Actuarial

LTC Morbidity Improvement Study: Main Results

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Purpose

The **LTC Morbidity Improvement Study** was designed to evaluate changes over time in activities of daily living (ADL) and cognitive impairment (CI) morbidity rates, and their impact on lifetime disability –

using **non-insured general population data** from the 1984 and 2004 National Long Term Care Survey (NLTCS).

Rationale: Improvement in LTC morbidity combined with declines in mortality rates can have profound consequences for lifetime disability and LTC/LTCI costs.

Specific Aims

1. Precise estimation of changes over time in ADL morbidity rates (using **simulated** HIPAA ADL Trigger) and the impact of those changes on lifetime disability.
2. Replicate Aim 1 for changes over time in CI morbidity rates (using **simulated** HIPAA CI Trigger).
3. Assess sensitivity to alternative sets of cross-sectional and longitudinal sampling weights.
4. Assess impact of alternative underwriting protocols using NLTCS variables and linked Medicare diagnostic data; adding other relevant data as necessary.

This presentation focuses on Aims 1–3.

HIPAA ADL Trigger

The individual is unable to perform without "substantial assistance" (hands-on or standby) from another individual **at least two out of six ADLs**:

bathing,	continence,
dressing,	eating,
toileting,	transferring

for at least 90 days due to a loss of functional capacity.

HIPAA CI Trigger

The individual requires “substantial supervision” to protect him/herself from threats to health and safety due to “severe cognitive impairment,” defined as:

A loss or deterioration in intellectual capacity that is

(a) comparable to (and includes) Alzheimer’s disease and similar forms of irreversible dementia, and

(b) measured by clinical evidence and **standardized tests** that reliably measure impairment in the individual’s

(i) short-term or long-term memory,

(ii) orientation as to people, places, or time, and

(iii) deductive or abstract reasoning.

NLTCS Cognitive Impairment

- Short Portable Mental Status Questionnaire (SPMSQ)

  Cut-Points typically set at 3+, 4+, or 5+ ***errors*** *out of 10 questions –* ***we used 3+ for this presentation;***

or

- Caregiver report of Alzheimer's Disease, dementia, or other cognition problem sufficient to prevent completion of SPMSQ with a passing score of 0–2, 0–3, or 0–4 errors.

Note: roughly comparable cuts for the MMSE are ≤22, ≤19, or ≤16 **correct** out of 30 questions.

1984 NLTCS Sample

Table 1.4
Unweighted Number and Percent of Persons Meeting HIPAA ADL Trigger, 1984 NLTCS, Unisex, Age 65 and Above, by Age

	Meets HIPAA ADL Trigger				
Age	No	Yes	Total	Percent	Std Error (Pct)
65-69	7,442	315	7,757	4.1%	0.2%
70-74	4,501	388	4,889	7.9%	0.4%
75-79	3,273	491	3,764	13.0%	0.5%
80-84	2,019	549	2,568	21.4%	0.8%
85-89	1,034	543	1,577	34.4%	1.2%
90-94	306	344	650	52.9%	2.0%
95+	60	134	194	69.1%	3.3%
Total	18,635	2,764	21,399	12.9%	0.2%

Note: The HIPAA ADL trigger requires substantial assistance on 2+ ADLs.

Source: Authors' calculations based on the 1984 NLTCS.

2004 NLTCS Sample

Table 1.5
Unweighted Number and Percent of Persons Meeting HIPAA ADL Trigger, 2004 NLTCS, Unisex, Age 65 and Above, by Age

	Meets HIPAA ADL Trigger				
Age	No	Yes	Total	Percent	Std Error (Pct)
65-69	4,008	104	4,112	2.5%	0.2%
70-74	2,731	140	2,871	4.9%	0.4%
75-79	2,400	164	2,564	6.4%	0.5%
80-84	2,314	284	2,598	10.9%	0.6%
85-89	1,798	448	2,246	19.9%	0.8%
90-94	442	192	634	30.3%	1.8%
95+	448	520	968	53.7%	1.6%
Total	14,141	1,852	15,993	11.6%	0.2%

Note: The HIPAA ADL trigger requires substantial assistance on 2+ ADLs.

Source: Authors' calculations based on the 2004 NLTCS.

NLTCS Survey Weights

Survey weights were employed for tabulation of responses as described in Manton et al. (2006).

Standard errors of weighted estimators of binomial proportions were based on rescaled sample weights using the procedures developed by Potthoff et al. (1992).

These procedures yielded overall estimated design effects of 1.13 in the 1984 NLTCS and 1.19 in the 2004 NLTCS –

increasing the binomial variances by 13% and 19% compared to simple random sampling.

1984 ADLs

Table 1.6
Number and Percent of Persons Meeting HIPAA ADL Trigger, United States 1984, Unisex, Age 65 and Above, by Age

	Meets HIPAA ADL Trigger				
Age	No	Yes	Total	Percent	Std Error (Pct)
65-69	8,449,660	285,558	8,735,218	3.3%	0.2%
70-74	7,173,626	380,409	7,554,035	5.0%	0.3%
75-79	5,065,338	473,580	5,538,918	8.6%	0.5%
80-84	2,908,882	524,112	3,432,994	15.3%	0.7%
85-89	1,419,003	504,335	1,923,337	26.2%	1.2%
90-94	370,717	302,329	673,046	44.9%	2.3%
95+	63,540	113,824	177,364	64.2%	4.4%
Total	25,450,767	2,584,148	28,034,914	9.2%	0.2%

Note: The HIPAA ADL trigger requires substantial assistance on 2+ ADLs.

Source: Authors' calculations based on the 1984 NLTCS.

2004 ADLs

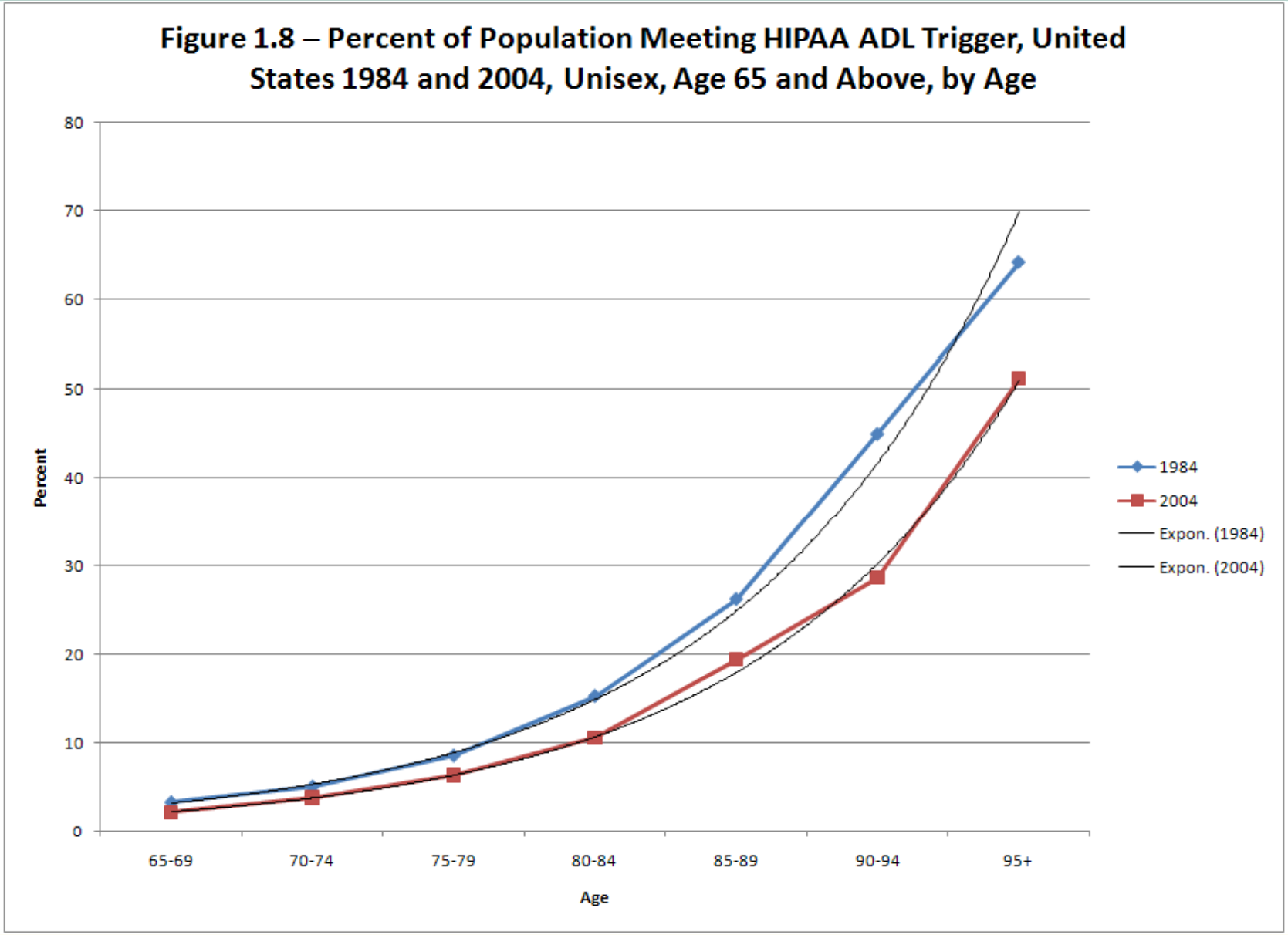
Table 1.7
Number and Percent of Persons Meeting HIPAA ADL Trigger, United States 2004, Unisex, Age 65 and Above, by Age

