



# Assessing SES differences in life expectancy: Issues in using longitudinal data

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# Why is this important?

- Socioeconomic disparities
- Life expectancy
- Longitudinal data



# Socioeconomic disparities

## ➤ Focus of health policy

“Inequalities in income and education underlie many health disparities in the United States.”

*Healthy People 2010: Understanding and Improving Health*



# Life Expectancy

- Useful (and intuitive) measure for summarizing mortality rates across all ages
- Derived from a life table

# Cohort life table for Swedish women born in 1890

Age	$q_x$	$a_x$	$l_x$	$d_x$	$L_x$	$T_x$	$e_x$
0	0.096	0.3	100000	9601	93663	5677927	56.78
1-4	0.072	1.5	90399	6484	345432	5584264	61.77
5-9	0.026	2.2	83915	2184	413539	5238832	62.43
10-14	0.019	2.5	81731	1563	404776	4825293	59.04
15-19	0.023	2.5	80168	1807	396315	4420517	55.14
20-24	0.026	2.7	78361	2013	387089	4024201	51.35
25-29	0.038	2.7	76348	2924	375058	3637112	47.64
30-34	0.022	2.4	73424	1579	362953	3262054	44.43
35-39	0.023	2.5	71845	1632	355189	2899102	40.35
40-44	0.024	2.4	70213	1685	346705	2543912	36.23
45-49	0.029	2.5	68528	1972	337737	2197208	32.06
50-54	0.034	2.6	66556	2290	327160	1859471	27.94
55-59	0.048	2.6	64266	3117	313786	1532310	23.84
60-64	0.068	2.7	61149	4131	296041	1218525	19.93
65-69	0.106	2.6	57018	6052	270723	922484	16.18
70-74	0.167	2.6	50965	8513	234671	651761	12.79
75-79	0.266	2.6	42453	11281	185158	417091	9.82
80-84	0.373	2.5	31172	11621	126755	231933	7.44
85-89	0.536	2.3	19550	10487	69875	105178	5.38
90-94	0.695	2.2	9063	6303	27651	35303	3.90
95-99	0.843	2.0	2761	2327	6812	7652	2.77
100-104	0.935	1.7	434	406	812	839	1.93
105-109	1	1.0	28	28	28	28	0.98
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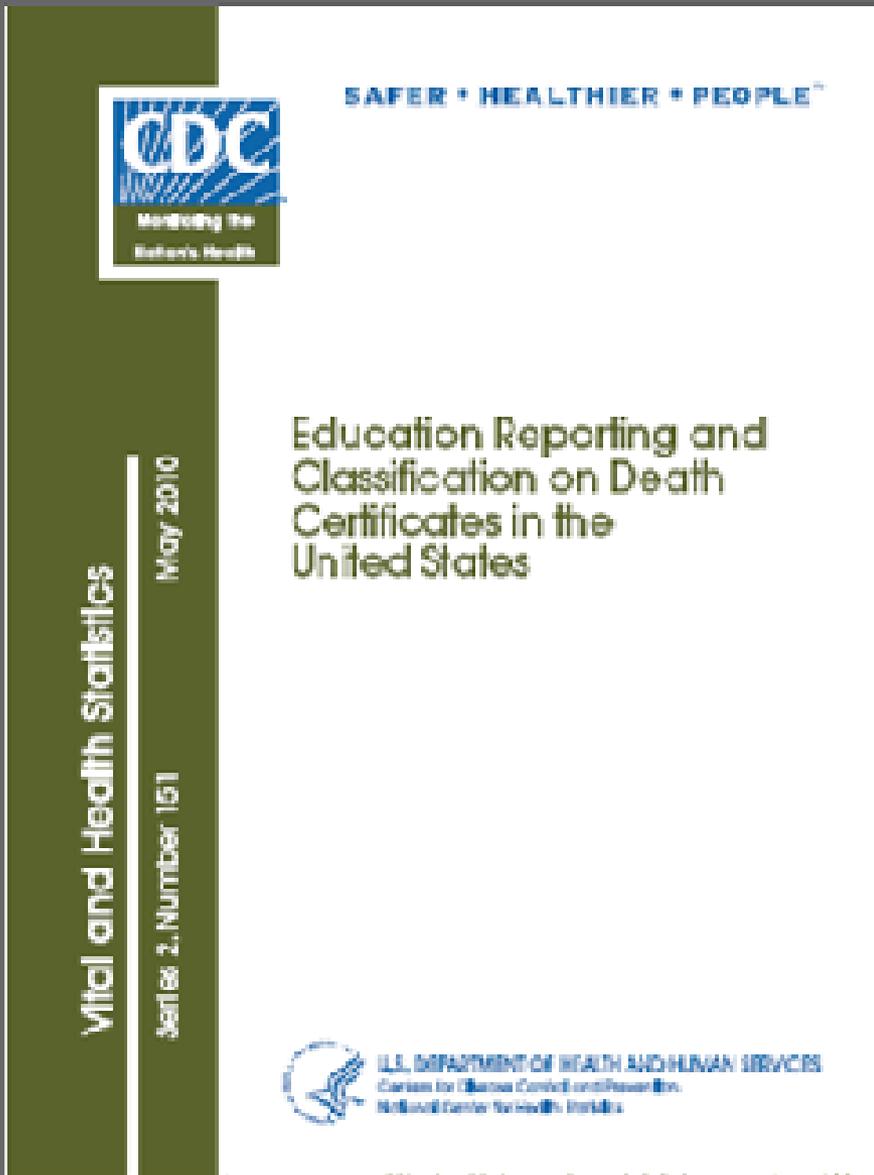
# Period Life Table for the United Kingdom, 1990

