2021, la esperanza de vida general fue de 79.51 años; de 81.40 años y 78.91 años para mujeres y para hombres, respectivamente. **Conclusiones:** La esperanza de vida calculada no presentó reducción después de la pandemia de COVID-19 para la población de empleados federales de México en 2021.

Palabras clave: Esperanza de vida. ISSSTE. México.

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Introduction

Historical context

Two historical milestones in biostatistics and epidemiology provide the foundation for life tables.

The first milestone is the pioneering work published in 1662 by Captain John Graunt, titled *Natural and Political Observations Mentioned in a Following Index, and Made Upon the Bills of Mortality*. This work laid the groundwork for calculating mortality rates as we know them today (deaths within a population over a period of time/population at the midpoint of that period) by a population constant (of 100, 1000, or 10,000 inhabitants) for that time and place. Graunt's work was based on weekly parish records of deaths and baptisms in London, a system established due to the bubonic plague epidemic in England.

Deaths were only estimated generically, indicating place and time, e.g., "Smallpox arrived in New Spain via the port of Veracruz in the spring or summer of 1779, spreading along the roads between the towns leading to Puebla and Mexico City, which was reached in autumn 1779. At least 45,000 cases were recorded in the last quarter of the year, with more than 14,000 fatalities. From Mexico City, it spread westward, reaching Toluca in December, Michoacán in early 1780, and New Galicia by February, affecting Guadalajara, where 1,268 inhabitants died between March and May¹."

The second milestone, mathematically driven by European mercantilist development, was achieved by Edmund Halley (with support from Gottfried Leibniz and endorsement by the Royal Society of England), who studied birth and death records from Breslau (a city in southwestern Poland) between 1687 and 1691. His findings were published in 1693 in one of Europe's earliest scientific journals, *Philosophical Transactions*, under the title *An Estimate of the Degrees of Mortality of Mankind, Drawn from Curious Tables of the Births and Funerals at the City of Breslaw; with an Attempt to Ascertain the Price of Annuities upon Lives*, aimed undoubtedly at insurance companies to help them calculate premium values and annuity payments based on age². The evolution of life table calculations has transitioned from the private domain (economic risk assessment) to the public sphere (health assessment) and from manual tabulation in so-called "statistical sheets" to computerized programs like Epidat, developed and freely distributed

by the Pan American Health Organization and the Health Council of the Regional Government of Galicia (Spain)³. Life tables are now a commonly used tool, and their application reveals that among the nations of the world, Japanese women currently have the highest life expectancy at birth, surpassing 87 years. However, it is worth noting that over 120 years ago, in 1840, the record was held by Swedish women, with an estimated life expectancy of 46 years⁴.

Applied context

Life tables have extended the narrow measure of early-life mortality to capture a population's life course, indicating the average death age within that population, thus making life expectancy a crucial indicator of population health. In the pre-modern world of 1800, life expectancy hovered around 30 years; today, no country has such a low life expectancy. Despite nearly tripling global life expectancy, inequality remains significant; for example, prior to the pandemic in 2019, the Central African Republic had a life expectancy of 53 years, while Japan's was 30 years higher⁵.

Technical background

A life table is a methodological statistical construct used to analyze survival probability within a specific population in a given time-space environment, considering interactions with epidemiological agents influencing health and disease processes at the group level. The life table also functions as a biostatistical measure of premature mortality within a population, representing the average age of death in the group, with survival results significantly affected by infant and preschool mortality rates.

There are 2 main types of life tables:

- Static period tables: Show current year-by-year or age-grouped probability of death.
- Cohort tables: Show death probability for individuals within a specific cohort (e.g., year of birth) over their lifetime.

By age grouping, life tables can take 2 forms:

- Year-by-year tables: From birth to the last known age.
- Abbreviated tables: Age values in the life table are presented in groups rather than individually, typically organized by functional life stages, such as under 1 year, ages 1–4, ages 5–9, and so forth in five-year increments up to 85+ years.

