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Education Reporting and Classification on Death Certificates in the United States



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics

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Education Reporting and Classification on Death Certificates in the United States

Data Evaluation and Methods Research

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics

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Abstract

Objectives

This report analyzes education reporting and classification on the death certificate and their effect on estimates of mortality and life expectancy by education level in the United States.

Methods

The National Longitudinal Mortality Study (NLMS) was used to analyze education information on the death certificate for participants in the Current Population Survey (CPS) from 1992 through 1998 who died by the end of 1998. Educational attainment reported on the death certificate for these persons was compared to their educational attainment reported in the CPS. NLMS was also used to calculate classification ratios consisting of the number of deaths by education level in the CPS compared to the number of deaths by education level on the death certificate. These classification ratios were then used to produce estimates of life expectancy by education level for the United States in 2005, adjusted for probable education misreporting on the death certificate.

Results

Comparison of educational attainment from the death certificate and CPS shows differences due to the different classification systems used in the two sources and probable misreporting on the death certificate. The difference is most pronounced regarding graduation from high school. Black and Hispanic persons at the high school graduate level appear to be more likely than other racial or ethnic groups to have their educational attainment underreported on the death certificate as less than 4 years of high school completed. Adjusted estimates for the U.S. population show a large disparity in life expectancy by education level, on the order of 10–12 years for females and 11–16 years for males.

Keywords: mortality • life expectancy • health disparities • socioeconomic status

Education Reporting and Classification on Death Certificates in the United States

by *Brian L. Rostron, Ph.D.*; *John L. Boies, Ph.D.*; and *Elizabeth Arias, Ph.D.*

Introduction

Disparities in mortality and life expectancy by educational attainment in the United States have attracted considerable attention from researchers and government agencies in recent decades (1). Accurate estimates of these differences for the U.S. population have been difficult to obtain because death counts and population counts, which provide the numerators and denominators for mortality rates, come from different sources and the information in these sources may be inaccurate or use different classification systems. Death counts by education level come from information on the death certificate, but death certificate education information is often inaccurate. Errors in education reporting on the death certificate usually occur when information is reported by a funeral director who may not have accurate information about the education of the deceased. Population counts by education level, on the other hand, come from information reported by persons in the census or social surveys about their own education or the education of fellow household members, and this information is considered to be generally accurate. Estimation of mortality measures is made even more difficult because different classification systems, typically categorizing educational attainment by year of education completed or degree completed, can be used on the death certificate and in social surveys and the categories in one system may not correspond exactly to categories in other systems.

This report analyzes education reporting on the death certificate by comparing educational attainment as reported on the death certificate and in the Current Population Survey (CPS). Data come from CPS participants from 1992 through 1998 who were included in the National Longitudinal Mortality Study (NLMS) and who died by the end of 1998. Results are presented for the total population and for selected racial or ethnic groups, including Asian or Pacific Islander and Hispanic persons, for whom this information has not been produced previously (2).

This report also uses NLMS data to calculate classification ratios that compare educational attainment reported in the CPS with educational attainment reported on the death certificate. These ratios are then used to produce adjusted estimates of mortality rates and life expectancy for the U.S. population that measure mortality differences by education level more accurately than unadjusted estimates. These classification ratios also allow for the estimation of mortality measures for more specific education levels, such as college graduate, than was possible in previous studies.

Background

Previous studies of education reporting on death certificates in the United States

Differences in mortality by educational attainment in the United States have been an important research topic for several decades. In 1973,

Kitagawa and Hauser published a landmark cross-sectional study of mortality differentials by measures of socioeconomic status including education in the United States (3). They found substantive differences in mortality by education level for both white men and women, with persons with less education generally having higher levels of mortality. Researchers subsequently reached this same general conclusion using longitudinal data from sources such as NLMS (4–6), and found that mortality differentials by educational attainment decreased but still existed when controls for other socioeconomic factors such as income, employment, and marital status were included in the analyses (5,6). Researchers also found that mortality differentials by educational attainment vary by sex, race, or ethnicity in the United States, with differences being greater for men than women and for African-American persons than white persons (7). Studies using U.S. vital statistics data have typically estimated mortality differentials for two or three broad education levels because of concerns about the accuracy of death certificate education information for more specific levels (1,8,9). Some studies using vital statistics data have also restricted analysis to ages 25–64 because of concerns about the accuracy of death certificate education information for persons who died at older ages (9).

Because the death certificate is an important source of information about the relationship between education and mortality, researchers have also examined the accuracy of education information on death certificates. Sorlie and Johnson compared death certificate education information for over 10,000 persons in the NLMS who died in 1989 to their education information in the CPS (2). They found that educational attainment tended to be overreported on the death certificate compared with survey data. In particular, those who were identified as having not completed 4 years of high school in the CPS were often reported as having completed 4 years of high school on the death certificate. Two smaller studies found similar results. Shai and Rosenwaike

showed that educational attainment was often overreported on the death certificate for older men, based on comparison of death certificate information from New York and Utah from 1982 through 1986 with information reported in the American Cancer Society Cancer Prevention Study II (CPS–II) (10). Makuc, Feldman, and Mussolino also concluded that educational attainment tended to be overreported on the death certificate, in their study of 800 participants in the first National Health and Nutrition Examination Survey (NHANES I) who died during the years 1989–1993 (11).

This report expands upon previous research on education reporting on the death certificate by analyzing deaths from a longer and more recent period. It also introduces new variables into this analysis, in particular additional racial or ethnic categories. The report also shows how education reporting on the death certificate affects mortality measures for the United States by estimating life expectancy by education level with and without adjustment for differential reporting.

