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GCDC
المركز الخليجي للوقاية من الأمراض ومكافحتها
Gulf Center for Disease Prevention and Control

Comprehensive Analysis of **HALE** in the

United Arab Emirates

Gulf Center for Disease Prevention and Control

وزارة الصحة ووقاية المجتمع
MINISTRY OF HEALTH & PREVENTION

المركز الاتحادي للتنافسية والإحصاء
FEDERAL COMPETITIVENESS AND STATISTICS CENTRE

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Gulf Health Council

Disclaimer

This report on Healthy Adjusted Life Expectancy (HALE) estimates for the UAE is based on the most current and reliable data available at the time of publication. The data, including population and mortality statistics, has been sourced from the World Population Prospects (WPP), with adjustments made in collaboration with UAE authorities.

Every effort has been made to ensure accuracy, the findings and estimates are subject to inherent limitations due to potential variations in local data quality and health reporting. HALE estimates have been derived using the Sullivan Method, incorporating health surveys and mortality data. These estimates are intended as approximations and should not be considered definitive. This report is designed for use by public health professionals, researchers, and policymakers; however, it does not constitute medical, legal, or policy advice.

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The data used is anonymized, aggregated, and complies with applicable privacy laws and regulations.

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Contents

I. Acknowledgment:

This report on Healthy Adjusted Life Expectancy (HALE) estimates for the UAE is based on the most up-to-date and reliable data available at the time of publication. Population and mortality statistics have been sourced from the World Population Prospects (WPP) and other reputable providers, with adjustments made in collaboration with local authorities to enhance accuracy and relevance.

We extend our appreciation to Gulf Center for Disease Prevention and Control (Gulf CDC), The Statistical Centre for the Cooperation Council for the Arab Countries of the Gulf (GCC-Stat), the Federal Competitiveness and Statistics Center (FCSC), and the UAE Ministry of Health & Prevention (MOHAP) for their valuable contributions in providing data, technical expertise, and guidance.

HALE estimates have been derived using the Sullivan Method, integrating health surveys and mortality data to offer meaningful insights. Despite rigorous efforts to ensure accuracy, findings may be subject to limitations due to variations in health reporting, data quality, and methodological constraints.

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II. Introduction:

Healthy-Adjusted Life Expectancy (HALE) is a measure that assesses a population's health status by combining mortality and morbidity data. It goes beyond traditional life expectancy by considering the prevalence and severity of health conditions. The calculation involves calculating life expectancy, incorporating health states, and assigning weights to each state based on severity, reflecting the proportion of healthy life lost due to specific conditions. HALE is the number of years that a person at a given age can expect to live in good health, considering both mortality and non-fatal conditions (i.e. disability). The assumption for calculation of HALE is that the person who is at age of x, will be exposed to the same rates of mortality and morbidity during all ages of x or after x that are happening to the people in those ages in the reference year. There is a similar assumption for calculating Life Expectancy (LE), however we only assume rates of mortality during the age of x or after that are like the reference year.

LE is the number of years that a person at a given age can expect to live; for each exact age of x, we can report LE_x or LE at the age of x; LE at birth and LE_{60} are more commonly used in public health. A few international organizations and studies provide estimates for LE and HALE across all countries. However, these estimates are often based on input data that may not be fully accepted by local officials and experts.

III. Objectives:

This study was conducted as a pilot to estimate HALE through collaborative efforts between GCC member states and Gulf CDC. Following the evaluation of this collaboration, the plan is to replicate the study with other member states, contingent on the readiness of their data. Support will be provided through targeted capacity-building initiatives and by offering extensive resources detailed in the HALE booklet developed by the Gulf CDC and GCC-Stat (1). The HALE estimate for the UAE in this study is based on official local data or other input data approved by national authorities. The study also aimed to assess the accessibility and quality of input data to support continuous quality improvement programs for mortality and other health data.

IV. Methods:

III.1. HALE estimation strategy: We used the methodology suggested by the Joint Action on Healthy Life Years (JA: EHLEIS) for estimating HALE (2). In this approach, the general subjective health status (or disability status) of the population is used to adjust life expectancy (LE) through the analytical methods explained by Sullivan, who developed a life table incorporating observed prevalence rates to calculate the first disability-free life expectancy. Known as the Sullivan method (1971), it remains the most widely utilized approach for

generating time series data and conducting international comparisons on health-related metrics (3). To determine the health status based on health surveys, a representative sample of the population are asked to self-rate their health (1,2). The input data necessary for this approach include population, deaths, and health status, all categorized (at least) by age group and sex. We then used the template provided by the "Ageing, Disability and Social Care team" of the UK Office for National Statistics to process input data (4).