Age	Pop	deaths	$M_x$	$q_x$	$a_x$	$d_x$	$l_x$	$L_x$	$T_x$	$e_x$
<1	2,533	20	<b>0.0079</b>	<b>0.0078</b>	0.1	784	100000	99294	7198691	71.99
1-4	11,130	1	<b>0.0001</b>	<b>0.0004</b>	0.5	36	99216	396793	7099397	71.55
5-9	15,519	2	<b>0.0001</b>	<b>0.0006</b>	0.5	64	99180	495742	6702604	67.58
10-14	16,409	4	<b>0.0002</b>	<b>0.0012</b>	0.5	121	99116	495280	6206862	62.62
15-19	16,133	9	<b>0.0006</b>	<b>0.0028</b>	0.5	276	98996	494289	5711582	57.70
20-24	21,482	10	<b>0.0005</b>	<b>0.0023</b>	0.5	230	98720	493026	5217293	52.85
25-29	15,997	22	<b>0.0014</b>	<b>0.0069</b>	0.5	675	98490	490765	4724267	47.97
30-34	16,026	35	<b>0.0022</b>	<b>0.0109</b>	0.5	1062	97816	486422	4233501	43.28
35-39	19,800	34	<b>0.0017</b>	<b>0.0086</b>	0.5	827	96753	481698	3747080	38.73
40-44	16,076	39	<b>0.0024</b>	<b>0.0121</b>	0.5	1157	95926	476739	3265381	34.04
45-49	13,404	59	<b>0.0044</b>	<b>0.0218</b>	0.5	2063	94770	468690	2788642	29.43
50-54	13,027	108	<b>0.0083</b>	<b>0.0406</b>	0.5	3765	92706	454120	2319953	25.02
55-59	10,051	136	<b>0.0135</b>	<b>0.0654</b>	0.5	5820	88942	430157	1865832	20.98
60-64	10,220	176	<b>0.0172</b>	<b>0.0826</b>	0.5	6862	83121	398451	1435675	17.27
65-69	9,190	320	<b>0.0348</b>	<b>0.1602</b>	0.5	12214	76259	350763	1037224	13.60
70-74	7,427	445	<b>0.0599</b>	<b>0.2606</b>	0.5	16687	64046	278510	686461	10.72
75-79	5,231	414	<b>0.0791</b>	<b>0.3304</b>	0.5	15645	47358	197679	407951	8.61
80-85	2,884	355	<b>0.1231</b>	<b>0.4706</b>	0.5	14925	31713	121253	210272	6.63
85+	1,840	347	<b>0.1886</b>	<b>1.0000</b>	0.5	16788	16788	89019	89019	5.30



# Longitudinal data

- Allows the calculation of life expectancies for groups defined by survey characteristics
- Eliminates numerator/denominator inconsistencies



“This result tends to validate a specific concern about U.S. mortality estimates calculated from death certificate data. NCHS typically publishes U.S. mortality rates by education level for ages 25–64 because of concerns about the accuracy of death certificate education information at older ages....”