Data and Methods

Evaluation of Education Reporting on Death Certificates

Data

NLMS was used to analyze education reporting on the death certificate in the United States. NLMS is a longitudinal cohort study of mortality administered by the U.S. Census Bureau. It consists of records from participants in the CPS and CPS Annual Demographic Supplements, dating back to 1973, as well as a subset of the United States 1980 Census participants (12). The U.S. Census Bureau conducts the CPS on a monthly basis as a complex probability sample of the civilian, noninstitutionalized population to obtain demographic and economic information about the United States. The surveys, which are conducted by

personal and telephone interview, are administered to 60,000 occupied housing units and have a response rate of close to 96% (13). CPS records in the NLMS are linked with death certificate information obtained through the National Vital Statistics System (NVSS). NVSS is the voluntary contractual arrangement between the National Center for Health Statistics (NCHS) and registration areas to collect U.S. birth and death data. NVSS coverage includes over 99% of deaths that occur in the registration areas, which consist of the 50 states, the District of Columbia, New York City, and the U.S. territories (14).

NLMS currently contains records for 2.3 million persons from 26 cohorts of survey participants from the years 1973 and 1978–1998. These records are followed for mortality by periodically matching the records to the National Death Index (NDI), which contains death certificate information collected by NVSS for all decedents in the United States since 1979. NDI is maintained by NCHS. Approximately 250,000 deaths in the NLMS have been identified through linkage with the NDI for deaths from 1979 through the end of 1998 (12).

Death certificate education information in the NLMS was reported using a year-based system. The U.S. Standard Certificate of Death included an item about educational attainment for the first time with the 1989 revision. Some registration areas including New York state, Puerto Rico, and Utah had added an education item to their death certificates in the 1970s (10). The education item from the 1989 revision categorized educational attainment according to the highest grade of education completed. Educational attainment could be reported as 0–12 years of primary and secondary education and 1–4 or 5 or more years of college education (15). Forty-five states and the District of Columbia included the education item on the death certificate in 1989, and in 33 of these areas the education item on the death certificate was completed for at least 80% of deaths. By 1998, 47 states and the District of Columbia included the item on the death certificate, and all of these areas except Kentucky had 80% completion of the item (16).

CPS education information in the NLMS was reported using a year-based or degree-based system. From the inception of the CPS in the 1940s until 1992, survey participants were asked to identify the highest grade or year of school that they and each member of their household had attended and whether the grade or year had been completed (17). Respondents could report completing 0–8 years of elementary school, 1–4 years of high school, or 1–6 or more years at a college or university. Beginning in January 1992, the CPS education item was changed to ask for the highest level of school completed or degree received. Survey participants could report completing 0–12 grades of education without graduating from high school; receiving a high school diploma or GED; attending some college without receiving a degree; or completing an associate's, bachelor's, master's, or professional or doctorate degree. The revised degree-based education item was tested in the February 1990 CPS (17). Respondents were asked to report educational attainment in the year-based system as part of the regular survey and in the degree-based system in a follow-up question. In most cases, respondents reported educational attainment in the two systems at levels that were considered comparable in the CPS, such as 4 years of high school completed and high school graduate or 4 years of college completed and bachelor's degree. In some cases however, respondents reported educational attainment for individuals at levels that were not considered comparable. Some of these differences probably occurred because individuals had completed a certain number of years of education without completing what was considered to be the corresponding degree. For example, a CPS respondent could report the educational attainment of a person who completed 4 years of college without obtaining a college degree as 4 years of college completed in the year-based system and some college but no degree in the degree-based system, even though these levels were not considered comparable in the CPS. Other differences probably resulted from slight variations in the levels in the

two classification systems. For example, 10% of persons reported as having 4 years of high school completed as their educational attainment in the year-based system were also reported as having some college but no degree as their educational attainment in the degree-based system, even though these levels were not considered comparable in the CPS. Some of these differences in reporting probably occurred because individuals had completed some college-level coursework, as reported in the degree-based system, without being enrolled in college for at least 1 year, and thus were not reported in the year-based system as having completed at least 1 year of college (17).

In this report, comparable levels in the year-based and degree-based classification systems will generally be defined as less than 4 years of high school completed and less than high school graduate, 4 years of high school completed and high school graduate, 1–3 years of college and some college including community college but no bachelor's degree, 4 years of college and bachelor's degree, and more than 4 years of college and graduate degree. These comparable levels are consistent with the more detailed comparable levels presented in the CPS report that explained the transition from the year-based classification system to the degree-based classification system in the survey (17).

Response rates for the education item in the CPS have been relatively consistent over time, with educational attainment missing for approximately 2.6% of participants in March 2003 and 2.8% participants in March 2009 (18). For CPS participants who do not report educational attainment, the information is imputed using a “hot deck” procedure that assigns an education level based on the response in a record with similar demographic characteristics such as age, race, and sex (13).

Selection of NLMS records for analysis

Decedents in the NLMS who were included in the CPS from 1992 through 1998 and who were aged 25 and over at the time of survey, were identified in mortality follow-up through the end of

1998. These cohorts were selected for analysis so that decedents had their educational attainment reported in the CPS using a single, consistent classification system. Given that most education is completed by age 25, it was assumed that there was little change in educational attainment between the time of survey and the time of death for these persons. Out of the 12,401 identified decedents who met these criteria, 2,750 lacked death certificate education information. Decedents whose deaths occurred in states in years in which an education item was not included on the death certificate or in which completion of the education item did not reach 80%, were then excluded from analysis. Additionally, death certificate education information for two states (Louisiana and New York) is not included in the NLMS, and decedents from these states were also omitted. [Table 1](#) lists the states by year for which decedents were removed for these reasons. After the removal of these decedents, 10,570 decedents remained, of which 1,199 lacked death certificate education information.

Methods

Education reporting on the death certificate was analyzed by comparing education information reported on the death certificate for NLMS decedents with education information reported for these same persons in the CPS. The analysis was conducted for decedents overall, and for decedents categorized by sex, race, or ethnicity as reported in the CPS and age at death as calculated from the death certificate. All analyses in this report that used NLMS data were conducted with deaths weighted by the appropriate person weights from the CPS.

