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Self-Care and Mobility Disability at Mid-Life in Lucky Few, Early-, and Late-Baby Boom Birth-Cohorts

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ABSTRACT

Disability is related in definite ways with makers of social stratum, as it can be influenced by and has the potential to contribute to the production and reproduction of social stratification. Intersectional markers of social stratification processes are ignored determinants of health. The Class, Race, Sex (CRS) hypothesis presented here argues that a low-education, racial-minority, and female *disadvantage* will compound to affect the prevalence and risks of disability. The evidence presented validates the CRS hypothesis by showing that disability prevalence and risk clusters first by class, race, and then sex. The cross-sectional study of community-dwelling adults in the Unites States, between the ages of 45 and 44, uses Public Use Microdata Sample (PUMS) 2010 files. The Lucky Few birth-cohort (born between 1936 and 1945) comes from the decennial 1990 PUMS file. The Early-Baby Boom birth-cohort (born between 1946 and 1955) comes from the decennial 2000 PUMS file. The Late-Baby Boom birth-cohort (born between 1956 and 1965) comes from the American Community Survey (ACS) 2010 PUMS file. Population-weighted disability prevalence and logistic regression models, using a total of 624,510 observations, support the CRS hypothesis. Decreasing health disparities requires that we continue to explore how the age-disability association differs between those at lower and upper socioeconomic stratum.

Keywords: demography; walking; ADL; life course; disparities; race;

INTRODUCTION

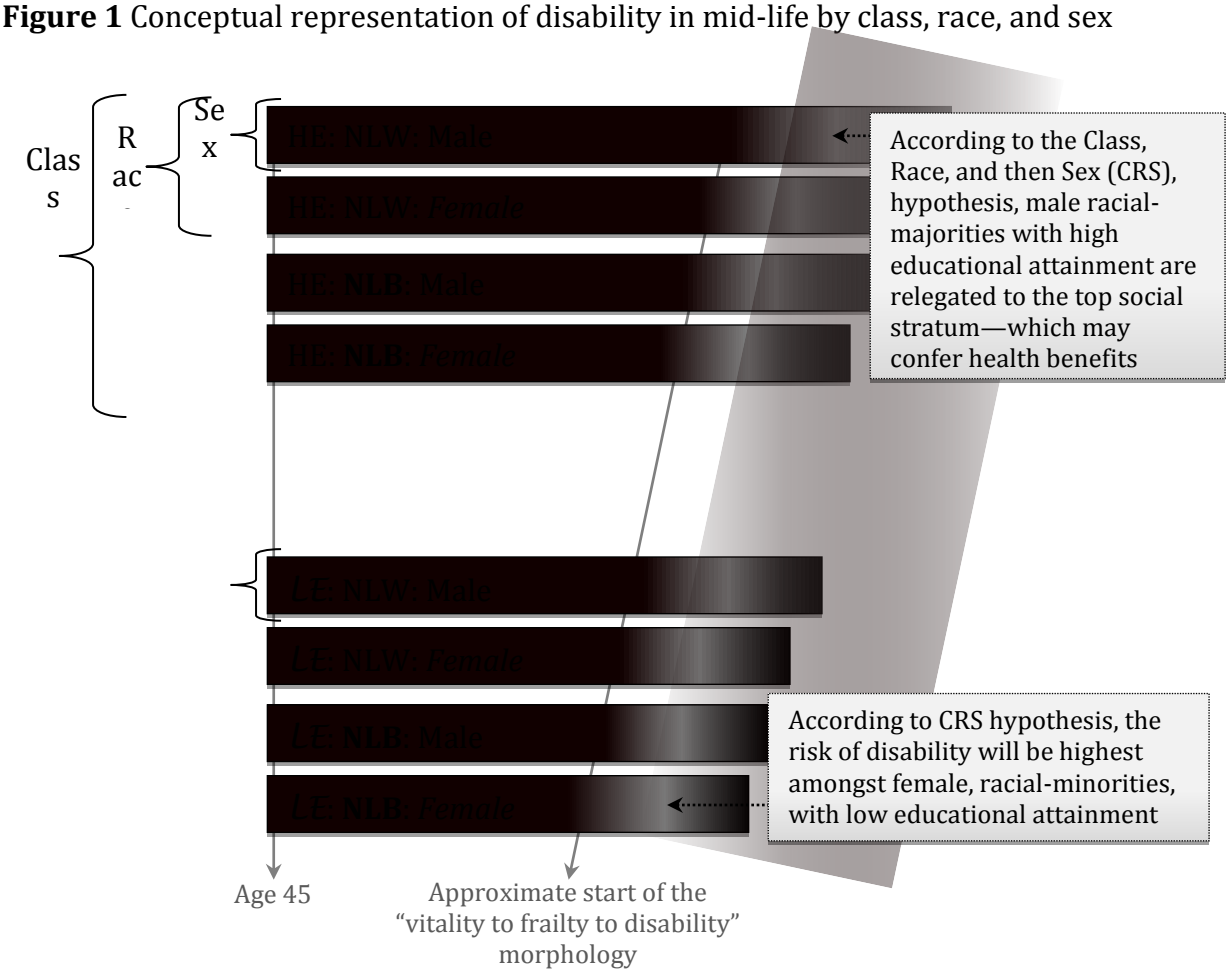
Conceptual models, at the ecological level, have been proposed to explain how disability prevalence would morph in the human population in the future. How, with the advancement of modern medicine, disability would develop in a life-span (maximum potential life). For example, in the 1980s Fries [1] presented a *compression of morbidity* hypothesis where natural limits to life span and a manipulable duration of morbidity before death were proposed. During the same time period, Manton [2] advanced a *dynamic equilibrium* hypothesis, where he posited that length of time with severe disease before death could be shortened by advances in medicine. In the mid-2000s Gruenberg [3] advance an *expansion of morbidity hypothesis*: where expanding