	Meets HIPAA ADL Trigger				
Age	No	Yes	Total	Percent	Std Error (Pct)
65-69	8,302,057	186,582	8,488,639	2.2%	0.3%
70-74	8,404,035	333,111	8,737,147	3.8%	0.3%
75-79	7,139,472	484,462	7,623,934	6.4%	0.5%
80-84	5,389,370	639,477	6,028,847	10.6%	0.7%
85-89	2,782,747	669,256	3,452,003	19.4%	1.1%
90-94	1,058,680	423,553	1,482,233	28.6%	1.9%
95+	211,606	220,917	432,523	51.1%	4.0%
Total	33,287,967	2,957,359	36,245,325	8.2%	0.2%

Note: The HIPAA ADL trigger requires substantial assistance on 2+ ADLs.

Source: Authors' calculations based on the 2004 NLTCS.

ADLs: 1984 vs. 2004



1984 CI

Table 2.14
Number and Percent of Persons Meeting HIPAA CI Trigger, United States 1984, Unisex, Age 65 and Above, by Age

	Meets HIPAA CI Trigger				
Age	No	Yes	Total	Percent	Std Error (Pct)
65-69	8,533,586	201,632	8,735,218	2.3%	0.2%
70-74	7,193,033	361,002	7,554,035	4.8%	0.3%
75-79	5,062,386	476,532	5,538,918	8.6%	0.5%
80-84	2,857,440	575,554	3,432,994	16.8%	0.8%
85-89	1,352,165	571,172	1,923,337	29.7%	1.3%
90-94	369,078	303,968	673,046	45.2%	2.3%
95+	75,410	101,955	177,364	57.5%	4.5%
Total	25,443,100	2,591,815	28,034,914	9.2%	0.2%

Note: The HIPAA CI trigger used 3+ errors on the SPMSQ.

Source: Authors' calculations based on the 1984 NLTCS.

2004 CI

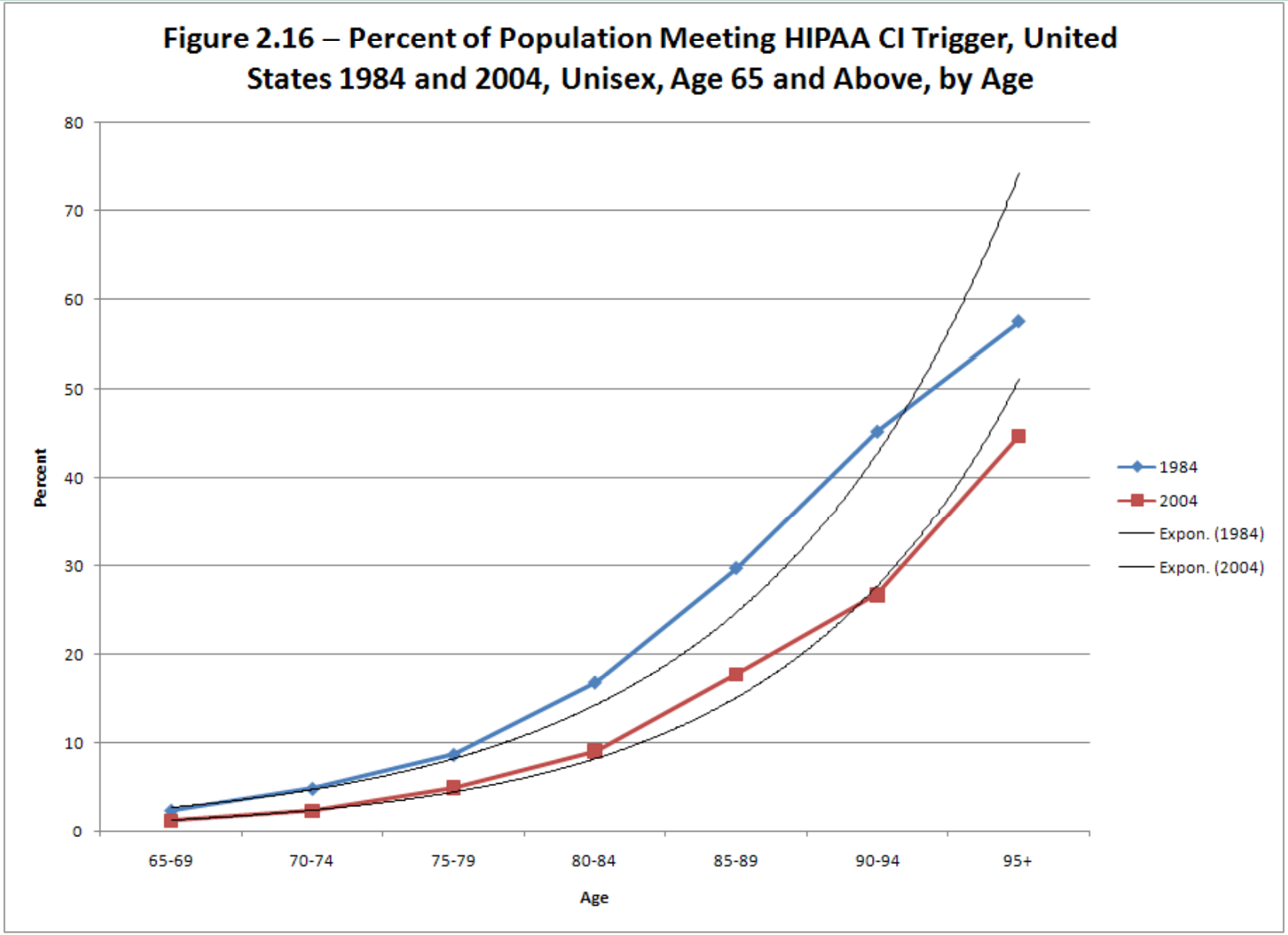
Table 2.15
Number and Percent of Persons Meeting HIPAA CI Trigger, United States 2004, Unisex, Age 65 and Above, by Age

	Meets HIPAA CI Trigger				
Age	No	Yes	Total	Percent	Std Error (Pct)
65-69	8,384,960	103,679	8,488,639	1.2%	0.2%
70-74	8,539,577	197,570	8,737,147	2.3%	0.3%
75-79	7,247,763	376,171	7,623,934	4.9%	0.4%
80-84	5,482,051	546,796	6,028,847	9.1%	0.6%
85-89	2,840,985	611,018	3,452,003	17.7%	1.1%
90-94	1,086,664	395,569	1,482,233	26.7%	1.9%
95+	239,316	193,207	432,523	44.7%	3.9%
Total	33,821,316	2,424,010	36,245,325	6.7%	0.2%

Note: The HIPAA CI trigger used 3+ errors on the SPMSQ.

Source: Authors' calculations based on the 2004 NLTCS.

CI: 1984 vs. 2004



1984 ADL/CI

Table 2.19
Number and Percent of Persons Meeting Either HIPAA Trigger, United States 1984, Unisex, Age 65 and Above, by Age

	Meets Either HIPAA Trigger				
Age	No	Yes	Total	Percent	Std Error (Pct)
65-69	8,359,909	375,310	8,735,218	4.3%	0.3%
70-74	6,972,483	581,552	7,554,035	7.7%	0.4%
75-79	4,848,302	690,617	5,538,918	12.5%	0.5%
80-84	2,667,720	765,275	3,432,994	22.3%	0.9%
85-89	1,199,094	724,244	1,923,337	37.7%	1.3%
90-94	283,592	389,454	673,046	57.9%	2.3%
95+	45,852	131,512	177,364	74.1%	4.0%
Total	24,376,952	3,657,963	28,034,914	13.0%	0.23%

Note: The HIPAA triggers are based on 2+ ADL Impariments or 3+ errors on the SPMSQ.