Differences in education reporting on the death certificate and in the CPS for NLMS decedents generally occur for two reasons. One reason is that the education information in one source can be inaccurate, typically the death certificate. It is generally assumed that education information in the CPS is correct, given that education information that is self-reported or reported by a fellow household member is usually

more accurate than information reported on the death certificate by a funeral director, who often has little personal knowledge of the decedent. Funeral directors are supposed to obtain education information from the decedent's next of kin, but sometimes this does not occur or the next of kin does not know this information. The second reason is that the sources used different classification systems. Death certificate education information for NLMS decedents was classified using a year-based system, whereas CPS education information was classified using a degree-based system. These classification systems have similar education levels, but as previously noted, research from the CPS has shown that in some cases educational attainment can be accurately reported in the two classification systems at levels that are not considered comparable (17).

Because of the use of different classification systems in the sources, it was not possible in this report to distinctly identify differences in reported educational attainment that were due to misreporting on the death certificate, as opposed to discrepancies caused by classification differences. As such, only general inferences about differences in education reporting in the data sources were made in this report because of the limitations of the data. These inferences were based on NLMS data as well as findings in previous research on the topic.

NLMS data were also used to calculate classification ratios by education level. These ratios consist of the total number of decedents with a particular level of educational attainment in the CPS divided by the total number of decedents with the comparable level on the death certificate. The ratios are similar to those produced in "The Validity of Race and Hispanic Origin Reporting on the Death Certificates in the United States" for racial or ethnic reporting on death certificates (19). The ratios can be used as adjustment factors to correct for bias in education reporting found on death certificates. The use of the classification ratios as adjustment factors is described in greater detail in the section on the effect of death certificate education reporting on

mortality measures.

Death certificate education information was imputed for NLMS decedents that were missing this information, for the calculation of the classification ratios. The classification ratios have death counts by education level from the death certificate as their denominators, so missing death certificate data would have caused the ratios to be centered on a value greater than 1.0. NLMS decedents without death certificate education information generally had lower educational attainment in the CPS than decedents with this information. For example, 49% of decedents without death certificate education information did not graduate from high school according to the CPS compared with 35% of decedents with death certificate education information. Because of these differences, simply omitting decedents without death certificate education information for the calculation of the classification ratios or assigning them the same education distribution as decedents with death certificate education information would have tended to bias the ratios. Instead, educational attainment for the death certificate was imputed for decedents without death certificate education information based on their educational attainment as reported in the CPS. The imputation procedure is described in detail in the "Technical Notes" section. In summary, the process assigned decedents without death certificate education information and with a particular CPS education level the same proportional distribution of educational attainment for the death certificate that was observed in the NLMS for decedents with death certificate education information who also had this same CPS education level.

Effect of Death Certificate Education Reporting on Mortality Measures

Data

The classification ratios were used with 2005 mortality and population data to estimate mortality measures by educational attainment for the United

States. Death counts by education level for the United States were obtained from death certificate information collected by the NVSS. Deaths were classified by state of occurrence, given that state of occurrence determined which state's death certificate was used to categorize educational attainment. In 2005, states used one of two education items on their death certificates: the year-based item from the 1989 revision of the standard death certificate or a degree-based item from the 2003 revision of the certificate. The degree-based item from the 2003 revision categorized educational attainment according to the highest level or degree of education completed (15), using the same classification system used in the CPS since 1992. In 2005, 31 states used the year-based education item from the 1989 revision of the standard death certificate, and 17 states used the degree-based education item from the 2003 revision. Two states (Georgia and Rhode Island) did not include either education item on their death certificates, and the District of Columbia switched to the 2003 education item during the year. For the sake of convenience, states using the education item from the 1989 revision of the standard death certificate in 2005 are referred to as the "1989 unrevised states" in the remainder of this report. States using the education item from the 2003 revision are referred to as the "2003 revised states." Overall in 2005, 2.4% of death certificates from the 1989 unrevised states and 1.9% of death certificates from the 2003 revised states were missing education information. All of the 1989 unrevised states and 2003 revised states had at least 80% completion of the education item used on their death certificates (16).

Population counts by education level used to calculate U.S. mortality measures for 2005 came from the CPS's Annual Social and Economic Supplement (formerly the Annual Demographic Supplement), which is conducted each March. This supplement obtains additional demographic information such as marital status, geographic mobility, work status and occupation, and educational attainment. The supplement is administered to

approximately 39,000 housing units in addition to the 60,000 units eligible for the basic monthly CPS, to obtain more reliable data for certain minority groups (20). Weighted sample results from the CPS are adjusted to agree with independent estimates of the civilian, noninstitutionalized population by age, sex, race, Hispanic origin, and state of residence. Population estimates from the CPS are adjusted to match midyear resident population totals for reporting states when used by NCHS to calculate mortality rates by education level (9).

Methods

Mortality rates by education level for the United States in 2005 were calculated from these death and population counts, with and without adjustment for differences in education reporting on the death certificate compared to the CPS. Because of the different classification systems used on death certificates, mortality rates were calculated separately for the 1989 unrevised and 2003 revised states. This division of states by classification system is customary in vital statistics reports that present mortality measures by educational attainment (9). For each group of states, death counts by education level from the death certificate were multiplied by the appropriate classification ratio obtained from the NLMS to produce counts adjusted for differential education reporting. This adjustment process can be represented for each education level i as,

$$\text{Observed Death Count}_i^* \text{ Classification Ratio}_i = \text{Adjusted Death Count}_i.$$

The adjustment process generally converted death counts to the degree-based classification system, as will be seen in greater detail. The adjusted death counts were then divided by the corresponding population counts by education level from the CPS, also categorized using the degree-based system,

$$\frac{\text{Adjusted Death Count}_i}{\text{Population Count}_i} = \text{Adjusted Mortality Rate}_i,$$

to calculate adjusted mortality rates by education level.