life span would be accompanied by longer periods in decline before death. The specific aim of this study is to investigate if and how the prevalence of disability has changed between the Lucky Few (born between 1936 and 1945), Early Baby Boom (born between 1946 and 1955), and Late Baby Boom (born between 1956 and 1965) birth-cohorts [4]. In doing so, the project explores whether self-care and mobility disability (defined below) have compressed, remained the same, or expanded between three neighboring birth-cohorts in the United States (US).

Because work has shown differences in disability by class [5,6], race [7,8], sex [6,9], and because neither the compression of morbidity, expansion of morbidity, nor the dynamic equilibrium hypotheses propose how prevalence and risk for disability would vary as a function of social stratification markers: the Class, Race, and *then* Sex (CSR) hypothesis is presented and tested. The CSR hypothesis argues that being in a lower socioeconomic status, of a racial-minority group, and female is accompanied with greater risk for disability. The study investigates the intersection between class, race, and sex in order to highlight important differences in disability prevalence and risk by social stratification markers [10].

The CSR hypothesis on disability amongst US residents at mid-life age ranges is visually represented in **Figure 1**. From the CSR perspective, disability is predicted to be lowest amongst those with a "high" level of educational attainment. Within this *upper-class* group, disability is expected to be lowest amongst individuals in the majority-race group: Non-Latino-White. Within this *majority-race* group, disability is expected to be lowest in the dominant sex group (i.e., males)—as the US may be considered a patriarchal society. Thus, if class is more important than race and the latter more important than sex, then: highly-educated males of the majority-race group can be expected to have the *lowest* risk for disability; whilst the lowest-educated females from the minority race-group could be expected to have the highest risk for disability. The 'vitality, to frailty, to disability' morphology (i.e., change from healthy to disabled) is captured in Figure 1 by the graying zones on the right hand-side of the bars. The CRS hypothesis posits that being socially stratified: to a low-class will burden the individual with a "low-education disadvantage"; to a racial-minority group will penalize the individual with a "racial-minority disadvantage"; and/or to an underpowered sex-group will unjustly create a "female disadvantage" [11]. Note how the hypothesis assumes that class is more important than race and the latter more than sex. Consequently, the CRS hypothesis predicts risk for disability will increase with each compounding marker of disadvantage.

