Cancer Screening Practices From National Health Interview Surveys: Past, Present, and Future

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The National Health Interview Survey (NHIS) has provided data about health behaviors at the national level since 1957. The 1987 and 1992 Cancer Control Supplements to the NHIS, along with other supplemental surveys administered intermittently on self-reported cancer-related behaviors, have contributed to important research and public health purposes. In this article, we reviewed 73 papers published between 1980 and 2001 that used NHIS data, including the first report from the 1998 NHIS, to examine what has been learned from past surveys. Our goal was to facilitate future analyses of recently released data on cancer screening practices from the Cancer Control Supplement to the 2000 NHIS, which is now known as the Cancer Control Module. We categorized the papers according to which of the following three study approaches they used: trends in screening rates, correlates of these rates with factors that may influence screening, and linkages or comparisons of NHIS data with other surveys or sources of information. We summarize knowledge gained in cancer screening for each of these three categories and identify areas that could benefit from more research. We highlight some of the new information available for the first time on the Cancer Control Module of the 2000 NHIS as fresh opportunities for cancer control research. Finally, we describe how the Cancer Control Supplements to the NHIS are integrated with the objectives of and developments in national cancer surveillance research that have emerged from federal planning efforts and collaborations with national partners in cancer surveillance in recent years. [J Natl Cancer Inst 2002;94:1837–46]

National estimates of the use of cancer screening procedures by the American public are important in several ways. They assess the dissemination of established screening modalities into clinical and community practice. They identify segments of the population in which these procedures are not widely used, thereby suggesting directions for intervention research and programs. They also provide a benchmark against which local, regional, and state programs can assess their progress in improving cancer screening behavior. Finally, they can be used to inform policy decisions for establishing coverage and reimbursement levels by Medicare, Medicaid, and other funding programs. The National Health Interview Survey (NHIS), a continuing nationwide household survey of the civilian noninstitutionalized population, is the standard source of national screening estimates and the official federal monitoring instrument for the cancer screening objectives of the goals of Healthy People 2000 and Healthy People 2010, which are a set of health objectives for the nation (1,2).

Cancer Control Supplements to the NHIS are additional surveys that were designed to monitor trends in cancer behavioral risk factors and cancer screening. These supplements, which have been financially supported by the National Cancer Institute (NCI) with recent (i.e., 2000) co-funding by the Centers for Disease Control and Prevention (CDC), have provided researchers, and public health professionals, planners, and policy makers with nationally representative data on the use of accepted cancer screening practices. These supplements have also enabled researchers to monitor the use and dissemination of cancer screening modalities, especially those for breast, cervical, and, to a lesser extent, colorectal cancer. Other aspects of screening, such as the frequency with which oral examinations (for cancers of the mouth and pharynx) and digital rectal examinations (for prostate cancer and rectal cancer) are used, have been included periodically. The NHIS supplemental surveys routinely ask respondents about their most recent screening, and for those not recently screened, why they did not use particular screening modalities. Researchers have also used the same questions and methods used by the NHIS to develop their own survey instruments, thus permitting comparisons between NHIS data and local, regional, and state data, as well as data from surveys conducted in other countries.

Cancer Control Supplements to the NHIS were administered in 1987, in 1990, during the first two quarters of 1992, during the last two quarters of 1993, and in 1998. Datasets from a new Cancer Control Supplement that was administered in 2000 were made publicly available early in 2002. This most recent survey is part of the expanded scope of cancer surveillance research, which seeks to understand and monitor environmental variables, cancer risk factors, and screening practices and to evaluate their association with cancer outcomes derived from population-based cancer registry data (3).

Herein we describe the NHIS and its Cancer Control Supplements as they relate to cancer screening, categorize the analyses that have resulted from them, present examples of each category, and summarize what has been learned. We discuss potential uses of the NHIS in the context of evolving program objectives and future directions in cancer surveillance. Our intent is to promote the timely and effective use of data from the 2000 Cancer Control Supplement.
DESCRIPTION OF THE NHIS CANCER CONTROL SUPPLEMENTS

The NHIS was initiated in 1957 by the National Center for Health Statistics (NCHS) and is conducted by the U.S. Bureau of the Census. Since 1985, the NHIS has been administered in person in approximately 49,000 households annually. In 1987, the NCI provided financial, technical, and scientific support for the first Cancer Control Supplement to the NHIS to monitor the Healthy People cancer screening objectives. The first Cancer Control Supplement to the NHIS, which was administered in 1987 to 22,043 respondents who were at least 18 years old, included questions to determine their knowledge of, attitudes about, and use of cancer screening modalities. The 1992 Cancer Control Supplement was administered for only half the year and had 12,035 respondents. Since the mid-1990s, the NCHS has referred to these supplemental surveys to the NHIS as modules. Thus, the 2000 supplement, which was administered to 32,374 persons, may be referred to as the 2000 Cancer Control Module (CCM).