Source: Authors' calculations based on the 1984 NLTCS.

2004 ADL/CI

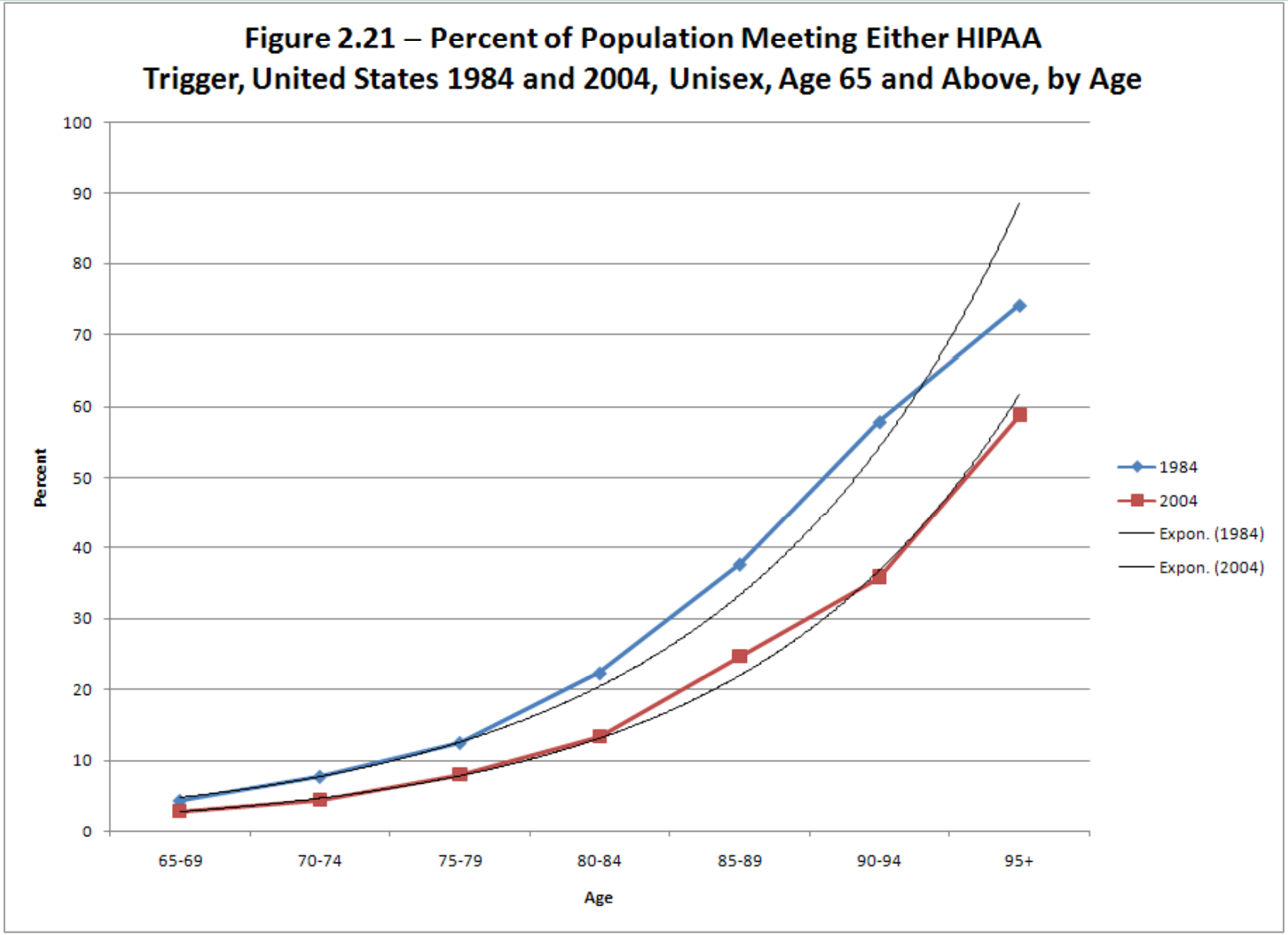
Table 2.20
Number and Percent of Persons Meeting Either HIPAA Trigger, United States 2004, Unisex, Age 65 and Above, by Age

	Meets Either HIPAA Trigger				
Age	No	Yes	Total	Percent	Std Error (Pct)
65-69	8,249,343	239,296	8,488,639	2.8%	0.3%
70-74	8,353,574	383,573	8,737,147	4.4%	0.4%
75-79	7,023,298	600,636	7,623,934	7.9%	0.5%
80-84	5,230,199	798,648	6,028,847	13.2%	0.7%
85-89	2,602,925	849,078	3,452,003	24.6%	1.2%
90-94	951,734	530,500	1,482,233	35.8%	2.0%
95+	178,647	253,875	432,523	58.7%	3.9%
Total	32,589,719	3,655,606	36,245,325	10.1%	0.2%

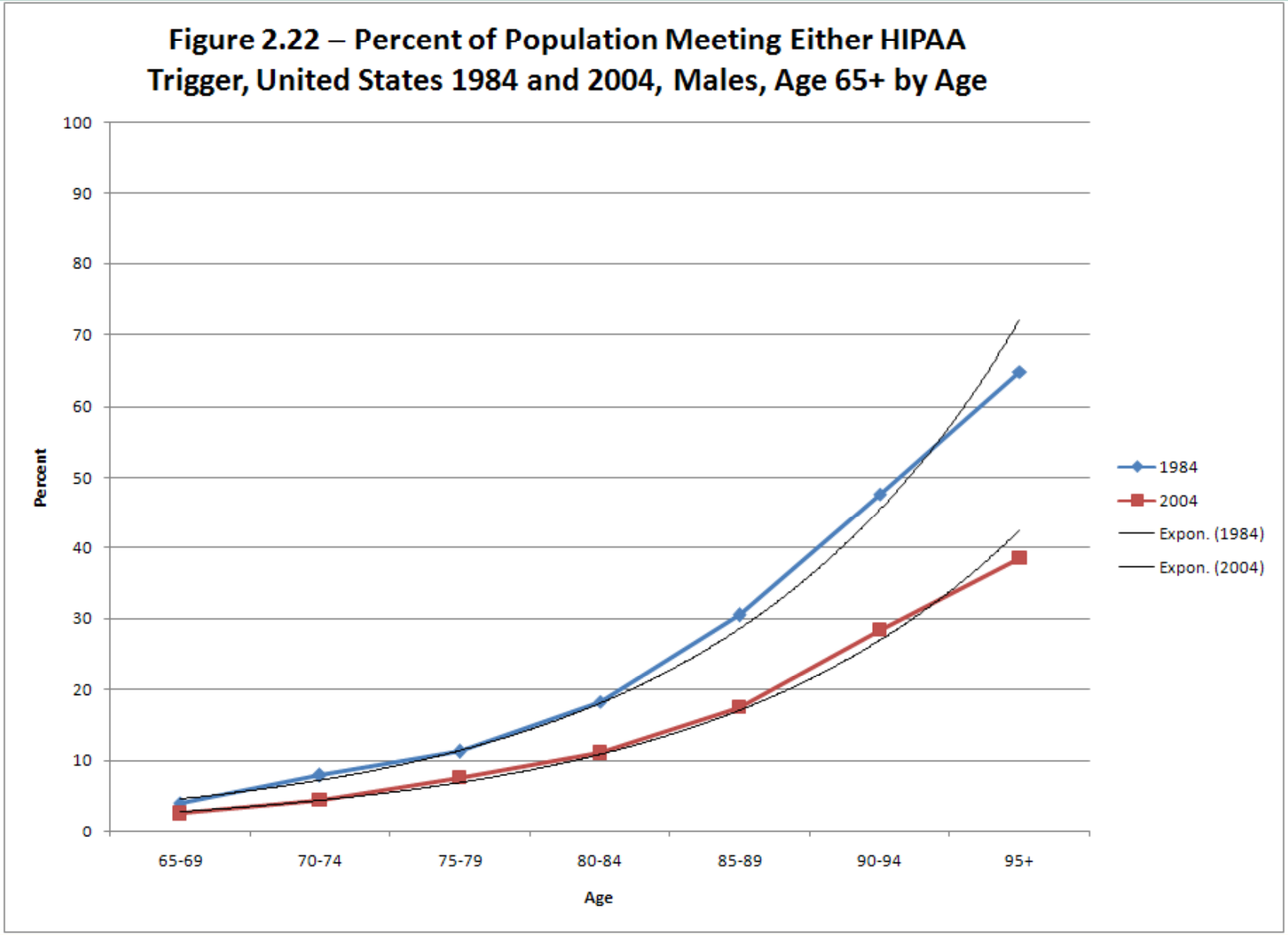
Note: The HIPAA triggers are based on 2+ ADL Impariments or 3+ errors on the SPMSQ.