III.2. Data sources:

To calculate Healthy Adjusted Life Expectancy (HALE), various data sources are utilized to ensure accuracy and comprehensiveness. These include:

III.2.1. Population data: We used the 2024 version 1-year age group population estimates for male, female and both sexes of the World Population Prospect (WPP); they are de facto population including both nationals and non-nationals and are available for 1950 to 2023(5,6). As a universal approach for all the countries, the WPP estimates have been based on the available local data including:

- Fertility rates by the age of mother, single ages from 10 to 54
- Sex ratio at birth (males/females)
- Mortality rates by sex and single age from 0 to 130+
- Net international migration by sex and single age from 0 to 130+: Since data on net international migration, or its components (immigration and emigration), was unavailable for many countries, the WPP team estimated them as the residual not accounted for by

natural increase between successive censuses. In other words, the difference between the population growth recorded in successive censuses (total increase) and the growth implied by estimated fertility and mortality levels (natural increase) was attributed to net international migration. A model pattern—such as family model, male labor, female labor, or population distribution—was then applied to this subset of the population. Net migration for GCC member states has a "male labor" pattern.

Censuses, registers or other high quality official statistics have been used as benchmarks to check the validity of estimates. For GCC countries, the WPP method has been transitioned from "model based" to "empirical" life tables to take advantage of the high-quality death registration and population estimates of the recent years. Also, the project team has used probabilistic projection of net international migration with their uncertainty intervals (5,6). For the UAE, the WPP estimates resulted from close collaboration between the WPP team at the United Nations and the UAE statistical and research center. This collaboration incorporated local data on population and deaths, applying both universal and customized approaches to adjust the raw data. Those estimates are acceptable to UAE officials and local experts. **Table 1** shows the WPP estimates for the population of UAE in 2023.

Table 1. World Population Prospect estimates of population and mortality for UAE, 2023 (WPP 2024)

Age group	Population Count, 2023			Death count, 2023		
	Both	Male	Female	Both	Male	Female
<1	107,537	54,927	52,610	509	290	219
1-4	465,637	236,940	228,698	127	67	60
5-9	613,449	310,032	303,418	34	20	16
10-14	552,181	279,672	272,509	31	14	18
15-19	505,938	270,318	235,620	70	59	13
20-24	926,826	558,255	368,571	183	166	16
25-29	1,436,652	999,339	437,314	325	272	53
30-34	1,608,556	1,131,404	477,152	526	433	93
35-39	1,419,434	956,938	462,496	651	539	112
40-44	1,040,954	707,035	333,919	651	525	127
45-49	714,417	504,086	210,332	699	579	117
50-54	506,461	346,213	160,248	675	547	128
55-59	371,691	236,445	135,246	665	494	170
60-64	191,900	120,832	71,068	704	502	203
65-69	81,607	46,830	34,777	653	387	268
70-74	55,258	30,664	24,594	802	459	341
75-79	23,936	12,494	11,443	697	400	296
80-84	13,327	6,902	6,426	906	519	387
85-89	4,915	2,384	2,531	674	371	303
90+	1,409	537	872	333	148	187
All ages	10,642,081	6,812,243	3,829,838	9,915	6,791	3,127

III.2.2. Mortality data: We used the 2024 version of WPP mortality estimates for 1-year age group population for male, female and both sexes. The WPP team has used empirical life tables (by dividing counts of sex and age specific deaths by population), and conducting the following adjustments (4,5):

a) Adjusting the under-five mortality rates for consistency with the estimates published by the United Nations Inter-Agency Group for Child Mortality Estimation (IGME) in 2023.

b) Adjusting mortality rates according to the estimated completeness of adult vital registration in each year.

c) Smoothing over time mortality rates from vital registration by computing a moving average with 3-, 5- or 7-year windows

d) Converting to single-year age intervals if the empirical data is abridged.

e) Interpolating across any gaps in the time series using the Limited Lee Carter method.

f) Extrapolating back to 1950 or forward to 2023, as needed, using the Lee Carter method adapted for non-sequential or sparse data.

g) Evaluating old age mortality and adjust as necessary to address any implausible levels or trends by age (expected to increase monotonically over age), over time (expected to decline over time in the absence of mortality crises), and between sexes (male mortality expected to exceed female mortality at older ages).

h) Smoothing the time series over age period or age period cohort or, alternatively, by using a moving average with 3-, 5- or 7-year windows, or the TOPALS model.

i) Extending to open ended age group 130+ using the DemoTools life table function[1].

j) Adding any crisis mortality impacts

[1] *Using the MortalityLaws R package.*

III.2.3. Health status data: We used the individual-level data of the UAE National Health Survey (2017-2018) to adjust LE according to the health status for estimating HALE(7). The Section 2000 (Health State Descriptions) of the questionnaire found in Appendix 1, was used for this purpose, and the health status was extracted by age and sex. The data were weighted to reflect sampling weights of age, sex and nationality. Data collection phase of the survey was conducted in 2018.

III.3. Health status definitions

First, four different definitions are used to determine the percentage of "good health" (or healthy state) based on the respondents' rating of their health state. Definition 2 was used for the main analysis and the other 3 definitions were used as alternative definitions for "sensitivity analysis".

III.3.1. Definition 1:

Disability=1 if the respondent answered "Severe" or "Extreme" to the a2002 question (Overall in the last 30 days, how much difficulty did you have with work or household activities?).

Healthy state: Anyone who has answered None, Mild or Moderate to the same question.