The 1987 and 1992 Cancer Control Supplements included two separate instruments, each of which was administered to half the sample to obtain responses to more questions than a single time-limited survey instrument could provide. In addition to the Cancer Control Supplements, shorter supplements to the NHIS in other years have included questions about cancer screening. These shorter supplements are the Health Promotion and Disease Prevention Surveys, which were administered in 1990 (n = 41,104 respondents to the cancer screening questions) and in 1994 (n = 19,738 respondents), and a Health Prevention Survey, which was administered in 1998 (n = 32,440 respondents). Cancer screening questions were also included in more general supplements that were administered in 1991 (n = 43,732 respondents) and 1993 (n = 21,021 respondents). Cancer screening questions have never been included in the core NHIS questionnaire.

Cancer screening questions were administered in the Cancer Control Supplements to one randomly selected adult (18 years old or older) per household, whereas questions on the core NHIS questionnaire were asked about all household members of any age or to a proxy. Questions on cancer screening were administered to age- and sex-specific respondents. For example, cervical cancer screening questions were administered to women aged 18 years and older. Mammography questions were administered to women aged 40 years and older for the 1987 survey, to women aged 35 years and older for the 1990 survey, and to women aged 30 years and older for surveys since 1992.

There are advantages to administering the Cancer Control Supplements in conjunction with the NHIS. The core survey provides data on health-related behaviors and sociodemographic characteristics that are not routinely collected by the supplemental surveys. Basic demographic information, including age, sex, race, and ethnicity, and socioeconomic information, including income, education, occupation, and industry, is routinely collected in the core surveys. The core surveys also collect information on the use of health services, health insurance status and type, and the usual source of health care. Questions that collect information on these variables have been updated and improved to reflect changing circumstances in population health and health services delivery in the United States. Cancer-related questions on the supplements, which include items about risk factors such as tobacco use, diet, alcohol consumption, hormone use, and occupational exposure and about issues related to the quality of life of persons living after a cancer diagnosis, also contribute to the rich range of covariates that are available for analysis.

NHIS questions on cancer screening first define the screening test and then ask respondents if they have heard of the test, particularly if it is not already widely used. Respondents are next asked if they have ever had one of these tests and, if they have, when their most recent test occurred. For most types of tests, respondents are asked whether their most recent test was performed to evaluate a problem, to follow up an abnormal test result, or as part of a routine checkup, or for preventive health care. Finally, respondents who say they have not had the test within the 3 years prior to the interview are asked to indicate the most important reason for not having had the test. The screening tests that respondents are asked about include mammography, clinical breast examination, breast self-examination, Pap smear, chest x-ray, digital rectal examination, fecal occult blood test (FOBT), and proctosigmoidoscopy. Questions about oral examinations for cancers of the mouth and pharynx are not routinely included in all surveys; those data are reviewed elsewhere (4). Response rates to the NHIS were 82%, 87%, and 74% for the 1987, 1992, and 1998 surveys, respectively. Appendix A (available on the Journal web Web site at http://jncicancerspectrum.oupjournals.org/jnci/content/vol94/issue24/index.shtml) contains a comparison of all cancer screening questions from the 1987, 1992, and 2000 Cancer Control Supplements as well as those included in the 1998 NHIS.

LITERATURE SEARCH AND METHODS

We performed a literature search for papers that used data from the Cancer Control Supplements to the NHIS as well as the shorter supplements and were published from January 1980 through November 2001 by using the National Library of Medicine PubMed database and the following keyword search terms: (National Health Interview Survey) AND (cancer OR screening OR mammography OR breast OR cervical OR Pap OR fecal OR sigmoidoscopy OR colonoscopy OR colon). Papers that reported on surveys other than NHIS or on topics specific to health conditions other than cancer were excluded from our analysis. With this search method, we identified 73 papers that included questions or data from the NHIS to study cancer screening use or for which NHIS data were an important benchmark or point of comparison. Six of the 73 papers addressed oral cancer screening, and two contained only casual mentions of cancer screening data from the NHIS; those eight papers were not included in this review.

LITERATURE REVIEW

We reviewed the remaining 65 papers to assess the relative levels of self-reported cancer screening they described. We then categorized the papers according to which of the following three study approaches they used: those that described trends in screening rates, those that examined correlates of screening use according to various independent variables, and those that performed comparative analyses of data obtained from the NHIS and data from other surveys or sources.

Not surprisingly, many papers could be categorized into more than one of these three groups. For example, most studies that reported on trends in screening rates also compared data from...
different demographic groups. In addition, studies that performed comparative analyses frequently examined correlates among different subgroups. A few studies used NHIS data as a starting point from which to carry out more complex analyses. Two papers reviewed mammography (5) and Pap smear (6) utilization and included NHIS data. In the following sections, we describe the general approach taken by the authors for each of the three main categories of papers, provide examples of research for each approach taken, and summarize what we have learned from the studies. We do not attempt to be exhaustive in these descriptions; however, we do attempt to categorize the ways in which the NHIS has been used.