Source: Authors' calculations based on the 2004 NLTCS.

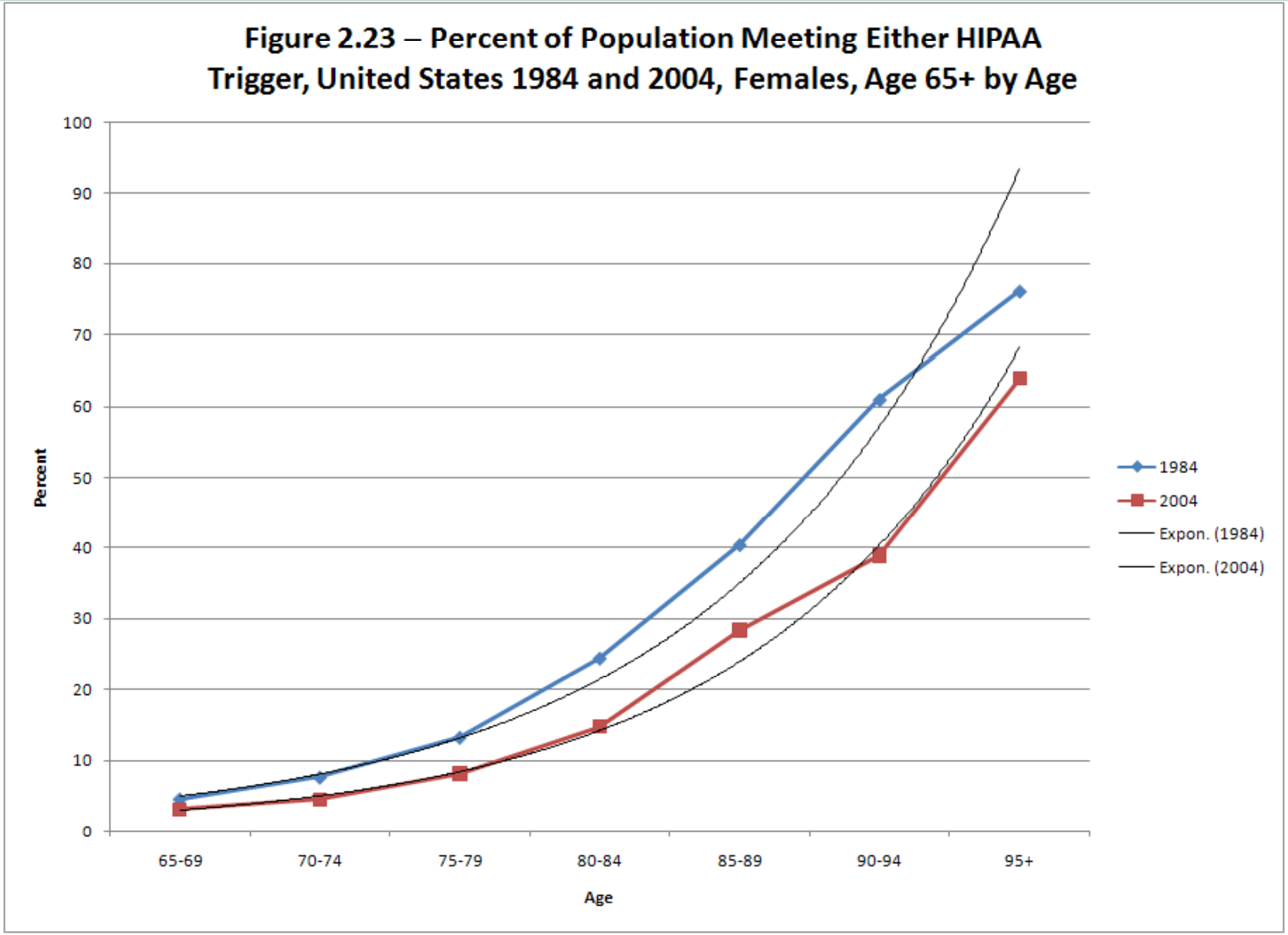
ADL/CI: 1984 vs. 2004



ADL/CI: 1984 vs. 2004 – Males



ADL/CI: 1984 vs. 2004 – Females



Age-Standardized Disability Rate

$$\mathrm{ASDR}_y(\{N_x\}) = \sum_{x=65}^{\omega} N_x \cdot \pi_{x,y} \Big/ \sum_{x=65}^{\omega} N_x$$

where

$N_x =$ Standard (mid-year) population at age x

and

$\pi_{x,y} =$ Disability prevalence rate at age x in year y

ADL Changes

Table 1.8 – Percent of Population Meeting HIPAA ADL Trigger, United States 1984 and 2004, Unisex, Age 65 and Above, by Age and Totaled Over Age, with Two Modes of Age Standardization

Age	1984	2004	Change	% Change	Annual Rate of Decline; 20 yr.
65-69	3.27	2.20	-1.07	-32.8	1.97%
70-74	5.04	3.81	-1.22	-24.3	1.38%
75-79	8.55	6.35	-2.20	-25.7	1.47%
80-84	15.27	10.61	-4.66	-30.5	1.80%
85-89	26.22	19.39	-6.83	-26.1	1.50%
90-94	44.92	28.58	-16.34	-36.4	2.24%
95+	64.18	51.08	-13.10	-20.4	1.13%
Total	**9.22**	**8.16**	-1.06	-11.5	0.61%
1984 ASDR	**9.22**	6.61	-2.61	**-28.3**	**1.65%**
2004 ASDR	11.42	**8.16**	-3.26	**-28.5**	**1.67%**
		Standard Error			
Total	0.20	0.23	0.30		
1984 ASDR	0.20	0.19	0.28		
2004 ASDR	0.24	0.23	0.33		
		t-statistic			
Total	46.31	36.20	-3.52		
1984 ASDR	46.31	33.94	**-9.38**		
2004 ASDR	47.13	36.20	**-9.85**		

NOTE: ASDR denotes age-standardized disability rate; the 1984 ASDR and 2004 ASDR results were age-standardized, respectively, to the 1984 and 2004 NLTCS weighted unisex population. The HIPAA ADL trigger requires substantial assistance on 2+ ADLs.

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

CI Changes

Table 2.16 – Percent of Population Meeting HIPAA CI Trigger, United States 1984 and 2004, Unisex, Age 65 and Above, by Age and Totaled Over Age, with Two Modes of Age Standardization

Age	1984	2004	Change	% Change	Annual Rate of Decline; 20 yr.
65-69	2.31	1.22	-1.09	-47.1	3.13%
70-74	4.78	2.26	-2.52	-52.7	3.67%
75-79	8.60	4.93	-3.67	-42.6	2.74%
80-84	16.77	9.07	-7.70	-45.9	3.03%
85-89	29.70	17.70	-12.00	-40.4	2.55%
90-94	45.16	26.69	-18.48	-40.9	2.60%
95+	57.48	44.67	-12.81	-22.3	1.25%
Total	**9.24**	**6.69**	-2.56	-27.7	1.61%
1984 ASDR	**9.24**	5.21	-4.03	**-43.6**	**2.82%**
2004 ASDR	11.65	**6.69**	-4.96	**-42.6**	**2.74%**
		Standard Error			
Total	0.20	0.21	0.28		
1984 ASDR	0.20	0.17	0.26		
2004 ASDR	0.25	0.21	0.32		
		t-statistic			
Total	46.75	32.62	-8.98		
1984 ASDR	46.75	30.79	**-15.49**		
2004 ASDR	47.52	32.62	**-15.53**		

NOTE: ASDR denotes age-standardized disability rate; the 1984 ASDR and 2004 ASDR results were age-standardized, respectively, to the 1984 and 2004 NLTCS weighted unisex population. The CI trigger used 3+ errors on the SPMSQ.