III.3.2. Definition 2 (Main definition):

Disability=1 if the respondent answered "Severe" or "Extreme" to at least one of the following questions: a2002, a2003, a2005, a2010, a2011, a2012, a2013, a2014, a2015, a2017, a2018, a2019 or a2020. [Please see the Appendix 1 to read the English translation of the questions].

Healthy state: Anyone who has answered the a2002 question and "has not" answered "Severe" or "Extreme" to any of the a2002, a2003, a2005, a2010, a2011, a2012, a2013, a2014, a2015, a2017, a2018, a2019 or a2020 questions.

III.3.3. Definition 3:

Disability=1 if the respondent answered "Moderate," "Severe," or "Extreme" to the a2002 question.

Healthy state: Anyone who has answered None or Mild to the same question.

III.3.4. Definition 4:

Disability=1 if the respondent answered "Moderate," "Severe," or "Extreme" to at least one of the following questions: a2002, a2003, a2005, a2010, a2011, a2012, a2013, a2014, a2015, a2017, a2018, a2019 or a2020.

Healthy state: Anyone who has answered the a2002 question and "has not" answered "Moderate," "Severe," or "Extreme" to any of the a2002, a2003, a2005, a2010, a2011, a2012, a2013, a2014, a2015, a2017, a2018, a2019 or a2020 questions.

III.4. Extrapolation of the survey results to the extreme age groups

The UAE National Health Survey was performed on individuals aged 18 years or older, so we did not have any estimate for individuals younger than 18. On the other hand, the number of elderly individuals in the sample was not sufficient to determine the percentage of "good health" among those groups. We assumed that the percentage in 15-17-year-old individuals is similar to that in 18-19-year-old individuals of the sample. We then used adjustment factors X1 to

X4 to extrapolate the results from the 18-19-year-old individuals to the younger age groups. Additionally, we used the percentage of "good health" for 80+-year-old individuals from the survey for the 80-84-year-old group and applied adjustment factors X5 and X6 to estimate the percentage for the 85-90 and 90+ age groups. **Table 2** Shows the adjustment factors derived from the UK template (3).

Table 2. Adjustment factors for extrapolating the survey results to the extreme age groups

Age group	Adjustment Factors	Good health
<1	X4=1.003907	H5=H4*X4
1-4	X3=1.002521	H4=H3*X3
5-9	X2=1.001834	H3=H2*X2
10-14	X1=1.005436	H2=H1*X1
15-19	Not applicable	H1 (18-19-year-old from the Survey)
20-79	Not applicable	Directly from the Survey
80-84	Not applicable	H6 (80+ year-old from the Survey)
85-89	X5=0.81303156	H7=H6*X5
90+	X6=0.86177057	H8=H7*X6

We compared the ratio of HALE-to-LE based on our calculation with the same ratio based on measures estimated by the global burden of disease (GBD 2021) for UAE. (6)

V. Results

Figure 1 below shows the population pyramid, and **Figure 2** demonstrates the age-sex pattern of death counts in UAE for 2023.

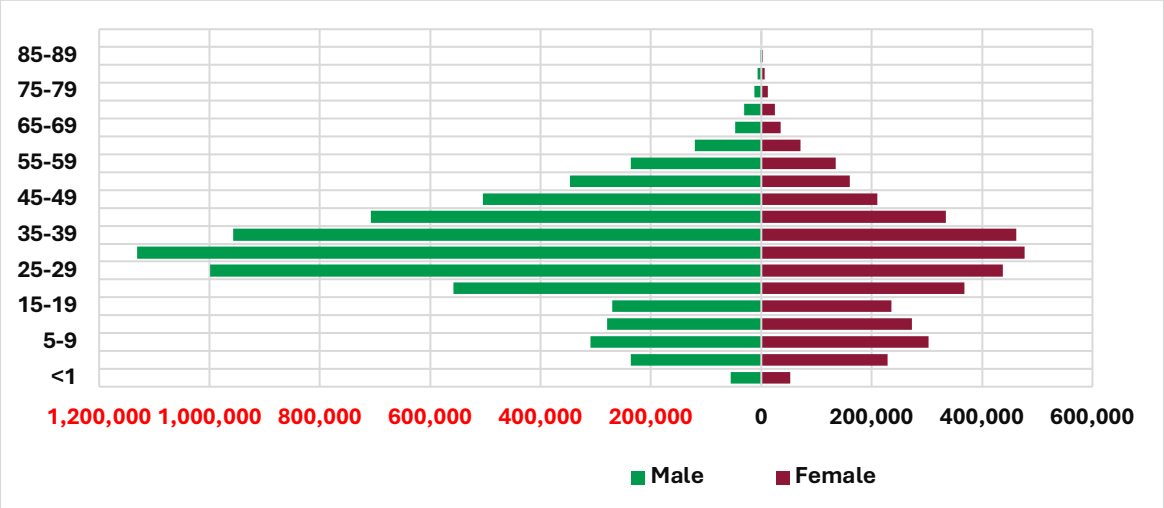

Figure 1. UAE Population by age groups and sex in 2023 (WPP 2024 estimates)