In this study, we use static life tables, applying Reed and Merrell's abbreviated method, as published in the *American Journal of Hygiene* (now the *American Journal of Epidemiology*) by the Department of Biometrics and Vital Statistics at Johns Hopkins University in 1939⁶.

The tables were applied to individuals covered by the Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado (ISSSTE), comprising employees and family members of federal departments forming the operational apparatus of the federal government⁷.

Objective

This report aims to estimate the life expectancy of the second-largest population of public servants in the country served by ISSSTE and their beneficiaries in 2021.

Method

The study population included those covered by ISSSTE as recorded in the *ISSSTE Yearbook* for 2021⁷ and deaths recorded for ISSSTE beneficiaries in 2021, included in the dynamic database of the Ministry of Health⁸.

Data were grouped into five-year age intervals, except for populations under 1 year (infants), 1-4 years (preschool), and 85+ years (elderly)⁹.

Life expectancy was calculated following Reed and Merrell's abbreviated method⁶ and recommendations by Camel for abbreviated life tables¹⁰.

Results

The construction of a life table is labor-intensive and requires adherence to a set of specifications listed after the tables (Table 1) for each column, labeled with a letter of the alphabet at the top of each column.

Accordingly, we estimated a life expectancy of 79.51 years for the population of both sexes covered by ISSSTE in the country for the year 2021 (Table 2); 81.40 years for women and 78.91 years for men (Tables 3 and 4).

Discussion

The results obtained in this study are valid for the life tables of the ISSSTE user population residing in Mexico in 2021. However, as with any population data

Table 1. Specifications for the Construction of Life Tables

(a) = Age groups
(b) = ISSSTE Population (2021 Yearbook)
(c) = Deaths registered (ISSSTE 2021 Yearbook)
(d) = cbbc
(e) = For age -1 year: $2d_2 + d_2 + d_{2d}$; For ages 1-4 years: $4x(2d_2 + d) 4x(2 + d_{2d})$; For ages 5-9 to 80-84 years: $5x(2d_2 + d) 5x(2 + d_{2d})$; For age 85 + years: 1.001.00
(f) = For age -1 year: 100,000100,000; For ages 1-4 years: $(e-1 \text{ year}) \times (f-1 \text{ year}) - (f-1 \text{ year})$; $(e-1 \text{ year}) \times (f-1 \text{ year}) - (f-1 \text{ year})$; For ages 5-14 years: $(e1-4 \text{ years}) \times (f1-4 \text{ years}) - (f1-4 \text{ years})$; $(e1-4 \text{ years}) \times (f1-4 \text{ years}) - (f1-4 \text{ years})$, and so on
(g) = For all age groups: $(e) \times (f)(e) \times (f)$
(h) = For age -1 year: $(0.25) \times (f-1 \text{ year}) + (0.75) \times (f1-4)(0.25) \times (f-1 \text{ year}) + (0.75) \times (f1-4)$; For ages 1-4 years: $(1.9) \times (f1-4 \text{ years}) + (2.1)(1.9) \times (f1-4 \text{ years}) + (2.1)$; For ages 5-9 years: $(5) \times (f5-9 \text{ years}) + f10-14 \text{ years} 2(5) \times (f5-9 \text{ years}) + 2f10-14 \text{ years}$; Continue similarly up to ages 80-84 years: $(5) \times (f80-84 \text{ years}) + (5) \times (f85 + \text{years}) 22(5) \times (f80-84 \text{ years}) + (5) \times (f85 + \text{years})$; For age 85 + years: $\log(85) \times (f85 + \text{years}) \log(85) \times (f85 + \text{years})$
(i) = For age 85 + years: $h85 + \text{yearsh}85 + \text{years}$; For age 80-84 years: $h80-84 \text{ years} + h75-79 \text{ yearsh}80-84 \text{ years} + h75-79 \text{ years}$; Continue in this pattern until age 1-4 years: $i5-9 \text{ years} + h1-4 \text{ yearsi}5-9 \text{ years} + h1-4 \text{ years}$; -For age -1 year: $i1-4 \text{ years} + h-1 \text{ yeari}1-4 \text{ years} + h-1 \text{ year}$
(j) = (i) of each age group/(f) of the same age group.

on birth and mortality, they may exhibit unquantified registration biases, limiting their generalization since the ISSSTE beneficiary status is sometimes not recorded for individuals born or deceased outside the institutional setting. This is not the case with hospital births and deaths, so we consider the table to be a reasonable approximation.