Figure 1 Conceptual representation of disability in mid-life by class, race, and sex



HE=High education; LE=Low education; NLB=Non-Latino-Black; NLW=Non-Latino-White

METHOD

Data

The analysis uses cross-sectional data on community-dwelling adults in their mid-life from: the 1% 1990 Public Use Microdata Sample (PUMS) US Census Decennial file; the 1% 2000 Public Use Microdata Sample (PUMS) US Census Decennial file; and the single-year 2010 Public Use Microdata Sample (PUMS) American Community Survey file.

The 1% PUMS data files represent about 1 in 1000 people in the population and provide social, economic, and housing information on individuals. The 3 PUMS files are made available by the US Census Bureau to anyone with an internet connection. The individual-level data in all 3 PUMS files was created using a national random sample. Data from Decennial census helps the US federal government in many ways, for example by determining the apportionment of the electoral votes that decide the national presidency [12]. The American Community Survey (ACS) is used by US federal government to help allocation of billions of dollars each year. For

example, in 2008, ACS data influenced the distribution of $562.2 billion in grants and $520.7 billion in direct payments [13].

Sample

The study uses 624,510 actual observations, that when weighted equal 38,638,651 individuals in the US population across the various time periods and birth cohorts. The samples from 1990, 2000, and 2010 only include Non-Latino-Blacks and Non-Latino-Whites who were born in the contiguous US, who only speak English, and who are between the ages of 45 and 54. Thus, from the 1990 PUMS file, the analysis uses people born between 1936 and 1945—here referred to as the Lucky Few birth-cohort. From the 2000 PUMS file, the analysis uses people born between 1946 and 1955—here referred to as the Early-Baby Boom birth-cohort. From the 2010 PUMS file, the analysis uses people born between 1956 and 1965—here referred to as the Late-Baby Boom birth-cohort. There are 114,771 unweighted observations used to compute disability prevalence in the Lucky Few birth-cohort. There are 157,994 unweighted observations used to estimate disability prevalence in the Early-Baby Boom birth-cohort. There are 351,745 unweighted observations used to calculate disability prevalence in the Late-Baby Boom birth-cohort. The sample size between PUMS files varies as a function of population size and methodology for producing samples and the actual birth cohort size (i.e., Baby Boomers are a much larger birth-cohort). Despite the variability in sample size, each sample may be generalized to its respective year and to the population of Non-Latino-Blacks and Non-Latino-Whites who were born in the contiguous US, who only speak English, and who were between the ages of 45 and 54 during survey period.

Difficulties with Self-Care and Mobility

Only two "disability" items are assessed in this study as they are the only ones available across all three time points: "self-care" and "mobility." Self-care could be argued to provide a measure related to *basic* activities of daily living. Mobility could be argued to provide a measure to *instrumental* activities of daily living. Each question was asked slightly differently at each time point. For example, in 1990, the US Census Bureau assessed self-care and mobility in the decennial census with the following questions: "Because of a health condition that has lasted for 6 or more months, does this person have any difficulty: Taking care of his or her own personal needs, such as bathing, dressing, or getting around inside the house?"; and "Because of a health condition that has lasted for 6 or more months, does this person have any difficulty: Going outside the home alone, for example, to shop or visit a doctor's office?"

In 2000, the US Census Bureau assessed self-care and mobility in the decennial census as follows: "Because of a physical, mental, or emotional condition lasting 6 months or more, does this person have difficulty doing any of the following activities: Dressing, bathing, or getting around inside the home?"; and "Because of a physical, mental, or emotional condition lasting 6 months or more, does this person have difficulty doing any of the following activities: Going outside the home alone to shop or visit a doctor's office?" The questions changed in 2010, where the American Community Survey assessed self-care and mobility with the following questions: "Does this person have difficulty dressing or bathing?"; and "Because of a physical, mental, or emotional condition, does this person have difficulty doing errands alone such as visiting a doctor's office or shopping?"

