

TABLE OF CONTENTS

LIST OF TABLES 18-i

18. LIFETIME.....18-1

18.1. INTRODUCTION18-1

18.2. RECOMMENDATIONS18-1

18.3. KEY LIFETIME STUDY18-3

18.3.1. Xu et al. (2010)—Deaths: Final Data for 200718-3

18.4. RELEVANT LIFETIME STUDY.....18-3

18.4.1. U.S. Census Bureau (2008)—U.S. Population Projections: Projected Life Expectancy at Birth by Sex, Race, and Hispanic Origin for the United States: 2010 to 2050.....18-3

18.5. REFERENCES FOR CHAPTER 18.....18-3

LIST OF TABLES

Table 18-1. Recommended Values for Expectation of Life at Birth: 2007..... 18-1

Table 18-2. Confidence in Lifetime Expectancy Recommendations 18-2

Table 18-3. Expectation of Life at Birth, 1970 to 2007 (years)..... 18-4

Table 18-4. Expectation of Life by Race, Sex, and Age: 2007..... 18-5

Table 18-5. Projected Life Expectancy at Birth by Sex, Race, and Hispanic Origin for the United States: 2010 to 2050..... 18-6

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Chapter 18—Lifetime

18. LIFETIME

18.1. INTRODUCTION

The length of an individual’s life is an important factor to consider when evaluating cancer risk because the dose estimate is averaged over an individual’s lifetime. The recommendations for life expectancy are provided in the next section, along with a summary of the confidence rating for this recommendation. Because the averaging time is found in the denominator of the dose equation, a shorter lifetime would result in a higher potential risk estimate, and, conversely, a longer life expectancy would produce a lower potential risk estimate.

The recommended values are based on one key study identified by the U.S. Environmental Protection Agency (EPA) for this factor. Following the recommendations, the key study is summarized.

18.2. RECOMMENDATIONS

Current data suggest that 78 years would be an appropriate value to reflect the average life expectancy of the general population and is the

recommended value. If sex is a factor considered in the assessment, note that the average life expectancy value for females is higher than that for males. It is recommended that the assessor use the appropriate value of 75 years for males and 80 years for females, based on life expectancy data from 2007 (Xu et al., 2010). If race is a consideration in assessing exposure for individuals, note that the life expectancy is longer for Whites than for Blacks. Therefore, assessors are encouraged to use values that most reflect the exposed population. Table 18-1 and Table 18-2 present the recommendations and confidence ratings for life expectancy, respectively.

This recommended value is different than the 70 years commonly assumed for the general population in U.S. EPA risk assessments. The Integrated Risk Information System does not use a 70-year lifetime assumption in the derivation of reference concentration and reference dose, cancer slope factors, or unit risks. Therefore, using a value different than 70 years will not result in an inconsistency with the toxicity data.

Table 18-1. Recommended Values for Expectation of Life at Birth: 2007		
Population	Life Expectancy (years)	Source
Total	78	Xu et al. (2010)
Males	75	
Females	80	

Table 18-2. Confidence in Lifetime Expectancy Recommendations		
Considerations	Rationale	Rating
Soundness		High
<i>Adequacy of Approach</i>	Recommendations are based on data from death certificates filed in the 50 states in the United States and District of Columbia.	
<i>Minimal (or defined) Bias</i>	There are no apparent biases.	
Applicability and Utility		High
<i>Exposure Factor of Interest</i>	Death certificate data were used to calculate life expectancy for various population groups born between 1940 and 2007.	
<i>Representativeness</i>	The data are representative of the U.S. population.	
<i>Currency</i>	The study was published in 2010 based on data collected in 2007.	
<i>Data Collection Period</i>	Data were collected in 2007.	
Clarity and Completeness		High
<i>Accessibility</i>	The key study is widely available to the public.	
<i>Reproducibility</i>	Results can be reproduced by analyzing death certificate data.	
<i>Quality Assurance</i>	Information on ensuring data quality are available publicly.	
Variability and Uncertainty		Medium
<i>Variability in Population</i>	Data were averaged by sex and race—but only for Blacks and Whites; no other nationalities were represented within the study.	
<i>Uncertainty</i>	Data were based on death certificates filed in the 50 states in the United States and District of Columbia.	
Evaluation and Review		High
<i>Peer Review</i>	Data are published and have been peer reviewed.	
<i>Number and Agreement of Studies</i>	Recommendations for expectation of life at birth were based on only one study.	
Overall Rating		High

18.3. KEY LIFETIME STUDY

18.3.1. Xu et al. (2010)—Deaths: Final Data for 2007

Xu et al. (2010) used information compiled from death certificates filed in the 50 states of the United States and District of Columbia and calculated life expectancy for various population groups born between 1940 and 2007. “Life expectancy at birth represents the average number of years that a group of infants would live if the group was to experience throughout life the age-specific death rates present in the year of birth” (Xu et al., 2010).