WHAT HAVE WE LEARNED?


For the purposes of this review, we classified papers that used data from at least two different years of the NHIS to compare screening rates as papers that examined trends in cancer screening. Because many of the studies made this type of comparison, we have chosen to summarize in this section only overall trends and trends by sex. Trends for different population subgroups, including those defined by race and ethnicity, are addressed in the section on correlates of cancer screening practices. Many of the studies that examined trends by using the Cancer Control Supplements selected survey data from interim NHIS surveys to use for comparisons. For example, the Health Promotion and Disease Prevention Supplements of 1990 and 1994 were frequently used, as were annual core data from the NHIS itself, when appropriate.

The major findings concerning trends in the use of cancer screening tests are summarized in Table 1. The use of all screening tests has increased at least slightly since the first Cancer Control Supplements were administered in 1987 (7). The most dramatic increase was in the use of mammography. Between 1987 and 1990, the percentage of women older than 40 years who reported having an annual mammographic examination increased nearly twofold, from 17% to 33% (8). Although the rate of increase in mammography use leveled off during the 1990s, biennial mammography use continued to increase to 67% in 1998 (7). Thus, the Healthy People 2000 goal, which was for 60% of women aged 50 years old or older to have a mammographic examination and a clinical breast examination in the preceding 1–2 years, was surpassed early (1). Although trends in other screening modalities have also increased, those increases were much less striking. For example, Pap smear screening, by far the oldest and most established early-detection test, was already reported in 1987 as having been practiced in the preceding 3 years by almost 75% of women who were at least 18 years old and had a uterine cervix (7). Further increases in the percentage of women screened by Pap smears would be expected to slow as this or any screening practice approaches total population coverage. Although the percentage of women who reported having had a Pap smear within the last 3 years increased by 6% between 1987 and 1998 (7), the Healthy People 2000 goals for this test were not quite met. For example, the Healthy People 2000 goals for the percentage of women who “ever had a Pap smear” and who had a Pap smear “in the last 3 years” were 95% and 85%, respectively, whereas the percentages for those categories reported by the NHIS were 93% and 79%, respectively. In addition, older women were screened by Pap smears less frequently after menopause than before menopause, and their rate of Pap smear screening declined with increasing age. Only 56% of women over 70 years of age were

<table>
<thead>
<tr>
<th>Screening tests (age group, y)</th>
<th>Major findings (reference)</th>
<th>Healthy People 2000 Goal</th>
<th>Goal reached? (reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammography (≥40)</td>
<td>Twofold increase in “recent use” reported by respondents during the late 1980s and early 1990s (5,8,12–15)</td>
<td>Clinical breast examination and mammography for 60% of women ≥50 years old in preceding 1–2 years.</td>
<td>Yes, surpassed at 64% (1)</td>
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<td></td>
<td>Use “in last 2 years” reported by respondents increased from 29% in 1987 to 67% in 1998 (7).</td>
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<td>Pap smear (≥25)</td>
<td>Highest adherence of any screening test between 1987 and 1992 (6,12).</td>
<td>Pap test received by 85% of women ≥18 years old in preceding 3 years.</td>
<td>No (1)</td>
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<td>Modest increase in overall use from 1987 through 1992 (6,12,15).</td>
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<td></td>
<td>Almost 80% of women reported using “in last 3 years” in 1998 (7).</td>
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<td>Fecal occult blood test (≥50)</td>
<td>Reported use “in past 3 years” increased slightly between 1987 and 1992 from 23% to 27% for women and from 20% to 25% for men (12,16).</td>
<td>Fecal occult blood test within preceding 2 years for 50% of persons ≥50 years old.</td>
<td>No (1)</td>
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<td>Use “in past 3 years” increased more in men (to 29%) than in women (to 26%) in 1998 compared with 1992 (7).</td>
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<td>Proctosigmoidoscopy (≥50)</td>
<td>Lowest level of reported use of any approved screening test between 1987 and 1992 (12).</td>
<td>40% of persons ≥50 years old ever received proctosigmoidoscopy.</td>
<td>NA</td>
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<td></td>
<td>Reported use “in past 3 years” increased slightly from 6% to 7% for women and from 7% to 12% for men between 1987 and 1992 (6,16).</td>
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<td>Use “in the last 3 years” by men was higher and increased faster (8% to 19%) than use by women (6% to 10%) between 1987 and 1998 (7).</td>
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<td>Digital rectal examination (≥50)</td>
<td>Reported use “in past year” increased slightly from 24% to 27% for women and from 17% to 22% for men between 1987 and 1992 (6).</td>
<td>NA</td>
<td>NA</td>
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<td></td>
<td>Use increased more rapidly among men than among women between 1987 and 1998 (7).</td>
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<tr>
<td>General</td>
<td>Use of all cancer screening tests increased between 1987 and 1998 (7,17)</td>
<td></td>
<td>NA</td>
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*NA = not applicable.*

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screened in the last 3 years (7), a percentage that fell short of the Healthy People 2000 goal of 70%. The fact that the cervical cancer mortality rate is also highest among older women (9) presents a continuing challenge for the control of this type of cancer.