There are differences in how the questions were asked between decennial and ACS questionnaires with regards to mobility and self-care: the condition that disability had to have been "lasting 6 months or more" was *only* made in the 1990 and 2000 questions; also, the

example of "getting around inside the house" was only used in the 1990 and 2000 self-care questions; in addition, the "going outside the home alone" statement in the 1990 and 2000 mobility questions was replaced in 2010 by the "doing errands alone" phrase. Readers should note that differences in questions, survey instrument, and interview mode have the potential to introduce measurement error. The fact that a condition had to last 6 months or more for both self-care and mobility only in the 1990 and 2000 datasets, but not in the 2010 data may influence the prevalence estimates by using a broader criteria in 2010. Unfortunately, there is now way to quantify the impact of removing the 6 month condition on the estimation of prevalence. This means over-reporting may be present for the Late-Baby Boom birth-cohort as their information comes from the 2010 PUMS file.

Class, Race, and Sex

Class is measured by educational attainment. Those with a bachelor's degree and beyond are coded as having a "high education" (HE) and those with less than a bachelor's degree as having a "low education" (LE). Alternate coding schemes for class status are discussed in closing. Two groups are included in the analysis: single-race African Americans who are not of Hispanic origin, labeled Non-Latino-Blacks (NLBs); and single-race Whites who are not of Hispanic origin, labeled Non-Latino-Whites (NLWs) [14]. The analysis only focuses on NLBs and NLWs to limit the complexity of the analysis. Including additional groups, e.g., Mexican-origin Hispanics, would require the delineation of a more complex CRS hypothesis to account for the Mexican paradox—i.e., the finding that low-socioeconomic (SES) status Mexicans have better health than other low SES individuals.

Under the assumption that when asked, "What sex are you?", individuals are responding with regards to their biological composition, the non-gender sex status is coded as male or female. The following CSR groups, in order from the most advantaged to most *disadvantaged*, are created: HE-NLW-male; HE-NLW-female; HE-NLB-male; HE-NLB-Female; LE-NLW-male; LE-NLW-female; LE-NLB-male; and LE-NLB-Female. The HE-NLW-males (i.e., the most advantaged group according to CSR hypothesis) are used as the reference group in regressions.

Statistical Approach

A SAS® 9.3 algorithm was used to produce estimates of CSR group size (i.e., denominators) and estimates on the number of disabled individuals within CSR groups (i.e., numerators). These estimates were used to compute the ratios (interpreted as percent) to discuss prevalence of disability by CSR groups. "Prevalence" in this paper refers to both new and existing cases—it measures the overall number of cases of disability within people surviving in the birth-cohorts. Thus, the numerator in the calculations of disability prevalence is the count of individuals in each CSR group and within birth-cohort who are disabled. The denominator consists of total number of people within CSR group and within birth-cohort from which cases of disability arise (i.e., the universe).

Logistic regression models predicting the likelihood of having a self-care or mobility disability (adjusting for age) are used to investigate how CRS groups are associated with the risk of being disabled. Model-1 predicts the likelihood of having self-care difficulty amongst CSR groups in the Lucky Few birth-cohort while adjusting for age. Model-2 predicts the likelihood of having self-care difficulty amongst CSR groups in the Early-Baby Boom birth-cohort while adjusting for age. Model-3 predicts the likelihood of having self-care difficulty amongst CSR groups in the Late-Baby Boom birth-cohort while adjusting for age. Model-4 predicts the likelihood of having mobility difficulty amongst CSR groups in the Lucky Few birth-cohort

while adjusting for age. Model-5 predicts the likelihood of having mobility difficulty amongst CSR groups in the Early-Baby Boom birth-cohort while adjusting for age. Model-6 predicts the likelihood of having mobility difficulty amongst CSR groups in the Late-Baby Boom birth-cohort while adjusting for age. The regression models do *not* include a population-weight variable.

RESULTS

Person Inflation Ratios

Table 1 presents the population-weighted and –unweighted counts for the CSR groups by birth cohort. The Person Inflation Ratio (PIR) is included as it is an informative value [14]. PIR is the average number of people being represented in weighted population by the unweighted count = (weighted ÷ unweighted)[15]. Note how PIR values from the 1990 and 2000 files range from 19 to 25, while the PIR values for 2010 range from 90 to 144. Thus, the average number of people being represented in population by each actual survey participant is much greater in 2010 than in 1990 and 2000. The 'amplification of representation' in the 2010 observations may be indicative that the standard errors (and thus size of widths in confidence limits) for "disability estimates" between the three time periods may be very different. As advised elsewhere [12,16], no statistical testing for the significance of disability prevalence between CSR groups is undertaken in this project.