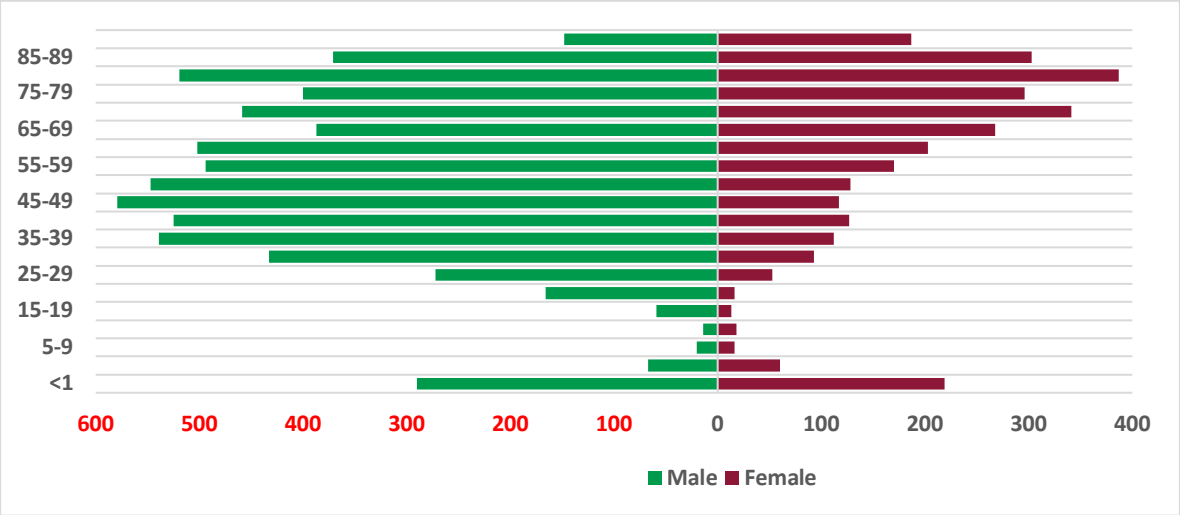

Figure 2. Number of deaths in UAE in 2023 by age and sex in UAE 2023 (WPP 2024)

Table 3 illustrates age-sex-specific mortality rates and life expectancies for 2023**.** LE at birth was 83.1, 82.2 and 84.3 years for both sexes, male and female, respectively.

Table 3. Age- and sex-specific mortality rates and life expectancies for UAE population based on WPP 2024 estimations of population and death counts (Reference year: 2023)

Age group	Mortality rate per 1000 individuals			Life expectancy*		
	Both	Male	Female	Both	Male	Female
<1	4.73	5.28	4.16	83.1	82.2	84.3
1-4	0.27	0.28	0.26	82.5	81.6	83.8
5-9	0.06	0.06	0.05	78.6	77.7	79.9
10-14	0.06	0.05	0.07	73.6	72.7	74.9
15-19	0.14	0.22	0.06	68.6	67.7	69.9
20-24	0.20	0.30	0.04	63.7	62.8	64.9
25-29	0.23	0.27	0.12	58.7	57.9	59.9
30-34	0.33	0.38	0.19	53.8	53.0	55.0
35-39	0.46	0.56	0.24	48.9	48.1	50.0
40-44	0.63	0.74	0.38	44.0	43.2	45.1
45-49	0.98	1.15	0.56	39.1	38.3	40.2
50-54	1.33	1.58	0.80	34.3	33.6	35.3
55-59	1.79	2.09	1.26	29.5	28.8	30.4
60-64	3.67	4.15	2.86	24.8	24.1	25.6
65-69	8.00	8.26	7.71	20.2	19.5	20.9
70-74	14.51	14.97	13.87	15.9	15.2	16.6
75-79	29.12	32.02	25.87	11.9	11.2	12.6
80-84	67.98	75.20	60.23	8.4	7.8	9.0
85-89	137.15	155.62	119.74	5.8	5.2	6.4
90+	236.42	275.61	214.57	4.2	3.6	4.7
All ages	0.93	1.00	0.82	NA	NA	NA

*Life expectancy at the exact starting age of the age group

We calculated the percentage of people in good health based on all 4 definitions by age-group and sex-of the survey respondents. **Tables 4**(a-d) summarize the findings based on 5-year age groups and sex, weighted and non-weighted by sampling weights. In total, 94.3% of male and 93.9% of female were in good health based on the main definition (definition 2). Percentages of good health were 99.2% and 98.8% based on alternative definition 1 (the most optimistic alternative), 93.1% and 90.8% based on alternative definition 3, and 80.1% and 77.9% based on alternative definition 4 (the most pessimistic alternative).