Colorectal cancer screening rates, as measured by the percentage of individuals who had FOBT, underwent sigmoidoscopy (or proctoscopy), or had a digital rectal examination, also increased (but only slightly) despite the fact that there is now sound evidence for the efficacy of both FOBT and sigmoidoscopy in the prevention of deaths from this type of cancer (10). For example, the use of FOBT increased from 18% for men and 21% for women in 1987 to 29% for men and 26% for women in 1998 (7). However, it is important to note that the surveys did not distinguish between screening and diagnostic tests for colorectal cancer. Thus, actual rates of colorectal cancer screening were probably substantially lower than those reported. Men were slightly more likely to receive FOBT and to undergo sigmoidoscopy than women, whereas women more often reported receiving a digital rectal examination, probably because that test is routinely given during gynecologic checkups. Colonoscopy was receiving a digital rectal examination, probably because that test is not used for screening purposes to any great extent during this time period and therefore was not covered in the Cancer Control Supplements.

Correlates of Cancer Screening Practices

Correlates of cancer screening practices help describe and explain how screening is used in various subpopulations. Although the overall national screening rates for all cancers increased, for each test there were geographically, culturally, or socially defined subgroups that did not have cancer screening rates consistent with national norms or that had not increased their use of these life-saving practices to the same extent that other groups had. Typically, the correlates from the NHIS that were available for study were those that described differences in screening use between population subgroups. Many, though not all, of the studies we identified that examined such correlates used multivariate models that considered multiple factors simultaneously to evaluate the relative influence of several determinants of differential screening.

We reviewed the 65 papers identified by our literature search to determine whether the investigators had assessed one or more correlates of screening use either to identify factors that could help to explain screening practices or to reveal differential screening. We examined each paper for the research question or hypothesis it addressed, for whether a theoretical framework or model was used to shape the analysis, for the data source or sources used, for the screening modalities and correlates examined, for the type of analysis used to relate the correlates to the screening use, and for main findings (Appendix B; available on the Journal Web site at http://jnccancerspectrum.oupjournals.org/jncc/content/vol94/issue24/index.shtml). For those studies in which statistical tests were used to assess the association between one or more correlates and screening use, we noted whether the association was positive or negative or whether no association was found. To facilitate interpretation, we categorized each correlate into one of the following types: 1) sociodemographic, 2) knowledge/behavioral/attitudinal, 3) health status/health profile, and 4) health care system (Appendixes C and D; available on the Journal Web site at http://jnccancerspectrum.oupjournals.org/jncc/content/vol94/issue24/index.shtml).

Forty-eight studies (7,8,11–56) examined correlates of screening use. Although these studies addressed a wide variety of research questions or hypotheses, only 10 studies (21%) used a theoretical framework or model (13,22,34,40,42,43,45,47,48,54). We believe that the use of a theoretical model is important because it explicitly guides the specification of the research question or hypothesis and the subsequent analysis and interpretation of the results. Forty-four studies assessed correlates associated with breast cancer screening (7,8,11–14,17–21,23–31,33–56), 26 studies examined correlates associated with cervical cancer screening (7,11,12,15,17,18,21,25,29,30–32,35,36,38,41,43,44,46,50–56), nine studies examined correlates associated with colorectal cancer screening (7,12,17,18,21,22,34,39,46), and two studies examined correlates associated with prostate cancer screening (using digital rectal examination) (7,22). Eight studies (12,15,17–19,26,33,41) used descriptive methods to examine relationships between correlates and screening use. Twenty-nine studies (7,8,11,14,20–25,27,29,32,34–36,38–40,43,46–48,50–52,54–56) used both descriptive and analytic methods, eight studies (30,31,37,42,44,45,49,53) used only analytic methods, and two studies (13,28) were reviews.

Key Correlates of Screening Identified From NHIS Data

The wealth of data on relevant correlates of cancer screening available in the NHIS (see Appendixes B–D) makes it impossible for us to discuss each individual correlate and its relationship to cancer screening in this review. We therefore briefly describe some of the more salient relationships that have emerged from analyses of NHIS data.

Sociodemographic correlates. Age and socioeconomic status were the sociodemographic variables that correlated most strongly and consistently with screening use. For example, older individuals were less likely to be screened for breast and cervical cancers (7,8,11,15,21,23,25,31,34,42–46,48,51,54) or to report active involvement in decision making about screening for these cancers (24) but were more likely to be screened for colorectal cancer (21,22,46) than younger individuals. Higher levels of educational attainment and income were associated with a greater likelihood of being screened for these three types of cancer (7,8,15,20–22,25,27,30–34,36,40,42–46,51,53). Although women who live in rural areas were slightly less likely than women who live in urban areas to have reported mammography use in the 1994 NHIS survey, there was no difference in Pap smear rates between those two groups (55). Black women consistently reported the highest rates of Pap smear use, whereas Hispanic women increased their Pap smear use rate to near parity with that of white women by 1998. These three groups of women reported similar rates of recent mammography use in the most recent survey (7). However, Hispanics of both sexes had substantially lower rates of colorectal cancer screening than blacks and whites (7).