Mortality rates for 2005 were calculated for more specific education levels for the 1989 unrevised states than for the 2003 revised states. The 1989 unrevised states used the same year-based education item on their death certificates that was used on the death certificates of the NLMS decedents. Death counts by education level for the 1989 unrevised states were thus produced with the same classification system used to produce the death counts used as the denominators of the classification ratios. The adjustment process therefore converted death counts by education level for these states (U.S.) from the year-based system used on their death certificates (DC) to the degree-based system:

$$\begin{aligned} & (\text{Observed death count}_i) \\ & \text{U.S. DC Deaths in Year - Based System}_i^* \\ & (\text{Classification ratio}_i) \\ & \text{NLMS CPS Deaths in Degree - Based System}_i = \\ & \text{NLMS DC Deaths in Year - Based System}_i \\ & (\text{Adjusted death count}_i) \\ & \text{U.S. DC Deaths in Degree - Based System}_i \end{aligned}$$

The adjusted death counts were then divided by CPS population counts, also categorized using the degree-based system, to calculate adjusted mortality rates by education level. This agreement in classification systems allowed adjusted mortality rates for the 1989 unrevised states to be estimated for five degree levels: less than high school graduate, high school graduate or equivalent, some college but no degree or associate's degree, bachelor's degree, and graduate degree.

This type of consistent agreement between sources did not exist for the 2003 revised states, which used the degree-based education item. Death counts for these states were also adjusted for differential education reporting by multiplying them by the appropriate classification ratios:

$$\begin{aligned} & (\text{Observed death count}_i) \\ & \text{U.S. DC Deaths in Degree - Based System}_i^* \\ & (\text{Classification ratio}_i) \\ & \text{NLMS CPS Deaths in Degree - Based System}_i = \\ & \text{NLMS DC Deaths in Year - Based System}_i \\ & (\text{Inexact adjusted death count}_i) \\ & \text{U.S. DC Deaths in Degree - Based System}_i \end{aligned}$$

These adjustments were not exact, however, because the death counts for these states and the death counts in the denominators of the classification ratios were categorized using different classification systems. Observed death counts for these states need to be adjusted for probable misreporting on the death certificate, but the classification ratios adjust for differences in classification systems and probable misreporting on the death certificate. Because of this inexact adjustment, the adjusted mortality rates for the 2003 revised states were calculated for three broad education levels: less than high school graduate, high school graduate, and more than high school graduate. This more general classification system is usually used for mortality measures by educational attainment when estimates are considered to be inexact due to misreporting on the death certificate or the use of different classification systems in the sources (9). It should be possible in the future to calculate mortality rates for the 2003 revised states more exactly and for more specific education levels. This will be possible when survey data linked to mortality data collected based on the 2003 revision of the standard death certificate are available in sufficient quantity to allow for calculation of classification ratios using only education data categorized with the degree-based system.

Approximately 2% of deaths in 2005 in both the 1989 unrevised states and 2003 revised states lacked death certificate education information, and these deaths were proportionally allocated to the various education levels for the calculation of mortality rates. It was assumed that the education distribution for U.S. decedents without death certificate education information was the same as the education distribution for U.S. decedents with death certificate education information. This allocation procedure for U.S. deaths differed from the imputation procedure used in the calculation of classification ratios with NLMS data. The procedure for U.S. deaths was used because of the small proportion of deaths without death certificate

education information and the absence of additional education information in U.S. mortality records that could be used to infer an education level for the death certificate.

Calculated mortality rates were then used to estimate life expectancy by educational attainment in the United States in 2005. Standard life table techniques were used (21), with mortality rates for advanced ages calculated for the open-ended age group of 85 and over.

Results

Evaluation of Education Reporting on Death Certificates

Results validate concerns about education reporting on the death certificate and illustrate the effects of different classification systems in the data sources. The overall distribution of educational attainment on the death certificate for NLMS decedents is shown by CPS education level in [Table 2](#). Educational attainment is shown using the comparable five-level classification systems for death certificate information, reported in the year-based system, and CPS information, reported in the degree-based system. The table suggests considerable differences in education reporting in the two sources, due to both differences in the classification systems in the sources and probable misreporting on the death certificate. Overall, calculation using data presented in [Table 2](#) shows that 28% of decedents had educational attainment reported on the death certificate and in the CPS at levels that are not considered comparable in this report. The correspondence between death certificate and CPS education reporting seen here is generally consistent with the results found by Sorlie and Johnson for deaths of NLMS participants that occurred in 1989 (2).

The results also indicate important differences in education reporting for particular education levels, some due to

differences in the classification systems and others likely due to misreporting. For example, 19% of decedents with less than a high school education in the CPS were identified on the death certificate as having completed 4 years of high school. This result is consistent with findings in previous studies, which found that people not completing 4 years of high school were often misreported as having completed 4 years of high school on the death certificate (2,10,11). In addition, 28% of decedents with some college education but no bachelor's degree in the CPS were identified as having 4 years of high school completed as their educational attainment on the death certificate, even though these education levels are not considered comparable in the CPS and in this report. Much of this particular difference in reporting is probably due to the use of different classification systems. Testing in the CPS showed that 18% of individuals reported as having some college education but no bachelor's degree with the degree-based item were also reported as having 4 years of high school completed as their educational attainment with the year-based item (17).

Sex and age

Results assessing education reporting on the death certificate are also presented by key demographic characteristics. The distribution of educational attainment on the death certificate is shown by sex in [Table 3](#), and [Table 4](#) presents classification ratios by sex. The ratios again suggest that the less than high school graduate or less than 4 years of high school level is underrepresented and the high school graduate or 4 years of high school level overrepresented on the death certificate compared to CPS data. The ratios also suggest that the bachelor's degree or 4 years of college level is overrepresented on the death certificate compared to CPS data, particularly for women. One reason for this result, as shown in [Table 3](#), is that 22% of women with a graduate degree in the CPS were reported on the death certificate as having completed 4 years of college.