Limits the age range & number of education groups that can be compared

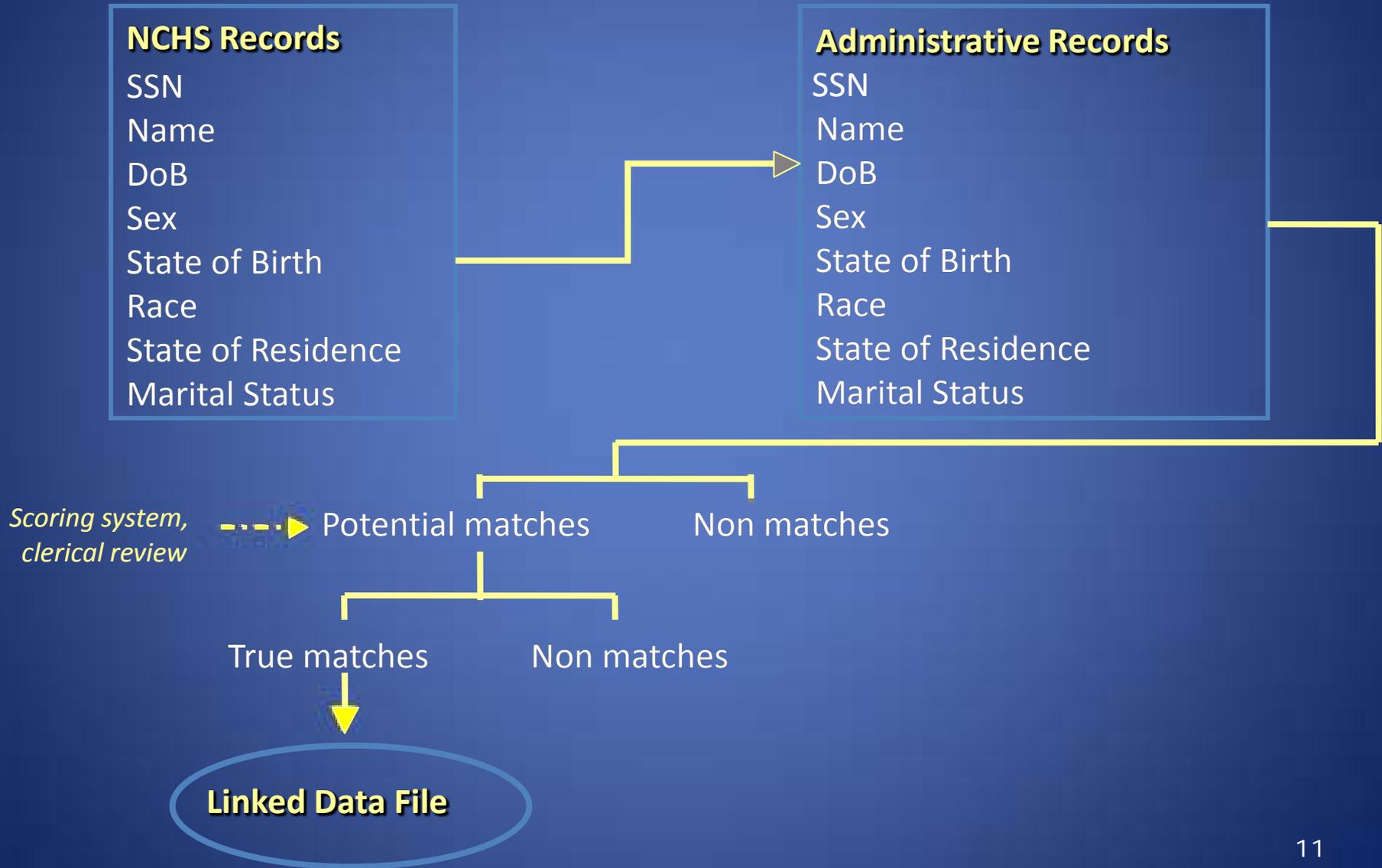


Issues arising from using  
longitudinal data to estimate  
life expectancies