Health care system correlates. There was a strong association between having a usual source of health care and receiving screening for breast and cervical cancers (7,14,15,27,31,32,40,42,43,47–49,54). However, we cannot make any generalizations about the relationship between the usual source of care and colorectal cancer screening because that relationship has not been well examined. Although the role of insurance coverage in screening use has been examined to a lesser extent than has the role of usual source of care, insurance coverage was consistently associated with breast (5,7,37) and cervical (7) cancer screening.
utilization. However, generalizations about the relationship between insurance coverage and colorectal cancer screening were not possible because that relationship has been examined in so few studies (46). There are few data about the relationship of specific types of insurance coverage to cancer screening for all three sites.

Knowledge/behavioral/attitudinal correlates. We detected an apparent pattern that indicated that women who practiced healthy behaviors (i.e., who exercised, conducted breast self-examination, refrained from smoking, and obtained clinical breast examinations and Pap tests) or who were more knowledgeable about cancer prevention and cancer risk factors had a greater likelihood of being screened for breast cancer, particularly by mammography, than women who did not practice such behaviors (21,32,40,42–45,47–51,54,57). Because knowledge, behavioral, and attitudinal correlates that are associated with cervical and colorectal cancer screening have been studied less than those associated with breast cancer screening, it was not possible to generalize about the potential role of these factors in cervical and colorectal cancer screening use.

Health status/health profile correlates. This domain has received less attention than the other three discussed here. Although some studies have suggested that an individual’s health status or health profile or the health practices of his or her spouse are related to screening use (7,22,43,52), other studies have not demonstrated a statistically significant association between health status and use of screening (23,26,46,48,51,54). More work is needed, particularly for cervical and colorectal cancer screening, before generalizations about the role of health status in cancer screening use can be made.

Comparative Analyses of Data From the NHIS and Other Sources

We evaluated studies that compared data from the Cancer Control Supplements to data from other national or local surveys as well as studies that included approaches that adopted or translated NHIS questions for particular populations.

National and International Surveys

Behavioral Risk Factor Surveillance System. One set of results with which the NHIS results could logically be compared is that from the Behavioral Risk Factor Surveillance System (BRFSS), a telephone survey that has been supported by the Centers for Disease Control and Prevention (CDC) since 1984. However, no studies have directly compared cancer screening data from the BRFSS with that from the NHIS, perhaps because the two surveys use substantially different methods and sample different populations. For example, the BRFSS is a state-based survey that is responsive to state-specific data collection needs, whereas the NHIS is a national household survey that is not designed to provide state-specific estimates. Ackermann et al. (58) discussed the difference between NHIS estimates of cancer control behaviors for 1987 and BRFSS estimates from 1987 through 1989 and found that the NHIS estimates were at the lower end of the estimate ranges reported by the states (i.e., BRFSS). The authors did not examine the reasons for the higher rates generated by the BRFSS. Although Janes et al. (59) reported cancer screening median values and ranges for states and referred to the NHIS, they did not directly compare the two sources of data.

For at least one specific correlate, data from NHIS has been used to validate results from the BRFSS. Saraiya et al. (60) found that 78.3% of women who had had a hysterectomy reported having had a Pap smear in the 1992–1997 BRFSS compared with 74.2% of women who responded to this question in the 1993–1994 NHIS. The need for a critical evaluation of differences in the results of these two major surveys was noted (61). However, a recent study that made a formal comparison of BRFSS and NHIS results did not include cancer screening measures (62).

Medicare claims. Using a direct methodologic comparison of the NHIS with another national data source, Medicare claims, May and Trontell (61) reported that data from these two sources generate disparate estimates of mammography utilization among older women. For example, in 1992, the NHIS estimated that 38.5% of women aged 65 years and older had had a mammographic examination in the preceding year, whereas Medicare claims estimated that only 24.6% of women were in this category. The authors attempted to explain the differences in utilization rates between the two data sources as being due to methodologic differences in the way those two data sources used the Medicare Current Beneficiary Survey. After adjusting for age, source of sample population (e.g., institutionalized or covered by health maintenance organizations [HMOs]), missing claims, and erroneous self-reports, the difference between the mammography utilization rates decreased from 13.9% to only 3%. The authors concluded that most of the discrepancy between the two data sources could be explained but warned that utilization rates obtained from either source should be interpreted with caution because of possible biases. One such bias that must be considered with respect to the NHIS is the possibility that respondents overestimated their screening utilization.