[Table 5](#) presents the education distribution on the death certificate by age at death. The same patterns in agreement and disagreement between death certificate and CPS information seen in the overall data are generally observed for each of the three age groups. Educational attainment, however, is generally much higher at younger ages, with 20% of decedents aged 25–44 having less than a high school education in the CPS compared to 46% of decedents aged 65 and over (data not shown).

Race and Hispanic origin

[Tables 6](#) and [7](#) identify differences in education reporting on the death certificate by race and Hispanic origin, which are especially noticeable at the CPS high school graduate level. Educational attainment from the death certificate and the CPS are classified using comparable three-level classification systems because of the small numbers of deaths that are available for education levels such as bachelor's degree and graduate degree for some racial or ethnic groups. [Table 6](#) shows that black persons reported as high school graduates in the CPS were more likely to have their educational attainment reported as less than 4 years of high school completed on the death certificate (16%) than white high school graduates (10%). [Table 6](#) also indicates that 22% of Asian or Pacific Islander high school graduates had their educational attainment reported as more than 4 years of high school completed on the death certificate, compared to 10% of white high school graduates. [Table 7](#) shows that Hispanic high school graduates were more likely to have their education reported as less than 4 years of high school completed on the death certificate (14%) than non-Hispanic high school graduates (10%).

Effect of Death Certificate Education Reporting on Mortality Measures

The classification ratios shown in [Table 4](#) were used to adjust death counts for differential education reporting on

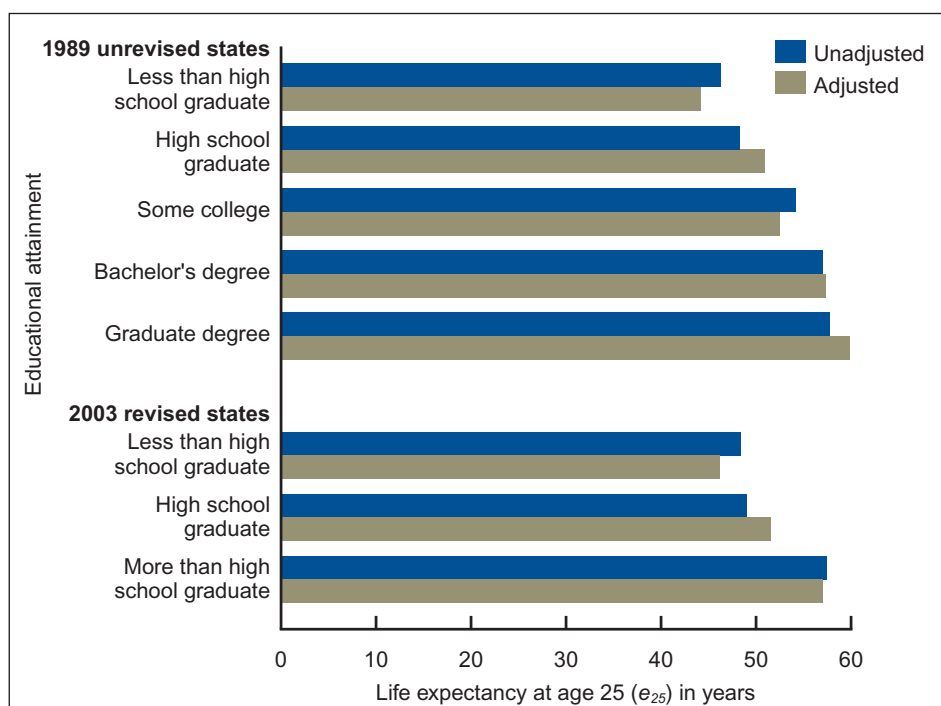


Figure 1. Adjusted and unadjusted life expectancy for males at age 25, by educational attainment: United States, 2005

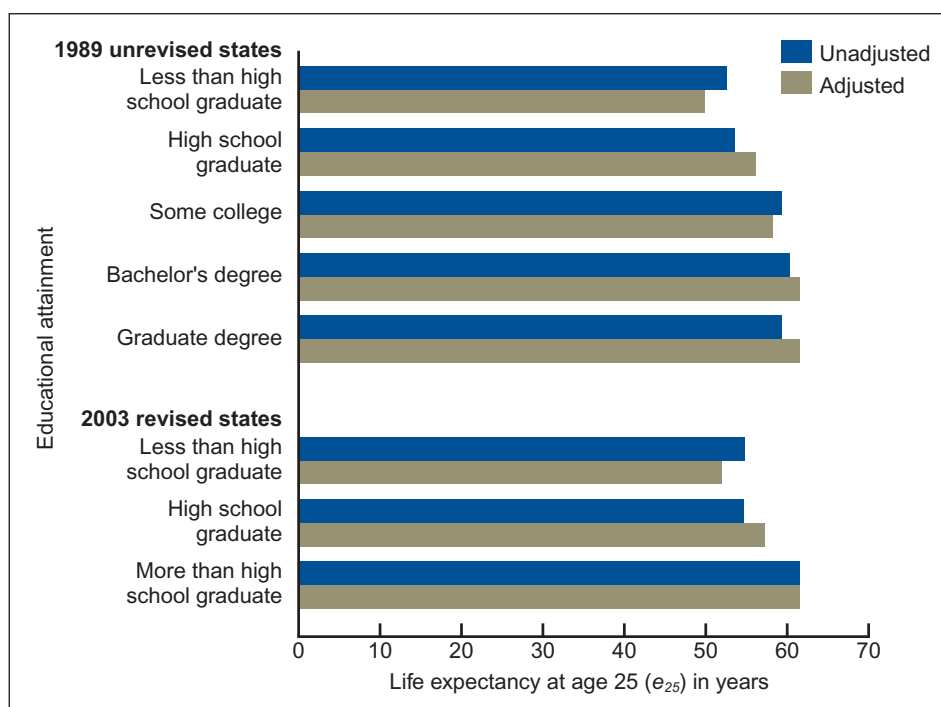


Figure 2. Adjusted and unadjusted life expectancy for females at age 25, by educational attainment: United States, 2005

the death certificate to improve mortality estimates. Tables 8 and 9 and Figures 1 and 2 present estimates of life expectancy at selected ages calculated from unadjusted and adjusted death counts for the United States in 2005. Estimates are given using the five-level classification system for the 1989

unrevised states, which used the year-based education item, and the three-level classification system for the 2003 revised states, which used the degree-based item.