In our case, the total life expectancy calculated for both sexes was 79.51 years among ISSSTE users in Mexico in 2021, slightly lower than the life expectancy for ISSSTE in Jalisco in 2016, which was calculated at 80.81 years¹¹.

The life expectancy estimated for ISSSTE is higher compared to the national life expectancy, which in 2018 was recorded at 75.0 years (72.2 years for men and 77.9 years for women) and in 2022 was 75.32 years (72.62 years for men and 78.38 years for women), with a slight increase influenced by the impact of the COVID-19 pandemic in the previous years¹².

It is important to note that, in our setting, life expectancy has been increasing over time, a trend observed in several population groups, especially where there is social security coverage. For example, in the city of Guadalajara in 1974, the total life expectancy was 67.80 years¹³, and for the insured under the Mexican Social Security Institute (IMSS) in Jalisco in 1983, life expectancy for both sexes was 74.97 years (73.38 years

Table 2. ISSSTE Life Tables 2021, Population of Both Sexes

Age Groups (a)	Population (1) (b)	Deaths (2) (c)	Specific Rates (d)	Adjusted Probability (e)	Standard Population (f)	Theoretical Deaths (g)	Survival Years at Midpoint (h)	Remaining Life Years (i)	Life Expectancy (j)
< 1 year	67,440	304	0.0045077	0.00449756	100,000	450	99,662	7,951,991	79.51
1-4 years	327,779	67	0.0002044	0.0008175	99,550	81	398,029	7,852,329	78.87
5-9 years	754,782	64	0.0000847	0.00042348	99,469	42	497,240	7,454,300	74.94
10-14 years	913,205	74	0.0000810	0.00040498	99,427	40	497,035	6,957,060	69.97
15-19 years	931,580	177	0.0001899	0.0009494	99,387	94	496,700	6,460,025	64.99
20-24 years	613,784	184	0.0002997	0.00149827	99,293	149	496,092	5,963,325	60.05
25-29 years	565,326	273	0.0004829	0.00241391	99,144	239	495,122	5,467,233	55.14
30-34 years	663,840	594	0.0008947	0.004471499	98,905	442	493,420	4,972,111	50.27
35-39 years	822,005	925	0.0011252	0.00562283	98,463	553	490,932	4,478,691	45.48
40-44 years	843,293	1462	0.0017333	0.00865899	97,910	847	487,743	3,987,759	40.72
45-49 years	881,095	2413	0.0027386	0.01367427	97,063	1327	481,997	3,500,016	36.05
50-54 years	918,255	3476	0.0037854	0.01889124	95,736	1808	474,160	3,018,019	31.52
55-59 years	1,067,404	6332	0.0059321	0.02957278	93,928	2778	462,695	2,543,859	27.08
60-64 years	1,108,627	8383	0.0075616	0.03766559	91,150	3433	447,167	2,081,164	22.83
65-69 years	936,458	9610	0.0126207	0.06270779	87,717	5500	424,835	1,633,997	18.62
70-74 years	726,816	10,225	0.0140682	0.06984967	82,217	5743	396,727	1,209,162	14.70
75-79 years	546,759	10,043	0.0183682	0.09100519	76,474	6959	364,972	812,435	10.62
80-84 years	405,867	9127	0.0224876	0.11187826	69,515	7729	328,252	447,463	6.43
85 + years	586,759	14,668	0.0249983	1.00000	61,786	61,786	119,211	119,211	1.92
No age	0	2	NC	NC	NC	NC			
Total	13,681,077	78,403	0.00573076						

(1) ISSSTE: Statistical Yearbooks 2021, Chapter 1, Population Statistics 1.4.