Table 4. Proportion of population in UAE reporting good health status by age and sex and various definitions – UAE National Health Survey (4a to 4d describe definitions 1 to 4, respectively)

4-a. Definition 1 (Alternative Definition)

Age group	Alternative: disability_ste (definition 1)						Alternative: disability_ste (definition 1)					
	Non-weighted						Weighted					
	Male		Female		Both sexes		Male		Female		Both sexes	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
18-19	70	100.0%	78	100.0%	148	100.0%	80	100.0%	79	100.0%	159	100.0%
20-24	240	98.8%	267	99.3%	507	99.0%	283	99.0%	296	99.0%	579	99.0%
25-29	409	99.3%	624	99.2%	1033	99.2%	551	99.3%	830	99.0%	1381	99.1%
30-34	650	99.1%	850	98.8%	1500	98.9%	663	99.1%	793	99.2%	1456	99.2%
35-39	663	99.5%	761	99.1%	1424	99.3%	683	99.6%	709	99.4%	1392	99.5%
40-44	537	99.3%	562	98.3%	1099	98.7%	553	99.8%	501	99.2%	1054	99.5%
45-49	448	99.3%	435	98.0%	883	98.7%	461	98.9%	362	98.9%	823	98.9%
50-54	312	99.7%	200	96.2%	512	98.3%	341	100.0%	170	98.8%	511	99.6%
55-59	219	98.2%	136	95.8%	355	97.3%	219	98.2%	97	97.0%	316	97.8%
60-64	137	96.5%	98	92.5%	235	94.8%	113	98.3%	66	94.3%	179	96.8%
65-69	80	95.2%	73	89.0%	153	92.2%	67	98.5%	46	92.0%	113	95.8%
70-74	55	98.2%	43	84.3%	98	91.6%	33	100.0%	24	92.3%	57	96.6%
75-79	34	91.9%	24	92.3%	58	92.1%	18	94.7%	9	90.0%	27	93.1%
80+	23	85.2%	11	68.8%	34	79.1%	11	78.6%	3	42.9%	14	66.7%
Total	3877	98.9%	4162	97.9%	8039	98.4%	4077	99.2%	3986	98.8%	8063	99.0%

4-b. Definition 2 (Main Definition)

Age group	Main: disability_ste2 (definition 2)						Main: disability_ste2 (definition 2)					
	Non-weighted						Weighted					
	Male		Female		Both sexes		Male		Female		Both sexes	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
18-19	64	91.4%	71	91.0%	135	91.2%	74	92.5%	74	93.7%	148	93.1%
20-24	220	90.5%	249	92.2%	469	91.4%	260	90.9%	281	94.0%	541	92.5%
25-29	394	95.6%	594	94.4%	988	94.9%	529	95.3%	792	94.5%	1321	94.8%
30-34	618	94.2%	812	94.3%	1430	94.3%	638	95.4%	767	95.9%	1405	95.6%
35-39	627	94.1%	716	93.1%	1343	93.6%	646	94.2%	670	93.8%	1316	94.0%
40-44	509	94.1%	532	93.0%	1041	93.5%	527	95.1%	481	95.2%	1008	95.2%
45-49	427	94.3%	411	92.6%	838	93.4%	444	94.9%	349	95.4%	793	95.1%
50-54	301	96.2%	185	88.5%	486	93.1%	330	96.8%	156	90.2%	486	94.6%
55-59	201	89.7%	125	88.0%	326	89.1%	209	93.3%	92	92.0%	301	92.9%
60-64	130	91.5%	79	74.5%	209	84.3%	111	96.5%	59	84.3%	170	91.9%
65-69	73	86.9%	62	75.6%	135	81.3%	61	89.7%	41	82.0%	102	86.4%
70-74	44	78.6%	33	64.7%	77	72.0%	28	84.8%	19	73.1%	47	79.7%
75-79	27	73.0%	17	65.4%	44	69.8%	17	89.5%	7	70.0%	24	82.8%
80+	12	42.9%	8	50.0%	20	45.5%	7	50.0%	3	42.9%	10	47.6%
Total	3647	92.9%	3894	91.5%	7541	92.2%	3880	94.3%	3791	93.9%	7671	94.1%

4-c. Definition 3 (Alternative definition, closest to the main definition)

Age group	Alternative: disability_mote (definition 3)						Alternative: disability_mote (definition 3)					
	Non-weighted						Weighted					
	Male		Female		Both sexes		Male		Female		Both sexes	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
18-19	63	90.0%	65	83.3%	128	86.5%	75	93.8%	70	88.6%	145	91.2%
20-24	222	91.4%	242	90.0%	464	90.6%	256	89.5%	269	90.0%	525	89.7%
25-29	377	91.5%	580	92.2%	957	91.9%	513	92.4%	785	93.7%	1298	93.2%
30-34	612	93.3%	787	91.5%	1399	92.3%	636	95.1%	741	92.7%	1377	93.8%
35-39	624	93.7%	680	88.5%	1304	90.9%	651	94.9%	650	91.2%	1301	93.0%
40-44	499	92.2%	502	87.8%	1001	89.9%	526	94.9%	458	90.7%	984	92.9%
45-49	421	93.3%	393	88.5%	814	90.9%	442	94.8%	335	91.5%	777	93.4%
50-54	283	90.4%	172	82.7%	455	87.3%	317	93.0%	153	89.0%	470	91.6%
55-59	189	84.8%	115	81.0%	304	83.3%	196	87.9%	85	85.0%	281	87.0%
60-64	126	88.7%	78	73.6%	204	82.3%	106	92.2%	56	80.0%	162	87.6%
65-69	67	79.8%	57	69.5%	124	74.7%	55	80.9%	36	72.0%	91	77.1%
70-74	43	76.8%	27	52.9%	70	65.4%	26	78.8%	15	57.7%	41	69.5%
75-79	26	70.3%	19	73.1%	45	71.4%	16	84.2%	8	80.0%	24	82.8%
80+	16	59.3%	8	50.0%	24	55.8%	10	71.4%	3	42.9%	13	61.9%
Total	3568	91.0%	3725	87.6%	7293	89.2%	3825	93.1%	3662	90.8%	7487	91.9%