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

ADL/CI Changes

Table 2.21 – Percent of Population Meeting Either HIPAA Trigger, United States 1984 and 2004, Unisex, Age 65 and Above, by Age and Totaled Over Age, with Two Modes of Age Standardization

Age	1984	2004	Change	% Change	Annual Rate of Decline; 20 yr.
65-69	4.30	2.82	-1.48	-34.4	2.09%
70-74	7.70	4.39	-3.31	-43.0	2.77%
75-79	12.47	7.88	-4.59	-36.8	2.27%
80-84	22.29	13.25	-9.04	-40.6	2.57%
85-89	37.66	24.60	-13.06	-34.7	2.11%
90-94	57.86	35.79	-22.07	-38.1	2.37%
95+	74.15	58.70	-15.45	-20.8	1.16%
Total	**13.05**	**10.09**	-2.96	-22.7	1.28%
1984 ASDR	**13.05**	8.16	-4.89	**-37.5**	**2.32%**
2004 ASDR	16.03	**10.09**	-5.94	**-37.1**	**2.29%**
		Standard Error			
Total	0.23	0.25	0.33		
1984 ASDR	0.23	0.21	0.31		
2004 ASDR	0.27	0.25	0.37		
		t-statistic			
Total	57.26	41.15	-8.85		
1984 ASDR	57.26	38.31	**-15.68**		
2004 ASDR	59.14	41.15	**-16.27**		

NOTE: ASDR denotes age-standardized disability rate; the 1984 ASDR and 2004 ASDR results were age-standardized, respectively, to the 1984 and 2004 NLTCS weighted unisex population. The HIPAA triggers are based on 2+ ADL Impariments or 3+ errors on the SPMSQ.

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

ADL/CI Changes – Males

Table 2.22 – Percent of Population Meeting Either HIPAA Trigger, United States 1984 and 2004, Unisex, Age 65 and Above, by Age and Totaled Over Age, with Two Modes of Age Standardization

Age	1984	2004	Change	% Change	Annual Rate of Decline; 20 yr.
65-69	4.01	2.50	-1.51	-37.7	2.34%
70-74	7.83	4.37	-3.45	-44.1	2.87%
75-79	11.24	7.56	-3.69	-32.8	1.97%
80-84	18.29	11.00	-7.30	-39.9	2.51%
85-89	30.50	17.41	-13.09	-42.9	2.76%
90-94	47.59	28.33	-19.26	-40.5	2.56%
95+	64.92	38.49	-26.44	-40.7	2.58%
Total	**10.08**	**7.47**	-2.61	-25.9	1.49%
1984 ASDR	**10.08**	6.10	-3.98	**-39.5**	**2.48%**
2004 ASDR	12.39	**7.47**	-4.92	**-39.7**	**2.50%**
		Standard Error			
Total	0.34	0.34	0.48		
1984 ASDR	0.34	0.30	0.45		
2004 ASDR	0.41	0.34	0.53		
		t-statistic			
Total	30.01	21.91	-5.45		
1984 ASDR	30.01	20.48	**-8.87**		
2004 ASDR	30.15	21.91	**-9.21**		

NOTE: ASDR denotes age-standardized disability rate; the 1984 ASDR and 2004 ASDR results were age-standardized, respectively, to the 1984 and 2004 NLTCS weighted unisex population. The HIPAA triggers are based on 2+ ADL Impariments or 3+ errors on the SPMSQ.

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

ADL/CI Changes – Females

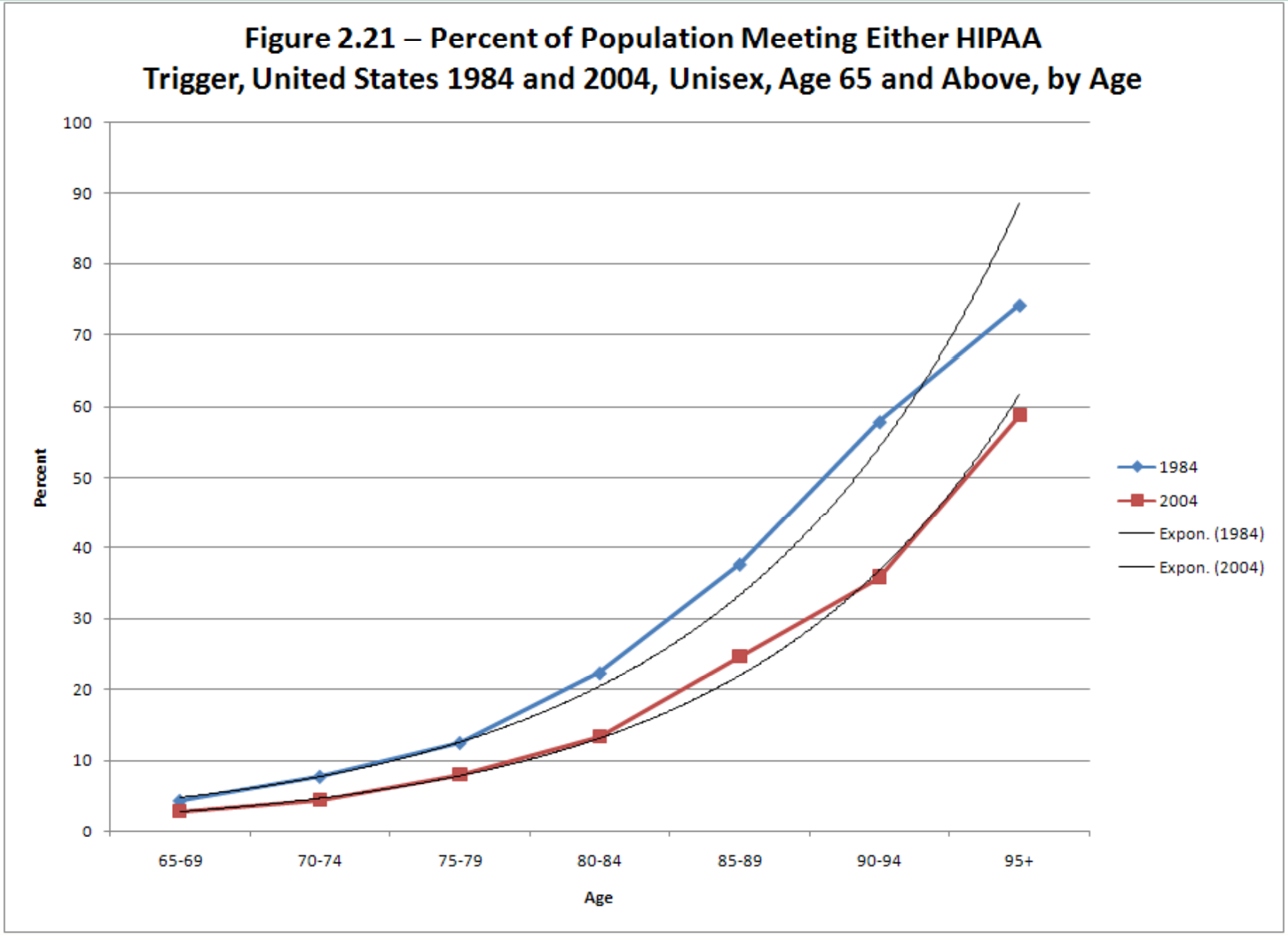
Table 2.23 – Percent of Population Meeting Either HIPAA Trigger, United States 1984 and 2004, Unisex, Age 65 and Above, by Age and Totaled Over Age, with Two Modes of Age Standardization

Age	1984	2004	Change	% Change	Annual Rate of Decline; 20 yr.
65-69	4.52	3.10	-1.42	-31.4	1.87%
70-74	7.61	4.41	-3.20	-42.1	2.69%
75-79	13.22	8.11	-5.10	-38.6	2.41%
80-84	24.39	14.70	-9.69	-39.7	2.50%
85-89	40.40	28.29	-12.10	-30.0	1.76%
90-94	60.96	38.82	-22.14	-36.3	2.23%
95+	76.08	63.84	-12.23	-16.1	0.87%
Total	**14.97**	**11.97**	-3.00	-20.0	1.11%
1984 ASDR	**14.97**	9.66	-5.32	**-35.5**	**2.17%**
2004 ASDR	18.38	**11.97**	-6.40	**-34.8**	**2.12%**
		Standard Error			
Total	0.31	0.34	0.46		
1984 ASDR	0.31	0.30	0.43		
2004 ASDR	0.36	0.34	0.50		
		t-statistic			
Total	49.03	35.07	-6.55		
1984 ASDR	49.03	32.51	**-12.48**		
2004 ASDR	51.11	35.07	**-12.92**		