As indicated in Tables 8 and 9, estimates of U.S. life expectancy by education level calculated from adjusted

data are more consistent and plausible than estimates from unadjusted data. The effect of adjustment is most apparent at the less than high school graduate and high school graduate levels given that unadjusted estimates of life expectancy for individuals without a high school education are close to or higher than estimates of life expectancy for high school graduates at some ages. This pattern is particularly noticeable at older ages. This result is not found with adjusted data, nor has it been found in previous studies that used CPS education data to estimate life expectancy by educational level (4,7). Higher unadjusted values of life expectancy for individuals who are not high school graduates compared to high school graduates are probably caused by education misreporting on the death certificate. As indicated in Table 2, those with less than a high school education in survey data are often reported as having completed 4 years of high school on the death certificate. This differential reporting tends to increase unadjusted life expectancy for people who are not high school graduates and decrease life expectancy for people who are high school graduates. Adjustment of death counts, however, corrects for differential reporting on the death certificate and produces estimates of life expectancy that generally increase with greater educational attainment. Overall, adjusted life expectancy at age 25 in the United States in 2005 varied by education level by 10–12 years for females and 11–16 years for males.

Summary and Conclusion

This report has examined the reporting and classification of education information on the death certificate in the United States through comparison with CPS education information. It has found substantial differences in reporting in the sources, some of which are probably due to misreporting on the death certificate and some of which are due to differences in the classification systems in the sources. These findings generally validate concerns about the

validity of mortality measures by education level from unadjusted death certificate data (9). This report has also shown, however, that classification ratios obtained from the NLMS can be used to adjust for differential education reporting and improve mortality estimates by education level.

Results presented here have also identified specific patterns of differential education reporting on the death certificate in the United States that affect mortality estimates. This report supports the finding that it is common for individuals who did not complete high school to have their educational attainment reported on the death certificate as having completed 4 years of high school. 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 (9). Given that the age group 65 and over in the United States has a higher proportion with less than a high school education than younger age groups, these results indicate that rates obtained from unadjusted mortality data for those aged 65 and over are particularly unreliable. This report has shown, however, that classification ratios can adjust for differential education reporting at older ages, thus allowing the estimation of mortality measures for advanced ages.

This report has also examined patterns in education reporting and classification on the death certificate in the United States for racial or ethnic groups. The classification systems used in the sources did not correspond exactly, but black and Hispanic high school graduates in the CPS appeared to be more likely than white or non-Hispanic high school graduates to have their educational attainment underreported on the death certificate. Asian or Pacific Islander high school graduates in the CPS also appeared to be more likely than white high school graduates to have their educational attainment overreported on the death certificate. Additional research is needed to verify these trends and to produce

mortality rates and life tables by educational attainment for specific racial or ethnic groups.

This report has also found the general pattern of mortality differentials by educational attainment observed previously, namely that life expectancy in the United States consistently increases with greater education and that differences in life expectancy by education level are greater for men than women. The range of values for U.S. life expectancy by education level found in this report is consistent with previously published results from death certificate data (1,8), although the adjustment process used here to correct for education misreporting has increased the accuracy of results for particular education levels and allowed for the estimation of mortality measures for more specific education levels.

This report has also illustrated the complications introduced by the use of different classification systems for educational attainment in the data sources. The use of a year-based item on the 1989 revision of the standard death certificate, as opposed to the degree-based item on the 2003 revision and in the CPS, has made the evaluation of education reporting on the death certificate and estimation of mortality measures for the 2003 revised states inexact. This situation should improve when data collected with the degree-based item of the 2003 revision are available in sufficient quantity to allow for the evaluation of education reporting on the death certificate and the calculation of classification ratios using data collected with a single classification system.

Finally, this analysis has other limitations that should be noted. Most notably, the classification ratios used to adjust for education misreporting on U.S. death certificates in 2005 were obtained using data from the years 1992–1998. Education reporting on the death certificate changes over time, so the classification ratios may not correct exactly for misreporting in more recent years. The classification ratios were also calculated from data that omitted decedents from certain states, and it is not known what effect, if any, these omissions had on the results.

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Table 1. Education reporting on the death certificate, by state, 1992–1998

Year	States without education item on death certificate	States with less than 80% completion of education item on the death certificate	States with death certificate education information not linked to NLMS
1992	Georgia, Oklahoma, Rhode Island, South Dakota	Connecticut, Kentucky, New York, West Virginia	Louisiana, New York
1993	Georgia, Oklahoma, Rhode Island, South Dakota	Kentucky, New York, West Virginia	Louisiana, New York
1994	Georgia, Oklahoma, Rhode Island, South Dakota	Kentucky	Louisiana, New York
1995	Georgia, Oklahoma, Rhode Island, South Dakota	Kentucky	Louisiana, New York
1996	Georgia, Oklahoma, Rhode Island, South Dakota	Kentucky	Louisiana, New York
1997	Georgia, Rhode Island, South Dakota	Kentucky	Louisiana, New York
1998	Georgia, Rhode Island, South Dakota	Kentucky	Louisiana, New York

NOTE: NLMS is National Longitudinal Mortality Study.