Cancer statistics. NHIS data have also been used to help interpret national trends in cancer incidence and mortality. Wun et al. (63) used the NHIS mammography data from the 1987 and 1990 Cancer Control Supplements to help explain the sharp increase in breast cancer incidence in the 1980s. Chevarley and White (57) noted the decline in breast cancer mortality that began in the early 1990s, according to NCHS mortality data, and attributed this nascent trend to increases in breast cancer screening on the basis of data from the 1987 and 1992 Cancer Control Supplements, although these two data sources were not directly linked in this study. Geographic differences in breast cancer mortality in the United States have likewise been compared with screening mammography data from the 1987 Cancer Control Supplement along with risk factor data from the Cancer Epidemiology Supplement of the same year (64). Martin et al. (38) made the same type of comparison for cervical cancer incidence by using Surveillance, Epidemiology, and End Results (SEER)1 Program data from 1988–1992 and Cancer Control Supplement data from 1992, and they highlighted the parallel observations of increasing cervical cancer incidence, increasing diagnosis rate at regional and distant stages, and lower Pap smear screening rates with increasing age.

Several studies used NHIS data to compare cancer screening practices in the United States with those in Canada. The first such comparison used data from the 1985 NHIS and from the 1985 Canadian Health Promotion Survey and found that Canadian women were substantially more likely than American women to have a clinical breast examination but slightly less likely to have a Pap smear (65). The authors also reported an...
association between higher level of education and increased use of screening in both countries. Katz and Hofer (36) extended this work by comparing the results of the 1990 NHIS with those of the 1990 Ontario Health Survey—two surveys of comparable size (≈24,000 respondents), with similar study design, question structures, and content. They found virtually no differences between Canadian women and U.S. women regarding Pap smear or clinical breast examination use, whereas mammography use was more common in the United States, especially for women in higher family income brackets. The authors made the provocative observation that universal access to health care, which has existed in Canada for some time, was not sufficient to eliminate socioeconomic (i.e., family income and education) differences in screening behaviors for all modalities examined. In later publications, this team found that neither the practice of a “healthy lifestyle,” as defined by a number of reported behaviors (e.g., lower smoking, less obesity), nor increases in overall annual mammography screening use negated the previously observed association between screening and higher income in either country (66,67). These international comparisons demonstrated both the value of having similar surveys for comparative purposes and the utility of evaluating complex relationships among cancer screening behaviors, other health behaviors, insurance coverage, and measures of socioeconomic status across countries. Unfortunately, such comparisons with other countries are limited by the lack of data sources comparable to the NHIS.

Local and Regional Surveys

Data from the NHIS were also used as a benchmark against which data from surveys at local or regional levels were compared. For example, to examine mammography use, the Breast Cancer Screening Consortium (BCSC) performed population-based surveys in six areas of the United States from 1987 through 1989, with sample sizes that varied from 277 to 2180 respondents, and compared the responses with those obtained in the 1987 Cancer Control Supplement to the NHIS from 697 women who were 50–74 years of age (19). The rates of mammography use estimated by all six surveys, which ranged from 26% to 46% of women reporting having such screening in the previous year, were slightly higher than the 25% rate estimated by the NHIS.

Data from the NHIS were also used as a benchmark against which to assess colorectal cancer screening practices. Richardson et al. (68) used questions from the NHIS to assess colorectal cancer screening behaviors in twin pairs in which one member had been diagnosed with colorectal cancer and the other had not. They compared the use of screening by the unaffected twin before and after that person’s co-twin was diagnosed with cancer and found that the level of screening by FOBT and sigmoidoscopy for the unaffected co-twin increased after the affected twin was diagnosed with cancer. In a review of colorectal cancer screening interventions, Vernon (16) also used the 1987 and 1992 Cancer Control Supplements to compare the intervention populations being reviewed.

Investigators have adapted NHIS survey instruments for administration to special subpopulations for which data were not readily available in the NHIS. For example, Hubbell et al. (69) administered the NHIS to random samples of Hispanic and white women in Orange County, CA, to explore whether the beliefs of Hispanics about cervical cancer influenced their use of cervical cancer screening. Kim et al. (70) used a similar approach, in which NHIS questions were translated into Korean, to assess colorectal cancer screening knowledge and use among Korean-Americans in Chicago. To assess mammography use, Hiatt and Pasick (33) used NHIS questions, adding translated questions for interviews of non-English-speaking Hispanic and Chinese women, in a 1992 household survey of 1599 women in the San Francisco Bay Area. They found that the rates of mammography use (reported as both ever use and use within the previous 2 years) for the white, black, and English-speaking Hispanic women who lived in San Francisco were higher than those estimated in the 1992 Cancer Control Supplement. However, the same California survey found that non-English-speaking populations had substantially lower rates of mammography use than those reported in the 1992 Cancer Control Supplement and those of the English-speaking populations—an observation that could not be made using the English-only version of the NHIS.