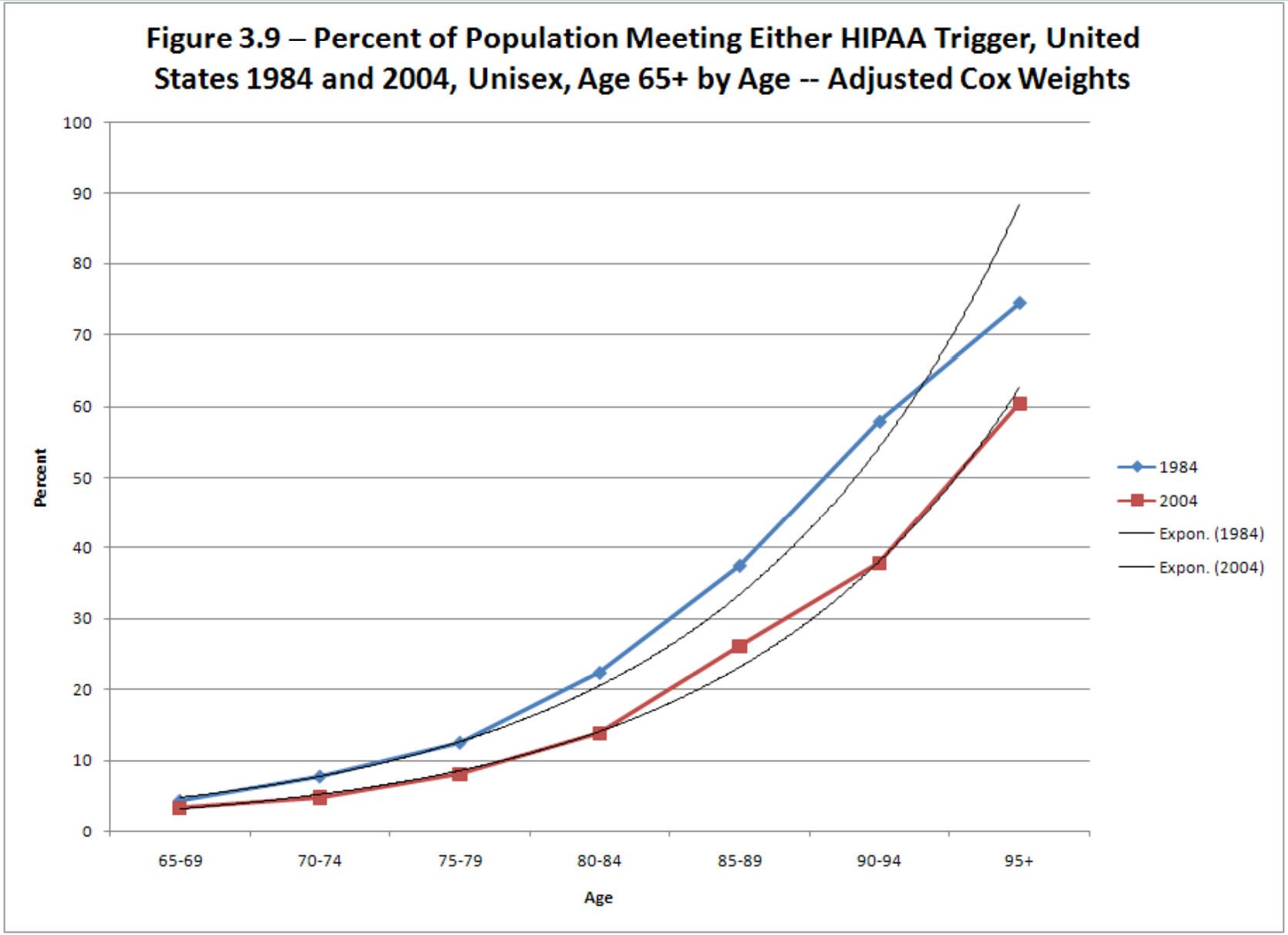
NOTE: ASDR denotes age-standardized disability rate; the 1984 ASDR and 2004 ASDR results were age-standardized, respectively, to the 1984 and 2004 NLTCS weighted unisex population. The HIPAA triggers are based on 2+ ADL Impariments or 3+ errors on the SPMSQ.

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

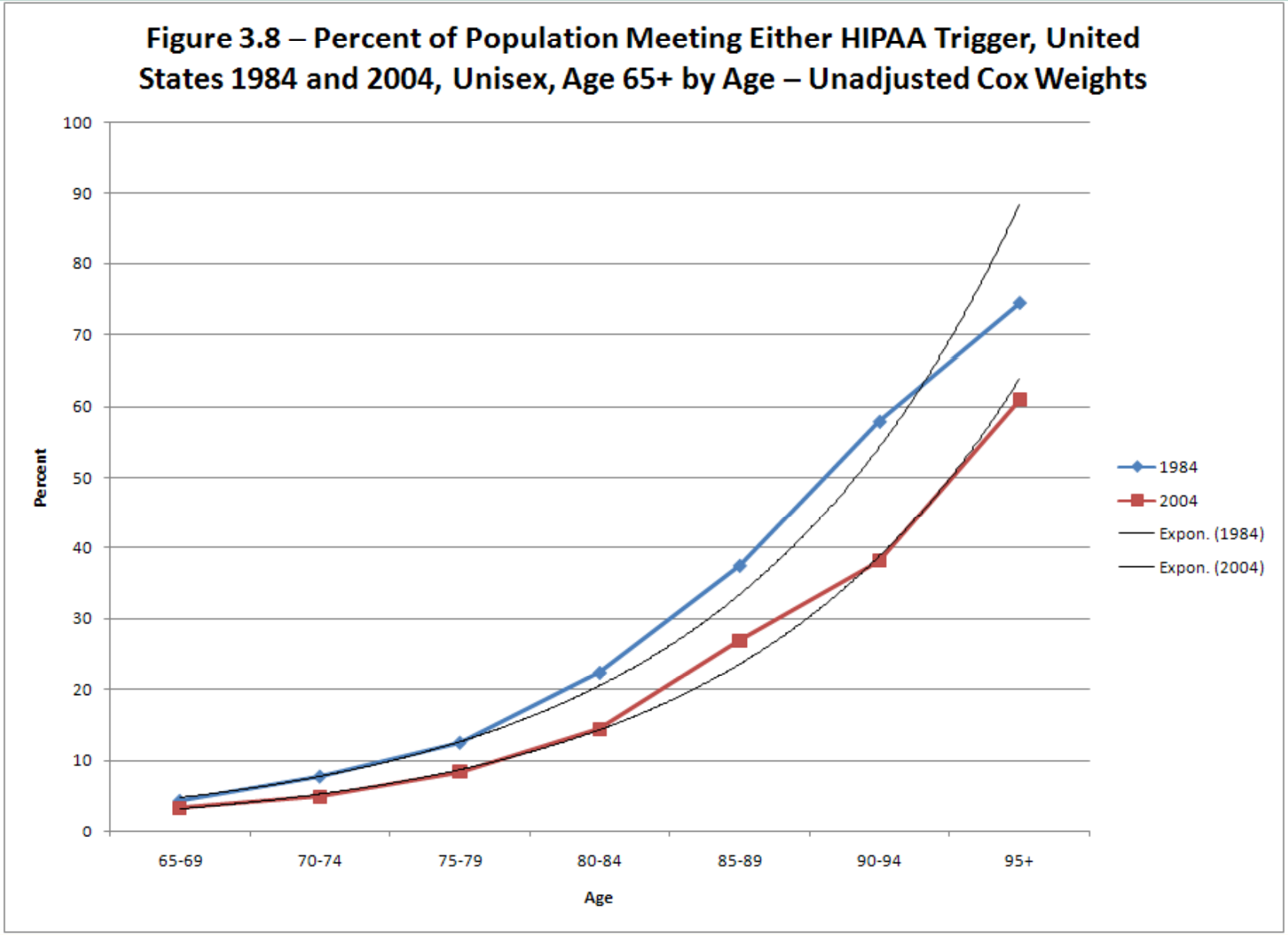
Sensitivity Analysis: Duke/PNAS Weights



Sensitivity Analysis: Adjusted Cox Weights



Sensitivity Analysis: Unadjusted Cox Wgts.