Disability Prevalence between Birth-Cohorts

Table 2 shows the numerators used to compute the prevalence of disability by CSR groups and birth-cohorts. The corresponding denominators are given in Table 1. From the "Percent with Self-Care Difficulty" mid-section of Table 2 we see that in general prevalence of self-care disability is lower amongst those with a high-education and decreases as you move from the Lucky Few, to the Early- and Late Baby Boom birth-cohorts. The same pattern can be observed in the mid-section entitled "Percent with Mobility Difficulty" in Table 2. Note that in the "2010" columns from these two mid-sections in Table 2: the gradient of disability prevalence functions as predicted by the CSR hypothesis. Markers of social stratification show a gradient of disadvantage by class, race, and sex for the Late-Baby Boom birth-cohort.

The lowest section in Table 2, under the title "Change in Self-Care Prevalence" shows that when qualitatively compared (i.e., without statistical testing) to the Lucky Few birth-cohort: both the Early- and Late-Baby Boom birth-cohorts have a lower prevalence of self-care disability. This suggests self-care disability may be *compressing* within these three mid-life birth-cohorts in the US. In Table 2, towards the bottom and under the title "Change in Mobility Prevalence," we see that when qualitatively compared to the Lucky Few birth-cohort: the Early-Baby Boom birth-cohort has a *higher* prevalence of mobility disability; and in contrast the Late-Baby Boom birth-cohort has a *lower* prevalence of mobility disability. This suggests mobility disability may not be compressing uniformly across the three birth-cohorts. It may be that the compression of morbidity, expansion of morbidity, and dynamic equilibrium hypotheses need to be expanded to be made "disease specific."

CSR Hypothesis with Self-Care Difficulties

From Table 3, the logistic models predicting the likelihood of having self-care difficulties, while adjusting for age, provides partial support for the CSR hypothesis with the Lucky Few (Model-1) and Early-Baby Boom (Model-2) birth-cohorts and complete support with the Late-Baby Boom (Model-3) birth-cohort. In particular, from the Lucky Few birth-cohort (i.e.,

odds ratios on the 1990 column), we see that low-education NLW males have a higher risk (3.13) than low-education NLW females (2.33) for having a self-care difficulty compared to high-education NLW males. This "male disadvantage" contradicts the "female disadvantage" predicted by the CRS hypothesis. A similar thing is observed in the Early-Baby Boom birth-cohort (i.e., odds ratios on the 2000 column), where low-education NLW males have a higher risk (4.17) than low-education NLW females (3.96) for having a self-care difficulty compared to high-education NLW males.

Despite this nuanced finding, the regression results predicting self-care disability for both the Lucky Few and Early-Baby Boom birth-cohorts support the CRS hypothesis in that class is more important, followed by race, and then sex. The CRS hypothesis is supported, without exception, with results from the Late-Baby Boom birth-cohort. The gradient of the odds ratios (under self-care in column 2010) clearly show that the low-education, minority-race, and female-disadvantage compound to increase risk of self-care difficulties.

CSR Hypothesis with Mobility Difficulties

From Table 3, the logistic models predicting the likelihood of having mobility difficulties, while adjusting for age, also provides partial support for the CSR hypothesis with the Lucky Few (Model-4) and Early-Baby Boom (Model-5) birth-cohorts and complete support from the Late-Baby Boom (Model-6) birth-cohort. In particular, from the Lucky Few birth-cohort (i.e., odds ratios under mobility and the 1990 column), we see that low-education NLW males have a higher risk (4.27) than low-education NLW females (3.88) for having a mobility difficulty compared to high-education NLW males. This "male disadvantage" contradicts the "female disadvantage" predicted by the CRS hypothesis. A similar thing is observed in the Early-Baby Boom birth-cohort (i.e., odds ratios under mobility and the 2000 column), where low-education NLW males have a higher risk (3.91) than low-education NLW females (3.44) for having a mobility difficulty compared to high-education NLW males.