4-d. Definition 4 (Alternative, most pessimistic)

Age group	Alternative: disability_mote2 (definition 4)						Alternative: disability_mote2 (definition 4)					
	Non-weighted						Weighted					
	Male		Female		Both sexes		Male		Female		Both sexes	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
18-19	47	67.1%	53	67.9%	100	67.6%	58	72.5%	61	77.2%	119	74.8%
20-24	186	75.9%	202	74.8%	388	75.3%	211	73.3%	233	77.9%	444	75.6%
25-29	337	81.8%	507	80.5%	844	81.0%	463	83.4%	705	83.9%	1168	83.7%
30-34	534	81.4%	677	78.6%	1211	79.8%	570	85.2%	658	82.3%	1228	83.6%
35-39	537	80.6%	565	73.4%	1102	76.7%	568	82.8%	542	75.8%	1110	79.2%
40-44	410	75.8%	412	72.0%	822	73.9%	446	80.5%	394	78.0%	840	79.3%
45-49	371	81.9%	326	73.4%	697	77.7%	392	83.8%	290	79.2%	682	81.8%
50-54	230	73.2%	142	67.9%	372	71.1%	259	76.0%	122	70.5%	381	74.1%
55-59	151	67.4%	87	61.3%	238	65.0%	171	76.3%	67	67.0%	238	73.5%
60-64	95	66.9%	45	42.5%	140	56.5%	79	68.7%	33	47.1%	112	60.5%
65-69	49	57.6%	38	46.3%	87	52.1%	44	63.8%	25	50.0%	69	58.0%
70-74	29	51.8%	20	39.2%	49	45.8%	20	60.6%	13	50.0%	33	55.9%
75-79	14	37.8%	9	34.6%	23	36.5%	9	47.4%	2	20.0%	11	37.9%
80+	7	25.0%	3	17.6%	10	22.2%	5	35.7%	1	14.3%	6	28.6%
Total	2997	76.3%	3086	72.5%	6083	74.3%	3296	80.1%	3146	77.9%	6442	79.0%

We estimated HALE based on different definitions. Based on the main definition (#2), HALE at birth was 73.5, 73.9 and 72.5 health-adjusted years for both sexes, male and female, respectively. **Table 5** shows HALE for different exact ages by sex for the main definition. The ratios of HALE-to-LE at birth were 0.884, 0.899 and 0.860 for both sexes, male and female, respectively. The corresponding ratios for UAE based on GBD 2021 were 0.868, 0.870 and 0.853, respectively. We also estimated HALE based on the three alternative definitions. The range of HALE at birth for both sexes varied between 57.1 (alternative definition 4) to 79.5 (alternative definition 1).

Table 5. Estimated HALE for UAE in 2023 based on the main definition of good health (#2) and alternative definitions (#1, #3 and #4)

Exact age	Alternative, Definition 1			Main, Definition 2			Alternative, Definition 3			Alternative, Definition 4		
	Both	Male	Female	Both	Male	Female	Both	Male	Female	Both	Male	Female
0	79.5	79.9	78.3	73.5	73.9	72.5	71.8	73.5	69.2	57.1	58.4	54.4
1	78.9	79.3	77.6	72.9	73.3	71.9	71.2	72.9	68.6	56.6	57.9	53.9
5	74.9	75.4	73.7	69.2	69.7	68.2	67.6	69.2	65.1	53.7	55.1	50.8
10	70.0	70.4	68.7	64.5	65.0	63.5	63.1	64.5	60.7	49.9	51.4	46.9
15	65.0	65.4	63.7	59.9	60.4	58.8	58.5	59.8	56.2	46.1	47.8	43.1
20	60.0	60.5	58.7	55.3	55.8	54.1	54.0	55.2	51.8	42.4	44.2	39.2
25	55.1	55.6	53.8	50.7	51.4	49.4	49.5	50.8	47.3	38.7	40.6	35.3
30	50.2	50.8	48.9	46.0	46.7	44.7	44.9	46.2	42.7	34.5	36.5	31.1
35	45.4	45.9	44.0	41.3	42.0	40.0	40.3	41.6	38.1	30.4	32.3	27.1
40	40.5	41.0	39.0	36.7	37.4	35.3	35.7	36.9	33.5	26.5	28.3	23.3
45	35.6	36.2	34.2	32.0	32.8	30.6	31.2	32.3	29.1	22.6	24.3	19.4
50	30.8	31.4	29.3	27.4	28.2	26.0	26.7	27.7	24.6	18.6	20.3	15.5
55	26.1	26.7	24.5	22.9	23.6	21.5	22.3	23.3	20.2	15.1	16.6	12.0
60	21.4	22.0	19.8	18.4	19.1	17.1	18.1	19.1	16.1	11.5	13.0	8.8
65	16.9	17.5	15.3	14.1	14.7	13.1	14.0	14.9	12.3	8.7	9.8	6.5
70	12.7	13.2	11.2	10.3	10.7	9.4	10.6	11.4	9.1	6.1	6.9	4.2
75	8.6	9.1	7.2	6.9	7.1	6.3	7.8	8.1	6.8	3.6	4.3	1.9
80	5.0	5.5	3.4	3.5	3.5	3.4	4.6	5.0	3.4	2.1	2.5	1.1
85	3.0	3.2	2.1	2.1	2.0	2.1	2.8	2.9	2.1	1.3	1.4	0.7
90	2.0	2.0	1.4	1.4	1.3	1.4	1.8	1.8	1.4	0.8	0.9	0.5