The 1985 NHIS was used as a benchmark against which a large employed population in Southern California was compared (71). That population, which was surveyed from 1988 through 1989, had substantially higher rates of clinical breast examination, mammography, and Pap smears compared with the rates obtained using the 1985 NHIS; those differences were attributed to the higher level of education and insurance coverage among the employed population.

Finally, Phillips et al. (45) examined correlates of mammography use by creating a unique database based on the county of residence of the 12,035 women who responded to the 1992 Cancer Control Supplement and linked NHIS data to three other databases that provided county-level data on the number of mammography facilities, HMO market share, and primary care shortage areas. The investigators tested a conceptual model of the screening process that considered such variables as access to a provider, recency of examination, and lifetime number of mammograms as reflections of adherence to guidelines. Sequential dependent variables were analyzed to assess the influence of health care system factors such as mammography facility supply, HMO market share, mammography charges, and physician supply on screening adherence.

THE NEXT CHALLENGE: CREATIVE FUTURE USES OF THE NHIS

As we have documented, the NHIS has been a valuable tool for describing national trends in cancer screening and for examining correlates of screening behavior. The CCM of the 2000 NHIS included new survey questions that provide novel opportunities to enhance the utility of this resource for cancer control. The content of the 2000 NHIS resulted from a collaboration among scientists at the NCI, in the Division of Cancer Prevention and Control at the CDC, at NCHS, and Census Bureau staff. The new questions included on the 2000 CCM were added to keep the survey current with recent developments in cancer screening methods and demonstrations of their efficacy. Questions from the previous surveys on tobacco use, mammography, Pap smears, oral examinations, colorectal cancer screening, and physical activity remain as part of the 2000 CCM. Details of the new questions are available at http://www.cdc.gov/nchs/nhis.htm. For ease of discussion, we have grouped the new questions into the following categories: breast and cervical cancer screening, prostate cancer screening, colorectal cancer screening, sun exposure and protective practices, and genetic testing.
Breast and Cervical Cancer Screening

As in previous surveys, respondents were asked if they had ever had a screening test for breast or cervical cancer, when was the most recent test, and whether the test was for a specific problem or for routine screening. The 2000 survey also asked about the usual frequency of screening and whether any test result had not been normal. If the test was positive, questions were asked about follow-up procedures. In addition, the 2000 survey asked respondents to estimate the number of tests they had had within a designated period of time. This new question was designed to enable researchers to assess screening utilization as a sustained behavior rather than as a one-time event.

Prostate Cancer Screening

The 2000 CCM was the first survey to ask questions about prostate cancer screening. Respondents were asked about their knowledge and practices with respect to prostate-specific antigen (PSA) screening, including whether they had discussed the advantages and disadvantages of the PSA test with a doctor and their main reason for having a PSA test. The usual questions about test frequency and follow-up were also included in the 2000 CCM.

Colorectal Cancer Screening

Questions in the 2000 CCM on colorectal cancer screening were modified versions of those used on previous surveys, and they reflected current practices and more recent scientific evidence for the efficacy of screening. Colorectal cancer screening questions in the 2000 CCM clearly distinguished between FOBT kits for home use and FOBTs performed in a doctor’s office; respondents were asked specifically about their use of home kits. Respondents were also asked about their most recent colorectal endoscopy examination as defined by sigmoidoscopy, proctoscopy, or colonoscopy; previous surveys asked only about proctoscopy.

Sun Exposure and Protective Practices

The 2000 CCM included questions about sun exposure and respondents’ vulnerability to sunburn as well as questions about preventive practices such as sun avoidance and use of protective clothing and sunscreen. Respondents were also asked about their knowledge of the effects of sun exposure and whether they had had skin examinations.

Genetic Testing

A new section on genetic testing was added to the 2000 CCM. In it, respondents were asked whether they had heard of genetic testing; for those who had, follow-up questions were administered concerning their attitudes toward and use of genetic testing, counseling, informed consent, and insurance coverage, as they relate to genetic testing.

Opportunities for Further Research

A number of topics may be fruitful for future research on cancer screening practices using both new and longitudinal data from the NHIS and its Cancer Control Supplements.

Colorectal Cancer Screening

Considerably less has been written about colorectal cancer screening than about breast and cervical cancer screening. This disparity is, of course, to be expected because the efficacy of FOBT and sigmoidoscopy in screening for colorectal cancer has been established more recently than has the efficacy of screening for breast and cervical cancers. Exploration of factors associated with both high and low levels of colorectal cancer screening compliance would help behavioral scientists and public health policy makers appropriately target intervention efforts.

Relationships Between Types of Screening

Much has been learned about the barriers to more effective screening for breast and cervical cancer, and that knowledge might be applicable to promoting colorectal cancer screening. Examining NHIS data for similarities and differences between the more established forms of cancer screening and colorectal screening could help shape interventions and policy and may preclude the need to initiate an entirely new research effort for improving adherence to colorectal cancer screening recommendations.