(b) Secretaría de Salud. DGIS. Cubos Dinámicos.

NC: Not Calculable

for men and 76.40 years for women)¹⁴. By 2015, the IMSS-insured population in Jalisco, covering 81% of the state's workforce¹⁵, recorded a total life expectancy of 79.22 years¹⁶. This progression aligns with the general increase in modern human life expectancy, driven by a demographic transition from high birth and death rates to a regime of low birth and death rates, where social security contributes to extending lifespan by saving lives and preventing deaths at early ages, allowing human populations to live longer and reach older ages of death, as seen in developed societies⁴.

This increase in age at death is both a product and a driver of social determinants that compel us to maintain positive life expectancy trends in the population,

in this case, by expanding coverage and reducing barriers to social security for its clear impact on life duration⁴, as populations lacking social security tend to accentuate and expose fundamental types of human inequality¹⁷ (class, gender, ethnic, urban, etc.) throughout their life course, shortening or slowing down its length or varying the internal distribution of human life expectancy within the population structure—inequalities that have not been observed among non-human primates for millions of years⁴.

In the case of social security in Mexico (ISSSTE and IMSS), an operational trajectory of three-quarters of a century has been achieved, where advancing the survival frontier toward older ages and individual life expectancy shows fewer disparities, as reflected in our

Table 3. ISSSTE Life Tables 2021, National Female Population

Age Groups (a)	Population (1) (b)	Deaths (2) (c)	Specific Rates (d)	Adjusted Probability (e)	Standard Population (f)	Theoretical Deaths (g)	Survival Years at Midpoint (h)	Remaining Life Years (i)	Life Expectancy (j)
< 1 year	33,234	135	0.0040621	0.00405386	100,000	405	99,696	8,140,043	81.40
1-4 years	159,863	33	0.0002064	0.00082551	99,595	82	398,207	8,040,347	80.73
5-9 years	369,495	29	0.0000784	0.00039198	99,513	39	497,467	7,642,140	76.79
10-14 years	447,219	30	0.0000670	0.00033498	99,474	33	497,287	7,144,673	71.82
15-19 years	456,472	62	0.0001358	0.00067895	99,441	67	497,037	6,647,386	66.84
20-24 years	310,169	58	0.0001869	0.00093441	99,374	92	496,640	6,150,349	61.89
25-29 years	332,693	97	0.0002915	0.00145728	99,282	144	496,050	5,653,709	56.94
30-34 years	399,509	194	0.0004855	0.00242691	99,138	240	497,590	5,157,590	52.02
35-39 years	473,837	315	0.0006647	0.00332239	98,898	328	493,670	4,660,069	47.11
40-44 years	468,520	542	0.0011568	0.00578065	98,570	569	491,427	4,166,399	42.26
45-49 years	495,645	939	0.0018945	0.00946000	98,001	927	487,687	3,674,972	37.49
50-54 years	536,675	1418	0.0026421	0.01319307	97,074	1280	482,170	3,187,285	32.83
55-59 years	633,379	2707	0.0042739	0.02132393	95,794	2042	473,865	2,705,115	28.23
60-64 years	640,165	3545	0.0055376	0.02761154	93,752	2588	462,290	2,231,250	23.79
65-69 years	527,823	4191	0.0079401	0.03954351	91,164	3604	445,818	1,768,960	19.40
70-74 years	406,988	4455	0.0109462	0.05443308	87,560	4766	425,885	1,323,142	15.11
75-79 years	312,018	4580	0.0146786	0.07285827	82,794	6032	398,890	897,257	10.83
80-84 years	234,796	4680	0.0199321	0.0986770	76,762	7574	364,875	498,367	6.49
85 + years	333,157	8426	0.0252913	1.00000	69,188	69,188	133,492	133,492	1.92
No age	NA	2	NC						
Total	7,571,657	36,438	0.0048124						

(1) ISSSTE: Statistical Yearbooks 2021, Chapter 1, Population Statistics 1.4.