Table 6 presents the ratios of HALE-to-LE at birth for alternative definitions were 0.956, 0.864 and 0.687 for alternative definitions 1, 3 and 4, respectively. The HALE-to-LE ratios in older age groups, especially after 70-year-old for the main definition were lower in our estimation compared to GBD.

Table 6. The ratios of HALE-to-LE for UAE 2023 based on different definitions of good health compared to the same ratio derived from the GBD 2021

Exact age	Alternative, Definition 1			Main, Definition 2			Alternative, Definition 3			Alternative, Definition 4			GBD for comparison		
	Both	Male	Female	Both	Male	Female	Both	Male	Female	Both	Male	Female	Both	Male	Female
0	0.956	0.972	0.927	0.884	0.899	0.859	0.864	0.894	0.820	0.687	0.710	0.645	0.868	0.870	0.853
1	0.956	0.972	0.926	0.884	0.899	0.858	0.863	0.893	0.819	0.686	0.710	0.643	0.867	0.869	0.851
5	0.954	0.971	0.923	0.881	0.897	0.854	0.861	0.891	0.815	0.683	0.709	0.636	0.861	0.863	0.844
10	0.950	0.968	0.918	0.877	0.894	0.848	0.857	0.887	0.810	0.678	0.707	0.627	0.853	0.856	0.834
15	0.947	0.966	0.912	0.873	0.892	0.841	0.852	0.883	0.804	0.672	0.706	0.616	0.846	0.849	0.825
20	0.943	0.963	0.905	0.868	0.889	0.834	0.848	0.878	0.798	0.666	0.704	0.604	0.839	0.842	0.817
25	0.939	0.961	0.898	0.863	0.887	0.825	0.843	0.877	0.789	0.659	0.702	0.589	0.832	0.834	0.809
30	0.934	0.958	0.889	0.855	0.881	0.814	0.835	0.873	0.776	0.642	0.689	0.566	0.825	0.826	0.802
35	0.928	0.955	0.879	0.845	0.874	0.799	0.825	0.864	0.761	0.622	0.672	0.541	0.817	0.817	0.794
40	0.920	0.950	0.866	0.834	0.866	0.784	0.813	0.855	0.744	0.603	0.654	0.517	0.807	0.807	0.787
45	0.910	0.944	0.851	0.819	0.855	0.763	0.798	0.842	0.724	0.579	0.635	0.484	0.797	0.796	0.780
50	0.899	0.937	0.831	0.800	0.840	0.736	0.778	0.826	0.697	0.544	0.604	0.440	0.784	0.782	0.771
55	0.882	0.926	0.805	0.775	0.818	0.709	0.754	0.808	0.665	0.510	0.577	0.396	0.770	0.767	0.760
60	0.863	0.914	0.772	0.744	0.794	0.667	0.731	0.794	0.629	0.464	0.539	0.343	0.753	0.750	0.746
65	0.837	0.897	0.731	0.700	0.750	0.625	0.694	0.761	0.587	0.429	0.500	0.312	0.734	0.732	0.728
70	0.798	0.867	0.674	0.647	0.701	0.565	0.670	0.744	0.547	0.381	0.454	0.254	0.712	0.712	0.700
75	0.725	0.805	0.571	0.581	0.633	0.497	0.659	0.724	0.534	0.303	0.384	0.153	0.691	0.692	0.678
80	0.592	0.706	0.377	0.423	0.449	0.377	0.550	0.642	0.377	0.254	0.321	0.126	0.670	0.671	0.660
85	0.515	0.612	0.329	0.368	0.389	0.329	0.478	0.556	0.329	0.221	0.278	0.110	0.649	0.650	0.634
90	0.467	0.551	0.300	0.334	0.350	0.300	0.434	0.500	0.300	0.200	0.250	0.100	0.630	0.632	0.609

VI. Discussion

The estimated HALE at birth based on definition 2 for good health was 73.5 health-adjusted years. It is higher than the HALE estimated by the GBD 2021 for UAE (65.1). Such a difference is expected because of the different calculation methods and sources of data. Since the ratio of HALE-to-LE at birth is close in the current estimate and GBD estimate, the difference is mainly related to the difference in mortality rates and LE, not the health adjustment part. In this study, we used the WPP estimates for population and death counts which have strong acceptability at international level. The HALE-to-LE ratio for older ages, based on the current estimates, is lower than the ratios reported in the GBD study. The survey data used in this study reflects the fact that the proportion of labor migrants within the total population declines after working age, which amplifies the natural trend of increasing disabilities with age.