Sensitivity Analysis: Summary Statistics

Table 3.10

Table 3.10 – Annual Rate of Decline in the Percent of Population Meeting Either HIPAA Trigger, United States 1984 and 2004, Unisex, Age 65+, by Age and Totaled Over Age, with Two Modes of Age Standardization – Tabulated Using Three Alternative Weighting Protocols

	Annual Rate of Decline (%)			Ratio of Cox to Duke/PNAS		*t*-statistic	
Age	Duke/PNAS Weight	Unadjusted Cox Weight	Adjusted Cox Weight	Unadjusted	Adjusted	Unadjusted	Adjusted
65-69	2.09	1.29	1.29	0.618	0.618		
70-74	2.77	2.26	2.39	0.817	0.862		
75-79	2.27	1.97	2.16	0.870	0.952		
80-84	2.57	2.19	2.37	0.851	0.922		
85-89	2.11	1.64	1.79	0.776	0.850		
90-94	2.37	2.06	2.10	0.868	0.886		
95+	1.16	1.00	1.04	0.859	0.891		
Total	1.28	1.05	1.18	0.819	0.919	1.60	0.72
1984 ASDR	**2.32**	**1.89**	**2.02**	0.814	0.869	**2.92**	**2.06**
2004 ASDR	**2.29**	**1.88**	**2.01**	0.823	0.879	**2.88**	**1.97**
		Standard Error					
Total	0.14	0.14	0.14	0.972	0.978		
1984 ASDR	0.15	0.14	0.15	0.975	0.981		
2004 ASDR	0.14	0.14	0.14	0.977	0.983		
		t-statistic					
Total	8.85	7.46	8.32	0.843	0.940		
1984 ASDR	**15.68**	**13.09**	**13.88**	0.835	0.886		
2004 ASDR	**16.27**	**13.71**	**14.54**	0.843	0.894		

NOTE: ASDR denotes age-standardized disability rate; the 1984 ASDR and 2004 ASDR results were age-standardized, respectively, to the 1984 and 2004 NLTCS weighted unisex population. The HIPAA triggers are based on 2+ ADL Impairments or 3+ errors on the SPMSQ.

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

Life Expectancy at Age *x* in Year *y*

$$e_{x,y} = \int_0^{\infty} {}_t p_{x,y} \; dt$$

where

$${}_t p_{x,y} = l_{x+t,y} \,/\, l_{x,y}$$

Disabled Life Expectancy at Age *x* in Year *y*

$$e_{D\ x,y} = \int_0^{\infty} {}_t p_{x,y}\ \pi_{x+t,y}\ dt$$

where

$${}_t p_{x,y} = l_{x+t,y} / l_{x,y}$$

and

$\pi_{x+t,y}$ = disability prevalence at age $x + t$

Change in DLE at Age *x*

$$e_{Dx,y} - e_{Dx,y_0} = \int_0^\infty \left({}_t p_{x,y} \ \pi_{x+t,y} - {}_t p_{x,y_0} \ \pi_{x+t,y_0} \right) dt$$

$$= \int_0^\infty \left({}_t p_{x,y} \ \pi_{x+t,y} - {}_t p_{x,y_0} \ \pi_{x+t,y_0} + 0 \right) dt$$

$$= \int_0^\infty \left({}_t p_{x,y} \ \pi_{x+t,y} - {}_t p_{x,y_0} \ \pi_{x+t,y_0} + {}_t p_{x,y} \ \pi_{x+t,y_0} - {}_t p_{x,y} \ \pi_{x+t,y_0} \right) dt$$

$$= \int_0^\infty \left({}_t p_{x,y} - {}_t p_{x,y_0} \right) \pi_{x+t,y_0} \ dt$$ Survival Increment

$$- \int_0^\infty {}_t p_{x,y} \left(\pi_{x+t,y_0} - \pi_{x+t,y} \right) dt$$ Morbidity Decrement

ADL Changes

Table 1.11
Components of Change in Unisex Life Expectancy and HIPAA ADL Expectancy (in Years at Age 65), United States 1984 and 2004

	Year				
At Age 65	1984	2004	Change	Survival Increment	Morbidity Decrement
Life Expectancy	16.64	18.11	1.48	1.48	—
HIPAA ADL Expectancy	1.79	1.46	**-0.33**	**0.25**	**0.58**
Standard Error	0.04	0.04	0.06	0.01	0.06
t-statistic	47.62	36.37	**-5.99**	**42.44**	**9.90**

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

CI Changes

Table 2.24
Components of Change in Unisex Life Expectancy and HIPAA CI Expectancy (in Years at Age 65), United States 1984 and 2004

	Year				
At Age 65	1984	2004	Change	Survival Increment	Morbidity Decrement
Life Expectancy	16.64	18.11	1.48	1.48	—
HIPAA CI Expectancy	1.81	1.20	**-0.61**	**0.27**	**0.88**
Standard Error	0.04	0.04	0.05	0.01	0.06
t-statistic	47.79	32.78	**-11.61**	**43.76**	**15.47**

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

ADL/CI Changes

Table 2.27
Components of Change in Unisex Life Expectancy and HIPAA ADL/CI Expectancy (in Years at Age 65), United States 1984 and 2004

	Year				
At Age 65	1984	2004	Change	Survival Increment	Morbidity Decrement
Life Expectancy	16.64	18.11	1.48	1.48	—
HIPAA ADL/CI Expectancy	2.50	1.81	**-0.70**	**0.35**	**1.05**
Standard Error	0.04	0.04	0.06	0.01	0.06
t-statistic	59.70	41.38	**-11.53**	**54.47**	**16.25**

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

ADL/CI Changes – Males

Table 2.28
Components of Change in Male Life Expectancy and HIPAA ADL/CI Expectancy (in Years at Age 65), United States 1984 and 2004

	Year				
At Age 65	1984	2004	Change	Survival Increment	Morbidity Decrement
Life Expectancy	14.41	16.67	2.26	2.26	—
HIPAA ADL/CI Expectancy	1.64	1.26	**-0.39**	**0.44**	**0.83**
Standard Error	0.05	0.06	0.08	0.02	0.09
t-statistic	30.54	21.97	**-4.93**	**25.75**	**9.25**

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

ADL/CI Changes – Females

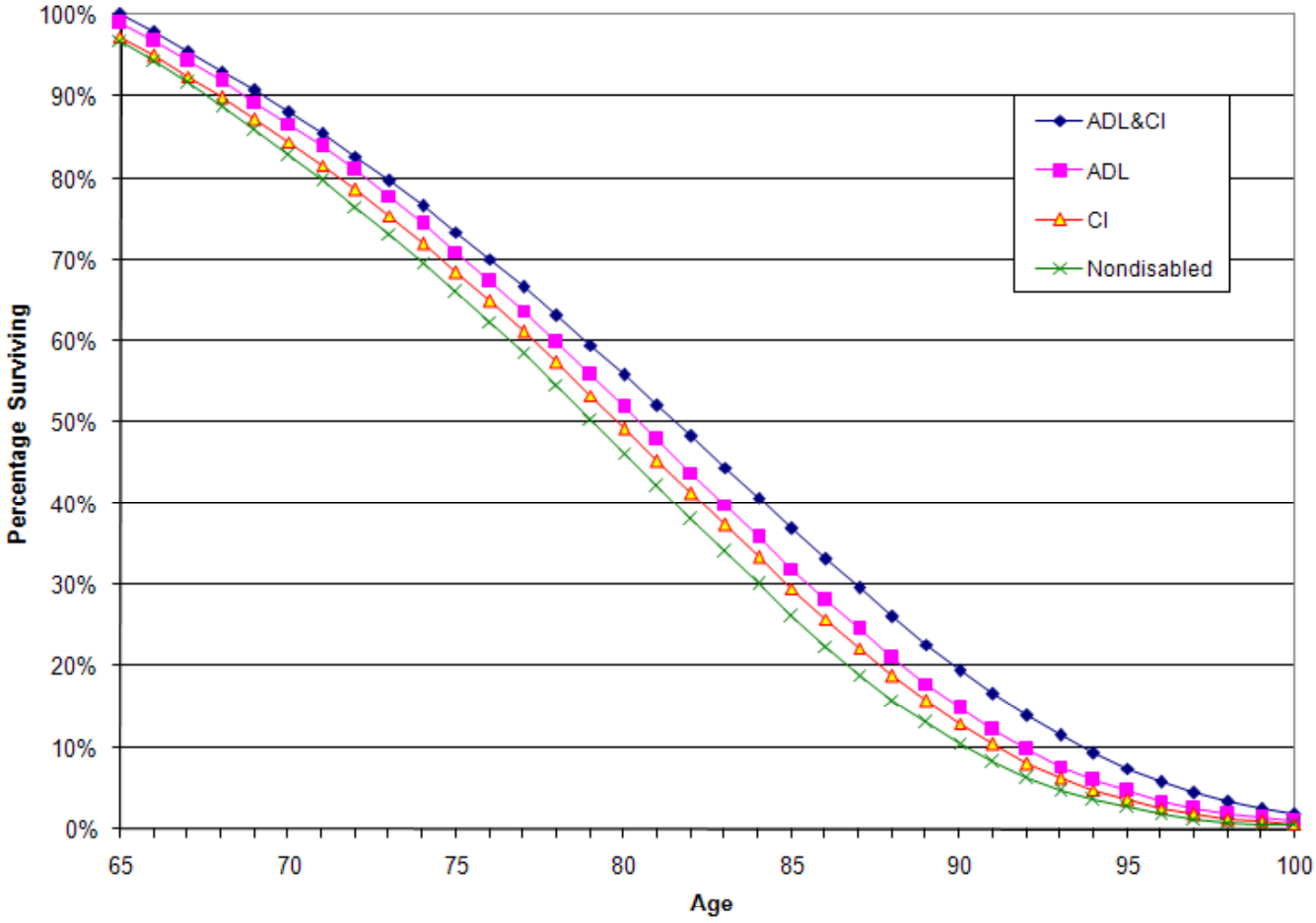
Table 2.29
Components of Change in Female Life Expectancy and HIPAA ADL/CI Expectancy (in Years at Age 65), United States 1984 and 2004