# Data quality

# How Records are Linked

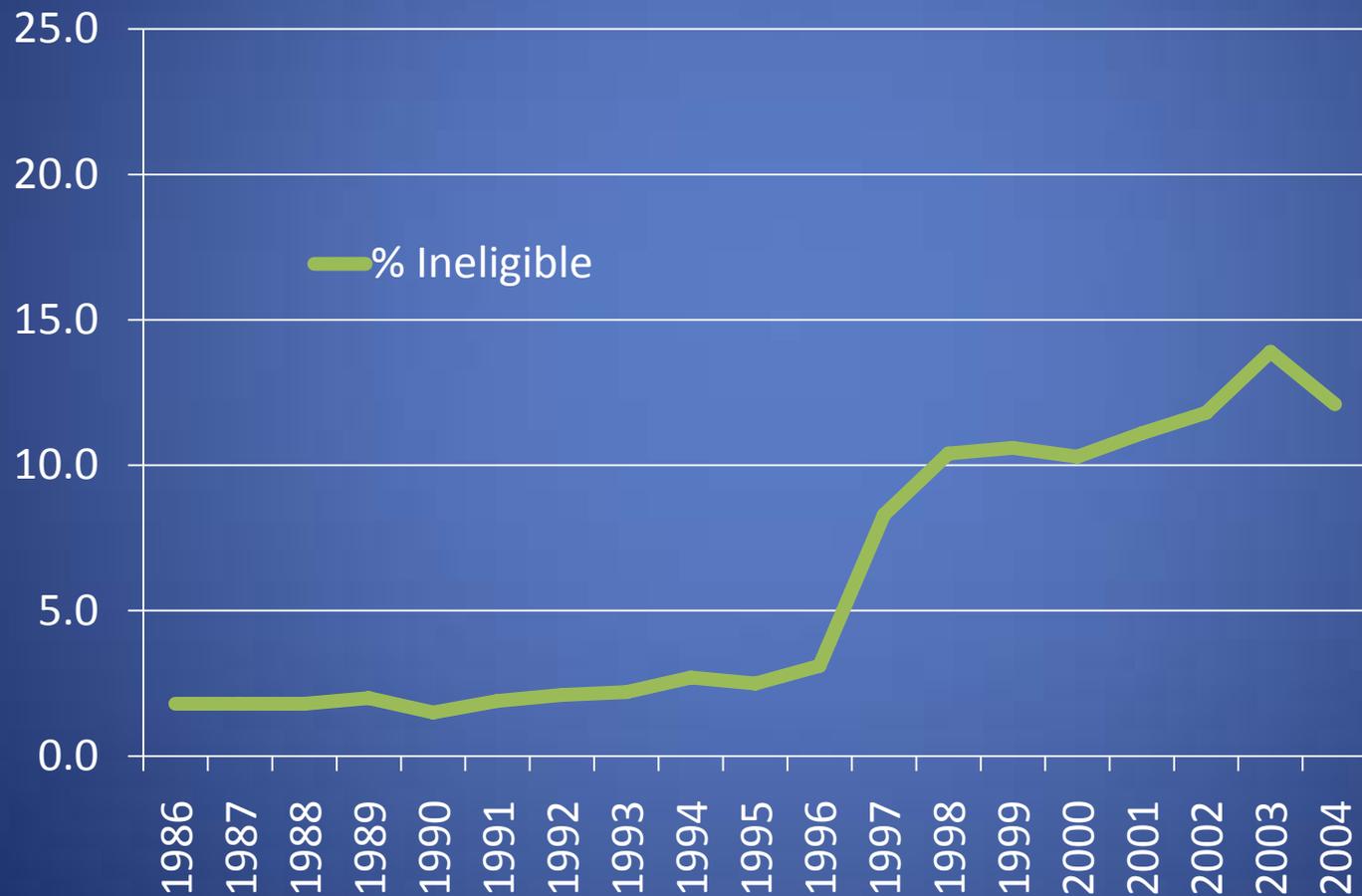




# Probabilistic Matching Procedure

- Missing identifying information from survey respondent → ineligible for matching
- Ineligibility not random across groups