SOURCES: CDC/NCHS, National Vital Statistics System and National Longitudinal Mortality Study.

Table 2. Education distribution on the death certificate, by Current Population Survey education level: National Longitudinal Mortality Study deaths from 1992–1998 cohorts

CPS education level	Death certificate education level						Total	
	0–3 years of high school	4 years of high school	1–3 years of college	4 years of college	5 or more years of college	Unknown	Percent of weighted deaths by CPS education level	Number of deaths by CPS education level
	Percent							
Less than high school graduate	66	19	1	0	0	13	41	4,389
High school graduate.	10	69	9	1	0	10	32	3,349
Some college	3	28	49	9	2	10	15	1,611
Bachelor's degree.	1	5	11	60	14	9	8	792
Graduate degree	1	2	2	16	70	9	4	429
Total weighted deaths by death certificate education level.	31	35	12	7	4	11	100	10,570

NOTE: CPS is Current Population Survey.

Table 3. Education distribution on the death certificate, by Current Population Survey education level and sex: National Longitudinal Mortality Study deaths from 1992–1998 cohorts

CPS education level	Death certificate education level											
	Female						Male					
	0–3 years of high school	4 years of high school	1–3 years of college	4 years of college	5 or more years of college	Unknown	0–3 years of high school	4 years of high school	1–3 years of college	4 years of college	5 or more years of college	Unknown
	Percent											
Less than high school graduate	63	21	1	0	0	14	69	18	1	0	0	12
High school graduate.	10	70	8	1	0	11	11	68	10	1	0	10
Some college	3	28	49	8	1	11	3	28	48	9	2	9
Bachelor's degree.	1	5	12	61	13	9	2	5	11	59	14	9
Graduate degree	2	1	2	22	64	9	1	3	2	14	72	8
Total weighted deaths by death certificate education level.	30	37	11	7	3	12	32	32	12	8	6	10

NOTE: CPS is Current Population Survey.

Table 4. Classification ratios of Current Population Survey deaths to death certificate deaths, by education level and sex: National Longitudinal Mortality Study deaths from 1992–1998 cohorts

Education level			
CPS	Death certificate	Females	Males
Less than high school graduate.	Less than 4 years of high school	1.23 (.021)	1.17 (.018)
High school graduate	4 years of high school	0.81 (.017)	0.82 (.018)
More than high school graduate	More than 4 years of high school overall	1.00 (.021)	1.03 (.018)
Some college.	1–3 years of college	1.09 (.041)	1.16 (.043)
Bachelor's degree	4 years of college	0.91 (.047)	0.97 (.043)
Graduate degree.	5 or more years of college	0.80 (.066)	0.84 (.038)

NOTES: Standard errors are in parentheses. CPS is Current Population Survey.

Table 5. Education distribution on the death certificate, by Current Population Survey education level and age at death: National Longitudinal Mortality Study deaths from 1992–1998 cohorts

CPS education level	Death certificate education level																	
	25–44						45–64						65 and over					
	Less than 4 years of high school	4 years of high school	1–3 years of college	4 years of college	5 or more years of college	Unknown	Less than 4 years of high school	4 years of high school	1–3 years of college	4 years of college	5 or more years of college	Unknown	Less than 4 years of high school	4 years of high school	1–3 years of college	4 years of college	5 or more years of college	Unknown
	Percent																	
Less than high school graduate	61	21	2	0	1	14	65	22	1	0	0	12	66	19	19	1	0	13
High school graduate	8	73	9	1	0	9	9	72	10	1	0	9	11	68	9	2	0	11
Some college	1	27	56	7	1	8	3	27	50	9	1	9	3	29	46	9	2	10
Bachelor's degree	0	1	10	70	11	8	1	6	12	62	10	7	1	6	11	58	15	9
Graduate degree	0	0	0	12	72	15	1	2	2	15	71	9	1	3	2	17	69	8
Total weighted deaths by death certificate education level	16	40	20	10	4	10	25	38	14	8	5	10	35	33	10	7	4	12

NOTE: CPS is Current Population Survey.

Table 6. Education distribution on the death certificate, by Current Population Survey education level and race: National Longitudinal Mortality Study deaths from 1992–1998 cohorts

CPS education level	Death certificate education level															
	White				Black				American Indian or Alaska Native ¹				Asian or Pacific Islander			
	Less than 4 years of high school	4 years of high school	More than 4 years of high school	Unknown	Less than 4 years of high school	4 years of high school	More than 4 years of high school	Unknown	Less than 4 years of high school	4 years of high school	More than 4 years of high school	Unknown	Less than 4 years of high school	4 years of high school	More than 4 years of high school	Unknown
	Percent															
Less than high school graduate	67	20	2	12	61	18	2	19	67	13	1	20	74	19	0	7
High school graduate.	10	70	10	10	16	60	12	11	5	58	7	30	6	69	22	3
More than high school graduate	2	18	71	9	2	23	63	12	0	11	80	9	0	9	87	5
Total weighted deaths by death certificate education level.	30	35	24	11	39	30	15	16	42	26	11	22	30	26	39	5

¹Distributions for American Indian or Alaska Native for high school graduate and more than high school graduate in the CPS are based on fewer than 20 unweighted deaths.

NOTE: CPS is Current Population Survey.

Table 7. Education distribution on the death certificate, by Current Population Survey education level and Hispanic origin: National Longitudinal Mortality Study deaths from 1992–1998 cohorts

CPS education level	Death certificate education level							
	Hispanic				Non-Hispanic			
	Less than 4 years of high school	4 years of high school	More than 4 years of high school	Unknown	Less than 4 years of high school	4 years of high school	More than 4 years of high school	Unknown
	Percent							
Less than high school graduate	61	13	3	23	66	20	1	12
High school graduate	14	48	7	31	10	70	11	10
More than high school graduate	2	22	62	13	2	18	71	9
Total weighted deaths by death certificate education level.	44	21	13	23	30	35	24	11

NOTE: CPS is Current Population Survey.