	Year				
At Age 65	1984	2004	Change	Survival Increment	Morbidity Decrement
Life Expectancy	18.66	19.50	0.84	0.84	—
HIPAA ADL/CI Expectancy	3.26	2.29	**-0.97**	**0.24**	**1.21**
Standard Error	0.06	0.06	0.09	0.01	0.09
t-statistic	51.54	35.28	**-10.70**	**47.01**	**12.87**

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

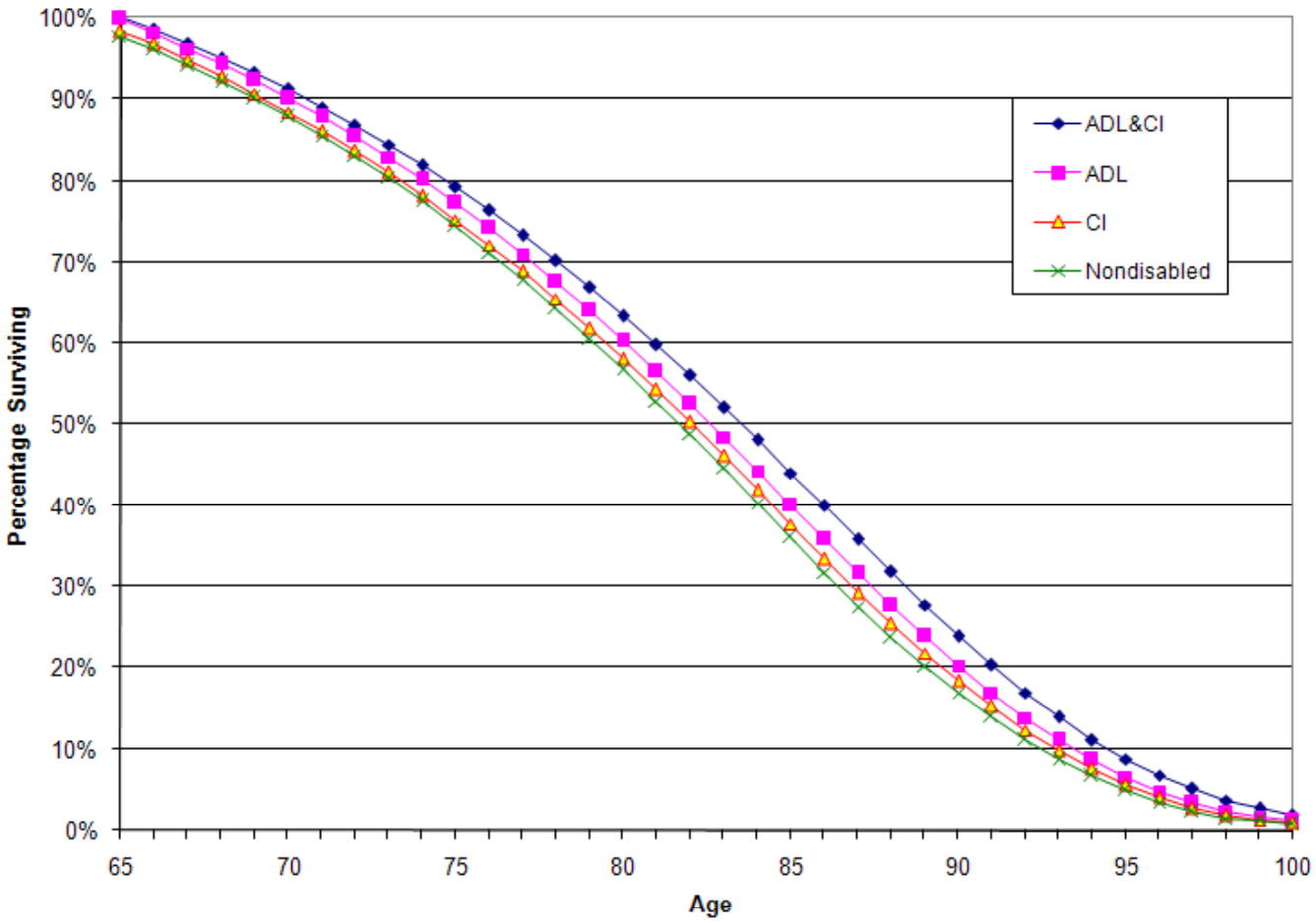
Decomposition of Disability – 1984

Figure 2.27a – Joint Relative Survival at Ages 65+, Meets Either HIPAA Trigger, United States, 1984, Unisex



Decomposition of Disability – 2004

Figure 2.27b – Joint Relative Survival at Ages 65+, Meets Either HIPAA Trigger, United States, 2004, Unisex



Sensitivity Analysis: More Statistics

Table 3.12a
Alternative Estimates of Change in Unisex HIPAA ADL/CI Expectancy (in Years at Age 65), United States 1984 and 2004

Weighting Protocol	Year 1984	Year 2004	Change	Survival Increment	Morbidity Decrement
Duke/PNAS Weight	2.50	1.81	**-0.70**	**0.35**	**1.05**
Adjusted Cox Weight	2.52	1.92	**-0.59**	**0.36**	**0.95**
Unadjusted Cox Weight	2.52	1.97	**-0.55**	**0.36**	**0.90**
Life Expectancy	16.64	18.11	1.48	1.48	—

Source: Authors' calculations based on the 1984 and 2004 NLTCS.

So What Did We Learn?

ADLs – Big declines in age-specific prevalence rates: 1.7%/yr.

- Rate of ADL decline was much greater for males than females, 2.1%/yr. vs. 1.4%/yr. (not shown).

CI – Much bigger declines in age-specific prevalence rates: 2.7%/yr. vs. 1.7%/yr.

- Rate of CI decline was more similar for males and females: 2.9%/yr. vs. 2.6%/yr. (not shown).

Combined ADL/CI – Intermediately big declines in age-specific prevalence rates: 2.3%/yr. vs. 1.7 or 2.7%/yr.

- Rate of ADL/CI decline was greater for males than females, 2.5%/yr. vs. 2.1%/yr.

So What Did We Learn?

- Declines in ADL and CI disability, separately and combined, were estimated with **high precision** and were **robust** with respect to alternative survey weighting protocols.

- Declines in ADL and CI disability were large enough to **substantially overcompensate** for the natural increase in disability due to mortality improvement.

- We found significant reductions in expected lifetime disability at age 65+, strongly supporting Fries' (1980) **Compression of Morbidity Hypothesis** when morbidity is defined using the HIPAA ADL and CI triggers.

Some Open Questions

- Can the rate of disability decline in the U.S. continue to be significantly larger than the rate of mortality decline?
- Why was the rate of improvement in CI so much greater than the rate of improvement in ADLs? and will the differentials continue?
- How will biomedical research and health care expenditures affect future disability and mortality rates?
- How will trends in these rates impact on LTC utilization and financing?

Thank You!

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References

Fries, J.F. Aging, natural death, and the compression of morbidity. *New England Journal of Medicine* 303(3):130–135, 1980.

Manton, K.G., Gu, X, and Lamb, V.L. Change in chronic disability from 1982 to 2004/2005 as measured by long-term changes in function and health in the U.S. elderly population. *Proceedings of the National Academy of Sciences, U.S.A.*, 103(48):18374–18379, 2006.

Potthoff, R.F., Woodbury, M.A. and Manton, K.G. "Equivalent sample size" and "equivalent degrees of freedom" refinements for inference using survey weights under superpopulation models. *Journal of the American Statistical Association*, 87(418):383–396, 1992.

Sullivan, D.F. A single index of mortality and morbidity. *HSMHA Reports* 86(4): 347-354, 1971.