Contextual Reasons for Observed Trends

Although many investigators have looked for correlates of cancer screening from data available in the NHIS itself, only a few studies, such as those that examined the availability of mammography facilities (45) and trends in mammography rates (8,11,12), have used data from other sources to explain trends in screening. Other datasets that describe structural medical care factors from the Medical Expenditure Panel Survey (MEPS) (72), those from other national surveys, and U.S. Census data linked geographically to the NHIS may prove useful for assessing the relationship between structural aspects of the medical care system and screening behavior.

Barriers to Screening in Subpopulations

As summarized above, many studies (7,8,11,20–25,30,31,34, 37,38,42,43,45–48,51,53,54) have analyzed the effects of age, race, and ethnicity on cancer screening behaviors. However, further research on other subpopulations, such as those defined by geography, socioeconomic status, insurance availability, and other factors, may help identify groups toward which targeted interventions could be focused.

The Effects of Combinations of Barriers to Screening

Most work has examined individual correlates of screening, both alone and within multivariate models. Further exploration of combinations of variables, such as insurance availability, access to screening facilities, and access to trained providers, may allow for the creation of indices that characterize populations or areas in need of interventions to improve screening. There is also an opportunity for theory-based and alternative modeling approaches to guide studies of the many complex correlates, their interrelationships, and their impact on screening practices.

Quality of Cancer Care

Finally, the national cancer surveillance system needs effective ways to monitor the quality of cancer care (73). Cancer screening and follow-up data from the 2000 CCM might help develop or assess screening measures as quality indicators of cancer care. For example, by linking the CCM to MEPS data, it may be possible to examine the relationship between screening and the adequacy of follow-up as a measure of the continuity of care.
The new questions from the 2000 CCM and the longitudinal data from the NHIS provide opportunities for cancer surveillance research within the larger framework of an evolving national cancer surveillance system (3) and the broader national cancer control research agenda (74). Surveillance research not only must describe the cancer burden and track changes in this burden over time but also must be able to provide explanations for observed disparities and trends in measures of the burden. The NHIS is one of the main tools that make such research possible.

Federal agencies and private groups that are partners in cancer prevention and control are taking steps to implement a broader scope for surveillance nationally. These partners have supported the expansion of existing national health surveillance systems, including the NCI’s SEER program, the CDC’s National Program for Cancer Registries, the Current Population Survey of the U.S. Census, the National Health and Nutrition Examination Survey, CDC’s state-based BRFSS (63), and the NHIS. In addition, the NCI has sponsored the development of selected health surveillance systems that link mammography screening data and cancer outcomes in defined geographic areas through the BCSC (75,76). Another example is the California Health Interview Survey (CHIS), which was administered in 2000–2001 to reach 55,000 adult respondents, with oversampling of Asian, American Indian, and Alaska Native subpopulations. The availability of a high-quality, statewide, population-based cancer registry in California will make it possible to correlate cancer-related behaviors to cancer incidence and to outcomes at the county level. The 2000 NHIS CCM was designed to be pooled with CHIS data for Asians, American Indians, and Alaska Natives. These data should allow more detailed analysis of these demographic groups than ever before (17).

As part of this evolving Surveillance Research Implementation Plan (3), investigators are encouraged to explore NHIS Cancer Control Supplement data, use their new-found information to enhance our understanding of “where we are” in terms of cancer screening, and use this understanding to generate new ideas for cancer control intervention research. Data from the NHIS and Cancer Control Supplements data are available through CDC’s NCHS Web site (http://www.cdc.gov/nchs/nhis.htm).

**CONCLUSIONS**

Since 1987, the NHIS Cancer Control Supplements have provided a vital resource for cancer control research. They have provided the standard for reliable national data on cancer screening and have been the benchmark for assessing progress toward Healthy People 2000 goals and will continue to be the benchmark for assessing progress toward Healthy People 2010 goals. Investigators have advanced our understanding of cancer screening by using the NHIS, sometimes with great creativity. These efforts have improved our understanding of trends in screening behavior and the factors associated with these trends. They have also led to additional insights by comparing NHIS data with other contemporary sources of information and, in a few cases, linking NHIS results to other datasets. The new Cancer Control Supplement to the 2000 NHIS will provide opportunities not only to explore screening in light of past surveys but also to evaluate use of new or evolving modalities, such as genetic testing, prostate cancer screening, and colorectal cancer screening. This review of screening data from the NHIS and its Cancer Control Supplements has attempted to show what has been learned so far and highlighted areas for further exploration.


NOTES

1 Editor’s note: SEER is a set of geographically defined, population-based central cancer registries in the United States, operated by local nonprofit organizations under contract to the National Cancer Institute (NCI). Registry data are submitted electronically without personal identifiers to the NCI on a biannual basis, and the NCI makes the data available to the public for scientific research.

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