Table 8. Life expectancy, by educational attainment for selected ages: U.S. males, 2005

Education level on death certificate	e_{25}		e_{45}		e_{65}	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
Unrevised states with 1989 year-based education item						
Less than high school graduate	46.3	44.2	29.0	27.2	15.7	14.3
High school graduate	48.3	50.9	30.5	32.8	15.5	17.3
Some college	54.2	52.5	35.4	33.8	18.5	17.2
College graduate	57.0	57.3	37.6	38.0	20.2	20.5
Graduate degree	57.7	59.8	38.4	40.5	20.5	22.4
Revised states with 2003 degree-based education item						
Less than high school graduate	48.4	46.2	30.9	29.0	16.6	15.1
High school graduate	49.0	51.5	30.9	33.2	16.1	17.8
More than high school graduate	57.4	57.0	38.3	37.9	21.1	20.8

NOTES: Death counts used in the calculation of life expectancy by education level came from death certificate information. The degree-based education item from the 2003 revision of the U.S. Standard Certificate of Death was used in 2005 in California, Connecticut, Florida, Idaho, Kansas, Michigan, Montana, Nebraska, New Hampshire, New Jersey, New York, Oklahoma, South Carolina, South Dakota, Utah, Washington, and Wyoming. Georgia and Rhode Island were excluded from the analysis because an education item was not included on their death certificates, and the District of Columbia was excluded because it transitioned from use of the 1989 item to use of the 2003 item during the year.

SOURCES: CDC/NCHS, National Longitudinal Mortality Study, National Vital Statistics System, and the U.S. Census Bureau.

Table 9. Life expectancy, by educational attainment for selected ages: U.S. females, 2005

Education level on death certificate	e_{25}		e_{45}		e_{65}	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
Unrevised states with 1989 year-based education item						
Less than high school graduate	52.6	49.9	34.4	32.0	18.9	16.9
High school graduate	53.6	56.2	35.0	37.4	18.4	20.4
Some college	59.3	58.3	40.0	39.1	22.3	21.4
College graduate	60.3	61.5	40.8	41.9	22.7	23.8
Graduate degree	59.3	61.6	39.8	42.0	21.4	23.4
Revised states with 2003 degree-based education item						
Less than high school graduate	54.8	52.0	36.3	33.8	20.3	18.3
High school graduate	54.7	57.3	35.9	38.4	19.3	21.4
More than high school graduate	61.6	61.6	42.1	42.2	24.3	24.3

NOTES: Death counts used in the calculation of life expectancy by education level came from death certificate information. The degree-based education item from the 2003 revision of the U.S. Standard Certificate of Death was used in 2005 in California, Connecticut, Florida, Idaho, Kansas, Michigan, Montana, Nebraska, New Hampshire, New Jersey, New York, Oklahoma, South Carolina, South Dakota, Utah, Washington, and Wyoming. Georgia and Rhode Island were excluded from the analysis because an education item was not included on their death certificates, and the District of Columbia was excluded because it transitioned from use of the 1989 item to use of the 2003 item during the year.

SOURCES: CDC/NCHS, National Longitudinal Mortality Study, National Vital Statistics System, and the U.S. Census Bureau.

Appendix

Technical Notes

Imputation of educational attainment for the calculation of classification ratios

As part of the calculation of classification ratios, educational attainment was imputed for National Longitudinal Mortality Study (NLMS) decedents without death certificate education information using a four-step procedure. First, NLMS decedents without death certificate education information were grouped together and the number of these decedents was found for each Current Population Survey (CPS) education level. These numbers are shown in the first column (see [table](#)). Second, decedents with death certificate education information were grouped by CPS education level, and the proportion of decedents reported at each education level on the death certificate was found for each CPS education level. The remaining columns show these proportions (see [table](#)). Third, the number of decedents without death certificate education information and with each CPS education level found in Step 1 was multiplied by the proportions found for that CPS education level in Step 2. This calculation provided the number of decedents by CPS education level that should be assigned each education level

for the death certificate. For example, the number of decedents without death certificate education information with less than a high school education in the CPS (588) was multiplied by the proportion of decedents with this CPS education level who also had less than 4 years of high school reported on the death certificate (0.761) to equal 447 records. The proportion of decedents with less than a high school education in the CPS who also had 4 years of high school reported on the death certificate (0.222) was then multiplied by 588. This continued across the row for the other death certificate education levels. This process was then repeated for the remaining CPS education levels. Finally, the resulting numbers of decedents were randomly selected from decedents without death certificate education information and with the appropriate education level in the CPS, and then assigned the selected education level for the death certificate. For example, 447 randomly selected decedents without death certificate education information who had less than a high school education in the CPS were assigned less than 4 years of high school completed as their education level for the death certificate.

Table. Education distribution on the death certificate, by Current Population Survey education level: National Longitudinal Mortality Study deaths from 1992–1998 cohorts

CPS education level	Number of records without education on death certificate	Weighted distribution of death certificate education by CPS education level for NLMS records with death certificate and CPS education information				
		Less than 4 years of high school	4 years of high school	1–3 years of college	4 years of college	5 or more years of college
Less than high school graduate.	588	0.761	0.222	0.013	0.003	0.001
High school graduate	347	0.115	0.768	0.098	0.015	0.003
Some college	154	0.035	0.311	0.537	0.098	0.018
Bachelor's degree	70	0.014	0.058	0.122	0.658	0.148
Graduate degree.	40	0.012	0.025	0.020	0.177	0.765

NOTE: CPS is Current Population Survey; NLMS is National Longitudinal Mortality Study.

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