In order to obtain reliable and generalizable results in calculating estimates of the burden of disease / expected healthy life of the population, it may be appropriate working on providing detailed population data by age groups, sex and nationality. This applies to both mortality and morbidity data. This would lead to the production of accurate, reliable and realistic measures of the expected healthy life. Although the national HALE estimates of the current study represent the entire population of the UAE, they are not necessarily generalizable to all strata and subgroups of the population, which may have different needs. Just as a policy or intervention suitable for a specific age or sex group may not be appropriate for others, the factors influencing HALE by nationality may differ between Emirati and non-Emirati subgroups. Also, some of the countries are interested in having reports on health indicators for

different subnational regions to address the different needs of the local populations. This looks feasible for UAE in case of access to accurate and timely input data on population, mortality and health status for different subnational regions. National health surveys that provide a comprehensive range of health and health-related data should be conducted regularly to enable professionals to monitor and track changes in the population's health profile. Given the existence of a unified medical file for the population containing the detailed medical history of all members of the community, the use of health databases would help for obtaining more realistic and accurate estimates. Vital registration systems, including population and death registries, as well as migration data, must be reliable, timely, and accessible to decision-makers and researchers. Additionally, methods used for estimating population and death data, such as net migration estimates, require independent validation, specifically for GCC member states. This is important because of the unique patterns of migration in the region.

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VIII. Appendix 1:

The questions used for defining disability and healthy states

Section 2000: Health State Descriptions

Serial	Question	Answer codes	skip
A2000	**Start time**:		

Now we will switch to questions specifically about your health. The first questions are about your overall health, including both your physical and your mental health

Serial	Question	Very good	good	Moderate	bad	very bad	I don't know
A2001	In general, how would you rate your health today?	1	2	3	4	5	7777

Now I would like to review the different functions of your body. When answering these questions, I would like you to think about the last 30 days, taking both good and bad days into account. When I ask about difficulty, I would like you to consider how much difficulty you have had, on average, in the last 30 days (while doing the activity in the way that you usually do it. By difficulty I mean requiring increased effort, discomfort or pain, slowness or changes in the way you do the activity).

Serial	Question	None	Mild	Moderate	Severe	Extreme	I don't know
A2002	Overall, in the last 30 days, how much difficulty did you have with work or household activities?	1	2	3	4	5	7777
MOBILITY: Overall, in the last 30 days, how much difficulty did you have							
A2003	With moving around?	1	2	3	4	5	7777
A2004	In vigorous activities ('vigorous activities' require hard physical effort and cause large increases in breathing	1	2	3	4	5	7777

	or heart rate)?						
SELF-CARE: Overall, in the last 30 days, how much difficulty did you have							
A2005	With self-care, such as bathing/washing or dressing yourself?	1	2	3	4	5	7777
PAIN AND DISCOMFORT: Overall, in the last 30 days, how much							
A2008	Of bodily aches or pains did you have?	1	2	3	4	5	7777
A2009	Bodily discomfort did you have?	1	2	3	4	5	7777
				If both **A2008** and **A2009**= 1 →			**2011**
A2010	How much difficulty did you have in your daily life because of your pain?	1	2	3	4	5	7777
COGNITION: Overall, in the last 30 days, how much difficulty did you have							
Serial	**Question**	**None**	**Mild**	**Moderate**	**Severe**	**Extreme**	**I don't know**
A2011	With concentrating or remembering things?	1	2	3	4	5	7777
A2012	In learning a new task (for example, learning how to get to a new place, learning a new game, learning a new recipe)?	1	2	3	4	5	7777
INTERPERSONAL ACTIVITIES: *Overall, in the last 30 days, how much difficulty did you have*							
A2013	With personal relationships or participation in the community?	1	2	3	4	5	7777
A2014	With dealing with	1	2	3	4	5	7777

	conflicts and tensions with others						
A2015	With making new friendships or maintaining current friendships?	1	2	3	4	5	7777
SLEEP AND ENERGY: Overall, in the last 30 days, how much of difficulty did you have							
A2017	With sleeping, such as falling asleep, waking up frequently during the night or waking up too early in the morning?	1	2	3	4	5	7777
A2018	Due to not feeling rested and refreshed during the day (for example, feeling tired, not having energy)?	1	2	3	4	5	7777
AFFECT: Overall, in the last 30 days, how much of a problem did you have							
A2019	With feeling sad, low or depressed?	1	2	3	4	5	7777
A2020	With worry or anxiety?	1	2	3	4	5	7777