Despite this nuanced finding, the mobility regression results for both the Lucky Few and Early-Baby Boom birth-cohorts support the CRS hypothesis in that class is more important, followed by race, and then sex. Here too, the CRS hypothesis is supported, without exception, with results from the Late-Baby Boom birth-cohort. The gradient of the odds ratios (under mobility in column 2010) clearly show that the low-education, minority-race, and female-disadvantage compound to increase risk of mobility difficulties.

Table 1 Population-weighted and –unweighted counts for Lucky Few, Early, and Late Baby Boom birth-cohorts

	Weighted Count			Unweighted Count			Person Inflation Ratio		
	1990[1]	2000[2]	2010[3]	1990	2000	2010	1990	2000	2010
High-Education									
NLW[4]: Male	268,080	436,772	4,148,107	13,117	21,427	44,771	20	20	93
NLW: Female	217,475	449,464	4,353,344	10,766	22,529	48,354	20	20	90
NLB[5]: Male	13,941	22,143	291,205	566	968	2,577	25	23	113
NLB: Female	20,831	31,240	471,188	873	1,386	4,272	24	23	110
Low-Education									
NLW: Male	630,623	777,751	10,027,781	32,097	41,948	107,547	20	19	93
NLW: Female	894,526	1,035,180	10,061,518	45,811	55,780	110,405	20	19	91
NLB: Male	130,944	147,464	1,890,559	5,350	6,735	16,072	24	22	118
NLB: Female	146,231	154,980	2,017,304	6,191	7,221	17,747	24	21	114

[1]Lucky Few; [2]Early Baby Boom; [3]Late Baby Boom; [4]NLW= Non-Latino-White; [5]NLB=Non-Latino-Black

Table 2 Population-weighted disability prevalence and between birth-cohort change

	Self-Care Numerator			Mobility Numerator		
	1990[1]	**2000**[2]	**2010**[3]	**1990**	**2000**	**2010**
High-Education						
NLW[4]: Male	3,407	3,160	25,305	2,460	8,249	40,981
NLW: Female	2,399	5,049	34,540	2,490	9,322	72,353
NLB[5]: Male	623	463	3,707	262	1,411	7,031
NLB: Female	1,259	681	6,542	418	2,063	11,749
Low-Education						
NLW: Male	25,457	23,033	294,795	23,142	53,396	514,055
NLW: Female	26,812	29,690	323,020	30,185	64,609	638,582
NLB: Male	13,604	6,402	79,634	8,156	19,270	150,391
NLB: Female	14,935	8,651	110,332	11,046	21,705	184,346

	Percent with Self-Care Difficulty			Percent with Mobility Difficulty		
	1990	**2000**	**2010**	**1990**	**2000**	**2010**
High-Education						
NLW: Male	1.3%	0.7%	0.6%	0.9%	1.9%	1.0%
NLW: Female	1.1%	1.1%	0.8%	1.1%	2.1%	1.7%
NLB: Male	4.5%	2.1%	1.3%	1.9%	6.4%	2.4%
NLB: Female	6.0%	2.2%	1.4%	2.0%	6.6%	2.5%
Low-Education						
NLW: Male	4.0%	3.0%	2.9%	3.7%	6.9%	5.1%
NLW: Female	3.0%	2.9%	3.2%	3.4%	6.2%	6.3%
NLB: Male	10.4%	4.3%	4.2%	6.2%	13.1%	8.0%
NLB: Female	10.2%	5.6%	5.5%	7.6%	14.0%	9.1%

	Change in Self-Care Prevalence			Change in Mobility Prevalence		
	1990	**2000**	**2010**	**1990**	**2000**	**2010**
High-Education						
NLW: Male	ref	-0.5%	-0.7%	ref	1.0%	-0.9%
NLW: Female	ref	0.0%	-0.3%	ref	0.9%	-0.4%
NLB: Male	ref	-2.4%	-3.2%	ref	4.5%	-4.0%
NLB: Female	ref	-3.9%	-4.7%	ref	4.6%	-4.1%
Low-Education						
NLW: Male	ref	-1.1%	-1.1%	ref	3.2%	-1.7%
NLW: Female	ref	-0.1%	0.2%	ref	2.9%	0.1%
NLB: Male	ref	-6.0%	-6.2%	ref	6.8%	-5.1%
NLB: Female	ref	-4.6%	-4.7%	ref	6.5%	-4.9%