(b) Secretaría de Salud. DGIS. Cubos Dinámicos.

NA: Not Applicable; NC: Not Calculable

data, presenting an optimistic scenario. If the current pace of life expectancy progress continues, a good number of children born in this millennium could celebrate their 100th birthday.

However, the uncertainty linked to the persistence of inequality and inequity in our environment tempers this optimism, as in reality, life expectancy may increase only slightly, despite significant advancements in understanding how long humans have lived and how long they might live over the last three decades. Thus, achieving a more egalitarian population-level life expectancy depends on social, economic, health, cultural, and political actions to improve quality of life in longevity, requiring the development of more robust sociodemographic methods for forecasting and evaluating population vitality¹⁸.

Concerning methodology, Dowd and Hamoud¹⁹ suggest that certain precautions can prevent biases in calculating life expectancy:

- Whenever possible, identify trends by tracking the same population.
- When comparing different populations, stratify the characteristics that have remained stable for at least one human generation, which do not significantly impact early life. This allows life expectancy measures to be calculated over time for subgroups, although this does not ensure valid interpretation of observed differences.
- Stratify populations with explicit reference to their social history, using a clear and articulated theoretical-conceptual framework in both social and biological sciences.

Table 4. ISSSTE Life Tables 2021, National Male Population

Age Groups (a)	Population (1) (b)	Deaths (2) (c)	Specific Rates (d)	Adjusted Probability (e)	Standard Population (f)	Theoretical Deaths (g)	Survival Years at Midpoint (h)	Remaining Life Years (i)	Life Expectancy (j)
< 1 year	34,206	169	0.0049406	0.004928425	100,000	494	99,629	7,891,349	78.91
1-4 years	167,916	34	0.0002024	0.000809518	99,506	20	397,982	7,791,720	78.30
5-9 years	385,287	35	0.0000908	0.000453979	99,486	45	497,317	7,393,738	74.31
10-14 years	465,986	44	0.0000944	0.000471978	99,441	46	497,090	6,896,421	69.35
15-19 years	475,108	115	0.0002420	0.001209854	99,395	120	496,675	6,399,331	64.38
20-24 years	303,618	126	0.0004149	0.00207407	99,275	205	495,862	5,902,656	59.45
25-29 years	232,633	176	0.0007565	0.00378107	99,070	374	494,415	5,406,794	54.57
30-34 years	264,331	400	0.0015132	0.00756028	98,696	746	491,615	4,912,379	49.77
35-39 years	348,168	610	0.0017520	0.00875233	97,950	857	487,607	4,420,764	45.13
40-44 years	374,773	920	0.0024548	0.01225895	97,093	1190	482,490	3,933,157	40.50
45-49 years	385,450	1474	0.0038241	0.01908401	95,903	1830	474,940	3,450,667	35.98
50-54 years	381,580	2058	0.0053933	0.02689397	94,073	2529	464,042	2,975,727	31.63
55-59 years	434,025	3625	0.0083520	0.04158633	91,544	3806	448,292	2,511,685	27.43
60-64 years	468,462	4838	0.0103274	0.05137173	87,773	4507	427,597	2,063,393	23.50
65-69 years	408,635	5419	0.0132612	0.06586936	83,266	5484	401,620	1,635,796	19.54
70-74 years	319,828	5770	0.0180408	0.08939759	77,382	6917	369,617	1,234,176	15.94
75-79 years	234,741	5463	0.0232724	0.11502356	70,465	8105	334,562	864,559	12.26
80-84 years	171,071	4447	0.0259950	0.12830732	63,360	8129	368,132	529,997	8.36
85 + years	253,602	6242	0.0246133	1.00000	83,893	83,893	161,865	161,865	1.92
Total	6,109,420	41,965	0.0068689						

(1) ISSSTE: Statistical Yearbooks 2021, Chapter 1, Population Statistics 1.4.