# Percent of survey participants ineligible for NDI match: NHIS 1986-2004 survey years





# Addressing insufficient information for matching:

## ➤ Ineligibility-adjusted weights

- Reweighting of matched respondents to be representative of civilian, non-institutionalized population

## ➤ Exclusion of problem groups

- No separate analysis of Hispanics



Generating appropriate  
measures of sampling  
variability

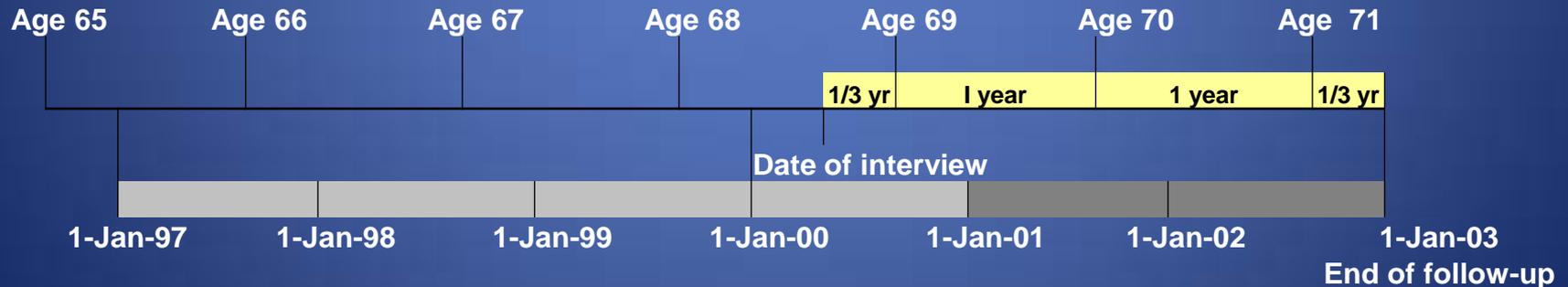
# Person-year calculations for the denominators of age-specific mortality rates

Hypothetical participants in a longitudinal study 1995-2000 with follow-up through 2003

## Interviewed in 1997 at age 65, died at age 71



## Interviewed in 2000 at age 68, no record of death



# Life Table for men with less than a high school education

## NHIS 2000-2004 with mortality follow-up through 12/31/2006

Age	Person- years	deaths	$nM_x$	$q_x$	$l_x$	$d_x$	$L_x$	$T_x$	$e_x$
25-29	1783386	1177	<b>0.0007</b>	<b>0.0033</b>	100000	329	499177	4726556	<b>47.27</b>
30-34	2801297	4450	<b>0.0016</b>	<b>0.0079</b>	99671	789	496382	4227379	<b>42.41</b>
35-39	3284224	7869	<b>0.0024</b>	<b>0.0119</b>	98882	1178	491467	3730998	<b>37.73</b>
40-44	4090508	22175	<b>0.0054</b>	<b>0.0267</b>	97705	2613	481991	3239531	<b>33.16</b>
45-49	3810275	27776	<b>0.0073</b>	<b>0.0358</b>	95092	3404	466949	2757540	<b>29.00</b>
50-54	3262289	41104	<b>0.0126</b>	<b>0.0611</b>	91688	5600	444439	2290591	<b>24.98</b>
55-59	3303044	65128	<b>0.0197</b>	<b>0.0940</b>	86088	8088	410218	1846152	<b>21.44</b>
60-64	3448930	68758	<b>0.0199</b>	<b>0.0949</b>	77999	7406	371482	1435934	<b>18.41</b>
65-69	3626932	115263	<b>0.0318</b>	<b>0.1472</b>	70594	10392	326989	1064452	<b>15.08</b>
70-74	3520709	158532	<b>0.0450</b>	<b>0.2024</b>	60202	12183	270553	737463	<b>12.25</b>
75-79	3128541	227089	<b>0.0726</b>	<b>0.3072</b>	48019	14751	203220	466910	<b>9.72</b>
80-84	2270825	209592	<b>0.0923</b>	<b>0.3750</b>	33268	12475	135156	263690	<b>7.93</b>
85-89	1227795	181566	<b>0.1479</b>	<b>0.5398</b>	20794	11225	75907	128535	<b>6.18</b>
90+	543131	124032	<b>0.2284</b>	<b>1.0000</b>	9569	9569	41901	52628	<b>5.50</b>