[1]Lucky Few; [2]Early Baby Boom; [3]Late Baby Boom; [4]NLW= Non-Latino-White; [5]NLB=Non-Latino-Black

Table 3 Logistic regressions predicting likelihood of having a self-care or mobility difficulty

	Predicting Self-Care			Predicting Mobility		
	Model-1	**Model-2**	**Model-3**	**Model-4**	**Model-5**	**Model-6**
	1990[1] OR[4]	**2000[2] OR**	**2010[3] OR**	**1990 OR**	**2000 OR**	**2010 OR**
High-Education						
NLW[5]: Male	ref	ref	ref	ref	ref	ref
NLW: Female	0.86†	1.54	1.27	1.39	1.08†	1.61
NLB[6]: Male	3.56	2.91	2.10	2.09	3.47	2.58
NLB: Female	4.99	2.93	2.63	2.18	3.73	2.74
Low-Education						
NLW: Male	3.13	4.17	4.96	4.27	3.91	5.43
NLW: Female	2.33	3.96	5.26	3.88	3.44	6.69
NLB: Male	9.04	6.25	8.13	8.13	8.07	9.49
NLB: Female	8.58	7.99	10.42	9.25	8.59	11.06
Age	1.03	1.05	1.06	1.05	1.03	1.04

The gradient predicted by the CRS hypothesis is present in the Late Baby Boom birth-cohort (i.e., in 2010):

Risk for disability compounds with a low-education, minority-race, and female *disadvantage*

† only coefficients not statistically significant, all others significant at least at $\alpha < 0.01$
[1]Lucky Few; [2]Early Baby Boom; [3]Late Baby Boom; [4]Odds Ratio; [5]Non-Latino-White; [6]Non-Latino-Black

CONCLUSION

The Class, Race, and then Sex (CSR) hypothesis finds support in the current analysis, which uses data on Lucky Few, Early- and Late-Baby Boom birth-cohorts. The findings show disability prevalence and risk clusters first by class, race, and then sex. More generally, it makes use of 624,510 actual observations to show that intersectional markers of social stratification are predictive of disability prevalence and risk.

There are limitations with the current study. Foremost is the fact that the cross-sectional approach prohibits us from understanding if the presences of differences in disability prevalence by educational attainment at mid-life reflect the impact of health on class rather than vice versa. The relationship between social stratification and disability may be bidirectional [17] and evidence exist that being socioeconomically disadvantaged precedes the presentation of disability [18]. The causal relationship between social and economic disadvantage and disability should be continually investigated as cross-sectional studies frequently find evidence of a gradient between disability and socioeconomic status [19,20]. The regression models are limited in that they do not measure comorbidity, body mass index, or more sophisticated measures of social status. Researchers should investigate this topic with data that includes these measures. In addition, future work should test alternate thresholds in educational attainment [21].

The analysis is limited in that issues relating to time effect and selection bias may affect the samples from the different decennial years. For example, it may be that changes in medical treatment and prevention awareness between 1990 and 2010 influenced the prevelance of self-care and mobility. The analysis does not account for whether such events actually played a role in the measured forms of disability. In addition, using education to measure class is complicated by the fact that the portion of people who had college degrees in the 1930s may be smaller than the 1960s—especially in females. The models do not account for how educational attainment increase between birth-cohorts. Future studies should seek to implement remedies to these limitations.

As has been shown before [22], the present study finds a gradient relationship between markers of social stratification and disability. Notwithstanding limitations, the study clearly shows that the compression of morbidity, expansion of morbidity, and dynamic equilibrium hypotheses may be improved in their predictive ability by making them disease specific. The investigation also provides evidence that *intersectional markers of social stratification* are important for modeling risk of disability. The findings lend support to the CSR hypothesis introduced in this paper by showing compounding penalties for risk of self-care and mobility disability first by class; then race; and finally by sex. Expanding public health's understanding of disability in the population necessitates that markers of social stratification be considered as we continue to explore how non-random mechanisms affect adverse health. Researchers should consider intersectional markers of social stratification as important determinants of disability in the US population.

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