NA: Not Applicable; NC: Not Calculable

If a result is measured in non-comparable populations, the mere fact that measurements are calculated in two “circumstances” does not make the discrepancy a “trend,” and the irresponsible use of terms such as “decline” or “decrease” may do more harm than good for the public¹⁹.

In the qualitative dimension, varied results in life expectancy continue to be found. For example, we observed a gender difference, with a higher expectancy for women. This trend has been corroborated nationwide since the records of 1930, which showed a life expectancy for women of 34.7 years and 33.0 years for men; or the spatial variability seen in 2019, when life expectancy was highest in Mexico City (formerly the Federal District) at 76.5 years and in Baja California at 75.9 years, while the lowest was recorded in Guerrero at 73.2 years and in Oaxaca at 74.0 years¹².

Other non-national examples show that life expectancy varies across populations, such as in the United States, where American Indian and Alaska Native populations have the lowest life expectancy of all populations in the nation and have seen reductions in their life expectancy indicators across most counties, with a gap exceeding 21 years²⁰. In Spain, the total life expectancy increased by 1.17 years from 2010 to 2018, but this increase was not proportionate between men and women; it rose by 1.41 years for men and only by 0.82 years for women, reducing the relative difference in life expectancy between women and men by 0.5 years, although women continued to have a longer life expectancy by an absolute margin of 5.39 years in 2018²¹.

The complexity of life expectancy is apparent in the overall mortality rate (per 1000 inhabitants), which may show considerable variation due to greater population

aging, higher lethality from specific diseases, or declines in infant mortality rates (now leveling between boys and girls), and the social determinants that create significant contrasts between geographic areas, ethnic groups, and socioeconomic levels²², where poverty and poorer health indicators, linked to sub-standard housing, issues in accessing a healthy diet, unemployment, underemployment, poor working conditions with increased health risks, higher consumption of toxic substances (alcohol, tobacco, drugs), lower education levels, less healthy habits, and limited access to many health benefits, play a key role.

Regarding changes in life expectancy in ISSSTE based on 2016 data¹¹ and this presentation (2021), whose slight magnitude may be attributed to the COVID-19 epidemic, its sustainability can also be credited to the protection provided by social security. Although we believe that future increases will likely be smaller vs those seen for Guadalajara and IMSS in Jalisco in past decades^{13,14}, paradoxically, these will result from the increased social security coverage and the balancing of mortality causes among the analyzed groups²³, as well as the impact of new epidemic events due to increasing globalization affecting our country. This should not discount the existence or persistence of “intrapopulation archipelagos or pockets” that could affect the heterogeneous population of social security users, in this case, federal employees covered by ISSSTE.

Thus, the rise in institutional population longevity should prompt us to consider:

- Whether our healthy, disability-free life expectancy will truly increase as much as total life expectancy²⁴.
- Whether these demographic changes are fundamentally quantitative, without changes in the social context of human longevity, i.e., without a true flourishing of humanity²⁵.

Conclusions

While a country's life expectancy increases with national income, it has also become evident that community-based policies and strategies are essential. These include equality and equity in access to goods and services, education (especially for women), gender empowerment, genuine community development associations, and population-wide political participation-not a model of mass consumption economy, limited social security, market-based health care, limited health promotion and protection, or inequalities related to gender, ethnicity, and age²⁶.

Unfortunately, there are few national studies that evaluate inequalities in life expectancy or analyze these according to social, economic, and cultural dimensions, which would aid in developing tools focused on service unity, prevention, and a multidisciplinary approach to health-disease understood as a process, helping to reduce differentials.

It is thus noteworthy that having social security coverage promotes greater life expectancy (79.51 years among ISSSTE users in Mexico for 2021), making it urgent to advance in social security²⁷, taking advantage of theoretical advances and evidence collected on the influence of social structure on the health of social groups. The study of life expectancy is still an emerging field, not yet clearly defined, and should not be conflated with the traditional risk factor approach²⁸.

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Conflicts of interest

None declared.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no patient data appear in this article. Furthermore, they have acknowledged and followed the recommendations as per the SAGER guidelines depending on the type and nature of the study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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