All data weighted using eligibility adjusted sample weights; closing value for the life table taken from 2000 vital statistics



# Obtaining standard errors for life expectancy derived from longitudinal data

Ideally, should take into account:

- Correlation within age-groups resulting from survey sampling design
- Correlation across age-groups resulting from respondents contributing to more than one age group



# Case study of the sensitivity of life expectancy standard errors to study and sample design:

Compared standard errors derived by

- Chiang method (traditional)
- Balanced Repeated Replication

Hybrid methods:

- BRR & Chiang
- Taylor Series (SUDAAN proc RATIO) & Chiang

# Comparison of standard errors

**Standard error as estimated by:**

	<b>E25</b>	<b>Chiang</b>	<b>Chiang / SUDAAN</b>	<b>Chiang/ BRR</b>	<b>BRR</b>
TOTAL	53.13	0.047	0.054	0.054	0.061
- Men	50.67	0.068	0.075	0.075	0.080
- non-Hispanic White	51.28	0.076	0.084	0.084	0.092
- < HS education	46.67	0.224	0.242	0.243	0.235
-Women	55.40	0.062	0.071	0.071	0.074
-non-Hispanic Black	51.90	0.184	0.207	0.208	0.210
- > HS education	54.55	0.366	0.428	0.427	0.435

# Study Conclusions

- Traditional method (Chiang) consistently underestimate standard errors

If balanced repeated replication procedure is impractical,

- Taylor Series (SUDAAN proc Ratio)/Chiang hybrid can yield reasonably accurate results for finer subgroups



# Exclusion of the institutionalized population

# Life expectancy at age 25 by sex and education level: NHIS/NDI linked mortality files, 1990-96\* & 2000-06\*

Education	Men				Women			
	1990-96*		2000 -06*		1990-96*		2000 -06*	
	e25	95% CI	e25	95% CI	e25	95% CI	e25	95% CI
<HS	46.1	45.4- 48.2	47.3	46.4- 48.2	52.3	51.6- 53.1	52.1	51.1- 53.2
HS/GED	50.3	49.8- 52.2	51.6	51.0- 52.2	56.4	56.0- 56.8	57.7	57.1- 58.2
Some college	51.2	50.5- 53.3	52.6	51.9- 53.3	57.8	57.2- 58.5	58.9	58.3- 59.6
College Grad+	54.4	53.8- 57.5	56.8	56.1- 57.5	58.8	58.0- 59.5	61.1	60.3- 61.9
Difference: College grad+ - <HS	8.3		9.5		6.5		9.0	

\* 1990-94 with follow-up through 1996; 2000-04 with follow-up through 2006



# Examination of the effect of excluding the facility dwelling elderly:

- Used MCBS data for facility dwelling beneficiaries for 1992-96/98 and 2000-2004/06
- Calculated death rates by sex and education level for ages 70-89 and combined with NHIS/NDI rates

# Life expectancy at age 25 by sex and education level: NHIS/NDI linked mortality files, 1990-96 & 2000-06 combined with MCBS files, 1992-98 & 2000-06

Education	Men				Women			
	NHIS/NDI		+ MCBS/NDI		NHIS/NDI		+ MCBS/NDI	
	1990- 96*	2000- 06	1990- 96*	2000- 06	1990- 96*	2000- 06	1990- 96*	2000- 06
<HS	46.1	47.3	45.4	46.2	52.3	52.1	51.1	49.9
HS/GED	50.3	51.6	49.5	50.8	56.4	57.7	55.2	55.6
Some college	51.2	52.6	51.1	51.7	57.8	58.9	56.8	56.6
College Grad+	54.4	56.8	54.2	55.8	58.8	61.1	58.5	59.1
<b>Difference: College grad+ - &lt;HS</b>	<b>8.3</b>	<b>9.5</b>	<b>8.8</b>	<b>9.6</b>	<b>6.5</b>	<b>9.0</b>	<b>7.4</b>	<b>9.2</b>

\*NHIS/NDI 1990-94/96 combined with MCBS 1992-96/98



# Using longitudinal data to examine SES differences in life expectancy

- Adds to our ability to routinely monitor SES differences in mortality
- Brings with it several methodological challenges