Table 18-3 shows life expectancy data by sex, age, and race (i.e., Whites and Blacks). Although data for other ethnic groups were collected, they were not considered as reliable because of inconsistencies between the race reported in the death certificates and in the censuses and surveys. Data for 2007 show that the life expectancy for an average person born in the United States is 77.9 years (Xu et al., 2010). The average life expectancy for males in 2007 was 75.4 years and 80.4 years for females. Whereas the gap between males and females was about 7 years in 1970, it has now narrowed to about 5 years. Table 18-3 also indicates that life expectancy for White males and females is consistently longer than for Black males and females. Table 18-4 presents data for the expectation of life for persons at a specific age in year 2007 (Xu et al., 2010). The advantages of this study are that it is representative of the United States and provides life expectancy data based on death certificates and calculations of death rates. A disadvantage is that the data were averaged by sex and race—but only for Blacks and Whites.

18.4. RELEVANT LIFETIME STUDY

18.4.1. U.S. Census Bureau (2008)—U.S. Population Projections: Projected Life Expectancy at Birth by Sex, Race, and Hispanic Origin for the United States: 2010 to 2050

Statistical data on life expectancy are published annually by the U.S. Department of Commerce in the publication, *Statistical Abstract of the United States*. Data are collected for the 50 states and the District of Columbia. The *Statistical Abstract of the United States* has been published by the U.S. Census Bureau since 1878 (U.S. Census Bureau, 2010). The U.S. Census Bureau (2008) computed life expectancy projections for 2010 through 2050, by decade. This analysis uses historical mortality trend data collected by the National Center for Health Statistics and applies forecast models to estimate projected life

expectancy at birth. These data are provided, by sex and race in Table 18-5.

The advantage of this survey is that it is representative of the United States, and it provides projections by sex and race. A disadvantage is that life expectancy estimates are based on future projections.

18.5. REFERENCES FOR CHAPTER 18

- U.S. Census Bureau. (2008). U.S. population projections: Table 10. Projected life expectancy at birth by sex, race, and Hispanic origin for the United States: 2010 to 2050. (NP2008-T10). Washington, DC. <http://www.census.gov/population/www/projections/summarytables.html>.
- U.S. Census Bureau. (2010). The 2010 statistical abstract. <http://www.census.gov/compendia/statab/2010>.
- Xu, JQ; Kochanek, KD; Murphy, SL; Tejada-Vera, B. (2010). Deaths: Final Data for 2007. Hyattsville, MD: National Center for Health Statistics. http://www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_19.pdf.

Table 18-3. Expectation of Life at Birth, 1970 to 2007 (years)^a

Year ^b	Total			White			Black		
	Total	Males	Females	Total	Males	Females	Total	Males	Females
1970	70.8	67.1	74.7	71.7	68.0	75.6	64.1	60.0	68.3
1975	72.6	68.8	76.6	73.4	69.5	77.3	66.8	62.4	71.3
1980	73.7	70.0	77.4	74.4	70.7	78.1	68.1	63.8	72.5
1982	74.5	70.8	78.1	75.1	71.5	78.7	69.4	65.1	73.6
1983	74.6	71.0	78.1	75.2	71.6	78.7	69.4	65.2	73.5
1984	74.7	71.1	78.2	75.3	71.8	78.7	69.5	65.3	73.6
1985	74.7	71.1	78.2	75.3	71.8	78.7	69.3	65.0	73.4
1986	74.7	71.2	78.2	75.4	71.9	78.8	69.1	64.8	73.4
1987	74.9	71.4	78.3	75.6	72.1	78.9	69.1	64.7	73.4
1988	74.9	71.4	78.3	75.6	72.2	78.9	68.9	64.4	73.2
1989	75.1	71.7	78.5	75.9	72.5	79.2	68.8	64.3	73.3
1990	75.4	71.8	78.8	76.1	72.7	79.4	69.1	64.5	73.6
1991	75.5	72.0	78.9	76.3	72.9	79.6	69.3	64.6	73.8
1992	75.8	72.3	79.1	76.5	73.2	79.8	69.6	65.0	73.9
1993	75.5	72.2	78.8	76.3	73.1	79.5	69.2	64.6	73.7
1994	75.7	72.4	79.0	76.5	73.3	79.6	69.5	64.9	73.9
1995	75.8	72.5	78.9	76.5	73.4	79.6	69.6	65.2	73.9
1996	76.1	73.1	79.1	76.8	73.9	79.7	70.2	66.1	74.2
1997	76.5	73.6	79.4	77.2	74.3	79.9	71.1	67.2	74.7
1998	76.7	73.8	79.5	77.3	74.5	80.0	71.3	67.6	74.8
1999	76.7	73.9	79.4	77.3	74.6	79.9	71.4	67.8	74.7
2000	76.8	74.1	79.3	77.3	74.7	79.9	71.8	68.2	75.1
2001	76.9	74.2	79.4	77.4	74.8	79.9	72.0	68.4	75.2
2002	76.9	74.3	79.5	77.4	74.9	79.9	72.1	68.6	75.4
2003	77.1	74.5	79.6	77.6	75.0	80.0	72.3	68.8	75.6
2004	77.5	74.9	79.9	77.9	75.4	80.4	72.8	69.3	76.0
2005	77.4	74.9	79.9	77.9	75.4	80.4	72.8	69.3	76.1
2006	77.7	75.1	80.2	78.2	75.7	80.6	73.2	69.7	76.5
2007	77.9	75.4	80.4	78.4	75.9	80.8	73.6	70.0	76.8

^a Based on middle mortality assumptions; for details, source: U.S. Census Bureau (2008).
^b Life expectancies for 2000–2007 were calculated using a revised methodology and may differ from those previously published; see Xu et al. (2010).

Source: Xu et al. (2010).

Table 18-4. Expectation of Life by Race, Sex, and Age: 2007

Exact Age in Years	All Races ^a			White			Black		
	Both Sexes	Males	Females	Both Sexes	Males	Females	Both Sexes	Males	Females
0	77.9	75.4	80.4	78.4	75.9	80.8	73.6	70.0	76.8
1	77.5	74.9	79.9	77.8	75.4	80.2	73.6	70.1	76.8
5	73.6	71.0	76.0	73.9	71.4	76.3	69.7	66.2	72.9
10	68.6	66.1	71.0	68.9	66.5	71.3	64.7	61.3	67.9
15	63.7	61.1	66.1	64.0	61.6	66.3	59.8	56.3	63.0
20	58.8	56.4	61.2	59.2	56.8	61.5	55.1	51.7	58.1
25	54.1	51.8	56.3	54.4	52.2	56.6	50.4	47.2	53.3
30	49.4	47.1	51.5	49.7	47.5	51.7	45.8	42.7	48.5
35	44.6	42.5	46.7	44.9	42.8	46.9	41.2	38.2	43.8
40	39.9	37.8	41.9	40.2	38.1	42.1	36.7	33.8	39.1
45	35.4	33.3	37.2	35.6	33.6	37.4	32.3	29.5	34.7
50	30.9	29.0	32.7	31.1	29.2	32.8	28.1	25.4	30.4
55	26.7	24.9	28.2	26.8	25.1	28.4	24.2	21.7	26.3
60	22.5	20.9	23.9	22.6	21.0	24.0	20.6	18.3	22.4
65	18.6	17.2	19.9	18.7	17.3	19.9	17.2	15.2	18.7
70	15.0	13.7	16.0	15.0	13.8	16.0	14.1	12.4	15.2
75	11.7	10.6	12.5	11.7	10.6	12.4	11.2	9.9	12.1
80	8.8	7.9	9.4	8.8	7.9	9.3	8.7	7.7	9.4
85	6.5	5.8	6.8	6.4	5.7	6.8	6.7	6.0	7.1
90	4.6	4.1	4.8	4.6	4.1	4.8	5.1	4.6	5.3
95	3.2	2.9	3.3	3.2	2.9	3.3	3.8	3.5	3.9
100	2.3	2.1	2.3	2.2	2.0	2.2	2.8	2.6	2.8

^a Includes races other than White and Black.

Source: Xu et al. (2010).

Table 18-5. Projected Life Expectancy at Birth by Sex, Race, and Hispanic Origin for the United States: 2010 to 2050					
Sex, Race, and Hispanic Origin	2010	2020	2030	2040	2050
Males and Females Combined					
Total Population	78.3	79.5	80.7	81.9	83.1
White	78.9	80.0	81.1	82.2	83.3
Black	73.8	76.1	78.1	80.0	81.8
American Indian and Alaskan					
Native	79.1	80.2	81.3	82.3	83.4
Asian	78.8	80.0	81.1	82.2	83.3
Native Hawaii or Pacific Islander	79.2	80.2	81.2	82.4	83.4
Two or more races	79.4	80.5	81.5	82.4	83.4
Non-Hispanic White alone	78.7	79.8	80.9	82.0	83.1
Hispanic ^a	81.1	81.8	82.6	83.3	84.1
Males					
Total Population	75.7	77.1	78.4	79.6	80.9
White	76.5	77.7	78.9	80.0	81.2
Black	70.2	72.6	74.9	77.1	79.1
American Indian and Alaskan					
Native	76.6	77.8	79.0	80.1	81.2
Asian	76.3	77.5	78.7	79.8	81.0
Native Hawaii or Pacific Islander	76.8	77.8	79.0	80.1	81.2
Two or more races	77.0	78.1	79.1	80.2	81.2
Non-Hispanic White alone	76.3	77.5	78.7	79.8	81.0
Hispanic ^a	78.4	79.3	80.2	81.0	81.8
Females					
Total Population	80.8	81.9	83.1	84.2	85.3
White	81.3	82.4	83.4	84.5	85.5
Black	77.2	79.2	81.0	82.7	84.3
American Indian and Alaskan					
Native	81.5	82.5	83.6	84.5	85.5
Asian	81.1	82.2	83.2	84.2	85.3
Native Hawaii or Pacific Islander	81.6	82.6	83.5	84.5	85.5
Two or more races	81.7	82.7	83.6	84.6	85.5
Non-Hispanic White alone	81.1	82.1	83.2	84.2	85.2
Hispanic ^a	83.7	84.4	85.0	85.6	86.3
^a Hispanics may be of any race.					
Source: U.S. Census Bureau (2008).					